

SEVEN TREMATODES FROM SMALL MAMMALS IN LOUISIANA¹

RICHARD D. LUMSDEN

and

JAMES ALBERT ZISCHKE,

Department of Zoology, Tulane University,
New Orleans, Louisiana

Several mammals from Louisiana localities have been examined for trematodes in connection with studies of trematodes encysted in crayfishes. During these studies, a collection of small mammals was trapped in the vicinity of the Goodhope oilfield near Norco, Louisiana. The locality is a cypress-tupelo swamp, approximately 20 miles west of New Orleans, Louisiana, bounded on the south by U. S. Highway 61 and on the north by Lake Pontchartrain.

The following were examined for helminth parasites: one river otter, *Lutra canadensis* (Schreber); one raccoon, *Procyon lotor* (Linn.); one short-tailed shrew, *Blarina brevicauda* (Say); two muskrats, *Ondatra zibethicus* (Linn.); two swamp rabbits, *Sylvilagus aquaticus* (Bachman); four minks, *Mustela vison* Schreber; four opossums, *Didelphus virginiana* Kerr; and sixteen rice rats, *Oryzomys palustris* (Harlan). The otter, shrew, and two muskrats were found uninfected with trematodes.

Trematodes were fixed in boiling water or between a coverslip and slide in acetoformol-alcohol (AFA), stained with Van Cleave's combination-hematoxylin or Delafield's hematoxylin, and mounted in piccolyte. Unless otherwise cited, all measurements were taken from mounted specimens, and are given in millimeters.

Acknowledgements are extended to Dr. Norman C. Negus for identifying the mammals, to Messrs. Joe Black and James L. Dobie for their assistance in running the traplines, and to Mr. James F. Lumsden for his assistance in the statistical analysis of the data. The study was done under the direction of Dr. Franklin Sogandares-Bernal.

Family DIPLOSTOMATIDAE Poirier, 1886

Fibricola cratera (Barker and Noll, 1915)

Dubois 1932

(Figures 1 to 2)

Synonymy.—*Hemistomum craterum* Barker and Noll, 1915; *Fibricola laruei* Miller,

1940; *Fibricola nana* Chandler and Rausch, 1946.

Hosts.—*Mustela vison* Schreber and *Procyon lotor* (Linn.).

Location.—Small intestine.

Locality.—Goodhope oil field, Louisiana [new locality record].

Diagnosis (based on 10 mature specimens, 5 each from *Mustela vison* and *Procyon lotor*).—*Fibricola*. Body superficially bisegmented, 0.602 to 1.435 long. Forebody longer and wider than hindbody, widest near junction with hindbody, 0.390 to 0.875 long by 0.319 to 0.630 wide. Lateral portions of forebody folded ventrally, meeting in midline of body at point of junction with hindbody. Junction of fore- and hindbody marked by a slight constriction (or by reduction in transverse diameter of forebody in small specimens). Hindbody 0.212 to 0.560 long by 0.177 to 0.525 wide, tapering slightly to rounded tip. Cuticular spines present on anterior forebody, diminishing in size and number posteriorly; hindbody smooth. Oral sucker 0.047 to 0.087 long by 0.050 to 0.067 wide. Acetabulum oval, in middle of forebody, usually wider than long, 0.041 to 0.064 long by 0.041 to 0.078 wide, often in contact with or overlapping posterior tribocytic organ, or separated from tribocytic organ by less than longitudinal diameter of acetabulum. Sucker ratio 1:0.872 to 1.12. Prepharynx short, sometimes appearing absent. Pharynx often in contact with oral sucker, 0.040 to 0.116 long by 0.030 to 0.084 wide. Esophagus usually shorter than pharynx, 0.011 to 0.056 long. Ceca two, extending to posterior end of body, terminating at level of genital atrium. Tribocytic organ oval, slightly longer than broad, 0.160 to 0.371 long by 0.160 to 0.243 wide, with a median, longitudinal cleft. Genital atrium posterior, subterminal, opening on dorsal surface of body.

¹ This study was supported in part by a research grant (E-3386) from the National Institutes of Health.

Testes two, irregular in shape and size; anterior testis sinistral to midline, just posterior to junction of fore- and hindbody, 0.076 to 0.230 long by 0.073 to 0.358 wide; posterior testis in middle of hindbody, wider than long, with a median constriction, 0.053 to 0.282 long by 0.138 to 0.448 wide. Seminal vesicle posterior to hind testis, mesial, extending anteriorly to middle of posterior testis then looping posteriorly to enter genital atrium *via* narrow ejaculatory duct. Ovary median or sinistral to midline, anterior to and dorsally overlapping fore testis, 0.034 to 0.102 long by 0.056 to 0.230 wide. Mehlis' gland dextral to ovary. Laurer's canal opening dorsally on midline between levels of ovary and vitelline reservoir. Uterus J-shaped, ascending from Mehlis' complex to a point midway between anterior border of ovary and tribocytic organ, then turning posteriorly, proceeding mesially to genital atrium. Eggs 0.090 to 0.115 long by 0.060 to 0.090 wide. Vitellaria follicular, generally confined to forebody, densest in region of tribocytic organ. Anterior extent of vitelline follicles to or slightly beyond level of fore margin of acetabulum; a few follicles extending posteriorly on ventral surface into hindbody to or just beyond posterior margin of vitelline reservoir. Vitelline reservoir median, intertesticular. Excretory system not observed.

Discussion.—A discussion of this species follows the diagnosis of *Fibricola lucida*.

Fibricola lucida (LaRue and Bosma, 1927)

Dubois and Rausch, 1950

(Figure 3)

Synonymy.—*Neodiplostomum lucidum* LaRue and Bosma, 1927; *Theriodiplostomum lucidum* (LaRue and Bosma, 1927) Dubois, 1944.

Hosts.—*Didelphis virginiana* Kerr and *Mustela vison* Schreber.

Location.—Small intestine.

Locality.—Goodhope oil field, Louisiana.

Diagnosis (based on 10 mature specimens, 5 each from *Didelphis virginiana* and *Mustela vison*).—*Fibricola*. Body superficially bisegmented, 1.097 to 1.750 long. Forebody longer and wider than hindbody, separated from latter by a well-defined constriction. Forebody 0.708 to 1.120 long by

0.525 to 0.814 wide, widest at level of tribocytic organ. Sides and posterior margin of forebody folded ventrally. Hindbody usually longer than wide, 0.390 to 0.525 long by 0.238 to 0.460 wide, tapering to a rounded end. Cuticular spines present on anterior forebody, diminishing in size and number posteriorly; hindbody smooth. Oral sucker 0.062 to 0.098 long by 0.067 to 0.075 wide, usually in contact with pharynx. Acetabulum oval, in middle of forebody, 0.062 to 0.078 long by 0.059 to 0.090 wide, usually separated from posterior tribocytic organ by a distance equal to longitudinal diameter of acetabulum. Sucker ratio 1:1.000 to 1.600. Prepharynx short, appearing absent in some specimens, 0.000 to 0.014 long. Pharynx 0.046 to 0.070 long by 0.041 to 0.065 wide. Esophagus 0.040 to 0.112 long. Ceca two, extending to posterior end of body, terminating at level of genital atrium. Tribocytic organ longer than broad, with a median, longitudinal cleft, 0.217 to 0.448 long by 0.127 to 0.269 wide. Genital atrium posterior, subterminal, opening on dorsal surface of body. Testes two, variable in size and shape; anterior testis sinistral to midline, just posterior to junction of fore- and hindbody, 0.138 to 0.243 long by 0.095 to 0.307 wide; posterior testis in middle of hindbody, wider than long, with a median constriction, 0.138 to 0.218 long by 0.265 to 0.358 wide. Seminal vesicle extending from middle of posterior testis to enter genital atrium *via* narrow ejaculatory duct. Ovary sinistral to midline, anterior to fore testis, 0.064 to 0.128 long by 0.106 to 0.148 wide. Mehlis' gland dextral to ovary. Laurer's canal extending dorsally from oviduct, opening on median dorsal surface of body between levels of ovary and vitelline reservoir. Uterus ascending from Mehlis' complex to fore margin of ovary then descending in midline of body to genital atrium. Eggs 0.093 to 0.116 long by 0.060 to 0.070 wide. Vitelline follicles most numerous in forebody at level of tribocytic organ, extending as two lateral bands from midway between acetabulum and cecal bifurcation to level of genital atrium. Vitelline reservoir median, intertesticular. Excretory system not observed.

Discussion.—There are five species in the genus *Fibricola*: (1) *F. cratera* (Barker and Noll, 1915) Dubois, 1932; (2) *F. lucida*

(LaRue and Bosma, 1927) Dubois and Rausch, 1950; and (3) *F. texensis* Chandler, 1942, all in North America; (4) *F. caballeroi* Zerecero, 1943; from Mexico, and (5) *F. minor* Dubois, 1936; from Australia.

F. lucida has been previously reported from Louisiana opossums (Dikmans, 1932) as *Neodiplostomum lucidum*. The present record constitutes the first report of *F. cratera* from Louisiana.

Each of four opossums was lightly infected with *F. lucida*. A single raccoon was infected with several hundred *F. cratera*. Four minks harbored heavy, mixed infections of *F. cratera* and *F. lucida*.

Mature specimens of *F. lucida* from the opossums were somewhat larger (1.133 to 1.750 long) than those recovered from the minks (1.097 to 1.330 long). Specimens of *F. cratera* from the minks were generally larger (0.814 to 1.435 long) than those from the raccoon (0.602 to 0.800 long). Dubois (1938) reported a size range of 1.50 to 1.74 for *F. lucida*; LaRue and Bosma's (1927) specimens reportedly attained a maximum length of 1.94. Dubois' (1938) measurements for *F. cratera* were 1.0 to 1.5; Barker's (1915) measurements for this species were given as 0.75 to 1.89. Chandler (1942) noted that size and shape of *F. texensis* were affected by the host species and the density of the infection. Perhaps the smaller size of some of our specimens can be explained by the numbers of worms present in each host. The raccoon was more heavily infected with *F. cratera* than any of the minks examined. The opossums harbored the lightest strigeid infection, but were heavily infected with another trematode, *Rhopalias macracanthus*.

F. cratera, *F. lucida*, and *F. texensis* are separated primarily by the vitelline distribution. The vitelline follicles of *F. lucida* are present in the hindbody as two lateral bands which extend posteriorly to the level of the genital atrium. In *F. cratera* a thin sheet of vitellaria on the ventral surface of the hindbody may extend to the level of the vitelline reservoir or slightly beyond. Ulmer (1955) observed that an intermediate condition may exist between the posterior extent of the vitellaria as originally described for *F. cratera* and *F. texensis*. Read (1948) differentiated *F. cratera* from *F. texensis* on the basis of a thin sheet of vitellaria limited

to the ventral side of the hindbody in the latter. Ulmer found that, in some specimens recovered from white mice fed metacercariae of *F. cratera* from the pelvic musculature of *Rana pipiens*, the vitellaria extended to the anterior margin of the posterior testis. In other specimens recovered from the same host the vitellaria on one side of the body extended to the posterior margin of the hind testis, whereas the vitelline follicles on the other side of the body extended only to the anterior margin of the hind testis. Chandler (1942) reported that the vitellaria of *F. texensis* extended anteriorly to the level of the pharynx. Dubois (1938) showed the anterior extent of vitellaria in *F. cratera* to be approximately midway between the acetabulum and the cecal bifurcation, and Ulmer's (1955) figures picture a similar condition. The vitellaria in our specimens of *F. cratera* extended slightly anterior to the fore margin of the acetabulum, never to the cecal bifurcation. Dubois and Rausch (1950) suggested that *F. cratera* and *F. texensis* are physiological species.

Family RHOPALIASIDAE Yamaguti, 1958

Rhopalias macracanthus Chandler, 1932

(Figures 4 to 5)

Hosts.—*Didelphis virginiana* Kerr, and *Mustela vison* Schreber [new host record].

Location.—Small intestine.

Locality.—Goodhope oil field, Louisiana [new locality record].

Diagnosis (based on 10 mature specimens from *Didelphis virginiana*).—*Rhopalias*. Body elongate, 2.45 to 5.0 long, superficially bisegmented by post acetabular constriction. Anterior body segment expanded laterally, concave ventrally. Posterior body segment narrower, two and one-half times length of anterior body segment, gradually tapering posteriorly to a point. Body with dorsal flexure at level of junction of fore- and hindbody. Forebody 0.700 to 1.500 long, hindbody 1.750 to 3.50 long. Cuticle spinous to level of posterior testis; spines largest and most numerous on forebody, diminishing in size and number posteriorly. Oral sucker subterminal, 0.145 to 0.230 long by 0.128 to 0.230 wide. Acetabulum well developed, its ventral protrusion visible when viewed laterally, 0.256 to 0.422

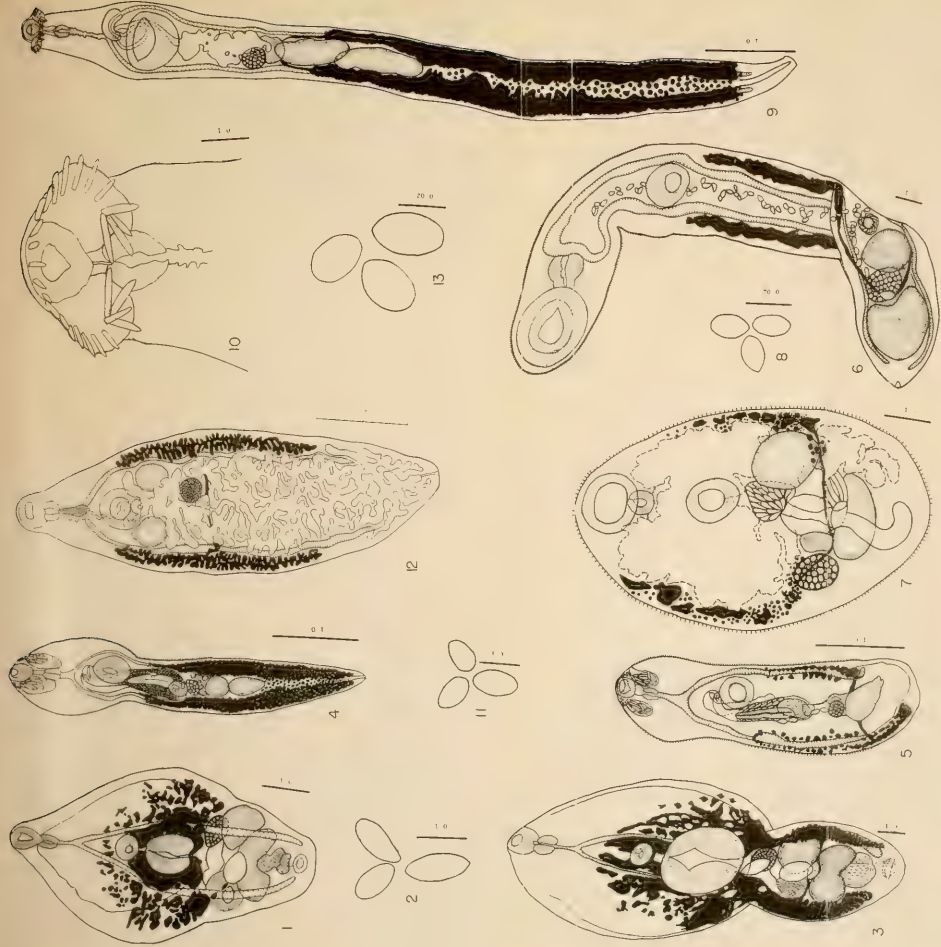
long by 0.102 to 0.384 wide. Sucker ratio 1:1.76 to 1.83. Prepharynx 0.44 to 0.145 long. Pharynx 0.142 to 0.256 long by 0.099 to 0.154 wide. Esophagus short, sometimes appearing absent, 0.000 to 0.087 long. Ceca two, extending along sides of body to terminate blindly, 0.260 to 0.333 from posterior extremity. Two proboscis sacs, one on each side of oral sucker, 0.256 to 0.333 long by 0.115 to 0.180 wide. Each eversible proboscide with 10 well developed spines measuring 0.078 to 0.128 long by 0.015 to 0.026 wide at their bases; posterior proboscis spines longest and widest. A single row of alternately arranged spines, six to eight in number and 0.023 to 0.035 long, present on each side of forebody on anterior margin between openings of proboscis sacs and oral sucker. Genital pore median, preacetabular, connecting with genital atrium containing openings of metraterm and male duct. Testes intercecal, tandem, in middle third of hindbody. Anterior testis 0.256 to 0.490 long by 0.230 to 0.350 wide; posterior testis often in contact with anterior testis, 0.346 to 0.875 long by 0.205 to 0.280 wide. Cirrus sac prominent, dextral to acetabulum, extending 0.700 to 1.085 posteriorly from genital pore, 0.180 wide at its base. Cirrus sac containing S-shaped seminal vesicle, large *pars prostatica*, prostate gland cells, and stout, unspined cirrus. Ovary pretesticular, sinistral to base of cirrus sac, separated from anterior testis by irregularly shaped Mehlis' gland, 0.128 to 0.154 long by 0.090 to 0.230 wide. Uterine coils pretesticular, ascending from Mehlis' gland to genital atrium; distal portion of uterus forming a large metraterm dextral to cirrus sac. Eggs 0.102 to 0.115 long by 0.051 to 0.064 wide. Vitellaria follicular, filling entire posttesticular region of hindbody, extending anteriorly as two lateral rows on ventral surface of hindbody to posterior margin of acetabulum. Vitelline reservoir posterior and dorsal to Mehlis' gland. Excretory system not observed.

Discussion: *Rhopalias macracanthus* Chandler, 1932, is a common parasite of *Didelphis virginiana* and has a wide distribution. Chandler (1932) described the species from opossums in the vicinity of Houston, Texas. Byrd *et al.* (1942b) found *R. macracanthus* in two of every three opossums examined at Reelfoot Lake, Tennessee.

The species has also been reported from Illinois (Babero, 1957) and Georgia (Babero, 1960 a). Yamaguti (1958) cited *Didelphus mesamexicana tabascensis* as a host for *R. macracanthus* in Mexico. Other species of the genus are *R. baculifer* Braun, 1901, *R. coronatus* (Rudolphi, 1819), and *R. horridus* (Diesing, 1850); these three species were described from South American opossums. Loftin (1960) reported *R. baculifer* and *R. coronatus* from opossums in Florida. Loftin's identification of these species is difficult to evaluate, as no figures or descriptions were presented in his paper.

The four opossums autopsied were heavily infected with *R. macracanthus* as well as with the strigeid, *Fibricola lucida*. Although *R. macracanthus* is predominantly found in opossums, this parasite is apparently capable of infecting a variety of hosts. McKeever (1961) reported a single mature specimen from the intestine of a wild turkey, *Meleagris gallopavo*, in Georgia, and we have recovered a single *R. macracanthus* from the intestine of a mink, *Mustela vison*, in Louisiana. Our specimen was evidently an immature worm, as judged by its small size (2.1 long), the absence of eggs in the uterus, poorly developed vitellaria, and relatively small ovary, Mehlis' gland and testes.

The location of the parasites in the host and the density of the infection appear to have a considerable effect on the size of the worms. Specimens from one heavily infected opossum showed a definite gradation in size with respect to the section of the intestine in which they were found. The majority of worms were found in the anterior third of the small intestine; these were large (3.8 to 4.62 long) and well developed. Several medium-sized worms (3.5 to 4.0 long) were found in the middle third of the small intestine, and a few, much-stunted (1.96 to 3.15 long) specimens in the posterior third of the small intestine. Most of the smaller worms, as well as the larger ones, were sexually mature, as judged by the presence of eggs in the uterus. One worm from the posterior section of the small intestine showed striking abnormalities (fig.-5). This specimen measured 3.15 long; there was only slight differentiation into anterior and posterior segments, and the posterior end of the body was bluntly rounded rather than tapered to a point. A single testis was pres-



Figures 1-13. 1. *Fibricola cratera*, ventral view of whole mount from *Procyon lotor*. 2. Same, uterine eggs. 3. *Fibricola lucida*, ventral view of whole mount from *Didelphis virginiana*. 4. Same, uterine eggs. 5. *Stenopatus mucronator*, ventral view of whole mount from *Didelphis virginiana*. 6. Same, uterine eggs. 7. *Haastisia tenax*, ventral view of whole mount. 8. Same, uterine eggs. 9. *Eupuriphium leaveri*, ventral view of whole mount. 10. Same, ventral view of anterior and showing shape and arrangement of crown spines. 11. Same, uterine eggs. 12. *Novaezaki*, ventral view of whole mount. 13. Same, piercing uterine eggs. 1, 10, 11 and 13 drawn with the aid of a microprojector. Projected scales have the approximate value in millimeters.

ent, the vitellaria were sparse and confined to the sides of the body, and the Mehlis' gland and ovary were somewhat reduced in size. There were, however, ten eggs in the uterus. The cirrus sac, with its contained structures, as well as the structures of the forebody, appeared normal. This unusual morphology appears to be degenerate or teratological rather than definitive in nature. Only a single specimen with the forementioned morphology was found, though evidence of some reduction of the hindbody was seen in other specimens recovered from the posterior regions of the opossum intestine.

It appears that in hyperinfections some individuals are forced posteriorly in the intestine, apparently with deleterious effects. The posterior regions of the digestive tract of the opossum may be unsuitable for normal development and/or proper maintenance of *R. macracanthus*.

Family BRACHYLAEMIDAE Joyeux and Foley, 1930

Brachylaemus virginianus Dickerson, 1930 (Figure 6)

Synonymy.—*Brachylaemus migrans* of Sinitzin, 1931.

Host.—*Mustela vison* Schreber [new host record].

Location.—Small intestine.

Locality.—Goodhope oil field, Louisiana.

Diagnosis (based on one mature specimen).—*Brachylaemus*. Body elongate with bluntly rounded extremities, 2.195 long by 0.319 wide at level of acetabulum. Cuticle spinose to level of midbody, remainder smooth. Oral sucker large, subterminal, 0.180 in diameter. Acetabulum smaller than oral sucker, 0.127 long by 0.138 wide, located 0.498 from anterior end of the body. Sucker ratio 1:0.705. Prepharynx very short. Pharynx in contact with oral sucker, 0.084 long by 0.106 wide. Esophagus very short. Ceca bifurcating almost immediately posterior to pharynx, extending laterally, then posteriorly, terminating midway between posterior testis and posterior end of body. Genital pore median on ventral surface of body just anterior to fore testis. Testes two, tandem, near posterior end of body; anterior testis 0.127 long by 0.148 wide; posterior testis 0.170 long by wide.

Tubular seminal vesicle and prostate gland cells between anterior testis and genital pore. Ovary sinistral to midline, intertesticular, 0.098 long by 0.112 wide. Mehlis' gland dextral to ovary. Uterus ascending on midline to a point midway between acetabulum and cecal bifurcation then descending to genital pore. Eggs 0.025 to 0.036 long by 0.014 to 0.020 wide. Vitelline follicles lateral, extending from posterior margin of acetabulum to fore margin of anterior testis. Vitelline ducts extending posteriorly from vitelline follicles to posterior margin of ovary, joining to form vitelline reservoir. Excretory system not observed.

Discussion.—This is the first report of *Brachylaemus virginianus* from the mink, *Mustela vison*. *B. virginianus* is commonly found in opossums, though Babero (1960b) reported Louisiana skunks, *Mephitis mephitis* (Schreber), infected with this trematode. Krull (1934) experimentally exposed white rats, dogs, cats and chickens to metacercariae from *Polygyra thyroides* and recovered mature specimens of *B. virginianus* from each of these hosts. We have also recovered specimens of a *Brachylaemus* sp., probably *B. virginianus*, from *Mesodon thyroidens* in Audubon Park, New Orleans. Other species of *Brachylaemus* in the United States are *B. dolichodira* Mason, 1953 in *Blarina brevicauda* (Say), *B. fuscata* (Rudolphi, 1819) in *Bonasa umbellus* (Linn.), *B. mcintoshi* Harkema, 1939, in *Strix varia* Barton, *B. opisthotrias* (Lutz, 1895), in *Didelphis virginiana*, *B. pellucida* Sinitzin, 1931, in *Planesticus migratorius* and *Procyon lotor*, and *B. peromysci* Reynolds, 1938, in *Peromyscus leucopus* (Rafinesque).

B. virginianus resembles *B. opisthotrias*, differing primarily in the anterior extent of the uterus. The uterus in our specimens of *B. virginianus* ascended to a point at least midway between the acetabulum and the cecal bifurcation. Byrd *et al.* (1942b.) reported that in most of their specimens of *B. virginianus* recovered from opossums in Georgia and Tennessee the uterus reached the cecal bifurcation. The uterus in a single specimen of *B. opisthotrias*, recovered by Byrd *et al.* (*loc. cit.*) from an opossum in Tennessee, ascended only to the posterior margin of the acetabulum. Other differences noted by Byrd *et al.* between the two

species included the larger size (4.06 long by 0.548 wide), smaller eggs (0.021 to 0.027 long by 0.012 to 0.015 wide) and a smooth cuticle in *B. opisthotrias*. In contrast, specimens of *B. virginianus* averaged 2.18 long and 0.348 wide, had eggs 0.029 to 0.033 long by 0.016 to 0.021 wide, and had cuticular spines present to the midlevel of the body.

Hasstilesia texensis Chandler, 1929

(Figures 7 to 8)

Host.—*Sylvilagus aquaticus* (Bachman).

Location.—Small intestine.

Locality.—Goodhope oil field, Louisiana [new locality record].

Diagnosis (based on 50 mature specimens).—*Hasstilesia*. Body oval to round in outline, 0.496 to 0.850 long by 0.420 to 0.665 wide. Cuticle entirely spinose, spines denser in anterior regions of body. Oral sucker well developed, 0.098 to 0.139 in diameter. Acetabulum usually smaller than than oral sucker, 0.095 to 0.132 in diameter, 0.192 to 0.384 from anterior extremity as measured from center of acetabulum. Sucker ratio 1:0.875 to 1.165. Prepharynx very short, appearing absent. Pharynx oval, in contact with or overlapping oral sucker, 0.034 to 0.050 long by 0.041 to 0.064 wide. Esophagus not visible. Ceca two, bifurcating immediately behind pharynx, extending on each side of body to terminate near posterior extremity with the blind ends almost in contact with one another. Genital pore median on ventral surface of body anterior to posterior testis, 0.138 to 0.180 from posterior extremity. Genital atrium shallow, containing openings of metraterm and male duct. Anterior testis sinistral to midline, 0.085 to 0.192 long by wide; posterior testis median, 0.074 to 0.141 long by 0.106 to 0.179 wide. Cirrus sac long, extending from posterior margin of acetabulum to genital atrium, containing numerous prostate gland cells at its base; cirrus long, stout, 0.230 to 0.256 long by 0.0233 to 0.058 wide. Ovary dextral to midline, between testes, 0.053 to 0.077 long by wide. Mehlis' gland slightly smaller than ovary, between ovary and posterior testis. Laurer's canal present. Uterus much convoluted, almost filling space between testes and engorging body to level of pharynx. Distal loop of uterus forming metraterm which

enters genital atrium sinistral to male duct. Eggs 0.015 to 0.023 long by 0.009 to 0.015 wide. Vitellaria in lateral regions of body from level of pharynx to level of ovary. Vitelline reservoir mesial to Mehlis' gland, receiving ducts from vitelline follicles on each side of body. Excretory system not observed.

Discussion.—Each of the two swamp rabbits collected was infected with thousands of *Hasstilesia texensis* Chandler, 1929. The infections were so dense that the wail of the intestine had a brown color imparted by the uterine eggs of the closely packed parasites.

There is one other species of *Hasstilesia*, *H. tricolor* (Stiles and Hassall, 1894) Hall, 1916. Chandler (1929) believed his specimens of *Hasstilesia* from *Sylvilagus floridanus* (Allen) in Texas to be specifically distinct from *H. tricolor* in; (1) the larger size of the suckers; (2) the more posterior location of the acetabulum; (3) absence of an esophagus; (4) the looser arrangement of the uterine coils; (5) the longer cirrus; (6) the less profuse and more scattered vitellaria; and (7) a distinct Laurer's canal. Marker and Cheng (1960) have proposed that *H. texensis* and *H. tricolor* are the same species. They based this conclusion on observations of specimens of *Hasstilesia* taken from cotton tail rabbits, *Lepus sylvaticus* (= *Sylvilagus floridanus* (Allen)), in Pennsylvania, and on life history studies of *H. tricolor* by Rowan (1955). Rowan observed that in young specimens of *H. tricolor* the uteri may be loosely coiled, a Laurer's canal is present, and the esophagus may sometimes appear absent. Robinson (1959) recognized *H. texensis* as a distinct species from *H. tricolor*, citing the larger sucker sizes in the former as a distinguishing character. Marker and Cheng (*loc. cit.*) discounted the validity of sucker sizes in separating the two forms. They noted that overlap exists in the lower size range of the acetabulum in *H. texensis* as reported by Chandler (1929) and in the upper size range of the acetabulum cited for *H. tricolor*. These investigators further stated that three microns existed between the smallest dimensions of the oral sucker reported for *H. texensis* (Chandler, 1929) and the largest dimensions of the oral sucker reported for *H. tricolor*. Marker and Cheng added

that in their specimens of *Hasstilesia* there was variation in the position of the acetabulum, the vitellaria were sometimes diffuse and scattered, and the cirrus was within the size range given by Chandler (1929) for *H. texensis*.

We have studied fifty specimens of *H. texensis* removed from the intestine of one of the two swamp rabbits collected. In order to minimize distortion of the muscular organs these worms were killed in boiling water prior to introduction into AFA. Measurements of body length and sucker diameter were analyzed statistically and compared with data reported for *H. tricolor* by Rowan

(1955) and Marker and Cheng (1960) (fig. 14). There was a difference between the means of the diameters of the oral sucker and acetabulum for our sample and Rowan's sample in excess of twice the sum of the standard errors. Marker and Cheng reported only the range and mean for their measurements. It should be noted, however, that the mean diameter of the oral sucker and mean diameter of the acetabulum reported by Marker and Cheng are even less than the means of the diameters of these structures in Rowan's material. Mean body length of our specimens was somewhat less than that of Rowan's specimens, and slightly

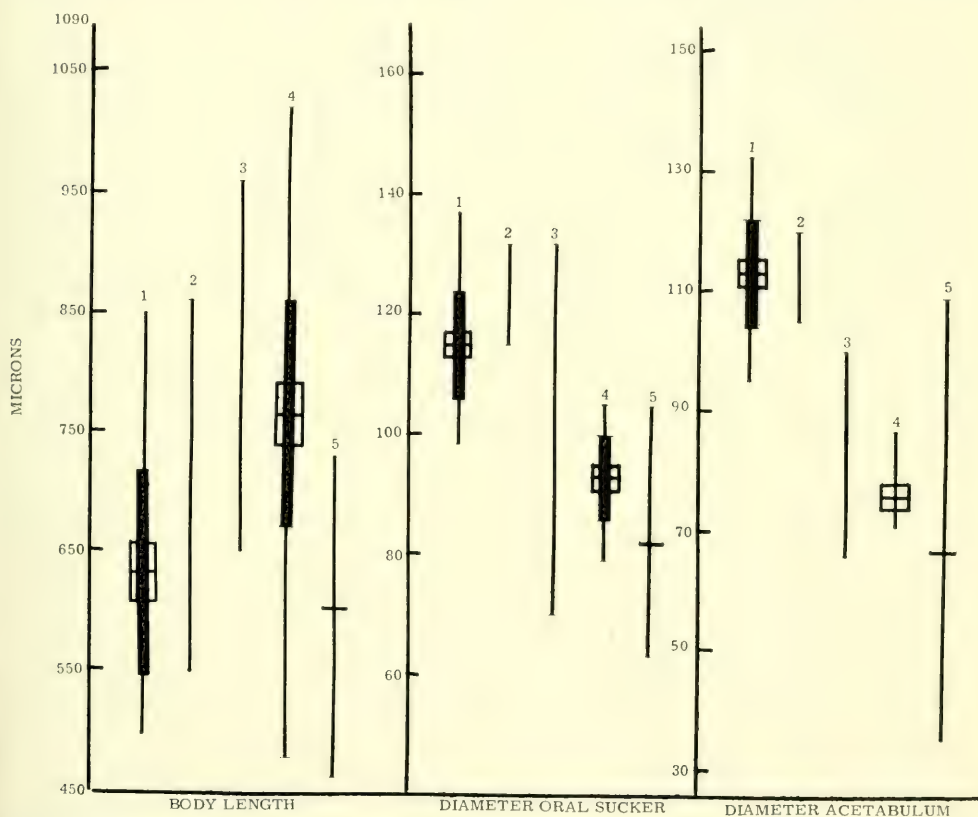


Figure 14. Comparison of measurements for *Hasstilesia texensis* and *H. tricolor*. In each sample the vertical line indicates the range of measurements; the crossbar, the mean; the solid rectangle, one standard deviation on each side of the mean; the hollow rectangle, two standard errors on each side of the mean. Numbers above each vertical line identify the sample. Sample 1. Lumsden and Zischke (1961). 50 specimens of *H. texensis* from *Sylvilagus aquaticus* in Louisiana. Sample 2. Chandler (1929). Unknown number of specimens of *H. texensis* from *Sylvilagus floridanus* in Texas. Sample 3. Byrd and Reiber (1942a.). Unknown number of specimens of *H. texensis* from *Sylvilagus aquaticus* and *S. floridanus* in Tennessee and Mississippi. Sample 4. Rowan (1955). 50 specimens of *H. tricolor* from domestic rabbits. Sample 5. Marker and Cheng (1960). 50 specimens of *H. tricolor* from *Lepus sylvaticus* in Pennsylvania.

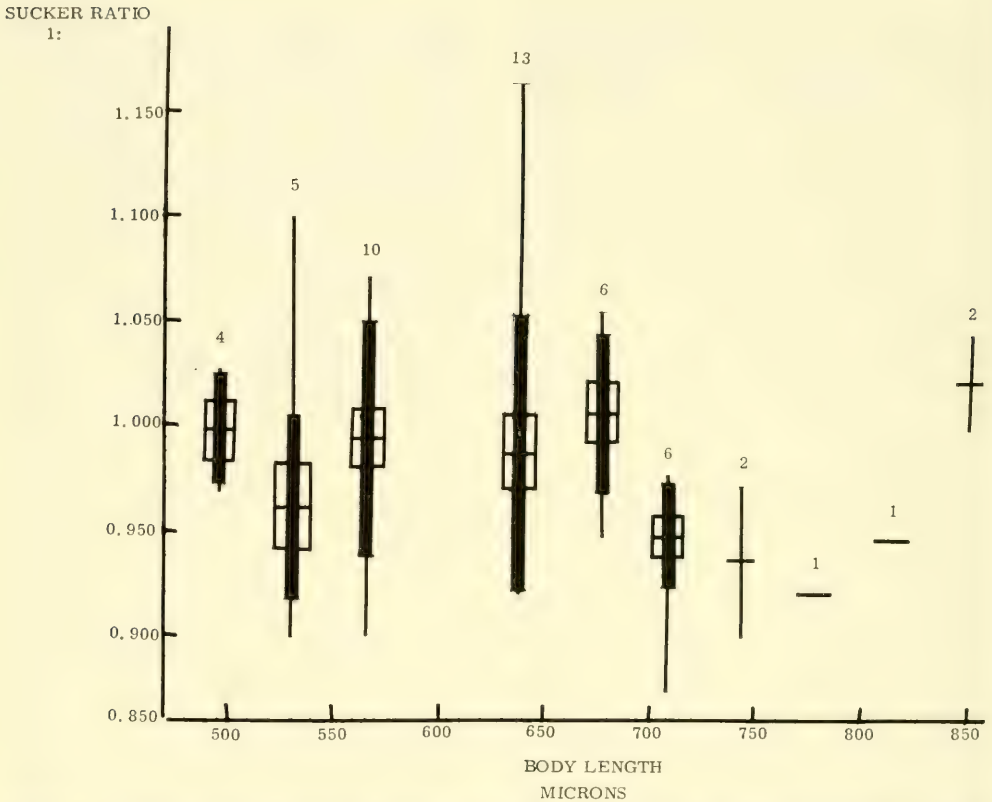


Figure 15. Relationship between sucker ratio and body length for 50 specimens of *Hassitesia texensis* from *Sylvilagus aquaticus* in Louisiana. Numbers above each vertical line denote the number of specimens comprising each group. The hollow rectangle indicates one standard error on each side of the mean.

larger than that of Marker and Cheng's. We conclude from these results that the difference with regard to sucker size between our sample and the samples of Rowan and Marker and Cheng is statistically significant, and hence the samples were not drawn from the same population.

Marker and Cheng ascribed all of their specimens of *Hasstilesia* to a single species, *H. tricolor*, contending it was improbable that two or more closely related species would be parasitic within a single host specimen. They therefore considered morphological variation within their sample of trematodes as intraspecific. There are, however, reports in the literature indicating certain closely related species are often found together within an individual host. Sogandares (1959) has reported mixed infections of *Dinurus* spp. in single hosts of *Coryphaena* spp. The poeciliid, *Mollienisia latipinna*

LeSueur, serves as a second intermediate host for *Ascocotyle* spp. in Louisiana. One of us (RDL) has frequently recovered metacercariae of *A. leighi* Burton, 1956, and *A. tenuicollis* Price, 1935, from the same *conus arteriosus*. Mixed infections of adult *A. leighi* and *A. tenuicollis* have also been found in Louisiana raccoons. This paper reports mixed infections of *Fibricola cratera* and *F. lucida* in *Mustela vison*.

H. texensis has been reported from New York, Ohio, and Georgia by Robinson (1959) from Tennessee and Mississippi by Byrd and Reiber (1942), from Texas by Chandler (1929), and this paper reports the species from Louisiana. *H. tricolor* has been reported from New York by Hall (1916), from Virginia by Stiles and Hassall (1894), and from Pennsylvania by Marker and Cheng (1960). The geographic range of *H. texensis* thus overlaps the geographic

range of *H. tricolor*. The possibility of mixed infections of *H. texensis* and *H. tricolor* occurring in lagomorphs in the eastern U. S. exists. Measurements which denote the upper ranges of the sucker diameters for *H. tricolor* conceivably could have been taken from specimens of *H. texensis* in mixed infections with the former species.

Adult morphology of the two forms is very similar, apparently differing only in the relative sizes of the muscular organs. Sucker sizes in proportion to body size in *H. texensis* and *H. tricolor* are significantly different, although there may be slight overlap or proximity in the range of actual measurements of the suckers for the two species. These data do not support the proposal of Marker and Cheng to synonymize *H. texensis* with *H. tricolor*. We believe that the status of *H. texensis* will be resolved only when the complete life histories of both *H. texensis* and *H. tricolor* are known. For this reason, the retention of *H. texensis* as a distinct species from *H. tricolor* is advocated at this time.

Family ECHINOSTOMATIDAE Poche
1926

Euparyphium beaveri Yamaguti, 1958
(Figures 9 to 11)

Synonymy.—*Euparyphium melis* (Schrank, 1788) of Beaver, 1941 *nec. Isthmiophora melis* (Schrank, 1788) Luehe, 1909.

Host.—*Mustela vison* Schreber.

Location.—Duodenum.

Locality.—Sarpy, Louisiana [new locality record].

Diagnosis (based on four mature specimens).—*Euparyphium*. Body elongate, 6.0 to 9.49. Maximum width at level of acetabulum, 0.64 to 0.85. Posttesticular region of body 2.83 to 5.31 long by 0.637 wide. Cuticular spines present nearly to posterior extremity, shorter and more numerous between oral sucker and acetabulum, becoming longer and less numerous posteriorly. Well defined circumoral collar 0.354 to 0.460 wide, bearing 27 long, abruptly tapered spines. Seven of these crown spines alternately arranged on dorsal surface, 0.085 to 0.106 long by 0.011 wide; 6 crown spines arranged in a single row on each lateral surface, 0.062 to 0.070 long by 0.011 to 0.014 wide; 4 crown spines present on each

ventral angle, directed medially, in anterior and posterior pairs, 0.103 to 0.109 long by 0.020 wide. Oral sucker 0.160 to 0.205 long by 0.166 to 0.218 wide. Acetabulum large, 0.403 to 0.595 long by 0.445 to 0.603 wide, in anterior third of body, 0.70 to 1.05 from anterior extremity. Sucker ratio 1:2.89 to 3.32. Prepharynx 0.023 to 0.115 long. Pharynx 0.166 to 0.192 long by 0.128 to 0.141 wide. Esophagus 0.333 to 0.397 long. Ceca two, one on each side of body, terminating blindly 0.256 to 0.448 from posterior extremity. Genital pore immediately preacetabular, just posterior to cecal bifurcation. Testes intercecal, tandem, elongate with a slight twist; anterior testis 0.512 to 0.840 long by 0.256 to 0.280 wide, 1.925 to 2.66 from anterior end of body; posterior testis 0.640 to 0.910 long by 0.218 to 0.245 wide. Cirrus sac elongate, extending dorsally and posteriorly to midlevel of acetabulum, enclosing seminal vesicle, prostatic gland cells, and cirrus. Cirrus long, covered with short stout spines. Ovary 0.230 to 0.294 long by 0.180 to 0.230 wide, dextral to midline, 0.460 to 0.673 behind acetabulum, separated from anterior testis by oval Mehlis' gland; Mehlis' gland 0.166 to 0.230 long by 0.218 to 0.307 wide. Laurer's canal opening dorsally on midline. Uterus in transverse loops between ovary and posterior margin of acetabulum, forming distally metraterm which lies sinistral to cirrus sac. Eggs 0.116 to 0.123 long by 0.061 wide. Vitelline follicles extending from level of ovary to termination of ceca, confluent in dorsal posttesticular region of body, present in lateral fields on ventral surface of hind-body. Vitelline reservoir posterior and dorsal to Mehlis' gland, receiving vitelline ducts from each side of body. Excretory pore subterminal, dorsal.

Discussion.—Law and Kennedy (1932) recovered echinostomes from Ontario mink which they reported as *Euparyphium melis* (Schrank), previously known only from European Mustelidae. Beaver (1941) elucidated the life history and redescribed this North American form. He noted that his specimens differed from *E. melis* as described by Dietz (1910) in the shape and position of the crown spines, but were identical in all other respects to the European species. The crown spines of Beaver's specimens were abruptly pointed at the outer

ends, and only four were oral in position. The spines of the European form were described by Dietz (1910) as being rounded at both ends, and ten were oral in position. Yamaguti (1958) proposed that the North American form, as described by Beaver (1941) warranted specific designation, differing from European species not only in the nature of the crown spines, but also in egg size (narrower in the American form) and in the type of cirrus (thickly spined in North American form, unspined in the European form). He named the North American form *Euparyphium beaveri*.

One of the four mink collected from the Sarpy locality was found to be infected with five echinostomes which are unquestionably the same species described by Beaver (1941) from *Mustela vison* and *Lutra canadensis* in Michigan and Minnesota.

Family DICROCOELIIDAE Odhner, 1911

Zonorchis komareki (McIntosh, 1939)

Travassos, 1944

(Figures 12 to 13.)

Host.—*Oryzomys palustris* (Harlan) [new host record].

Location.—Bile duct.

Locality.—Bonnet Carre Spillway at Norco, St. Charles Parish, Louisiana [new locality record].

Diagnosis (based on six mature specimens).—*Zonorchis*. Body lanceolate, 3.675 to 5.250 long by 1.487 to 1.735 wide. Cuticle aspinose. Forebody 0.743 to 1.062 long. Body posterior to anterior edge of acetabulum 2.932 to 4.188 long. Oral sucker subterminal, 0.319 to 0.390 long by 0.354 to 0.390 wide. Acetabulum in anterior third of body, 0.425 to 0.496 long by 0.460 to 0.531 wide. Sucker ratio from 1:1.27 to 1:3.6. Prepharynx short, appearing absent. Pharynx 0.177 to 0.390 long by 0.212 to 0.390 wide. Esophagus extending from pharynx to half the distance from posterior border of oral sucker to anterior border of acetabulum. Ceca two, narrow extending along sides of body lateral to acetabulum ending blindly in about posterior sixth of body. Genital pore at level of posterior margin of pharynx opening into very shallow genital atrium. Testes two, roundish, juxtaposed at posterior border of acetabulum, 0.248 to 0.425 long by 0.212 to 0.354 wide. Cirrus

sac ventral to esophagus, extending from genital atrium to cecal bifurcation; anterior two thirds containing unspined cirrus; posterior third containing convoluted internal seminal vesical and surrounding prostate gland cells. Ovary roundish, posttesticular, sinistral to mid-line of body, 0.212 to 0.283 long by 0.212 to 0.319 wide. Seminal receptacle dorsal to dextral margin of ovary. Ootype and Mehlis' gland median. Laurer's canal not observed. Vitellaria lateral to ceca, extending from level of anterior border or midlevel of acetabulum to posterior third of body. Vitelline reservoir dextral to ovary. Uterus intercecal, occupying most of hind-body, intruding between ovary and testes, perforating genital atrium dextral to cirrus sac. Eggs 0.025 to 0.031 long by 0.011 to 0.022 wide. Posterior portion of excretory vesicle tubular, anterior extension not observed.

Discussion.—The bile duct of a single rice rat, *Oryzomys palustris*, from the Bonnet Carre Spillway at Norco, Louisiana, was found infected with *Zonorchis komareki*. In subsequent collections of rice rats at the Goodhope oil field at Norco, one was found infected with *Z. komareki*. This rat died in the trap and partial cytolysis and contraction left the worms in a much distorted condition. Measurements of these five trematodes are not included. However, the diagnosis for these specimens is comparable to that of the six specimens given above, and both groups are unquestionably members of the same species.

Since no life cycle has been elucidated for any member of the genus *Zonorchis*, the host specificity and morphological variation of the adult specimens of several species remain an enigma. It is doubtful if studies of the adults from natural infections will yield much definitive information concerning the status of several species of *Zonorchis*. Present information indicates a great degree of overlap and convergence of adult characteristics in this genus. Our specimens from the rice rat closely resemble *Zonorchis komareki*, though they differ in; (1) size (3.68 to 5.25 long by 1.49 to 1.74 wide vs. 2.8 long by 0.8 wide in *Z. komareki*); (2) sucker ratio (1: 1.27 to 1.36 vs. 1: 1.72 in specimens for record collection); (3) ceca extending only to posterior sixth of body (as compared to posterior end of body in

Z. komareki); and (4) in a sinistral as compared with a dextral ovarian position. These small differences do not seem to warrant the naming of a new species at this time.

SUMMARY

The following trematodes are reported from Louisiana for the first time: *Fibricola cratera* (Barker and Noll) Dubois, 1932, *Hasstilesia texensis* Chandler, 1929, *Euparyphium beaveri* Yamaguti, 1958, *Zonorchis komareki* (McIntosh, 1939) Travassos, 1944, and *Rhopalias macracanthus* Chandler, 1932.

New host records are: *Rhopalias macracanthus* Chandler, 1932, and *Brachylaemus virginianus* in *Mustela vison* Schreber, and *Zonorchis komareki* in *Oryzomys palustris* (Harlan).

Mixed infections of *Fibricola cratera* and *F. lucida* were found in four minks examined. The former was also recovered from a single raccoon, and the latter from four opossums. Our specimens of *Fibricola* from the raccoon and the minks which we have identified as *F. cratera* correspond to the description of Dubois (1938) for that species, primarily in the anterior extent of the vitellaria. Vitelline follicles apparently extend into the hindbody at least to the fore-margin of the posterior testis in both *F. cratera* and *F. texensis* Chandler, 1942.

The development and/or maintenance of *Rhopalias macracanthus* appears to be influenced by the location of these worms in the opossum's intestine. The normal site for these parasites is apparently the anterior third of the digestive tract. The more posterior regions of the opossum's gut may be suboptimal, as worms found in these areas were of small size or abnormal morphology.

Comparison of sucker sizes reported for *Hasstilesia tricolor* and our measurements of sucker diameters from specimens of *H. texensis* in Louisiana swamp rabbits indicates a significant difference in this character between the two species. The retention of *H. texensis* as a separate species from *H. tricolor* is advocated.

Specimens ascribed to *Zonorchis komareki* are reported from Louisiana rice rats, but differences are noted from the original descriptions of this species in body size, sucker ratio, posterior extent of the ceca, and position of the ovary. A dearth of information regarding host specificity and morphological

variation of adult specimens of several species in *Zonorchis* preclude the naming of a new species at this time.

REFERENCES CITED

- BABERO, B. B. 1957. Some helminths from Illinois opossum. *Jour. Parasitol.* 43: 232.
- 1960a. Further studies on helminths of the opossum, *Didelphis virginiana*, with a description of a new species from this host. *Ibid.* 46: 455-463.
- 1960b. A survey of parasitism in skunks, *Mephitis mephitis*, in Louisiana, with observations on pathological damages due to helminthiasis. *Ibid.*, 46 (supp.): 26.
- BARKER, F. D. 1915. Parasites of the American muskrat (*Fiber zibethicus*). *J. Parasitol.* 1: 184-197.
- BEAVER, P. C. 1941. Studies on the life history of *Euparyphium melis* (Trematoda: Echinostomatidae). *J. Parasitol.* 27: 35-43.
- BYRD, E. E., and REIBER, R. J. 1942a. Mammalian trematodes II. Three flukes from small mammals. *J. Tenn. Acad. Sci.* 17: 143-156.
- BYRD, E. E., REIBER, R. J., and PARKER, M. V. 1942b. Mammalian trematodes I. Trematodes from opossum, *Didelphis virginiana*. *Ibid.* 17: 130-142.
- CHANDLER, A. C. 1929. A new species of trematode worm belonging to genus *Hasstilesia* from rabbits in Texas. *Proc. U. S. Nat. Mus.* 75: 1-5.
1932. Notes on the helminth parasites of the opossum (*Didelphis virginiana*) in southeast Texas with descriptions of four new species. *Ibid.* 81: 1-15.
1942. The morphology and life cycle of a new strigeid, *Fibricola texensis*, parasitic in raccoons. *Trans. Am. Microscop. Soc.* 61: 156-167.
- DIETZ, E. 1910. Die Echinostomiden der Vögel. *Zool. Jahrb. (Supp.)* 12: 265-512.
- DIKMANS, G. 1931. A new nematode worm, *Viannaia bursobscura*, from the opossum with a note on the other parasites of the opossum. *Proc. U. S. Nat. Mus.* 79: 1-4.
- DUBOIS, G. 1938. Monographie des Strigeida (Trematoda). *Mém. Soc. Neuchâteloise Sc. Nat.* 6: 1-535.
- and RAUSCH, R. 1950. Troisième contribution à l'étude des Strigéides (Trematoda) nord-américains. *Bull. Soc. Neuch. Sc. Nat.* 73: 19-50.
- HALL, M. C. 1916. *Hasstilesia tricolor* (Stiles and Hassall, 1894) a common parasite of rabbits in the United States. *Jour. Amer. Vet. Assoc.* 48: 453-456.
- KRULL, W. H. 1934. New experimental hosts for *Brachylaemus virginiana* (Dickerson) Krull. *Jour. Wash. Acad. Sci.* 24: 483-485.

- LARUE, G. R. and BOSMA, N. J. 1927. Studies on the trematode family Strigeidae (Holtomidae). *Neodiplostomum lucidum* n. sp. *Jour. Parasitol.* 14: 124-125.
- LAW, R. G. and KENNEDY, A. H. 1932. Parasites of fur-bearing animals. *Bull. Dept. Game Fisheries Ont.* 4: 1-30.
- LOFTIN, H. 1960. An annotated check-list of trematodes and cestodes and their vertebrate hosts from northwest Florida. *Quart Jour. Fla. Acad. Sci.* 23: 302-314.
- MARKER, G. E. and CHENG, T. C. 1960. Intraspecific variations in *Hasstilesia tricolor* (Trematoda: Hasstilesiidae) and notes on the systematics of the family. *Proc. Penn. Acad. Sci.* 34: 191-198.
- McKEEVER, S. 1961. The occurrence of *Rhopalias macracanthus* (Trematoda: Rhopalaisidae) in the wild turkey (*Meleagris gallopavo*). *Jour. Parasitol.* 41: 60.
- READ, C. P. 1948. Strigeids from Texas mink with notes on the genus *Fibricola* Dubois. *Trans. Am. Microscop. Soc.* 67: 165-168.
- ROBINSON, E. J. 1959. New hosts for *Hasstilesia tricolor* and *H. texensis* (Trematoda: Brachylaimidae) and an emended diagnosis for the latter. *Trans. Am. Microscop. Soc.* 78: 317-322.
- ROWAN, W. B. 1955. The life cycle and epizootiology of the rabbit trematode, *Hasstilesia tricolor* (Stiles and Hassall, 1894) Hall, 1916 (Trematoda: Brachylaimidae). *Trans. Am. Microscop. Soc.* 74: 1-21.
- SOGANDARES-BERNAL, F. and HUTTON, R. F. 1929. Studies on helminth parasites from the coast of Florida. IV. Digenetic trematodes of marine fishes of Tampa, Boca Ciega Bays, and the Gulf of Mexico. 3. *Quart. Jour. Fla. Acad. Sci.* 21: 259-273.
- STILES, C. W. and HASSALL, A. 1894. Nouvelle espece de doure intestinale (*Distoma tricolor*) chez le lapin à queue cotonneuse (*Lepus sylvaticus* Bachman) et chez le lievre du nord (*Lepus americanus* Erxleben). *Bull. Soc. Zool. Fr.* 19: 160-162.
- ULMER, M. J. 1955. Notes on the morphology and host parasite specificity of *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932 (Trematoda: Diplostomatidae). *Jour. Parasitol.* 41: 460-466.
- YAMAGUTI, S. 1958. *Systema Helminthum*. Vol. I. *Digenetic Trematodes. Part I*. Interscience Publ., N. Y., 979 pp.

ABSTRACT

The following trematodes were found in mammals collected at Norco, Louisiana and vicinity: *Fibricola cratera* (Barker and Noll, 1915) Dubois, 1932, in the mink, *Mustela vison* Schreber; *F. lucida* (LaRue and Bosma, 1927) Dubois and Rausch, 1950, in *Mustela vison* and the opossum, *Didelphis virginiana* Kerr; *Brachylaemus virginianus* Dickerson, 1930, in *Mustela vison*; *Hasstilesia texensis* Chandler, 1929, in the swamp rabbit, *Sylvilagus aquaticus* (Bachman); *Euparyphium beaveri* Yamaguti, 1958, in *Mustela vison*; *Zonorchis komareki* (McIntosh, 1939) Travassos, 1944, in *Oryzomys palustris* (Harlan); and *Rhopalias macracanthus* Chandler, 1932, in *Didelphis virginiana* and *Mustela vison*. *Fibricola lucida* and *Brachylaemus virginianus* have been previously reported from Louisiana; all other species represent new locality records. New host records include *Rhopalias macracanthus* and *Brachylaemus virginianus* in *Mustela vison*, and *Zonorchis komareki* in *Oryzomys palustris*.