

# THE HELMINTHS PARASITIC IN THE AMPHIBIA AND REPTILIA OF HOUSTON, TEXAS, AND VICINITY

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## INTRODUCTION

Our knowledge of the helminths parasitic in the amphibians and reptiles of North America is still very limited. Leidy, Stafford, Cort, Stunkard, and Walton have made the most important contributions to the scientific study of this group of worms, but many authors have contributed important papers. I was engaged in the collection and study of the parasites of the Reptilia and Amphibia of the Houston, Tex., region, for 2½ years. More than 500 host animals representing 50 species have been examined. All adult parasitic worms, other than leeches, were collected and preserved for study. Usually the encysted forms were neglected, but one interesting cysticeroid is herein described.

There is no universal agreement among helminthologists as to the exact status of many of the major groups that are used in systematic classification. In this paper the classification of the trematodes is based on Faust's Human Helminthology, that of the cestodes on Southwell's Fauna of British India: Cestodes, and that of the nematodes on Baylis and Daubney's A Synopsis of the Families and Genera of Nematoda. The host names employed are those used in Stejneger and Barbour's A Check List of North American Amphibians and Reptiles, second edition.

This work has been done under the direction and criticism of Dr. A. C. Chandler, of the Rice Institute, Houston, Tex., for whose interest and suggestions I wish to express my sincere appreciation. I am further indebted to him for the use of his private library of reprints. Many other acknowledgments are made in various places throughout the paper.

## Class TREMATODA

## Family POLYSTOMIDAE van Beneden, 1858

## Genus POLYSTOMA Zeder, 1800

Worms of this genus have long been known to be parasitic in North American turtles, but Stunkard (1917) has suggested that they are not cogenetic with *Polystoma integerrimum*, the type species of the genus. Ward (1917) erected for them a new subgenus, *Polystomoides*. I have found four species of polystomes belonging to Ward's subgenus, one of which appears to be new.

## POLYSTOMA (POLYSTOMOIDES) HASSALLI Goto, 1899

This trematode has been found in the urinary bladder of *Kinosternon subrubrum hippocrepsis* and *Chelydra serpentina* in the vicinity of Houston, Tex., and in the former species at Huntsville, Tex.

## POLYSTOMA (POLYSTOMOIDES) ORBICULARE Stunkard, 1916

A polystome, which I assign to this species, was found in the bladder of several specimens of *Pseudemys elegans* taken at Houston, Tex. Some of the material exceeds in size the limits given by Stunkard (1917) for *Polystoma orbiculare*, but the relative size of the organs remains constant, and there can be very little doubt that my material is identical with Stunkard's. In respect to size, these larger specimens resemble *Polystoma inerme* and *P. spinulosum* MacCallum (1918b) rather closely, but because my material shows many intermediate types I believe that both species may prove to be synonymous with *P. orbiculare*, as Stunkard (1924) has already suggested.

## POLYSTOMA (POLYSTOMOIDES) TERRAPENIS, new species

## PLATE 1, FIGURE 1

*Specific diagnosis.*—*Polystoma*: Small polystomes of a flattened, ovoid shape. The body length varies from 1.9 to 2.5 mm, and the width varies from 0.72 to 0.82 mm. The caudal disk is circular, from 0.64 to 0.8 mm in diameter, and the six suckers are nearly equally spaced. The suckers are of the usual form, and in the bottom of each there is a small hook. The suckers are 0.18 to 0.2 mm in diameter. Sometimes the larval hooks may be found on the disk, but otherwise there are no hooks present. The larval hooks are about 20 $\mu$  long. The oral sucker is 0.26 to 0.28 mm long and 0.29 to 0.36 mm wide. It is followed immediately by the pharynx, which is 0.13 to 0.17 mm long and 0.19 to 0.22 mm wide. Even in whole mounts a short esophagus may be distinguished. The in-

testinal ceca extend nearly to the posterior end and are of the usual type. The testis is located in the middle of the body. It is 0.3 to 0.33 mm long by 0.23 to 0.28 mm wide. The vas deferens passes forward on the ovarian side of the body, median and dorsal to the ovary. The terminal portion of the tube is enlarged to form a seminal vesicle. The cirrus sac is  $82\mu$  to  $90\mu$  in diameter. The genital coronet contains 16 hooks. The ovary is lateral in position, nearly spherical, and  $67\mu$  to  $85\mu$  in diameter. The ootype is median, ventral, and caudal to the ovary. As usual it receives the two vitello-vaginal ducts. From it the genito-intestinal canal could be seen extending to the intestinal cecum of the ovarian side. A few nuclei around the ootype appear to represent Mehlis's gland. The vitellaria are extensively developed in the lateral fields, but they leave the intercecal space relatively free. The lateral fields converge just posterior to the pharynx and again posterior to the most anterior pair of suckers of the caudal disk. Between these lines the vitellaria extend only slightly beyond the median border of the intestinal ceca. The vaginae open at the lateral margins of the body, on the level of or slightly anterior to the ovary. The sides of the body are sharply indented at this point. The egg is 0.18 to 0.22 mm in diameter. No specific characters were observed in the excretory system.

*Host.*—*Terrapene carolina triunguis*.

*Locality.*—Houston, Tex.

*Habitat.*—Urinary bladder.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30864.

*Remarks.*—This species is very similar to *P. orbiculare* and *P. floridanum*, but it is a smaller worm, and the vitellaria do not crowd into the intercecal area posterior to the testis as they do in *P. orbiculare* and *P. floridanum*. Furthermore, the pharynx and cirrus sac are much smaller in *P. terrapenis*.

#### POLYSTOMA (POLYSTOMOIDES) MEGACOTYLE Stunkard, 1916

In spite of slight differences from this form as described by Stunkard (1917), I am referring a number of specimens from the mouth of *Pseudemys elegans* to this species. Stunkard's material consisted of three specimens from the mouth of *Chrysemys marginata* from Creston, Iowa. A fourth specimen from the same host Stunkard described as type and sole specimen of another species, *Polystoma microcotyle*. Though the differences between the two forms were distinct they were not very great, and my material shows many intermediate forms.

My material consists of eight adult specimens, and only the length of the great hooks consistently varies from Stunkard's description. The length of the great hooks varies from  $140\mu$  to  $190\mu$  in my ma-

terial, while Stunkard gives only one measurement,  $116\mu$ , for both *P. megacotyle* and *P. microcotyle*. Stunkard lists, as the distinguishing characters between *P. megacotyle* and *P. microcotyle*, the number of hooks in the genital coronet, and the size of the caudal suckers.

For *P. megacotyle* he gives 36 and 42 as the number of hooks in the genital coronet of the two specimens counted. For *P. microcotyle* he gives 32. In my material the number varies from 29 to 37. Stunkard does not give the size of the caudal sucker of *P. megacotyle*, but by measuring the figure we arrive at 0.4 mm as the probable diameter of the caudal suckers. The diameter of the caudal suckers of *P. microcotyle* is given as 0.28 mm. The diameter of the caudal suckers in my material varies from 0.3 to 0.45 mm. The range of variation in my material is so great that specific distinction between *P. megacotyle* and *P. microcotyle* seems unlikely. This seems even more unlikely when Stunkard's limited material is taken into consideration.

### Family HERONIMIDAE WARD, 1918

#### Genus HERONIMUS MacCallum, 1902

This genus is known only from the lungs of North American turtles.

#### HERONIMUS CHELYDRAE MacCallum, 1902

Since MacCallum described this worm it has been reported from many hosts other than *Chelydra serpentina*. At Houston, Tex., it has been found in the lungs of *Kinosternon subrubrum hippocrepis* and of *Pseudemys elegans*. Only the former host is new.

### Family SPIRORCHIDAE Stunkard, 1921

#### Subfamily SPIRORCHINAE Stunkard, 1921

#### Genus HENOTOSOMA Stunkard, 1922

This genus was established in 1922 by Stunkard for *Spirorchis chelydrae* MacCallum and *Henotosoma haematobium* Stunkard. MacCallum (1926) rejected it, but neglected to say why. Although undoubtedly closely related to *Spirorchis*, it seems to be worthy of recognition as a distinct genus, with characters as defined by Stunkard (1923).

#### HENOTOSOMA CHELYDRAE (MacCallum, 1922)

Four specimens of this fluke were taken from the heart of a snapping turtle captured near Houston, Tex. Comparison of my specimens with the descriptions of *H. haematobium* Stunkard and of *H. chelydrae* MacCallum left me in some doubt as to which of the

two my specimens should be referred. Comparison with some specimens of *H. haematobium*, which were kindly supplied by Doctor Stunkard, showed that my forms are not identical with these. They differ in having more closely packed and more deeply lobed testes, which are the characters that Stunkard pointed out as essential differences between his *H. haematobium* and the specimen that was sent to him by MacCallum as representative of *H. chelydrae*. From MacCallum's description it is not possible to differentiate the two species. My specimens are, therefore, referred to *Henotosoma chelydrae*.

Family PARAMPHISTOMATIDAE (Fischoeder, 1901) Stiles  
and Goldberger, 1910

Subfamily DIPLODISCINAE Cohn, 1904

This subfamily was founded in 1904 by Cohn to include the three genera *Diplodiscus*, *Opisthodiscus*, and *Catadiscus*. The history of the North American members of this group began somewhat previous to that time, for both Stafford and Leidy had reported the presence of *Diplodiscus subclavatus* in North American frogs. Stafford (1905) separated the North American form from the European and named it *Diplodiscus temperatus*. No other representatives of this group were described from North America until Chandler (1923) proposed the genus *Megalodiscus* for a new species that he discovered in the rectum of *Amphiuma means*. Millzner (1924) added *Megalodiscus ranophilus* from the rectum of the common leopard frog to Chandler's genus. Since that time some little doubt has been thrown on the validity of *Megalodiscus*, but no thorough discussion of the problem has been forthcoming. Chapin (1926) believed that *Megalodiscus ranophilus* was identical with *Diplodiscus temperatus*. Cort (1926) agreed with Chapin, and in addition stated his belief that *Megalodiscus* should be considered a synonym of *Diplodiscus*. Hunter (1930) placed *Megalodiscus americanus* in the genus *Diplodiscus*. On the other hand, Holl (1928a) expresses himself as follows: "The writer has not seen any specimens of *Megalodiscus*, but believes that future work will show that there are a number of species, belonging to this group, in North America." Poche (1926) listed *Megalodiscus* with the Diplodiscinae. Fukui (1929) rejected *Megalodiscus*, stating that the differences cited are not of generic value. He included *Diplodiscus temperatus*, however, with those forms having a single testis in contrast to those having two, and thereby confused the whole group. Neither in my own material nor in any available descriptions have I found any reference to *D. temperatus* having any tendency whatsoever toward fusion of the testes.

The foregoing account briefly indicates the uncertainty and disagreement that exist among investigators concerning the validity of *Megalodiscus*. A comparison of *Megalodiscus americanus* with other North American forms shows a striking resemblance. Thus *Diplodiscus temperatus* possesses the small sucker in the center of the acetabulum, although it is very inconspicuous in many adult specimens. The acetabulum, although relatively a smaller structure than in *Megalodiscus americanus*, is, nevertheless, as wide as or wider than the body. The testes are conspicuously smaller. In other respects the differences are very minor, and as the differences already pointed out are of specific rather than of generic value, there can be little doubt that these two forms are cogenetic. I agree with Chapin (1926) that *Megalodiscus ranophilus* Millzner is synonymous with *Diplodiscus temperatus* Stafford. *Diplodiscus intermedius* Hunter seems to be a valid species, in many respects intermediate between the above-mentioned forms.

Holl (1928a) has described a new species of this group from *Triturus viridescens*. Apparently the basis for including his form in the genus *Opisthodiscus* is the presence of a small sucker in the center of the acetabulum and the absence of black concretions in the excretory system. I have already shown that the first character is common to other North American forms of this group, while in my collection there exist examples of *Diplodiscus temperatus* with conspicuous granules in the excretory ducts, while other specimens lack these. On the other hand, Holl's description of *Opisthodiscus americanus* shows some important differences from *O. diplodiscoides*, the type species of *Opisthodiscus*. The type species lacks an esophageal bulb, the oral sucker and pharyngeal pockets are relatively extremely large, the intestinal ceca are asymmetrical, and the ovary is median and between the testes. Holl's species has none of these characters but is, on the other hand, similar to the other North American forms of the group that have been placed in the genera *Diplodiscus* and *Megalodiscus*. It therefore becomes necessary to transfer Holl's species to one of these two genera. Indeed, on comparing some specimens of *Opisthodiscus americanus*, which Doctor Holl kindly sent me, with some barely mature examples of *Diplodiscus temperatus*, which were taken from local frogs, I find it impossible to separate the two forms, and I therefore consider Holl's species to be identical with *Diplodiscus temperatus*.

It appears, from what has been said above, that all the American species of this group [*temperatus* Stafford (including *ranophilus* Millzner and *americanus* Holl), *americanus* Chandler, and *intermedius* Hunter] are cogenetic. If, however, these species be com-

pared with *Diplodiscus subclavatus*, the type species of *Diplodiscus*, important differences appear. In *D. subclavatus* the testes are single except in very young specimens; the vitellaria extend in two groups from the pharyngeal region to the caudal end of the intestinal ceca; and the posterior sucker has a cavity in its center instead of a prominence with special musculature. In the North American forms there is never any indication of fusion of the testes; the vitellaria are arranged in two or four compact groups with the anterior follicles scarcely reaching the level of the anterior testis; and the posterior sucker has a prominence with special musculature. These seem to me to be rather fundamental differences and to justify the placing of the North American forms in a separate genus. The name *Megalodiscus* Chandler (1923), proposed for his species *americanus*, is available for these North American forms. *Diplodiscus temperatus* Stafford and *D. intermedius* Hunter become *Megalodiscus temperatus* (Stafford) and *M. intermedius* (Hunter), respectively. *Megalodiscus americanus* stands as the type species of the genus. *Opisthodiscus americanus* Holl and *Megalodiscus ranophilus* Millzner fall into synonymy with *M. temperatus*.

**Genus MEGALODISCUS Chandler, 1923**

**MEGALODISCUS AMERICANUS Chandler, 1923**

A single specimen taken from the rectum of *Rana sphenoccephala* is tentatively referred to this species. The testes are relatively somewhat larger than any of Chandler's specimens of *M. americanus*, and they overlap more. These are minor differences, and in view of the limited material and wide host ranges known to exist among amphistomes, there seems to be no justification for its separation into a new species.

**MEGALODISCUS TEMPERATUS (Stafford, 1905)**

Stafford described this species from frogs. It is widely distributed in these animals in eastern North America. I have taken it from *Rana sphenoccephala*, *R. catesbeiana*, *R. areolata*, *R. clamitans*, and *Pseudacris triseriata*, at Houston, and from the first two hosts mentioned and *Hyla cinerea* at Huntsville, Tex.

The above account, besides adding to our locality records, includes four new hosts.

The material from the various hosts presented such a variety of appearances that I at first thought a number of species were present, but on careful examination it was impossible to find any constant character by which to separate any new species. The five specimens from *Pseudacris triseriata* were barely 1 mm long, yet eggs were

present in the uterus of one specimen. These small specimens, however proved to be *Megalodiscus temperatus*, by comparison with young individuals from other hosts.

### Family DICROCOELIIDAE Looss, 1907

#### Genus MESOCOELIUM Odhner, 1911

This genus is known by many species from Asia, Africa, and Australia, but so far as I am aware there is no previous record from America.

#### MESOCOELIUM AMERICANUM, new species

#### PLATE 1, FIGURE 2

*Specific diagnosis.*—*Mesocoelium*: Body length 1.2 to 2 mm, maximum width 0.5 to 0.7 mm. When properly relaxed before fixing and not flattened, the body is widest in the region of the intestinal fork, rounds anteriorly, and tapers gradually posteriorly. The cuticula is thin, and in the cephalic region it contains numerous short spines. The oral sucker is subterminal and nearly circular in outline. The diameter varies from 0.21 to 0.27 mm. The acetabulum in young specimens lies at the end of the first third of the body, but because of the distention of the posterior region with eggs it is relatively more cephalad in the older specimens. It is 0.13 to 0.2 mm in diameter. The ratio between the acetabulum and the oral sucker varies somewhat, but usually falls between 3:5 and 3:4. The prepharynx is very short and in whole mounts is often obscured. The pharynx is nearly globular and measures  $63\mu$  to  $105\mu$  in diameter. It is very close to one-half the diameter of the acetabulum. The esophagus is short, seldom equaling the diameter of the pharynx. The ceca curve sharply laterad, then turn caudal and run parallel to the lateral margins. In young specimens they nearly reach the middle of the body, but in fully matured specimens they do not extend far beyond the end of the first third of the body. The genital organs lie close in the fork of the intestine. The ovary is posterior to the testes on the left side, and its cephalic margin nearly always lies anterior to the posterior margin of the acetabulum. It is somewhat irregular in shape but is usually more or less ovoid, with the tip directed medio-caudad. It varies from 0.084 to 0.092 mm to 0.14 by 0.18 mm. The ootype and Mehlis's gland lie medio-caudad of the ovary. On the caudal margin of these structures there is a small yolk reservoir; at this point a seminal receptacle empties and Laurer's canal leaves. The seminal receptacle is a simple sac lying posterior to the yolk reservoir. Laurer's canal runs medio-caudad, loops back on itself,



and finally opens on the median, dorsal surface at the level of the yolk reservoir. The extensive coils of the uterus fill the body posterior to the genital field and to some extent invade the genital field itself. In unflattened specimens they usually obscure the ootype and Mehlis's gland and often extend laterad beyond the ceca. The eggs measure 20–31 $\mu$  by 38–44 $\mu$ . The vitellaria reach cephalad to the middle of the oral sucker and caudad to the ends of the ceca. They only slightly overlap the ceca and are mostly lateral to them. In the esophageal region the vitellarian fields widen considerably. The testes lie anterior to the ovary, but only slightly so. The testis of the ovarian side is the more anterior of the two. They are somewhat irregular in shape, apparently because of pressure from the intestinal ceca, the acetabulum, and the female genital system. They are of approximately equal size and vary from 0.07 by 0.105 mm to 0.14 by 0.15 mm. The vasa efferentia leave from the medio-cephalic corners and extend to the seminal vesicle in the cirrus sac. The cirrus sac is about 0.15 mm long and runs caudad from the genital pore, which is median and lies in the region of the intestinal fork. A pars prostatica is present. The simple capillary excretory vesicle extends from the terminal excretory pore to a point slightly behind the seminal receptacle.

*Hosts.*—*Storeria dekayi*, *Leiolopisma laterale*, and *Eumeces fasciatus*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimens.*—U.S.N.M. Helm. Coll. No. 30868; paratype, No. 30869.

*Remarks.*—This species is very similar to *Mesocoelium microon* Nicoll (1914a) from Australian anurans. The chief difference is that the esophagus is never longer than the pharynx in the present species, while it is twice as long in the Australian form. The testes are smaller relative to the acetabulum, and the ovary appears to be slightly more anterior relative to this organ. The suckers, pharynx, and eggs seem to be a little larger in my species than in Nicoll's.

The record for *Eumeces fasciatus* is based on a single individual, which is so young that there is no indication of either eggs or vitellaria. The ovaries and testes, however, are well developed and occupy the same position relative to each other and to the acetabulum. The ratios between pharynx, acetabulum, and oral sucker are identical with those for the mature specimens of *Mesocoelium americanum*. In the specimen from *Eumeces fasciatus*, however, the acetabulum is relatively farther posterior, being near the middle of the body, and the intestinal ceca are distinctly longer when compared with the length of the body.

## Family BRACHYCOELIIDAE S. J. Johnston, 1912

## Genus BRACHYCOELIUM Dujardin, 1845

This genus is known in North America by two species from the vermilion-spotted newt, and one species from a North American snake, which died in a London zoo. The following adds three more species.

## BRACHYCOELIUM HOSPITALE Stafford, 1900

This fluke was described by Stafford (1900) from Canadian salamanders. I refer to it some specimens taken from *Rana sphenoccephala*. Stafford's (1903) later description is for the most part adequate, but my material shows a few variations that need to be mentioned. Stafford gives the ratio of the oral sucker to the acetabulum as 4:3. In my material this ratio varies from 3:2 to 4:3. The eggs in fully matured individuals fall very close to the dimensions given by Stafford, but in young individuals they are very variable in size.

## BRACHYCOELIUM STORERIAE, new species

## PLATE 1, FIGURE 3

*Specific diagnosis.*—*Brachycoelium*: Body length 1.19 mm, width 0.25 mm. The cuticula is thin, and very fine spines are imbedded in it in the region of the oral sucker, but these disappear before the middle of the body is reached. The oral sucker is subterminal and measures  $140\mu$  in diameter. The acetabulum measures  $84\mu$  by  $100\mu$ . The ratio of oral sucker to acetabulum, therefore, approximates 3:2. The anterior margin of the acetabulum is 0.42 mm from the anterior end. It, therefore, lies entirely caudal of the posterior limit of the first third of the body. A very short prepharynx leads to the oval pharynx, which measures  $38\mu$  by  $46\mu$ . The esophagus is rather long, measuring about 0.126 mm. At its posterior end lie the two short, divergent ceca, which just reach the acetabulum. The ovary lies on the right side of the body at the level of the acetabulum. It is a nearly spherical structure,  $70\mu$  in diameter. The rest of the ovarian complex could not be made out with certainty, but it is believed that the ootype and Mehlis's gland lie median and dorsal to the ovary. A structure that appears to be a seminal receptacle lies median to the cephalic margin of the ovary. The exact course of the uterus can not be traced. The eggs lie in the posterior portions of the body, behind the ovary but to some extent overlying the testes. Apparently the uterus passes around the left side of the acetabulum to the median genital pore. The genital pore lies just anterior to the acetabulum. The vitellaria are extensively developed. They extend from a line, the width of the pharynx behind that structure, to the level of the testes. They are within the dorsal portions of the body and occupy

the median as well as the lateral fields. The eggs are oval, measuring  $50\mu$  by  $34\mu$ . The testes are not quite symmetrically placed, the right one being slightly caudal to its mate; they measure about  $80\mu$  by  $47\mu$ . They are slightly obscured by the eggs ventrad and the vitellaria dorsad. The vasa efferentia could not be traced, but a seminal vesicle appears in the cirrus pouch. The cirrus pouch is a V-shaped structure, with the ventral arm the longer and more distended. It runs cephalo-laterad for a short distance, then loops back in a medio-caudal direction. It ends dorsal to the center of the acetabulum. The excretory system could not be seen.

*Host.*—*Storeria dekayi*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30873.

*Remarks.*—This species is easily distinguished from other known species of *Brachycoelium* by the distribution of the vitellaria. Also the acetabulum is more posterior than in most species, but this is a poor character because of the distention of the posterior end by the egg mass in fully matured individuals.

#### BRACHYCOELIUM sp.

A single poorly prepared specimen taken from the intestine of *Ophedryx aestivus* is referred to this genus. This is the same host from which Nicoll (1914a) described *Brachycoelium obesum*, but the distribution of the vitellaria is somewhat different from that figured by Nicoll, and consequently it is impossible to refer it to his species.

#### BRACHYCOELIUM MERIDIONALIS, new species

#### PLATE 1, FIGURE 4

*Specific diagnosis.*—*Brachycoelium*: A small oval worm, colorless except where the eggs show through. Length 0.8 mm to 0.95 mm, width 0.3 mm to 0.4 mm. The cuticula is thickly studded with small spines in the cephalic regions, but these become sparser caudad. The oral sucker is subterminal and measures about 0.145 mm in diameter. The acetabulum lies near the caudal boundary of the first third of the body and has a diameter varying from 0.125 mm to 0.138 mm. The ratio of the oral sucker to the acetabulum is very close to as 3:2. The pharynx is an oval with the long diameter lying transversely. It measures  $38\mu$  by  $50\mu$ . The esophagus is about twice as long as the pharynx. In fully matured individuals these two structures are often wholly concealed by the transverse band of vitellaria. The intestinal ceca are short pockets, measuring  $85\mu$  by  $130\mu$ . The testes are  $105\mu$  to  $115\mu$  in diameter and are slightly irregular in outline. They lie one on each side of the body, their cephalic margins near the

level of the caudal boundary of the acetabulum, but the testis on the ovarian side is slightly posterior to its mate. The genital pore is slightly cephalic to the acetabulum. The cirrus sac, which contains the seminal receptacle, usually resembles the shape of an inverted comma and usually lies partially beneath the acetabulum. The ovary is nearly globular, is lateral in position, and lies at the level of the acetabulum. It measures  $76\mu$  to  $84\mu$  in diameter. Mehlis's gland lies medio-caudal to the ovary. The vitellaria lie between the middle of the esophagus and the caudal end of the intestinal ceca. Two yolk ducts become visible at the caudo-lateral limits of the vitellarian follicles and extend in a curve from this point to a small yolk reservoir, dorsal to Mehlis's gland. The vitellaria extend from the caudal margin of the oral sucker to the caudal extremities of the intestinal ceca but not beyond. In the dorsal portions of the worm they extend in a continuous band from side to side. The uterus fills the body caudal to the testes. The eggs measure  $29\mu$  by  $42\mu$ .

*Host*.—*Triturus meridionalis*.

*Habitat*.—Upper intestine.

*Locality*.—Houston, Tex.

*Type specimens*.—U.S.N.M. Helm. Coll. No. 30874; paratype, No. 30875.

*Remarks*.—The host, *T. meridionalis*, is so closely related to *T. viridescens* that for some time it was considered to be a variety of the latter. A species of *Brachycoelium*—*B. hospitale* Stafford—has already been described from *T. viridescens* in Canada. A form of *Brachycoelium*, which seems to be identical with *B. hospitale*, has been found several times in specimens of *Rana sphenoccephala* captured locally, but oddly enough it was not found in *T. meridionalis*. The situation is further complicated by Holl's species *B. trituri*, from the eastern form of the newt. Doctor Holl kindly loaned me two specimens of *B. trituri* from his private collection. A comparison of this material resulted in the following observations:

*B. meridionalis* differs from *B. hospitale* and *B. trituri* by having a continuous bridge of vitellarian follicles from one side to the other. It further differs from *B. hospitale* by having larger intestinal ceca, and the vitellaria do not extend so far caudad.

#### BRACHYCOELIUM DAVIESI, new species<sup>1</sup>

#### PLATE 1, FIGURE 5

*Specific diagnosis*.—*Brachycoelium*: The worms vary from 0.65 to 0.95 mm in length and from 0.3 to 0.55 mm in width. Those whose

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<sup>1</sup>I take pleasure in naming this trematode after J. I. Davies, of the Rice Institute, in recognition of the friendly interest he has taken in this work and of the assistance he has given, particularly in matters involving technique.

measurements are equal to the smaller dimensions given are barely mature and have only a few eggs in the uterus. The body when relaxed is proportionately wider than is the case with other species of *Brachycoelium*. Usually it is about twice as long as wide. The cuticula is thin and set with small spines in the cephalic region. These disappear about the level of the genital glands. The oral sucker is subterminal and nearly circular in outline. Its diameter varies from 0.13 to 0.23 mm. It is about twice the size of the acetabulum. In the type specimen the oral sucker is 0.23 mm and the acetabulum 0.125 mm in diameter. This in my experience represents the extreme variation from the mean of 2:1. The acetabulum has its cephalic margin 0.32 to 0.42 mm from the anterior end and, therefore, is wholly behind the caudal limits of the cephalic third of the body. The prepharynx is lacking, and the oval pharynx measures  $42\mu$  to  $50\mu$  by  $60\mu$  to  $65\mu$ , with the long diameter lying transversely. The esophagus is short, being about  $30\mu$  long. From its caudal extremity the intestinal ceca extend almost directly laterad. They are largely obscured by the vitellaria. The ovary is lateral, but it may lie on either side. It is usually nearly circular in outline and very variable in size, being relatively larger in younger specimens. It averages  $100\mu$  in diameter. The ootype and Mehlis's gland can not be seen in whole mounts, but in sections they plainly show on the latero-dorsal side of the ovary. The seminal receptacle could not be located. The uterus fills the body behind the ovary, partially if not wholly obscuring the testes and Mehlis's gland. The eggs are  $29\mu$  to  $31\mu$  by  $40\mu$  to  $42\mu$ . The vitellaria are well developed. They fill the lateral fields from the ovary to the oral sucker, and a band of follicles extends across the body between the oral sucker and the genital pore. As the digestive system is included in this region these follicles make observations on this system difficult in whole mounts. In the median field, they are confined to the dorsal half of the body, but laterad they lie both dorsal and ventral to all other organs. The testes are level with the acetabulum and posterior to the ovary. The testis on the ovarian side is closely pressed against the ovary but is, nevertheless, slightly caudal to its mate. The vasa efferentia could not be traced. The genital pore lies at the cephalic margin of the acetabulum. The cirrus sac, containing a seminal vesicle, runs first cephalad and then curves laterad away from the ovary, and its distal end lies at the level of the genital pore. The excretory vesicle is quite concealed by the uterus in whole mounts, but in sections it shows as a characteristic simple sac extending to the caudal limits of the testes.

*Hosts.*—*Leiolopisma laterale*, *Pseudacris triseriata*, *Hyla cinerea*, and *Ambystoma microstomum*. As the parasites from the last two hosts mentioned are both immature, these two records must be regarded as tentative.

*Habitat.*—Intestine, more frequently in the anterior half.

*Localities.*—Houston and Huntsville, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30876; additional specimen, No. 30877.

*Remarks.*—*Brachycoelium daviesi* differs from most other species of *Brachycoelium* in many ways. The body when relaxed is proportionately wider, the esophagus is shorter, and the ovary is cephalic to the acetabulum. It is distinguished from all but *B. trituri* by the ratio of the acetabulum to the oral sucker, and from all but *B. storeriae* and *B. meridionalis* by the presence of a transverse bridge of vitellarian follicles between the lateral fields.

#### Genus GLYPTHELMINS Stafford, 1905

Miller (1930) has carefully redescribed the type species of this genus, *G. quieta*, and partially revised the genus. He has shown that *Margeana* Cort (1919) is a synonym of *Glypthelmins*. Since Cort had already placed *Margeana* in the same group with *Brachycoelium*, I refer *Glypthelmins* to the Brachycoeliidae. The following species is the third of this genus to be described from North American frogs:

#### GLYPTHELMINS SUBTROPICA, new species

#### PLATE 1, FIGURE 6

*Specific diagnosis.*—*Glypthelmins*: The body is 1.43 to 2.65 mm long and 0.44 to 0.92 mm wide. The cuticula is covered with small spines except at the extreme anterior end and a part of the posterior end. The oral sucker varies from 0.16 by 0.18 mm to 0.32 by 0.34 mm, and the acetabulum varies from 0.1 to 0.16 mm in diameter. The ratio of the oral sucker to the acetabulum approximates as 5:3 in young specimens, but in fully mature specimens it is nearer as 1:2. The distance from the cephalic margin of the acetabulum to the anterior end is 0.59 to 0.92 mm. The oral sucker is closely followed by a large muscular pharynx. This structure is always a little larger than the acetabulum and varies from 0.12 by 0.15 mm to 0.19 by 0.27 mm. The esophagus is rather short, usually about the length of the pharynx or slightly longer. The ends of the intestinal caeca are removed from the extreme caudal end by a distance of about 0.15 to 0.3 mm. On each side a group of glands extends

from the middle of the pharynx to the level of the intestinal fork. The ovary lies above the right margin of the acetabulum. It is a globular structure 0.3 to 0.6 mm in diameter. It is followed closely by a small ootype and Mehlis's gland. Lateral to the caudal margin of these structures lies a seminal receptaculum about half the size of the ovary. Laurer's canal leaves the female genital system at the point where it is joined by the transverse vitelline ducts and, after a short cephalic course, turns abruptly dorsad to open above the acetabulum. The vitellaria occupy two lateral fields from slightly caudal to the intestinal fork to a point the length of the testes caudal to those structures. Posterior to the acetabulum they extend mesad to the inner margin of the ceca, but anterior to it they extend entirely across the worm. The uterus passes posteriorly in transverse loops, ventral to the testes, and between the intestinal ceca. Caudal to the ceca they spread out the entire width of the body. The ascending loops follow the same course to the level of the ovary, where the uterus passes to the left of the acetabulum and terminates in a metraterm  $50\mu$  long. The eggs vary from  $33\mu$  by  $17\mu$  to  $46\mu$  by  $25\mu$ . The testes are symmetrically placed and a little more than their diameter behind the ovary. They are globular or oval structures and measure 0.3 by 0.5 mm or more. The vas efferens of the right side passes cephalad, ventral to the seminal receptaculum and ootype, but bends sharply mesad behind the ovary. It meets its fellow and enters the cirrus sac. The vas efferens of the opposite side follows much the same course. The cirrus sac, which contains a seminal vesicle, is an elongate structure curving from the genital pore to the right of the acetabulum and terminating at the caudal border of the ovary. The genital pore is located about halfway between the acetabulum and the intestinal fork. The excretory pore lies at the extreme caudal tip of the body. The vesicle extends forward and forks at the posterior margin of the testes, and the two arms extend forward to the level of the genital pore. The anterior arms are relatively small.

*Hosts.*—*Rana catesbeiana*, *R. sphenoccephala*.

*Habitat.*—Intestine.

*Localities.*—Houston and Huntsville, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30878.

*Remarks.*—This distome most closely resembles *Glypthelmins quieta*, but it may readily be distinguished from this form by the transverse band of vitellaria, the location of the testes behind the transverse vitelline duct, and the tendency of the uterus to pass ventral to the testes rather than between them.

## Family PLAGIORCHIIDAE Lühe, 1901

## Subfamily PLAGIORCHIINAE Pratt, 1902

## Genus HAEMATOLOECHUS Looss, 1899

Synonym: *Pneumonoeces* Looss, 1902.

Concerning the status of these two names, *Haematoloechus* Looss and *Pneumonoeces* Looss, Cort (1915) writes as follows:

In 1902 on account of Stål's hemipteran genus *Haematoloccha* established in 1874 Looss (1902:732) changed the generic name *Haematolocchus* to *Pneumonoeces*. He did this influenced by Braun's (1901:55) contention that if family or subfamily names are formed from generic names which differed only in endings, they would be identical. This seems to me to be a logical application of the rule of priority and I shall accept the later name *Pneumonoeces*.

Cort's opinion in this matter is not illogical, but unfortunately the International Code of Zoological Nomenclature specifically states that a generic name is not to be considered preoccupied when it differs only in ending from a genus already published. As examples, the genera *Picus* and *Pica* are cited. Therefore, the earlier name *Haematoloechus* must be used. Since this paper was first submitted for publication, the same conclusion has been reached independently by Ingles (1932). It is unfortunate that this change is necessary, since the name *Pneumonoeces* has been in common use for nearly 30 years.

Cort (1915) adequately summarizes our knowledge of this group in North America previous to that date. Since then Irwin (1929) has added one more species, *H. parvipleaxus*, and two more are described below.

HAEMATOLOECHUS FLOEDAE, new species

PLATE 1, FIGURE 7

*Specific diagnosis.*—*Haematoloechus*: Flukes of medium size; the body is elongate, flattened, pointed toward the anterior end but rounded behind. The largest specimen in my possession is 10 mm long; the average, however, are about half that long. The smallest specimen measures 4.4 mm and seems to be fully mature. The width varies from 1.2 to 1.6 mm. The cuticula is smooth and entirely without spines. It is extremely thin, never being more than  $4\mu$  in thickness. The large oral sucker measures 3.6 to 4.4 mm in diameter. The ratio between the oral sucker and the pharynx is nearly as 1:2, but the pharynx is often a little smaller; however, the ratio does not fall below as 2:5. The ratio of the oral sucker to the acetabulum falls very close to as 1:3. The acetabulum is only slightly anterior to the middle of the body. In a worm measuring 5.4 mm long the acetabulum is 2.4 mm from the anterior end.



The esophagus in properly expanded specimens is somewhat longer than the pharynx. The wide ceca extend to the posterior end of the body. The ovary lies beside the acetabulum and is irregularly lobed. It is 0.65 to 0.83 mm in length and 0.32 to 0.45 mm in width. The vitellarian follicles are arranged in 19 to 24 groups of irregular size and shape. It is difficult to count the individual follicles in each group, but they seem to range from 1 to 2 dozens. The uterus is arranged much like that of *Haematoloechus parvipleurus* Irwin. There are a few loops at the anterior end of the ovary, then the uterus turns caudad, passes between the testes, and after a series of loops in the posterior end of the body there are the usual longitudinal folds outside the intestinal ceca, and then the uterus follows the same route cephalad to the genital pore in the pharyngeal region. There is a little difference in the lengths of the longitudinal folds in my material. They may extend only to the cephalic border of the posterior testis or to the cephalic border of the anterior testis. Not infrequently the uterine fold on the ovarian side of the body is somewhat shorter than its mate. The eggs vary from  $21\mu$  by  $17\mu$  to  $17\mu$  by  $13\mu$ . The testes are oval elongate bodies, somewhat irregular in outline. Not infrequently they are pointed at the anterior end. The two overlap for half their length. The posterior testis is usually slightly larger. It measures 0.8 to 1.2 mm in length and 0.34 to 0.7 mm in width. The anterior testis is 0.7 to 1.1 mm in length, and 0.32 to 0.65 mm in width. The size of the testes shows but very little correlation with the size of the worm. The distance of the posterior testis from the posterior end varies too much to be of any use as a character. The seminal vesicle is a large oval sac lying beside the ovary. The genital field is approximately two-fifths of the length of the body, but here again the variation is so great that the character must be of very doubtful use. In a worm 5.5 mm long the genital field measured but 1.8 mm, while in a worm 5.25 mm long the genital field measures 2.2 mm.

*Hosts.*—*Rana catesbeiana* and *R. clamitans*.

*Habitat.*—Lung.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30879.

*Remarks.*—This species most closely resembles *Haematoloechus parvipleurus* Irwin, but it may be distinguished from that form by the smaller pharynx, the larger acetabulum, the smooth cuticula, the smaller egg, and the longer longitudinal folds of the uterus. *H. brevipleurus* also has a smooth cuticula, but in this species it is exceptionally thick, whereas in *H. floedae* it is very thin. The present species also differs from *H. brevipleurus* in size, relatively smaller acetabulum, and the unlobed testes.

## HAEMATOLOECHUS UNIPLEXUS, new species

## PLATE 2, FIGURE 1

*Specific diagnosis.*—*Haematoloechus*: The body is an elongated oval, slightly pointed at the anterior end. It measures 4.25 by 0.7 mm. The cuticula is smooth and without spines. The oral sucker is 0.22 mm in diameter. Its ratio to the pharynx is as 2:3, and its ratio to the acetabulum is close to as 1:3. The pharynx is 0.14 mm in diameter, and the acetabulum is 0.08 mm in diameter. The length of the esophagus is equal to about two-thirds the diameter of the pharynx. From it the intestinal ceca extend to the posterior end of the body. The ovary lies beside the acetabulum. It is an elongate, irregularly lobed structure with its long axis parallel to the long axis of the body. The uterus, after a few folds just anterior to the ovary, turns toward the posterior end. It follows the usual course with the usual confusion of loops and windings to the posterior end of the body. The longitudinal folds outside of the intestinal ceca are very poorly developed. There is a short loop on the left side of the body extending only to the caudal margin of the posterior testis. There is no loop of the uterus on the right side of the body. From the posterior end of the body, the uterus follows the usual course forward to the genital pore, which lies in the pharyngeal region. The vitellarian follicles are so closely grouped that it is very difficult to form an accurate opinion of the number of follicles to the group. There seem to be 9 or 10 follicles to the group and about 21 groups. On the left side of the body the follicles cease at the level of the cephalic margin of the caudal testis. On the right side there are three groups of follicles, below this point. The eggs vary from  $21\mu$  by  $17\mu$  to  $17\mu$  by  $13\mu$ . The testes are elongate bodies, with entire margins that overlap slightly. The anterior testis measures 0.5 by 0.16 mm and the posterior one 0.48 by 0.16 mm. The caudal testis is somewhat more than its own length from the caudal tip of the body. The seminal vesicle lies beside the ovary. The length of the genital field, exclusive of the vitellaria, equals slightly more than one-third of the total body length.

*Host.*—*Rana sphenoccephala*.

*Locality.*—Houston, Tex.

*Habitat.*—Lung.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30880.

*Remarks.*—This form closely resembles *Haematoloechus floedae* described above, but it is easily distinguished from that form by the short longitudinal uterine loop, of which there is only one, its unsymmetrical character, the ratio between the oral sucker and the acetabulum, and the position of the testes relative to each other.

The foregoing description of *Haematolocchus uniplexus* is based on a single specimen. No more examples were found, although more than a score examples of the host were examined. Because of the limited material and the great variation known to exist among species of *Haematolocchus*, this form must be regarded as a species inquirenda until more material becomes available. It is possible that it is an example of *Haematolocchus floedae* that is somewhat stunted and malformed by residence in an unsuitable host, but this seems hardly likely.

### Subfamily RENIFERINAE Pratt, 1902

#### Genus RENIFER Pratt, 1902

Of the species originally included in this genus only the type species, *Renifer ellipticus*, remains. Since that time several species have been described in the genus from North American snakes, but many of them have been removed to other genera. At present the genus includes, besides the type species, the following North American species: *Renifer acetabularis* Crow, *R. kansensis* Crow, *R. ancistrodontis* MacCallum, *R. septicus* MacCallum, *R. ophiboli* MacCallum, and *R. natricis* MacCallum. The unnamed *Renifer* species described by Job (1917) seems to belong to *Lechriorchis*.

#### RENIFER TEXANUS, new species

#### PLATE 2, FIGURE 2

*Specific diagnosis.*—*Renifer*: Body with parallel sides, rounded at each end, 1.83 to 2.2 mm long by 0.75 to 0.85 mm wide. The cuticula is very thickly beset with spines in the anterior region, but more sparsely so in the posterior region. The oral sucker is subterminal with the mouth directed ventrad. It is 0.27 to 0.35 mm in diameter. No prepharynx is present, and therefore the pharynx lies directly above the caudal margin of the oral sucker. The esophagus is short, about equal to the diameter of the pharynx. The ceca barely reach the testes. The acetabulum lies anterior to the middle of the body. It is a large structure measuring about 0.46 mm in diameter. The testes are large, more or less oval structures, lying a short distance behind the acetabulum. They may be arranged either symmetrically or obliquely. They vary from 0.23 by 0.3 mm to 0.22 by 0.4 mm. The vasa efferentia could not be traced. The cirrus sac, which contains the seminal vesicle, extends diagonally across the body from the left cephalic margin of the acetabulum. The genital pore is situated near the lateral body margin, slightly behind the middle of the oral sucker. The ovary is a globular structure, lying on the left side, dorsal to the caudal half of the acetabulum. It is about 0.2 mm in

diameter. Mehlis's gland and the ootype lie on the midline and slightly caudal to the ovary. Laurer's canal was not located. The uterus is a much coiled structure, running caudad between the testes; after filling the body behind the testes with its coils it returns anteriorly by the same course. It passes dorsal to the center of the acetabulum, loops to the left, and runs parallel and ventral to the cirrus sac throughout the length of that organ. The eggs measure  $40\mu$  by  $21\mu$ . The vitellaria are lateral and are divided by the acetabulum into two fields on each side. The posterior fields extend from the middle of the testes to the middle of the ovary. The anterior fields extend from the intestinal fork to the level of the tip of the cirrus sac. They usually overlies the ceca, but do not extend median to them.

*Host.*—*Heterodon contortrix*.

*Habitat.*—Mouth.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30881.

*Remarks.*—The foregoing description is based on five specimens of flukes taken from two snakes. *Renifer ellipticus* is recorded from this same host, but the two forms are easily distinguished by the location of the genital pore and the division of the vitellaria.

*Renifer texanus* seems to be most closely related to *R. acetabularis* Crow, but the cirrus sac in that form does not cross the median line, nor reach the acetabulum, and there is an esophagus present.

#### RENIFER KANSENSIS Crow, 1913

*Renifer kansensis* Crow and *R. ancistrodontis* MacCallum are both described from specimens taken from the mouth of copperhead snakes (*Agkistrodon mokasen*). *R. ancistrodontis* is described as having the genital pore on the right side, while in *R. kansensis* it is described on the left side. Since helminthologists seem to be rather careless about considering the inverting power of the microscope, this character may be due to an error. Other differences between Crow's and MacCallum's species are: The location of the testes, the ratio of the oral sucker to the acetabulum, the position of the caudal end of the cirrus sac, and the location of the genital pore. With the exception of the last-named difference the variation in my material is practically as great as the differences noted. Crow (1913) describes the genital pore as being on the left side, at the level of the posterior margin of the pharynx; MacCallum (1921) as being on the right side, in advance of the intestinal fork. In my material the genital pore is on the right side, at the level of the pharynx. There seems to be no way of settling this point definitely without the specimens; therefore, I refer my material, which was found in the mouth of *Agkistrodon mokasen* and *Sistrurus miliarius*, to *R. kansensis* and regard *R. ancistrodontis* as a species inquirenda.

## RENIFER ANIARUM (Leidy, 1890)

## PLATE 2, FIGURE 3

Leidy (1890) described this parasite under the name of *Distomum aniarum*, but since that time the form seems to have been ignored by helminthologists. Leidy's description, while in many points very inadequate from the standpoint of modern taxonomy, is, nevertheless, sufficiently detailed to leave little doubt as to the specific identity of his parasites and of my material from the same host. Since Leidy's description is so brief, the species is redescribed as follows:

*Specific diagnosis.*—*Renifer*: Small worms with their sides parallel, rounded at both ends or pointed at the posterior end, length 2.25 to 3.5 mm, width 0.7 to 1.1 mm. The cuticula is well armed with spines in the anterior regions, but posteriorly the spines are weak and scattered. The oral sucker is subterminal and circular in outline, and the mouth opening points cephalo-ventrad. The diameter varies from 0.3 to 0.42 mm. The acetabulum lies close to the center of the body and has a diameter of 0.46 to 0.66 mm. It is, therefore, about one and one-half times the diameter of the oral sucker. A short prepharynx is followed by a globular or oval pharynx 0.13 to 0.16 mm in diameter. The length of the esophagus equals about twice the diameter of the pharynx. The intestinal diverticulae reach to the testes. The testes are oval or circular in outline, and the margins may be slightly irregular. They are usually symmetrically placed, but they may be oblique. They measure from 0.16 by 0.2 mm to 0.38 by 0.36 mm. The vasa efferentia may either join as they enter the cirrus sac or enter separately. The cirrus sac, which contains the seminal vesicle and pars prostatica, extends from a point, slightly to the left of the median line and posterior to the intestinal fork, diagonally across the body to the genital pore, which lies on the right side at the level of the oral sucker. The ovary is a globular structure, which lies on the left side, posterior to the acetabulum but anterior to the testes. Its diameter varies from 0.145 to 0.18 mm. The ootype and Mehlis's gland lie median and usually slightly caudal to the ovary. A short oviduct may or may not be discernible in whole mounts. A small yolk reservoir is present, but the spermatozoa are stored in the ovarian end of the uterus. The uterus, with many loops and coils, descends between the testes, nearly to the caudal end, returns by the same course to the caudal end of the cirrus sac, where the loops cease, and runs parallel and caudal to the cirrus sac to the general pore. The eggs vary from  $32\mu$  by  $20\mu$  to  $42\mu$  by  $25\mu$ . The vitellaria are divided into two groups by the acetabulum. The anterior groups extend from the pharynx to points a little caudal of the cephalic margin of the acetabulum. They

usually overlap the intestinal ceca to some extent. The posterior groups begin a little cephalic to the ovary and extend to the testes. They are fairly compact and usually lie outside the intestinal ceca.

*Hosts.*—*Natrix sipedon* and *N. sipedon fasciata*.

*Habitat.*—Mouth.

*Locality.*—Philadelphia, Pa., and Houston, Tex.

*Specimens.*—U.S.N.M. Helm. Coll. Nos. 30885 and 30886.

*Remarks.*—This form is apparently very similar to *Renifer natrix* MacCallum, from the mouth of *Natrix taxispilota*. The description of this species is in many ways misleading. The name is not stated to be new, and in the first paragraph of the description MacCallum seems to confuse this worm with certain species of trematodes that are known only from birds and are usually referred to the genus *Prosthogonimus*. MacCallum states that *Renifer natrix* possesses a seminal reservoir, but as this is not known in any other species of *Renifer* it seems doubtful. Differences that seem to justify the separation of MacCallum's form from Leidy's are the distribution of the anterior groups of vitellaria, the presence of a prepharynx, a relatively larger acetabulum, and the position of the genital pore on the opposite side of the body.

#### Genus LECHRIORCHIS Stafford, 1905

Sumwalt (1926) has reviewed the status of this genus, and she has carefully pointed out the discrepancies and possible errors of past authors. Because of differences in the intestinal ceca and in the location of the genital pore, she has suggested that the genus be divided.

#### LECHRIORCHIS VALIDUS Nicoll, 1911

Several specimens that I have collected from the lungs and mouths of the hog-nosed snake [*Heterodon contortrix* (= *H. platyrhinus*)] and the king snake (*Lampropeltis getulus holbrooki*) are referred to the above species. These specimens differ in some particulars from Nicoll's description of the types, but in my opinion the differences admit of other explanations than the erection of a new species. Nicoll states that the esophagus is three-fourths the length of the pharynx, while in my material the esophagus, though variable in length, is always longer than the pharynx. In one of Nicoll's figures of *L. validus*, however, the esophagus is distinctly the longer. In all other particulars my specimens agree exactly with Nicoll's description, and therefore I refer them to his species. Manter (1927) has reported this species from the body cavity of the blue racer (*Coluber constrictor flaviventris*).

Genus *DASYMETRA* Nicoll, 1911*DASYMETRA CONFERTA* Nicoll, 1911

I have a total of 26 specimens of this fluke taken from the mouth of two specimens of *Natrix sipedon fasciata* at Houston, Tex. This genus was established in 1911 to receive a single species described at that time from the mouth of *Natrix rhombifera*.

There are two points in which my material shows slight differences from Nicoll's description. Nicoll (1911, p. 684) writes as follows:

The cirrus pouch is short and stout; in some cases almost globular. \* \* \* As already mentioned, the latter (cirrus) was exerted in every case, so that the arrangement depicted in Figure 8 (Pl. XXVIII) must be regarded as hypothetical.

In my material there are specimens with both exerted and withdrawn cirrus. In the former condition the cirrus pouch is quite as Nicoll has described it, but in the latter condition it is considerably more elongate. In a typical case it is an elongated sac curving to the left of the acetabulum and just reaching the caudal border of that structure. In the caudal end of the cirrus sac is a coiled seminal vesicle, of the usual type for this group. The pharynx is not globular but oval, with the long axis located transversely. Its anterior margin is typically lobate. It measures on the average 0.24 by 0.38 mm.

Genus *MANODISTOMUM* Stafford, 1905

Stafford founded this genus for a single species, *M. occultum*. The genus is poorly defined and has not been recognized again until Price (1930) pointed out that *Plagitura* Holl (1928) was a synonym of *Manodistomum*. In the following discussion I show that other forms should also be referred to this genus.

*MANODISTOMUM OCCULTUM* Stafford, 1905

This is the type species of the genus and was reported originally from two hosts, *Diemyctylus viridescens* and *Rana virescens*. The description, however, was based solely on material from the former host. In his discussion of the species, Stafford states that its habitat in the newt was unknown to him, but certain forms, which he had found encapsuled in the muscles of the frog, appeared to be the same, although slightly less mature. My material of this species consists of four specimens, two of which were found in *Triturus viridescens* (= *Diemyctylus viridescens*) at Elizabethtown, N. Y., and two from *Triturus meridionalis* at Houston, Tex. In both cases they were in the intestine, and while the Texas specimens, one of which is figured, were barely mature, the New York specimens were fully mature. All

differences noted between the two lots of material could easily be explained on the basis of age differences or individual variation. When these forms were compared with Stafford's description of *M. occultum* and Holl's description of *Plagitura salamandra*, no differences of importance could be noted. It is, therefore, probable that *Plagitura salamandra* Holl, 1928, should fall as a synonym of *Manodistomum occultum* Stafford, 1905.

At the close of the discussion on *Manodistomum occultum*, Stafford makes the following statement: "The worms bear many resemblances to Nr. 86 from the snake of which, indeed, they may be the young." From my experience (outlined above) it seems probable that *M. occultum* was described from material in its definitive host; but it is only possible at this time to suggest a probable relationship between the type material and the specimens which Stafford found encysted in the frog. "Nr. 86" is described in the same paper as *Zeugorchis aequatus*, a parasite of the garter snake. *Z. aequatus* is poorly described, and while it seems to be specifically distinct from *M. occultum*, I am unable to find valid generic differences. Furthermore, if we examine Sumwalt's excellent description of *Zeugorchis syntomentera*, the only other species referred to the genus *Zeugorchis*, we are still unable to find generic differences. Therefore *Zeugorchis* appears to be a synonym of *Manodistomum*, and it is possible that the encysted forms from the frog are the young of *Z. aequatus*. Accordingly *Zeugorchis aequatus* Stafford, 1905, becomes *Manodistomum aequatum* (Stafford, 1905); *Zeugorchis syntomentera* Sumwalt, 1926, becomes *Manodistomum syntomentera* (Sumwalt, 1926); and *Manodistomum occultum* Stafford, 1905 (= *Plagitura salamandra* Holl, 1928), stands as the genotype.

#### Genus STOMATREMA Guberlet, 1928

This genus was founded for a single species from the mouth of a snake that had died in the Zoological Gardens of London. As the host had been received from Florida only a fortnight before its death, it is almost certain that the parasites are native to North America.

#### STOMATREMA PUSILLA Guberlet, 1928

My material consists of 24 specimens taken from the esophagus of *Farancia abacura*, the trophotype for the parasite. There are a few points in which they differ from this form as described by Guberlet (1928), but the general agreement is so close that very little room is left for doubt as to their specific identity. The only important difference is in the seminal receptacle. Guberlet claims that this structure lies between the posterior borders of the testes and empties



by a duct at the point where the ootype enters the uterus. He states that it can not be seen readily in whole mounts as the egg-laden coils of the uterus conceal it. I let some of my specimens remain in tap water until the uterus had been emptied. In these, motile spermatozoa could be plainly seen in the descending portion of the uterus in live specimens, but I was unable to locate any seminal receptacle either in live or in stained material. Two of the flukes were sectioned, but again it was not possible to locate a seminal receptacle. As this structure is lacking in other genera of the Reniferinae, it seems probable that it is lacking in *Stomatrema*. Also, my material is about twice the size of Guberlet's, and in some specimens the vitellaria extend caudad as far as the middle of the ventral sucker. These latter-mentioned differences are of no importance and may be readily explained on the basis of individual variation and different states of contraction.

### Family GORGODERIDAE Looss, 1901

#### Subfamily GORGODERINAE Looss, 1899

#### Genus GORGODERA Looss, 1899

The bladder flukes of North American frogs were very ably revised by Cort (1912). Since that time only one paper has appeared concerning North American forms.

#### GORGODERA AMPLICAVA Looss, 1899

I have taken many specimens of *Gorgodera* from the bladder of *Rana catesbeiana* both at Houston and at Huntsville, Tex. Although this fluke is known to have a wide host range, I have been unable to find it in any other local species of frogs. Guberlet (1920) has described *Gorgodera circava* from the bladder of *Rana catesbeiana* in Oklahoma. This fluke differs from *G. amplivava* in ratio of the oral sucker to the acetabulum, the number of vitellarian follicles, the lobation of the ovary, and the possession of an ejaculatory pouch. The number of vitellarian follicles and the lobation of the ovary are in my material very variable characters. Furthermore, the ratio of the oral sucker to the acetabulum in my material covers the entire range reported for both *Gorgodera amplivava* and *G. circava*. The variations, however, showed a strange chronological sequence. In the early part of my collecting I killed my specimens by pouring fixative over them, after the manner recommended by Guberlet. Later I discovered that these flukes could be shaken from the bladder easily if the dish containing them was first thoroughly chilled by exposure to an ice-salt mixture. The degree of cold also completely relaxed the flukes, and they could then be killed with any cold fixa-

tive. The flukes killed by the latter method always possessed acetabula more than 2.5 times larger than the oral sucker, while many of those killed by the former method possessed relatively smaller acetabula. I was unable to distinguish any differences in the male genital system in my material, but as the ejaculatory pouch has not been mentioned in earlier descriptions, it can not be regarded as certainly absent. Therefore, it seems to me that *Gorgoderia circava* is a synonym of *G. amplicava*.

### Family TELORCHIIDAE Stunkard, 1924

Stunkard included two subfamilies, the Telorchiinae and the Auridistominae, under the family Telorchiidae, but the relationship of the two to each other and to the distomes as a whole is very uncertain. Various authorities have suggested that they are related to the Bunoderidae, the Plagiorchiidae, the Opisthorchiidae, or the Echinostomatoidea. I feel that until more is known concerning the life history of the trematodes included in this group, it will be impossible to settle their phylogenetic relations.

### Subfamily TELORCHIINAE Looss, 1899

#### Genus CERCORCHIS Lühe, 1900

This genus has been treated as a synonym of *Telorchis* by most writers, especially since Stunkard (1916) showed that the characters used by Lühe to separate them were unreliable. Recently Perkins (1929) has shown that the two genera are distinct, and that Lühe's characterization of them had been inadequate. Consequently it becomes necessary to transfer all the North American species of *Telorchis* to *Cercorchis*. These include many species that are parasitic in turtles, and a few that parasitize snakes or amphibians.

#### CERCORCHIS TEXANUS, new species

#### PLATE 2, FIGURE 6

*Specific diagnosis.*—*Cercorchis*: The fully matured specimens in my material are 6.6 to 8.24 mm long and 0.48 to 0.7 mm wide. The greatest width is usually in the region of the acetabulum. The spines are very thick in the cephalic region, but caudad they become progressively thinner until they quite disappear near the testes. The oral sucker is 0.12 to 0.16 mm in diameter; the acetabulum is the same size and is usually about one-sixth of the body length from the anterior end. The prepharynx is very short, being less than 100 $\mu$  long. The pharynx is circular; and its diameter is 0.9 to 1.1 mm. The esophagus is moderately long, measuring 0.13 to 0.2 mm

in length. The intestinal ceca extend nearly to the posterior end. The ovary is spherical and lies on the midline or just to the left; it is usually anterior to the middle of the body, but its exact relative location is subject to some little variation. This point will be discussed more fully below. The shell gland and ootype lie immediately behind the ovary; and in favorable specimens Laurer's canal may be seen extending directly to the dorsal wall. The uterus extends posterior on the left side and anterior on the right. The metraterm is straight and measures from 0.67 to 0.8 mm long, or very nearly one-half the distance from the genital pore to the ovary. The vitellaria are arranged in lobes between the intestinal ceca and the lateral margins of the body. The follicles are arranged in groups, with 20 to 40 to the group. The most cephalic extent of the vitellaria is about the level of the caudal end of the metraterm. Their length is to the length of the body as 2:5. They extend about three-fourths of the total distance from ovary to the anterior testis. The eggs vary in size from  $34\mu$  by  $17\mu$  to  $34\mu$  by  $21\mu$ . The testes are oval and of about equal size. They vary in size from 0.42 by 0.3 to 0.2 by 0.12 mm. The caudal testis is removed from the posterior end by a distance greater than its diameter. The cirrus sac is shorter than the distance from the genital pore to the ovary. It is 1.5 to 1.2 mm long and contains a seminal vesicle that is 0.36 to 0.43 mm long.

*Host.*—*Pseudemys elegans*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30889; additional specimen, No. 30890.

*Remarks.*—The position of the ovary in the body has frequently been used as a criterion for separating different species in the genus *Cercorchis*. A study of my material, which consists of fully mature worms and of barely mature worms, as is shown by their undeveloped vitelline glands and weakly outlined ovary and testes, has demonstrated that the position of the ovary may vary widely according to the age of the specimen. In one individual, which is 8.3 mm long and fully mature, the ovary is 3.2 mm from the anterior end. In another individual, 3 mm long but sexually mature as shown by the presence of eggs in the uterus, the ovary is 1.5 mm from the anterior end. From analogy with the nematodes this variation might be expected. In these worms it has been found that the anterior region of the worm changes but little after reaching sexual maturity, while the posterior end may enlarge considerably on account of the pressure of the enormous number of eggs. So it might be expected that the posterior region of a *Cercorchis* worm would

enlarge relatively more rapidly, after reaching sexual maturity, than the anterior end, since the former is essentially a sac for holding the genital organs.

*Cercorchis texanus* resembles most closely *Cercorchis corti* described by Stunkard in 1916. The differences that seem to justify the erection of a new species are: The longer esophagus, more than twice as long as in *C. corti*, the longer metraterm, and the distribution of the vitellaria, which begin at a point more cephalic than in *C. corti*.

CERCORCHIS BAIRDI, new species

PLATE 2, FIGURE 7

*Specific diagnosis.*—*Cercorchis*: Sexually mature worms are 2.9 to 2.95 mm in length and 0.38 to 0.36 mm in width. The cuticular spines at the anterior end are very fine, scarcely distinguishable even with the aid of an oil immersion objective; the rows are less than  $1\mu$  apart. The oral sucker is usually wider than long, it varies from  $72\mu$  to  $96\mu$  in length and from  $88\mu$  to  $114\mu$  in width. The acetabulum is small and circular in outline. It measures  $84\mu$  in diameter. It is 0.46 to 0.5 mm from the anterior end. A prepharynx is lacking, and the pharynx is a globe measuring  $40\mu$  to  $58\mu$  in diameter. The esophagus is of medium length, varying from  $63\mu$  to  $84\mu$ . The intestinal ceca extend beyond the testes, and nearly to the posterior end. The ovary is globular in outline and lies on either side of the body. It is  $80\mu$  to  $111\mu$  in diameter and in my material is slightly caudal to the first third of the body length. The shell gland and ootype lie immediately behind the ovary. The ascending and descending coils of the uterus do not cross, but frequently they overlies the intestinal ceca. The metraterm is thrown into numerous waves. The eggs measure  $32\mu$  by  $20\mu$ . The vitellaria lie outside the intestinal ceca. Their farthest anterior extent is the level of the anterior margin of the ovary. Their farthest caudal extent is usually about the diameter of the anterior testis, cephalic to that organ. The testes are usually circular in outline, lying adjacent to each other, and of about equal size. They measure 0.13 mm in diameter. The cirrus sac is much coiled and stops well short of the ovary. It extends through four-fifths of the ovarian-genital pore distance. The vas deferens is not coiled.

*Host.*—*Sternotherus carinatus*.

*Habitat.*—Intestine.

*Locality.*—Huntsville, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30891.

*Remarks.*—This form resembles *Cercorchis medius* Stunkard (1916) very closely. It is, however, a slightly smaller form, the

esophagus is less than half as long as in Stunkard's species, the testes lie in juxtaposition, and the uterus overlies the intestinal ceca. Other differences, which may be of importance if checked carefully with a larger supply of material, are: The size and shape of the acetabulum, the distribution posteriorly of the vitellaria, and the positions in the body of the acetabulum and ovary.

The foregoing description is based on four specimens taken from a single turtle, which was given to me by Dr. Don. O. Baird, of the Sam Houston State Teachers College. I have, therefore, named the species in his honor.

**CERCORCHIS ROBUSTUS** Goldberger, 1911

This species was first described by Goldberger (1911); it was redescribed by Stunkard (1916). I have nothing to add to the description as revised by Stunkard. My specimens that are referred to this species come from the intestine of two examples of *Pseudemys elegans*, taken at Houston and Rosenberg, Tex.

**Genus PROTENES** Barker and Covey, 1911

The genus *Protenes* is very closely related to *Cercorchis*, from which it differs only in the position of the genital pore. The first known species was described by Stafford (1900) as *Distomum angustum* and the second by Barker and Covey (1911) as *Telorchis leptus*. These authors established for their species and Stafford's the subgenus *Protenes*. Stunkard (1916) raised *Protenes* to generic rank. The following adds the third species to this genus.

**PROTENES CHAPMANI**, new species

PLATE 2, FIGURE 8

*Specific diagnosis.*—*Protenes*: One worm measures 3 mm long by 0.4 mm in maximum width, and the other is 3.1 by 0.5 mm. The body is of relatively even breadth, the widest part being in the region of the ovary. Very small spines are buried in the cuticula. Near the oral sucker these spines are about  $3\mu$  long and arranged in rows about  $3\mu$  apart. Caudad the rows are farther apart; at the level of the genital pore they are about  $5\mu$  apart and at the level of the ovary  $10\mu$  apart. Beyond the ovary the rows become even farther apart until near the caudal end the spines disappear. The cuticula is about  $2\mu$  thick. The acetabulum is 0.77 to 0.88 mm from the anterior end; that is, about one-fourth the body length. It is circular and is 0.11 mm in diameter. The oral sucker is slightly larger and somewhat oval, the transverse diameter being the longer. It measures 0.13 by 0.15 mm in one specimen and 0.13 by 0.17 mm in the

other. The prepharynx is very short, being but  $8\mu$  to  $10\mu$  long. The pharynx varies in size from  $76\mu$  by  $90\mu$  to  $72\mu$  by  $82\mu$ . It is longer in the transverse diameter. Curiously, the pharynx of one specimen seems to be perfectly normal, while that of the other seems to be divided into quadrants as described by Barker and Covey (1911) for *Protenes leptus*. The length of the esophagus varies appreciably. In one specimen it is 0.18 mm long and in the other only 0.12. Oddly the small specimen has the longer esophagus. The intestinal ceca end in the posttesticular region near the caudal end of the body. The ovary is 1.14 to 1.08 mm from the cephalic end and 0.3 to 0.28 mm from the acetabulum. Therefore, it is slightly caudal to the end of the first third of the body length. It measures 0.12 by 0.09 mm. The structure in this region is very similar to that described by Barker and Covey. A short oviduct leads to the ootype directly caudal to the ovary, a well-developed Mehlis's gland surrounds the ootype while just at its caudal boundary it is joined by the common vitelline duct. A small vitelline reservoir is present. Laurer's canal leaves at this point, and in the one specimen in which it could be traced with certainty, it extended laterad, to open on the dorsal surface  $84\mu$  below the ovary, at the median edge of the intestinal ceca of the left side. The other specimen was mounted with the ventral side uppermost; and while the actual pore of Laurer's canal could not be seen, the duct could be traced to the same position. No seminal reservoir could be seen although the location was searched with an oil immersion objective. The upper part of the uterus and the proximal portion of Laurer's canal were filled, in both specimens, with a deeply staining mass, in appearance not unlike the tangled mass of spermatozoa in the male system of this fluke.

The uterus extends caudad in undulating coils on the left side of the body to the testes, then turns cephalad, and returns on the right side of the body. Cephalic to the ovary there are very few waves in the uterus. The metraterm is but poorly differentiated. The vitellaria are extra cecal in the lateral fields. Their most cephalic extent is slightly more than the width of the ovary posterior to that structure, and the most caudal extent is slightly more than the long diameter of the testis cephalic to the anterior testis. The testes lie in the posterior region in juxtaposition. They are oval bodies with the longest diameter in the transverse direction. They are of about equal size and measure 0.13 to 0.14 mm by 0.15 to 0.17 mm. The caudal testis is about twice its long diameter from the caudal end. As is usual for this genus the genital pore is in advance of the acetabulum, dorsal in position and near the lateral margin. In opposition to the other two known species, the cirrus sac and uterus of this species pass ventral to the right intestinal ceca, and both open

in the common genital pore near the right margin of the body. The cirrus sac is 0.46 to 0.42 mm long and contains in its caudal portion an elongate seminal vesicle. The excretory system is identical with that of *Protenes leptus*.

*Host*.—*Pseudemys elegans*.

*Habitat*.—Intestine.

*Locality*.—Rosenberg, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 30893.

*Remarks*.—This species most closely resembles *Protenes leptus* Barker and Covey, but from this form it is readily distinguished by the location of the genital pore on the opposite side of the body, the location of the opening of Laurer's canal, and slight differences in the length of the cirrus sac and the location of the ovary and acetabulum. Apparently it is also a slightly larger form.

The two specimens upon which the above description is based were found in company with several examples of *Cercorehis texanus*, in a turtle, which T. S. Chapman sent me from Rosenberg, Tex.

### Subfamily AURIDISTOMINAE Stunkard, 1924

#### Genus AURIDISTOMUM Stafford, 1905

This genus is represented by a single species, which is already known to be widely distributed.

#### AURIDISTOMUM CHELYDRAE Stafford, 1905

I have taken a single example of this parasite from the intestine of each of two snapping turtles, *Chelydra serpentina*.

## Class CESTODA

### Family PROTEOCEPHALIDAE La Rue, 1911

#### Genus PROTEOCEPHALUS Weinland, 1858

The unsettled condition of the classification of this genus has been thoroughly discussed by other authors. Meggitt (1927) lists the species and gives tables for their determination. It is sufficient to state here that all the following species definitely belong to Woodland's (1925) *Crepidobothrium* group, or, as it has been more generally known in the past, La Rue's (1914) genus *Ophiotaenia*.

#### PROTEOCEPHALUS MAGNUS (Hannum, 1925)

The original description of this species is based on a single specimen from the intestine of *Rana catesbeiana* from Oklahoma. I encountered a tapeworm in the same host at Huntsville, Tex., and

because of a number of differences between that worm and Hannum's description of *P. magnus* I at first believed it to be a distinct species. Later, however, I found three tapeworms in the intestine of *Rana clamitans*, at Houston, Tex.; and the variations exhibited by these three worms are such that only one important difference remains to be explained. Hannum states that the shell gland is represented by only a few unicellular glands, which are clustered about the caudal portion of the ootype, while in all my material a well-developed shell gland, which practically envelops the coils of the oviduct, is always present. I have noticed in other closely related forms, however, that the shell gland soon loses its property of retaining stains, and therefore a portion of it may easily be overlooked in a specimen that has been kept in a preservative for some time. Aside from this point there is such close correspondence between my material and Hannum's description that specific identity seems quite certain.

Variations in my material, which are strikingly greater than those recorded in the original description, are as follows: The testes vary from 98 to 190 to the segment; the main excretory ducts frequently run through the middle of the testicular field; the vagina usually opens anterior to the cirrus, but it may open beside or posterior to the cirrus; and the specimen from *Rana catesbeiana* is only 22 cm long. The three specimens from *Rana clamitans* are each about 65 cm long. The genital pore is commonly farther anterior than Hannum describes, frequently lying between the caudal borders of the first sixth and the first fourth of the lateral margins, but occasionally it is as far caudal as the union between the first and middle thirds of the segment. Furthermore, in Hannum's figure the genital pore is distinctly anterior to the caudal border of the first third of the lateral margin.

This marked extension of the limits of variation of *P. magnus* suggests the possibility that it may be synonymous with *P. filaroides* La Rue. When one considers the widely separated hosts, the remaining differences appear insignificant, but I have not seen any specimens of *P. filaroides*, and therefore hesitate to draw any definite conclusions.

PROTEOCEPHALUS FARANCIAE (MacCallum, 1921)

PLATE 3, FIGURE 1

My material, which is referred to this species, consists of fragments of a tapeworm taken from the intestine of *Farancia abacura*. The snake had been run over by an automobile when found and a portion of the intestine badly mutilated. Judged by the scoleces



found, there were five tapeworms in the snake, three of them *Ophio-taenias*, and two *Oochoristicas*, belonging to a species that will be described later in this paper.

MacCallum's (1921) original description of this tapeworm is based on a number of immature specimens, and is therefore quite inadequate. The points of interest mentioned in his paper are: Strobila 1 mm wide, genital pore irregularly alternating, head 0.6 mm wide, suckers 0.2 mm in diameter, a slight eminence (fifth vestigial sucker ?) present. This is admittedly not sufficient for certain identification, but since my material is from the same host species and agrees very closely with the characters given by MacCallum, I refer it to his species. A description of the material is given, as it is possible to make out some structures not mentioned by MacCallum, but this description is admittedly somewhat incomplete, because of the mutilated condition of the material.

*Specific diagnosis.*—*Proteocephalus*: A flat white tapeworm. The length can best be estimated by a single piece, with scolex attached, which measured 18 cm. The last segment of this piece was barely mature. Maximum width about 1.3 mm at the level of the first mature segments. The scolex is 0.5 mm wide. It bears a vestigial fifth sucker besides the usual four. The four suckers are about 0.2 mm in diameter. The neck is about the same width as the scolex and about 5 cm long. The first segments are much broader than long, and in them the rudiments of the genital organs are already present. They mature very slowly, however, and no mature segments are found until very near the end of the long piece mentioned above. When first mature the segments are somewhat longer than broad, measuring 1.85 by 1.3 mm. They gradually elongate as they mature until they measure 3.85 by 1 mm, when the testes first begin to degenerate. The genital pore lies between the caudal border of the first sixth and the first third of the lateral margin of the segment. It is relatively farther forward in the younger segments. The cirrus is very stout and usually protrudes; the ejaculatory duct is straight. The cirrus sac measures 0.28 to 0.32 mm in length and 0.09 to 0.11 mm in width. From the median end of the cirrus sac the coils of the vas deferens reach to the midline. The testes are very numerous and are crowded between the uterus and vitellaria. There are 390 to 420 testes to the segment, and about 60 per cent of these are on the aporal side. The testes vary from 0.09 to 0.32 mm in diameter. The vagina usually opens posterior to the cirrus sac, but segments in which it opens anterior to that structure are not uncommon. It lies ventral to the cirrus sac, but it curves dorsad over the vas deferens and lies on the dorsal side of the uterus. The bi-

lobed ovary extends nearly across the caudal end of the segment. The proximal portion of the oviduct is enlarged to form the so-called occapt. The oviduct makes two or three turns in the interovarian space before running anteriorly to the uterus. These coils of the oviduct form the ootype and are surrounded by a very diffuse shell gland, that can not be seen readily in whole mounts. The uterus extends from the ovary up the midline to the cephalic boundary of the segment. It has from 30 to 50 diverticula on each side. The vitellaria occupy the typical position for the genus. In a sectioned mature segment a very weakly developed layer of longitudinal muscle fibers could be seen. The relationship between these and the genital organs is in every way normal for the genus *Protocephalus* as defined by Woodland (1925). Ripe segments are lacking.

*Host.*—*Farancia abacura*.

*Habitat.*—Intestine.

*Localities.*—New York Zoological Gardens, New York City, and Houston, Tex.

*Specimens.*—U.S.N.M. Helm. Coll. No. 30896.

*Remarks.*—The most striking character of this worm is the large number of testes. The only rival in this respect is *P. gerrardii* (Baird), from which it differs in the shape of the suckers.

#### PROTEOCEPHALUS sp.

An immature specimen of this genus was removed from the intestine of *Anolis carolinensis*. Although several specimens of the host have been examined, this tapeworm has not been encountered a second time. Because no mature segments are present no description is attempted.

#### PROTEOCEPHALUS sp.

A single tapeworm of this genus, but without mature segments, has been removed from the intestine of *Terrapene carolina triunguis*.

### Family ANOPLOCEPHALIDAE Cholodkowsky, 1902

#### Genus OOCHORISTICA Lühe, 1898

This rather large genus has hitherto been known from all the principal land masses except North America, but I have found it common in a number of species of snakes and lizards in Texas and have found it advisable to recognize five distinct species. As in many other tapeworm genera, classification is difficult because of the paucity of characters and the great individual variation that exists in the few characters present. The classification of the forms considered below is further complicated by the limited material, and

should more material become available it may be necessary to combine some of the forms that are here treated separately.

OOCHORISTICA NATRICIS, new species

PLATE 3, FIGURE 2

*Specific diagnosis.*—*Oochoristica*: A flat white worm. The total length is about 13 cm. The scolex is 0.5 to 0.6 mm in diameter. The suckers vary from 0.16 by 0.22 mm to 0.22 by 0.3 mm. They are, therefore, very large oval structures, with their long diameters lying parallel with the long axis of the worm. The neck is 0.3 to 0.35 mm wide and from 1 to 2 mm long. When the segments first appear they are very short. The mature proglottids appear some 30 to 40 mm from the scolex. They vary considerably in shape but are usually somewhat longer than wide. Extreme measurements for my material are 0.75 mm long by 0.80 mm wide and 0.105 mm long by 0.7 mm wide. The genital pore lies at the caudal border of the first fourth of the proglottid or slightly posterior to that level. The cirrus sac is an oval structure that measures 0.65 by 0.22 mm to 0.9 by 0.18 mm. A much coiled vas deferens, which acts also as a seminal vesicle, extends mesad from the inner end of the cirrus sac nearly to the median line. The testes lie in the caudal portions of the proglottid, but extend cephalad to or slightly beyond the caudal boundary of the ovary. There are 50 to 70 testes in each segment. The vagina opens into the genital atrium just caudal to the cirrus sac. As in other members of the genus it remains on the caudal side of the male ducts. Before reaching the median line the vagina curves caudal between the halves of the ovary and ends in a small seminal receptacle, lying ventral to the shell gland. The bilobed ovary and the vitellaria crowd the small shell gland between them. The ovarian complex is an oval mass measuring 0.3 by 0.6 mm. The sexual ducts pass between the main tubes of the excretory system. The ripe segments are about twice as long as broad. The eggs are scattered singly in capsules. They are  $42\mu$  in diameter; and their embryos are  $20\mu$  in diameter.

*Host.*—*Natrix rhombifera*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30897.

*Remarks.*—This form most closely resembles *O. zonuri* Baylis, but it is a slenderer form with more elongate segments. In *O. zonuri* the scolex is 0.9 to 1 mm wide, and the maximum width is 3 mm. In *O. natricis* the scolex is only 0.6 mm wide, and the maximum width is less than 1 mm. There are structural differences in the distribution of the testes, size of cirrus pouch, and other minor features.

## OOCHORISTICA ANOLIS, new species

## PLATE 3, FIGURE 3

*Specific diagnosis.*—*Oochoristica*: A white flat tapeworm, with conspicuous segmentation. The total length of a specimen with ripe segments is 70 mm, and the maximum breadth about 1 mm. The scolex is 0.35 mm broad and distinctly marked off from the neck. The suckers are relatively very large, measuring 0.16 by 0.3 mm. The neck is 0.35 mm wide and about 2 mm long. As usual the first segments are wider than long. The first mature segments appear about 20 mm from the scolex, and they are about 0.95 mm long by 0.85 mm wide. The genital pore lies close to the caudal end of the first fourth of the proglottid. The cirrus sac is from 0.16 to 0.145 mm long by 0.11 to 0.09 mm wide. The vas deferens runs mesad to a point directly above the ovary and then turns caudad. The testes lie almost entirely caudal to the ovary, but caudal and lateral to the vitellaria. There are from 20 to 35 testes in each proglottid, and the testes are about 0.3 mm in diameter. The ovary is distinctly bilobed and about 0.35 mm wide. Directly caudal to it lie the shell gland and the vitellaria in the order named. The vitellaria measure 0.145 by 0.13 mm. A small seminal receptacle lies dorsal to the shell gland, and from this structure the vagina runs cephalad. At the cephalic margin of the ovary the vagina curves laterad. The sexual ducts pass between the longitudinal ducts of the excretory system, which is much branched and forms a network in each proglottid. The ripe proglottids are usually a little more than twice as long as broad. Within them the eggs are scattered singly in capsules. The eggs are about  $64\mu$  in diameter, and the embryos  $40\mu$ .

*Host.*—*Anolis carolinensis*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30898.

*Remarks.*—The foregoing description is based on a single tapeworm and therefore gives no idea of the variation that may occur between different individuals of the same species. It is very similar to *O. fibrata* Meggitt, but it differs from this form in the size of the cirrus pouch and in the smaller number of testes. It is also closely related to the species from *Eumeces* described below, under which the relationship of these forms is more fully discussed.

## OOCHORISTICA EUMECIS, new species

## PLATE 3, FIGURE 4

*Specific diagnosis.*—*Oochoristica*: A flat white tapeworm with distinct segmentation. The total length is 103 mm, but there are

no fully ripened segments present. The scolex is 0.5 mm wide, and distinctly marked off from the neck. The suckers are large, but not so large relatively as in *Oochoristica anolis*. They measure 0.22 by 0.26 mm. The neck is about 0.35 mm wide and about 2 mm long. It is rather difficult to tell just where segmentation begins, but as usual the first segments are much broader than long. The mature segments first appear about 65 mm from the scolex and continue through about 35 mm before the eggs appear and the sex organs begin to degenerate. In this worm the mature segments are somewhat broader than long. Extreme measurements are 0.8 to 0.9 mm in length and 1.18 to 1.2 mm in breadth. The genital pore lies at the end of the anterior fourth or fifth of the lateral margin. The cirrus sac is an elongate oval, measuring from 0.26 to 0.18 mm in length and from 0.06 to 0.07 mm in breadth. From its inner end a much coiled vas deferens runs mesad to disappear as it reaches the ovary. The testes lie caudal and lateral to the ovary and vitellaria. Frequently they extend cephalad nearly to the anterior border of the ovary, but occasionally they only reach the middle of the ovary. There are from 40 to 55 testes in each proglottid. The ovary lies rather far forward in the segment, its anterior margin lying at the level of the genital pore. It is a bilobed structure about 0.4 mm wide. Behind it lie the shell gland and vitellaria in the order named. A small seminal receptacle lies directly dorsal to the shell gland. From it the vagina runs, at first anteriorly between the lobes of the ovary, and then curves toward the lateral margin. The genital ducts pass between the lateral excretory tubes and dorsal to the nerve. No fully ripened segments are present so it is impossible to make any statements concerning them.

*Host.*—*Eumeces fasciatus*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30899.

*Remarks.*—This description like the preceding is based on a single specimen. It, therefore, becomes necessary to regard this as a species inquirenda until more material is available for study. The differences noted between this form and the preceding lie in the number and distribution of the testes, the shape of the cirrus sac, the relatively broader segments, and the relatively smaller suckers. Most of these differences are the same as those pointed out as the important differences between *O. fibrata* and *O. anolis*. I do not, however, regard *O. eumecis* as identical with *O. fibrata*, because of the difference in the number and distribution of the testes. Unfortunately Meggitt does not mention the scolex in his description so it is impossible accurately to compare this structure in the two

species. Presumably, however, the scolex of *O. fibrata* is the same as that of *O. agamae* since Meggitt was unable satisfactorily to distinguish his form from *O. agamae* as described by Baylis. Therefore, we may surmise that the suckers of *O. fibrata* are similar to *O. agamae* and smaller than those of *O. eumecis*. It is admitted that these morphological differences are scarcely great enough to separate species, in a group as variable as tapeworms of the genus *Oochoristica*. If any two of the above-mentioned forms, however, are to be combined, it promptly becomes necessary to refer three of them to the same species. The result would be that forms from a Burmese amphibian and North American lizards would be referred to a single species. The identity of these forms seems very unlikely, so it appears best for the present to consider all three as separate species, although their characters are rather unsatisfactory.

OOCHORISTICA AMERICANA, new species

PLATE 3, FIGURE 5

*Specific diagnosis.*—*Oochoristica*: A flat white worm, with distinct segmentation; the total length is 40 mm, but no ripe segments are present. The scolex is 0.5 mm wide, but it is not distinctly marked off from the neck. The suckers are small and circular; they measure 0.16 mm in diameter. Segmentation first appears about 3 mm from the scolex. Mature segments appear about 25 mm from the scolex. Even in the last segments available the uterus has not commenced to develop. The mature segments are about 1.1 mm long and 0.85 mm broad. The genital pore lies slightly caudal to the first fourth of the lateral margin. The cirrus pouch is large, measuring 0.2 by 0.09 mm. From it the coiled vas deferens extends mesad. The testes lie beside and behind the female glands. The most anterior of the testes lie behind the middle of the ovary. There are 35 to 40 testes in each segment. They frequently overlies one another slightly, especially in the younger segments. The ovary is a bilobed structure, lying in the caudal portion of the first half of the segment. It is about 0.35 mm wide. Behind it lie the shell gland and vitellaria, in the order named. The sex ducts pass between the longitudinal excretory tubes.

*Host.*—*Farangia abacura*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 30900.

*Remarks.*—This form is very similar to *O. anolis* and *O. eumecis*; from the former it is distinguished by the greater number of testes, and from the latter by the lesser number of testes. It differs from

both species in having much smaller suckers. There are also differences in the size of the cirrus sac and the position of the genital organs.

OOCHORISTICA ELAPHIS, new species

PLATE 3, FIGURE 6

*Specific diagnosis.*—*Oochoristica*: A slender, white, semitranslucent tapeworm. Length 65 to 75 mm. The scolex is about 0.35 mm wide and bears four circular suckers about 0.145 mm in diameter. The neck is not sharply marked off from the scolex. It seems to be 5 or 6 mm long. The mature segments are nearly square, about 0.75 mm each way. The genital pore is slightly posterior to the end of the first fourth of the lateral margin. The cirrus sac is 0.145 mm long by 0.068 mm wide. The vas deferens is a much convoluted structure extending mesad to the ovary where it vanishes. The testes are very variable. The extreme counts are 30 to 53. They overlap one another and the shell gland, so that counting is more difficult than usual. The ovary is a bilobed structure lying near the center of the segment. It is about 0.3 mm broad. Behind it lie the shell gland and vitellaria. The vitellaria are more extensive than usual. Not only do they underlie the testes but they extend laterad as far as or farther than the ovary. The vagina starts from a seminal receptacle dorsal to the shell gland, and runs first cephalad, then curves laterad around the lobe of the ovary, and finally opens into the genital atrium just posterior to the cirrus sac. Both genital ducts pass between the lateral tubes of the excretory system. The ripe segments are about one and one-half times as long as broad, and are crowded throughout with eggs. The eggs measure about  $50\mu$  in diameter and the embryos about  $34\mu$ .

*Host.*—*Elaphe obsoleta lindheimeri*.

*Habitat.*—Intestine.

*Locality.*—Houston, Tex. (Houston Zoological Gardens).

*Type specimen.*—U.S.N.M. Helm. Coll. No. 31676.

*Remarks.*—The snake from which the type material was taken died in the Houston Zoo. Presumably it was captured somewhere in the vicinity of Houston, but the exact locality is unknown. It had refused to eat during several weeks of captivity, and this fact may have affected the tapeworms somewhat. The worm most closely resembles *Oochoristica americana* described above. Like this form the testes are distributed in more than one layer, but in *O. elaphis* the vitellaria are much more extensive and underlie the testes. Furthermore, *O. elaphis* seems to be a much smaller and more delicate form.

## DIOCHETOS, new genus

*Generic diagnosis.*—Linstowinae: With relatively few elongate segments. Mature segments two to six times as long as broad. Genital pores alternate irregularly, and the sexual ducts pass dorsal to the single lateral excretory duct. The dorsal excretory ducts and secondary ramifications are usually absent except at the extremities of young worms. Testes very numerous with a tendency to arrangement in two lateral fields. Ovary median and very small. About the anterior two-fifths of a mature segment is unoccupied by the sex glands. Uterus breaks up into capsules, each of which contains a single egg. The capsules are evenly distributed but very sparse. Adults parasitic in lizards of the genus *Phrynosoma*. The above diagnosis is based on a single species, and will doubtlessly have to be modified if other species are discovered.

*Type species.*—*Diochetos phrynosomatis*, new species.

## DIOCHETOS PHRYNOSOMATIS, new species

PLATE 3, FIGURE 7; PLATE 4, FIGURE 1

*Specific diagnosis.*—*Diochetos*: A flat white tapeworm, composed of relatively few elongate segments. The total length varies from 55 to 70 mm. The scolex is 0.4 to 0.6 mm wide, and the suckers are only 0.145 to 0.16 mm in diameter. There is no line of demarcation between the neck and the scolex. Segmentation becomes apparent about 2 mm from the scolex; and almost immediately the rudiments of the sex organs appear. The mature segments are 15 or 20 mm from the scolex. They vary considerably in length but are always much longer than broad. In my material, segments in which the uterus has not yet developed may be as much as six times as long as broad; younger segments, which seem to be perfectly mature, are not quite three times as long as broad. Extreme measurements are 1 by 6.1 mm for the older segments and 1 by 2.45 mm for the younger. The genital pore lies between the end of the first fifth and the end of the first third of the lateral margin. The cirrus sac is an oval measuring from 0.13 by 0.22 mm to 0.18 by 0.3 mm. The vas deferens lies directly posterior to the median end of the cirrus sac. It is at first much coiled, but straightens before reaching the level of the ovary. There are 125 to 180 testes in each segment. These lie almost wholly posterior to the ovary, but in nearly every segment a few lie cephalic to that organ. They tend to group themselves in two elongate lateral fields. The ovary lies slightly anterior to the center of the segment. It is bilobed and relatively small, about 0.25 mm wide. Behind it lie the vitellaria and shell gland in the usual positions.



The ripe segments are four to six times as long as broad, and the eggs are scattered sparsely throughout. The eggs are  $55\mu$  in diameter, and the embryos are  $30\mu$  in diameter. The excretory system is very unusual. Plate 4, Figure 1, is a diagrammatic reconstruction of a terminal segment of a young worm studied in sections. At the caudal end of the terminal sterile segment there are the usual median bladder and pore. Four excretory tubes of approximately equal size, one pair dorsal to the other, leave the bladder but very quickly come together to form a single pair of tubes. These again split apart and come together again, a process that is repeated several times. By the time the end of the terminal fourth of the segment is reached, however, the dorsoventral splitting ceases, and the tubes are single on each side throughout the rest of the segment. At irregular intervals throughout the worm, however, the tubes split again into dorsal and ventral parts for short distances, and in one instance such a split forms a loop through which the reproductive ducts pass. There are also some branch tubes that form anastomoses in the median portion of the worm, but these are rather infrequent. A scolex with about 3 mm of neck was sectioned, and throughout this area the usual dorsal and ventral excretory ducts were present. It is evident, therefore, that the single pair of tubes existing throughout the greater part of the worms represents a fusion of dorsal and ventral vessels, this fusion being not quite complete.

*Host.*—*Phrynosoma cornutum*.

*Habitat.*—Intestine.

*Locality records.*—Houston and Anderson, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 31677.

## Family NEMATOTAENIIDAE Lühe, 1910

### Genus CYLINDROTAENIA Jewel, 1916

This genus was proposed by Jewel for a single species, taken from the intestine of various North American amphibians. More recently Joyeux (1924) has reported it from South Africa.

### CYLINDROTAENIA AMERICANA Jewel, 1916

Specimens taken from *Acris gryllus*, *Hyla squirella*, *Pseudacris triseriata*, and *Leiopisma laterale* are referred to this species. It is perhaps a little surprising to find an amphibian cestode in a reptile, but in every detail of the anatomy the worms from *Leiopisma laterale* matched Jewel's description, and the measurements fell within the variations which she recorded.

It is interesting to recall Joyeux's (1924) comparison between his material from African amphibians and Jewel's description. The dis-

crepancies that Joyeux noted are so great that specific identity seems very unlikely, particularly since a form discovered from an American reptile appears so similar.

### Genus CYSTICERCUS Rudolphi, 1809

#### CYSTICERCUS sp.

#### PLATE 4, FIGURES 2, 3

A larval cestode was encountered three times, twice in *Leiolopisma laterale* and once in *Eumeces fasciatus*. It was found lying free in the body cavity or entangled in the mesenteries; in all three cases it was present in great abundance. The cyst is a white globular structure about 0.6 mm in diameter and exhibits very little movement when removed to a dish of water. The unarmed scolex lies entirely free within the cyst wall. This type of larval form corresponds to the group of cysticercoids which Villot (1883) designated by the name *Monocercus*. The known members of this group include the larval forms of certain species of *Anomotaenia*. The unarmed scolex and the occurrence of the cysts in lizards suggest the possibility of this form being the larval stage of an *Oochoristica*.

## Class NEMATODA

### Family RHABDIASIDAE Railliet, 1915

This family is not recognized by Baylis and Daubney (1926), but it seems to the author that its peculiar life history and the structure of the parasitic form justify the recognition of a family for this group of worms.

### Genus RHABDIAS Dujardin, 1845

The presence of members of this genus in the lungs of the North American frog has long been known, but until recently they were regarded as specifically identical with *R. bufonis* of European Amphibia. Two other species of *Rhabdias* have recently been described from South America, which bring to three the total number of species from the Americas. Two of these three species were found locally.

#### RHABDIAS RANAE Walton, 1929

This parasite has been found in the lungs of *Rana catesbeiana* and *R. sphenoccephala*, which were captured in the region of Houston, Tex., and from the former host at Huntsville, Tex.

## RHABDIAS VELLARDI Pereira, 1928

Parasites referred to this species have been taken from the lungs of the following snakes: *Heterodon contortrix*, *Storeria dekayi*, *Potamophis striatulus*, and *Thamnophis proximus*. Two differences were noted between Pereira's description and my material, but it is believed that both may be explained without the erection of a new species. The measurements of the cephalic glands were found to be approximately ten times as great in my material as those given by Pereira, but on comparison with the figure it became at once apparent that Pereira had misplaced the decimal. The uterus in my material was often empty, and in no case did it contain as many as a dozen eggs. But since the uteri are never distended, as they are in Pereira's figures, I considered this difference too small for the erection of a new species.

## Family ASCARIDAE Cobbold, 1864

## Subfamily ASCARINAE Travassos, 1913

## Genus OPHIDASCARIS Baylis, 1921

## OPHIDASCARIS sp.

A single female nematode, which was taken from the stomach of *Coluber constrictor flaviventris*, is referred to this genus. The mouth has a very different appearance from that figured by Walton (1927) for *Ophidascaris labiatopapillosa* from the same host, and therefore the parasite is thought to belong to another species. A brief description of the worm is given, to aid in its later classification.

Length, 90 mm; cuticular striations about  $60\mu$  apart, but not very conspicuous. The three lips each bear two papillae. Interlabia are present. The esophagus is 4.9 mm long. The nerve ring and excretory pore are 0.75 and 0.85 mm from the anterior end, respectively. The vulva is in the posterior part of the body about 60 mm from the lips. The eggs are apparently unfertilized and measure  $85\mu$  in diameter. The tail is very short and blunt. It is 0.3 mm long.

## Genus POLYDELPHIS Dujardin, 1845

## POLYDELPHIS sp.

Two males and three females, all immature, were taken from the body cavity of *Coluber constrictor flaviventris*. The location is very unusual for a worm of this group, but as the snake had been dead for 24 hours before it was examined, it is possible that the parasites had migrated from their typical habitat in the intestine, much after the manner of *Ascaris lumbricoides*. These parasites could not be

identified with any known *Polydelphis* species, and because of the immature condition of the worms it is believed better not to name them at this time. A brief description is added, however, to aid in their future classification.

When alive the worms are light yellow. The cuticula is marked with numerous fine longitudinal striations.

*Male*: Length 35 to 40 mm; width about 0.7 mm. The esophagus is 2.5 mm long. The nerve ring is 1.2 mm from the anterior end. The tail is 0.185 mm long and ends in a short spike about  $25\mu$  long. The spicules are equal, 0.4 mm long, and  $25\mu$  wide. There are two pairs of lateral papillae placed just anteriorly to the base of the tail spike, and two rows of papillae running from behind the anus anteriorly. These rows are very irregular and 44 papillae could be counted in one row, but only 23 in the other.

*Female*: In only one specimen were the female genital organs sufficiently developed to count the number of uteri. A description of this one is given. Length 53 mm. Esophagus 2.6 mm long. Nerve ring and excretory pore 1.2 and 1.85 mm, respectively, from the anterior end. The vulva is 24.5 mm from the anterior end, and from it the ovejector runs posteriorly for 0.55 mm before giving rise to four uteri by dichotomous branching.

*Polydelphis anoura* has been reported from several North American snakes, and by Baylis (1921) is doubtfully reported from the above-mentioned host. The spicules, however, clearly separate this form from *P. anoura*.

## Family KATHLANIIDAE Travassos, 1918

### Genus FALCAUSTRA Lane, 1915

This genus has been considered a synonym of *Spironoura* by many recent authors. *Spironoura*, as erected by Leidy (1856), contained two species, *S. gracile*, type species, from the stomach of *Emys serrata*, and *S. affine* from the cecum of *Cistodo carolina*. Only the latter species has subsequently been found and redescribed. Boulenger (1923) redescribed it under the name of *Falcaustra chapini*, but Chapin found it to be the only parasite present in the ceca of box turtles in the vicinity of Washington, D. C., and on the strength of this evidence suggested that it was identical with *Spironoura affine*. He further suggested that *Falcaustra* Lane should be considered a synonym of *Spironoura* Leidy, but since Leidy's species *gracile* is the type, and this form has not since been studied, it would seem premature to dispose of the genus *Falcaustra* as a synonym of *Spironoura*. This opinion is further supported by an observation that Walton (1927) made on the existing Leidy collection of nematodes. For these reasons the genus *Falcaustra* is here retained.

## FALCAUSTRA AFFINE (Leidy, 1856)

Worms that I have taken from the ceca of several specimens of *Terrapene carolina triunguis* agree very closely with the description given by Boulenger except for size. As none of Boulenger's material was fully mature, this discrepancy is rather to be expected. In my material males 10 mm long and females 11.5 mm long were not uncommon.

## FALCAUSTRA PROCERA (Canavan, 1929)

I have taken specimens that agree very closely with Canavan's description of this species from the rectum of *Pseudemys elegans*. Only in the length of the male tail is there a conspicuous difference. Canavan gives the total length as 13 mm and the length of tail as 1.4 mm, but the tail of a specimen 13.8 mm long in my collection measures only 0.75 mm. However, if one measures the male tail figured by Canavan, he finds that its length falls very close to 0.8 mm.

Canavan considers his species to be most closely related to *Falcaustra testudinis* Baylis and Daubney, but I find it very difficult to distinguish it satisfactorily from *S. affine*. As I have stated above, fully matured specimens of *S. affine* are much larger than those which Boulenger described. Between these larger specimens and *S. procera* I could find only slight differences in lengths of the esophagus and of the tail. These are certainly sufficient to warrant the erection of a subspecies, but I have some little doubt if they are of full specific value. Table 1 gives the more important measurements and represents the extremes found in measuring five examples of each sex of each species.

TABLE 1.—Comparison of measurements of *Falcaustra affine* and *F. procera* (five examples of each sex)

Species	Total length		Length of esophagus		Length of tail		Ratio of length of tail to length of esophagus	
	Male	Female	Male	Female	Male	Female	Male	Female
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>		
<i>F. affine</i> .....	8.55-10.3	11.3-11.4	2.3-2.54	2.54-2.6	0.37-0.5	0.75-0.85	1:5-1:6.3	1:3-1:3.4
<i>F. procera</i> .....	8.7-13.7	8.6-14.5	1.75-2.2	1.7-2.3	0.55-0.73	0.67-1.35	1:3-1:3.8	1:1.7-1:2.5

## FALCAUSTRA CHELYDRAE, new species

## PLATE 4, FIGURE 4

*Specific diagnosis.*—*Falcaustra*: A slender white nematode with a finely striated cuticula. The mouth is surrounded by three large lips each of which bears two forked papillae. The esophagus con-

sists of three parts, a pharynx, a cylindrical midportion, and a terminal hourglass-shaped bulb. The tail of both sexes is sharply pointed.

*Male*: 10 to 12.5 mm long and about 0.4 wide. The pharynx is about 0.1 mm long, and the entire esophagus varies from 2 mm to 2.25 mm in length. The hourglass-shaped bulb is 0.39 to 0.44 mm long and 0.22 to 0.24 mm wide. The nerve ring and excretory pore are about 0.44 and 1.3 mm, respectively, from the anterior end. The tail measures 0.42 to 0.5 mm in length. The spicules are 3.4 to 3.9 mm long, about 40 $\mu$  wide near the anterior end, and plainly cross-striated. The gubernaculum is about 0.17 mm long. The papillae are very similar in arrangement to those of *S. affine*. There are two ventral pairs placed slightly beyond the middle of the tail, and at the same level a subdorsal pair. There are three ventral pairs, placed close together just caudal to the cloacal opening, and again at the same level a subdorsal pair. There are three pairs of preanal papillae, but in this species they are not evenly spaced. The anterior two pairs of these rows are farther apart than the posterior two pairs. A precloacal sucker is plainly outlined by the musculature, but it does not possess a cutinous rim.

*Female*: 12.5 to 13.75 mm long, and 0.5 to 0.55 mm wide. The pharynx is about 0.13 mm long, and the esophagus is 2.33 to 2.52 mm long. The hourglass-shaped bulb measures 0.4 to 0.51 mm by 0.24 to 0.26 mm. The nerve ring and excretory pore are 0.45 and 1.3 mm, respectively, from the anterior end. The vulva is 8.5 to 9 mm from the anterior end, and therefore lies close to the cephalic end of the caudal third of the body. The tail is 0.6 to 0.75 mm long.

*Hosts*.—*Chelydra serpentina* and *Amyda ferox*.

*Habitat*.—Rectum.

*Localities*.—Houston, Tex., and Whitehall, N. Y.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 31699; paratype, No. 31700.

*Remarks*.—This species very closely approximates in size and in many structures *Falcaustra affine* and *F. procera*, but from these it is easily distinguished by the extremely long spicules.

#### FALCAUSTRA CATESBEIANAE Walton, 1929

This is a very common parasite of the bullfrog (*Rana catesbeiana*) both at Houston and at Huntsville, Tex.

#### Genus CRUZIA Travassos, 1917

Until recently this genus has contained only one species, *Cruzia tentaculata* from opossums, but Maplestone (1930), Khalil (1926), and Khalil and Vogelsang (1930 and 1932) have raised the total

number to six. Likewise, the host list for the genus has increased until it now includes several mammals of diverse groups and one reptile, a Mexican lizard. In the rectum of a turtle I found a species that so closely resembles *Cruzia tentaculata* that it was at first referred to that species. Indeed, the American representatives of this genus are very similar to one another, notwithstanding the diversity of their hosts. The genus is well characterized by an intestinal diverticulum, that projects into the esophageal region. So pronounced is this character that some authors have recognized a separate family, *Cruziidae*, based on it, while others have included the genus in the *Kathlaniidae*. I have followed the latter course, as the presence or absence of a diverticulum does not seem to me to be of more than generic rank.

**CRUZIA TESTUDINIS, new species**

*Specific diagnosis.*—*Cruzia*: The parasite is a smooth, white worm, somewhat attenuated at the ends. The greatest diameter lies just caudal to the end of the esophagus. The cuticula is smooth and thick. The mouth is surrounded by three large triangular lips, each of which bears near its inner angle a pair of conspicuous papillae. Aside from these there are two double papillae on the dorsal lip, and another, likewise double, on each of the subventral lips. Each subventral lip also bears an amphid. This organ opens by a minute pore near the summit of a large papillalike prominence.

*Male*: Mature males vary from 7.3 to 13.5 mm in length and from 0.4 to 0.6 mm in width. The entire esophagus is from 1.8 to 3.17 mm long. It is divided into four parts: The first part, or pharynx, is 0.2 to 0.29 mm long; the second tubular part is 1.17 to 2.5 mm long; the third part, a small bulb, is 0.07 to 0.15 mm long; and the fourth part, a large bulb, is 0.27 to 0.31 mm long. The nerve ring is 0.47 to 0.77 mm, and the excretory pore is 0.8 to 1.4 mm, respectively, from the cephalic end. The intestinal diverticulum varies from 0.5 to 1.1 mm in length. The male tail bears nine papillae, which are distributed exactly as in the well-known *Cruzia tentaculata*. The spicules are 0.76 to 1.05 mm long, and the gubernaculum is 0.13 to 0.16 mm long. The tail is 0.13 to 0.19 mm long, sharply pointed, and curved slightly ventrad.

*Female*: The female is 10 to 15 mm long and 0.4 to 0.65 mm wide. The esophagus is 3 to 3.8 mm long, of which 0.25 to 0.32 mm is pharynx, 2.3 to 3 mm is narrow, tubular portion, 0.09 to 0.13 mm is the small bulb, and 0.32 to 0.36 mm is the larger caudal bulb. The intestinal diverticulum is 0.85 to 1.2 mm long. The nerve ring is 0.54 to 0.66 mm, and the excretory pore is 1.34 to 1.71 mm from the anterior end, respectively. The vulva lies near the middle of the body, usually a trifle caudal of the middle in young worms and

a trifle cephalic in old ones, but in no case was it observed more than 1 mm from the middle. The female tail varies from 0.3 to 0.5 mm in length. The ova measure  $60\mu$  to  $70\mu$  wide by  $100\mu$  to  $130\mu$  long.

*Host.*—*Terrapene carolina triunguis*.

*Location.*—Rectum.

*Locality.*—Houston, Tex.

*Type specimens.*—U.S.N.M. Helm. Coll. No. 3173; paratypes, No. 3174.

*Remarks.*—These nematodes occurred in large numbers in the recta of nearly all the hosts examined. They are remarkably similar to *Cruzia tentaculata*, for careful study has shown only one constant difference between the two forms. The female tail of *Cruzia testudinis* varies from 0.3 to 0.5 mm in length, and its ratio to the total length varies from 1:28 to 1:40. The female tail of *Cruzia tentaculata* varies from 0.6 to 1 mm, its ratio to the body length varies from 1:14 to 1:18. There are also average differences in the length of the esophagus, but here the variation is too great for the character to be of any importance. So striking is the similarity between these two species and so slight are the differences that the writer would still consider them to be conspecific were it not for the great phylogenetic separation of the hosts.

## Family OXYURIDAE Cobbold, 1864

### Subfamily OXYURINAE Hall, 1916

#### Genus PHARYNGODON Diesing, 1861

This genus has been unknown in North America until very recently. Walton (1929) described *P. bratrachiensis* from the tadpoles of *Rana pipiens*. Walton, however, had only female specimens on which he based his description, and while they are very similar to the females of *Pharyngodon*, they show certain peculiarities not found in other members of the genus.

With this possible exception the genus is represented only in lizards. The excretory pore and the vulva are unusually posterior in position, and the plugs in the eggs are in the inner instead of the outer membrane. Most of these differences were pointed out by Walton, and while they do not necessitate the removal of the worm from the genus at this time, the discovery of the male may make such a change necessary.

#### PHARYNGODON WARNERI, new species

#### PLATE 4, FIGURES 5, 6

*Specific diagnosis.*—*Pharyngodon*: White, stout nematodes, usually showing marked cross striations of the cuticula near the cephalic end



but gradually growing fainter caudad. The esophagus has the characteristic bulb, and just behind that structure the excretory pore opens on the ventral surface.

*Male:* Length 2.25 to 3 mm; width 0.15 to 0.17 mm. The esophagus is 0.5 to 0.51 mm long, and the bulb measures  $84\mu$  to  $92\mu$  by  $108\mu$  to  $116\mu$ . The nerve ring is 0.16 to 0.2 mm from the anterior end, and the excretory pore 0.8 to 1.1 mm. The male tail ends rather bluntly and is 0.1 to 0.125 mm long. The cloacal opening is surrounded by the usual three pairs of papillae. The pedicles of the preanal pair are dome-shaped. The next pair caudad has long stout pedicles, while those of the caudal pair are very much bent. Both of the more caudal pairs are included in the caudal alae. No spicule could be seen, and if present it must be imperfectly cutinized. A well-developed genital cone is present and is about  $17\mu$  long. A cuticular fold, starting at the base of the cone, overlies a part of its ventral surface. The distal end of the fold is emarginate and at each side more or less pointed. The internal male genital organs are of the ordinary type. A seminal vesicle is preceded by the single testis, whose most cephalic extent is about 0.2 mm posterior to the excretory pore.

*Female:* Body length 3.4 to 4.6 mm; width 0.13 to 0.2 mm. The esophagus is 0.55 to 0.7 mm long; the nerve ring and the excretory pore are 0.16 to 0.18 and 0.9 to 1.05 mm, respectively, from the anterior end. The esophagus ends in a characteristic bulb 0.114 to 0.125 mm wide and 0.125 to 0.14 mm long (the length includes the narrow anterior neck of the bulb). The vulva, as in most members of this genus, follows immediately after the excretory pore. It is 1 to 1.2 mm from the lips. The vagina extends along the ventral body wall about 0.75 mm, then crosses over and gives rise to the two divergent uteri, which in turn give rise to the ovaries. Because of the excessive number of eggs in the uteri, it is impossible to trace out their convolutions accurately in whole mounts. The female tail is unusual for the genus, for instead of narrowing abruptly just behind the anus it tapers gradually to a sharp point. It is 0.5 to 0.7 mm long. The eggs have the usual plugs in each end; they vary from  $125\mu$  by  $34\mu$  to  $130\mu$  by  $36\mu$ .

*Host.*—*Cnemidophorus sexlineatus*.

*Habitat.*—Rectum.

*Locality.*—Huntsville, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 31701.

*Remarks.*—This species belongs to that group of the genus *Pharyngodon* in which the caudal papillae are included in the caudal membrane. These include the species *hindlei*, *mamillatus*, *spinicauda*, *inermicauda*, and *tiliquae*. From all these, as well as from *P. batra-*

*chiensis*, known only by females, it is distinguishable by the shape of the female tail. Furthermore, the species is separated from *P. mamillatus* and *P. inermicauda* by the width of the lateral alae; from *P. spinicauda* and *P. tiliquae* by the lack of a support for the anterior margin of the bursa; and from *P. hindlei* by the latter's conspicuous spicule.

Two of the 6-lined race runners examined were heavily parasitized by this worm. Race runners are rare about Houston but are very common at Huntsville, Tex., where these specimens were collected. I am greatly indebted to Dr. S. D. Warner, of the Sam Houston State Teachers' College, for assistance given me while collecting in that locality, and I name this species in his honor.

#### Genus COSMOCERCOIDES Wilkie, 1930

This genus was erected for two species of Oxyuridae from Japanese amphibians. It is distinguished from *Cosmocerca* by the absence of true plectanes and by the presence of a ring of tubercles about the base of the large papillae. No mention is made in the description of the genus *Oxysomatium*, yet this genus can only be distinguished from *Cosmocercoides* by the presence in the latter of the above-mentioned tubercles. In certain specimens, which I have obtained from the blue-tailed skink, and which are described more fully below, these tubercles may be lacking. Since the worms from this host are all very small and appear to retain juvenile characters after reaching sexual maturity, it seems not unlikely that they are in an unsuitable host. Until more knowledge concerning their relationship to the normal members of the species is obtained, however, it seems best to recognize *Cosmocercoides* as a genus for those forms possessing cuticular tubercles about the base of certain large papillae.

#### COSMOCERCOIDES DUKAE (Holl, 1928) Travassos, 1931

Synonyms: *Cosmocerca dukae* HOLL, 1928; *Oxysomatium variabilis* HARWOOD, 1930.

As Wilkie has suggested, this species should be transferred to his new genus *Cosmocercoides*. Holl's type material came from *Triturus viridescens*, which does not occur in this vicinity; but I have found the same species of parasite very common in other hosts. Unfortunately I was not aware until recently of Holl's species, and I described this worm separately under the name of *Oxysomatium variabilis*. Although it is an extremely variable form, there can be no doubt that Holl and I described the same species, and as Holl's name has priority it must stand. Accordingly *Oxysomatium variabilis* Harwood, 1930, falls as a synonym of *Cosmocerca dukae* Holl, 1928.

In the paper referred to (Harwood, 1930) I have recorded this species from a considerable number of amphibians and reptiles, and several others have been added since. The complete host list is now as follows: *Triturus viridescens*, *T. meridionalis*, *Ambystoma microstomum*, *A. talpoideum*, *Hyla squirella*, *Pseudacris triseriata*, *Rana areolata*, *R. palustris*, *R. sphenoccephala*, *R. sylvatica*, *R. clamitans*, *R. catesbeiana*, *Bufo valliceps*, *B. terrestris*, *Gastrophryne areolata*, *Ophisaurus ventralis*, *Leiopisma laterale*, *Eumeces fasciatus*, *Heterodon contortrix*, *Storeria dekayi*, *Micrurus fulvius*, *Terrapene carolina triunguis*, and *Terrapene ornata*. It may be noted that the majority of these hosts are mainly terrestrial. *R. catesbeiana* is the most nearly aquatic host, but only a very light infection was encountered in 20 specimens of this frog examined. In the laboratory cultures the larvae do not develop in saturated soil.

An interesting variation of this species has been obtained from *Eumeces fasciatus*. The worms from this host are unusually small, the males being only 1.65 to 2.2 mm long. The spicules are variable, often being unequal. In one worm the long spicule was 0.233 mm long and the other only 0.166 mm long. The large papillae are often without the cuticular tubercles around them. All these characters appear, though seldom in such a pronounced manner, in immature worms from *Bufo valliceps*, a common host. The worms from *E. fasciatus*, however, are mature, as is shown by the presence of fertile eggs in the females. The females from this host are also very small.

Travassos (1931) gained the impression that I (Harwood, 1930) included a number of species in my discussion of *Cosmocercoides dukae*. It may be well to emphasize, therefore, that the recorded variations other than size can not be correlated in any way with the type of host invaded. Indeed, on studying material obtained by further collecting, those few groups mentioned by me (1930) have been found to be untenable. That free-living animals possessing a wide geographic range, and living under a variety of conditions, show a great range of variation is a well-known biological principle. Two examples come readily to mind; namely, *Melospiza melodia* among the birds, and *Papilio glaucus* among the insects. Accordingly, we might expect to find a great range of variation among those parasites that are able to invade a variety of host species. This has been amply demonstrated with *Syngamus trachea*.

### Family ATRACTIDAE Travassos, 1920 (?)

#### Genus ATRACTIS Dujardin, 1845

This is a genus of very small worms that are parasitic in reptiles. Only one species, *A. opeatura* Leidy, has previously been described

from America. The following account contains the description of a second species, which is parasitic in the three-toed box turtle:

ATRACTIS CAROLINAE, new species

PLATE 4, FIGURE 7

*Specific diagnosis.*—*Atractis*: A very small, white, parasitic worm. Body cylindrical, and tapering at each end. Tail of both sexes sharply pointed. Cuticular striations faint and  $1\mu$  to  $2\mu$  apart. Mouth surrounded by six lips, each of which bears two papillalike protuberances at the distal end and two more just proximal to them. The esophagus is divided into two equal parts and ends in the usual bulb.

*Male*: Length 2.3 to 2.85 mm; width  $63\mu$  to  $80\mu$ . The esophagus is 0.48 to 0.55 mm long, and the bulb measures  $75\mu$  to  $80\mu$  long by  $63\mu$  to  $75\mu$  wide. The nerve ring and excretory pore are 0.35 to 0.38 and 0.375 to 0.415 mm, respectively, from the anterior end. The tail is 0.33 mm long. The spicules are very unequal, the long one being 0.333 to 0.34 mm long, and the short one only  $75\mu$  to  $84\mu$  long. The long spicule is well cutinized, conspicuously cross-striated, and about  $10\mu$  wide. The short spicule is but slightly cutinized and unmarked. The gubernaculum is  $60\mu$  to  $80\mu$  long and notched near the anterior end. There is a row of five papillae, placed close together on each side of the anus. There may be four more pairs of postanal papillae, but they are not always present.

*Female*: Length 2.5 to 2.95 mm; width about  $85\mu$ . Esophagus 0.47 to 0.57 mm long, its bulb measuring  $71\mu$  to  $80\mu$  long by  $63\mu$  to  $71\mu$  wide. The nerve ring and the excretory pore are 0.25 to 0.3 and 0.35 mm, respectively, from the anterior end. The vulva is only  $63\mu$  to  $85\mu$  in front of the anus. The tail is 0.5 to 0.55 mm long.

*Host.*—*Terrapene carolina triunguis*.

*Habitat.*—Rectum.

*Locality.*—Houston, Tex.

*Type specimens.*—U.S.N.M. Helm. Coll. No. 31702; paratypes, No. 31703.

*Remarks.*—These nematodes were always present in large numbers in the rectum of the host, but they are so small that at first they were passed over as larval forms of other nematodes present in the same host. Possibly other investigators have encountered this same form and have disregarded it for the same reason. This species may easily be separated from Leidy's *A. opeatura* by size, structure of lips, size of spicules, and number of papillae.

## Family DIAPHANOCEPHALIDAE Travassos, 1919

## Genus KALICEPHALUS Molin, 1861

The worms belonging to this genus are very widely distributed, but many of them are imperfectly known, having been inadequately described by earlier workers; and as yet no redescriptions are available. Only two species, *K. coronellae* and *K. parvus* Ortlepp (1923), have been adequately described from North America. MacCallum (1921) described a new species of nematode, *Strongylus boae*, from the stomach of *Boa constrictor*. He lists also a number of other snakes, many of them North American species, as hosts to this parasite. His description is very general, and it would be impossible to determine the genus of the worm were it not for the figure, which leaves no doubt that the worm belongs to the genus *Kalicephalus*. The name *boae* is preoccupied in this genus, and as both Molin and Blanchard have described worms of this genus from *Boa constrictor*, MacCallum's trophotype, it seems best to let MacCallum's species sink into synonymy with *K. boae* (Blanchard).

I have collected two species of this genus from Texas snakes, and both of them appear to be new. I have followed Ortlepp's example, however, and have disregarded Molin's species, which have not been redescribed, as none of my worms are from the same hosts and as his descriptions are too brief for purposes of modern taxonomy.

## KALICEPHALUS AGKISTRODONTIS, new species

## PLATE 5, FIGURE 1

*Specific diagnosis.*—*Kalicephalus*: A light orange or yellow nematode, with a smooth cuticula. The mouth capsule is typical for the genus. The dorsal gutter extends about half the distance into the mouth capsule. The esophagus is distinctly thickened in the posterior half. The nerve ring encircles the esophagus about one-third of the distance from its anterior end. The excretory pore is very faintly indicated and usually lies at the level of the thickest portion of the esophagus. The intestine is an inconspicuous tube among the reproductive organs and glands.

*Male*: Body length varies from 6.5 to 9.5 mm; the width from 0.2 to 0.3 mm. The buccal capsule is 0.13 to 0.16 mm long and of approximately the same width at the base. The esophagus is 0.31 to 0.34 mm long; the nerve ring is 0.22 mm to 0.28 mm from the anterior end, and the excretory pore 0.33 to 0.4 mm. The spicules are long, slender, and alate. They are 0.46 to 0.58 mm long and about 10 $\mu$  wide at the anterior end. The alae are transversely striated. A well-cutinized gubernaculum is present, but its size is somewhat vari-

able. It measures 0.11 to 0.155 mm in length, and about  $15\mu$  at the widest point near the anterior end. The genital cone is 0.13 to 0.145 mm long and 0.09 to 0.11 mm wide at the base. The bursa is obliquely truncated; its rays are of the usual pattern. The common trunk of the dorsal ray usually bifurcates near its middle, and each branch almost immediately divides again. The inner rays are again divided for from one-half to one-third their length.

*Female*: The total length varies from 10 to 13.75 mm; width from 0.26 to 0.33 mm. The mouth capsule is 0.16 to 0.18 mm long and at the base about as broad as long. The esophagus is 0.35 to 0.47 mm long. The nerve ring and excretory pore are 0.28 to 0.32 and 0.4 to 0.51 mm, respectively, from the anterior end. The vulva is 7 to 9.13 mm from the anterior end and therefore in the posterior part of the body. The vulva divides the body in the ratio of 1.6:2; the lips of the vulva are very prominent, measuring about 0.11 mm in length. The uteri are divergent, and therefore this species falls into Ortlepp's group A. The rest of the female genital system is quite typical for the genus. The eggs measure  $67\mu$  to  $75\mu$  by  $38\mu$  to  $46\mu$ . The tail varies in length from 0.3 to 0.4 mm, and it ends bluntly.

*Hosts*.—*Agkistrodon mokasen*, *Heterodon contortrix*, *Pituophis sayi*, *Natrix rhombifera*, *N. sipedon fasciata*, *Lampropeltis getulus holbrooki*, *Thamnophis proximus*, and *Micrurus fulvius*.

*Habitat*.—Stomach.

*Locality*.—Houston, Tex.

*Type specimens*.—U.S.N.M. Helm. Coll. No. 31704; paratype, No. 31705.

*Remarks*.—This parasite closely resembles *Kalicephalus coronellae*, which Ortlepp found in the stomach of a North American snake (*Coronella triangulum*) dying in the Zoological Gardens of London. *K. agkistrodontis* is a much smaller form; the buccal capsule is more elongate; the female tail is much shorter (in actual measurement, but about the same proportionately); the spicules and gubernaculum are both shorter, in actual measurements, and the gubernaculum is shaped differently.

#### KALICEPHALUS AGKISTRODONTIS FLAGELLUS, new subspecies

*Subspecific diagnosis*.—These worms differ from the typical variety in the following respects: They are smaller, the males vary in length from 6.3 to 7 mm, the females from 6.72 to 8.15 mm. The female tail is shorter measuring 0.24 to 0.32 mm in length. The inner rays of the dorsal ray are divided for less than one-fifth their length, and in one specimen there is no bifurcation at all.

*Hosts*.—*Coluber flagellum* and *C. constrictor flaviventris*.

*Habitat*.—Stomach.

*Locality*.—Houston, Tex.

*Type specimens.*—U.S.N.M. Helm. Coll. No. 31706; paratype, No. 31707.

*Remarks.*—This subspecies is based on two males and three females from *C. flagellum* and a single male from *C. constrictor*. The differences mentioned above are believed to be too great to go unnoticed, and yet they are too variable and too near the type to justify the erection of a new species.

KALICEPHALUS RECTIPHILUS, new species

PLATE 5, FIGURE 2

*Specific diagnosis.*—*Kalicephalus*: A yellowish cylindrical worm, with a faintly striated cuticula. The striations are about  $2\mu$  apart. A large mouth, of a shape typical for the genus, is separated from the rest of the body by a slight constriction. The esophagus is short, and constricted where the nerve ring encircles it at the level of the union between the first and second thirds. The excretory pore is usually slightly below the widest part of the esophageal bulb.

*Male*: Length 5.3 to 5.7 mm, width 0.2 mm. The mouth capsule is 0.17 to 0.18 mm long and 0.18 to 0.2 mm wide. The esophagus is 0.22 to 0.23 mm long. The nerve ring and excretory pore are 0.28 and 0.33 mm, respectively, from the anterior end. The spicules are 0.28 to 0.3 mm long and provided with narrow, transversely striated alae. They are about  $10\mu$  wide near the anterior end. There is a well-cutinized gubernaculum, about 0.13 mm long and only about  $3\mu$  wide in lateral view, with a definite hook present near the anterior end. The bursa is obliquely truncate and, with the exception of the dorsal ray, typical for the genus. The main trunk of the dorsal ray is very short. It bifurcates immediately after the separation of the externo-dorsal rays, and almost at once the two branches again bifurcate. The inner rays are again bifid near the tip. The pattern of the dorsal ray is, therefore, very similar to that of *Diaphanocephalus galeatus*.

*Female*: Body length 6.9 to 7.7 mm; maximum width 0.22 to 0.26 mm. The mouth capsule is 0.2 to 0.22 mm long and 0.22 to 0.24 mm wide. The esophagus is 0.25 to 0.28 mm long. The nerve ring and excretory pore are 0.28 to 0.3 and 0.36 to 0.4 mm, respectively, from the anterior end. The vulva is 4 to 4.3 mm from the anterior end and divides the body in the proportions of 1.2 to 1.4:1. The ovejectors and uteri are divergent. The eggs measure  $63\mu$  to  $71\mu$  by  $18\mu$  to  $22\mu$ . They are in a very early stage of development when deposited. The female tail is 0.25 to 0.38 mm long and ends very bluntly.

*Host.*—*Coluber constrictor flaviventris*.

*Habitat.*—Rectum.

*Locality*.—Houston, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 31708.

*Remarks*.—The foregoing description is based on two males and three females taken from the rectum of a blue racer. Like the preceding species, it belongs to the group of *Kalicephalus* worms with divergent uteri. It is easily distinguished from *K. coronellae* Ortlepp and *K. agkistrodontis* by the smaller size, the shorter esophagus and spicules, the shape of the gubernaculum, the shape of the dorsal ray, the position of the vulva, and the blunt female tail.

#### Genus OSWALDOCRUZIA Travassos, 1917

A representative of this genus has been known from North America since the time of Joseph Leidy. It is now known by the name of *O. leidyi* Travassos, but, as Steiner (1924) has already pointed out, it is impossible as yet satisfactorily to distinguish this form from certain species described earlier. Recently Walton has reported several other species from this continent.

#### OSWALDOCRUZIA PIPIENS Walton, 1929

#### PLATE 5, FIGURES 3-6

The features used to differentiate *Oswaldocruzia pipiens* Walton and *O. leidyi* Travassos are not satisfactory in view of the variation present in my material. Walton (1929) lists "size, possession of distinct cervical alae, and decidedly different dorsal ray pattern" as the important differences between these forms. The difference in size between *O. pipiens* and *O. leidyi* is only an apparent one, since neither Walton nor Steiner records any variation in their measurements, while in my material the variation is nearly as great as the range between their measurements. The dorsal ray pattern is also variable. Of three males taken from *Terrapene carolina triunguis*, two had a pattern similar to that figured by Walton (1929) for *O. pipiens*, while one was similar to that figured by Steiner (1924) for *O. leidyi*; and of two males from a specimen of *Leiolopisma laterale*, one had a pattern similar to *O. pipiens*, and the other a pattern similar to *O. leidyi*. My material from other hosts is limited, but among these there is also a great variation of the dorsal ray pattern. The remaining character mentioned by Walton, the cervical alae, is always present in my material. Steiner mentions lateral alae, but he does not mention the cervical alae. Therefore, we may presume that they were absent in his material. It is, however, well to remember that Steiner published before Morishita (1926) had attached such great systematic importance to the cervical alae. For the present, therefore, it seems advisable to retain both *pipiens* and *leidyi* as separate species distinguishable by the presence or absence



of cervical alae. Since the size variations are not mentioned by either Walton or Steiner, it seems advisable to give those that I have found in my material.

*Male*: Length, 6 to 10.75 mm; width, 0.35 to 0.65 mm. The esophagus is 0.35 to 0.5 mm long. The cuticular expansions at the anterior end are  $75\mu$  to  $120\mu$  long; and the head is  $38\mu$  to  $55\mu$  wide. The nerve ring and excretory pore are 0.14 to 0.19 mm and 0.3 to 0.375 mm, respectively, from the anterior end. The spicules are 0.16 to 0.25 mm long and  $25\mu$  to  $34\mu$  wide.

*Female*: Length, 9.5 to 13.55 mm; breadth, 0.55 to 0.85 mm. The esophagus is 0.3 to 0.6 mm long. The cuticular expansions at the anterior end are  $85\mu$  to  $125\mu$  long; and the "head" is  $40\mu$  to  $55\mu$  wide. The nerve ring and excretory pore are 0.16 to 0.225 mm and 0.3 to 0.374 mm, respectively, from the anterior end. The vulva is 6 to 9.5 mm from the anterior end and divides the body as 1.8 to 2.6:1. The female tail is 0.26 to 0.32 mm long. The eggs are  $42\mu$  to  $50\mu$  wide by  $75\mu$  to  $88\mu$  long.

From the foregoing measurements it will be seen that my largest female is smaller than the average recorded by Walton, but as environment makes large differences in the size of nematodes I do not consider this significant.

I have taken these worms from *Bufo terrestris*, *B. valliceps*, *Rana palustris*, *R. sphenocephala*, *Leiolopisma laterale*, *Eumeces fasciatus*, *Terrapene carolina triunguis* and *T. ornata* at Houston, Tex.; from *Hyla cinerea*, *Rana sphenocephala*, *Sceloporus undulatus*, and *Leiolopisma laterale* from Huntsville, Tex., and from *Rana sylvatica* at Crown Point, N. Y.

## Family SPIRURIDAE Orley, 1885

### Subfamily PHYSALOPTERINAE Stossich, 1898

#### Genus PHYSALOPTERA Rudolphi, 1819

Of this large and widely distributed genus there has been until very recently only one well-described species, *Physaloptera phrynosoma*, from North American cold-blooded hosts. Walton (1927) has added several other species to this list.

#### PHYSALOPTERA SQUAMATAE, new species

#### PLATE 5, FIGURE 7

*Specific diagnosis*.—*Physaloptera*, group "didelphis." A slender, white nematode with very finely striated cuticula, reflexed over the lips. The lips are dome-shaped, and each bears a large outer tooth and three small, inconspicuous inner teeth. The nerve ring lies near

the union of the fourth and last fifth of the muscular portion of the esophagus. The cervical papillae lie near the posterior end of the muscular esophagus and the excretory pore is slightly farther posterior.

*Male*: Length 7.4 to 9.2 mm; width 0.3 to 0.4 mm. The muscular portion of the esophagus is 0.2 to 0.25 mm long, and the glandular portion is 1.43 to 2 mm long. The nerve ring and excretory pore are 0.2 to 0.25 and 0.4 mm, respectively, from the anterior end. The cervical papillae are about midway between these two structures. The tail is 0.28 to 0.35 mm long. The spicules are subequal, but as the two vary independently either the left or right may be the shorter. They are only 0.155 to 0.175 mm long. The left spicule is well cutinized and about  $10\mu$  wide near the anterior end. It widens a very little beyond its middle and ends in a moderately sharp point. The right spicule is poorly cutinized and about  $13\mu$  wide at its base. Beyond the middle it widens to a maximum of  $25\mu$ , then tapers to a sharp point. The usual caudal alae are present and are supported by four pairs of circumcloacal papillae. The inner surface of the alae is decorated with raised longitudinal ridges. There are three papillae on the cephalic cloacal lip, and two pairs of papillae on the caudal lip. Three pairs of papillae are evenly spaced between the cloaca and the tip of the tail.

*Female*: Length 9 to 14.2 mm; width 0.35 to 0.4 mm. The muscular esophagus is 0.27 to 0.33 mm long, and the glandular esophagus is 1.7 to 2.8 mm long. The nerve ring and excretory pore are 0.25 to 0.28 and 0.3 to 0.45 mm, respectively, from the anterior end. The cervical papillae are about halfway between these two structures. The vulva lies slightly behind the caudal limits of the first third of the body; it is nonprotuberant, and from it the vagina runs caudad for 1.35 mm. The two uteri are convergent. The eggs measure  $25\mu$  by  $42\mu$ . The female tail is 0.33 to 0.5 mm long and ends bluntly. The pores of the caudal glands are situated very near the tip of the tail.

*Hosts*.—*Leiolopisma laterale* and *Agkistrodon mokasen*.

*Habitat*.—Stomach.

*Locality*.—Houston, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 31711.

*Remarks*.—The host distribution of this species seems at present to be rather unusual, since it includes a snake and a lizard. It was this that suggested the specific name *squamatae*. The parasite was not present, however, in a very high proportion of the hosts examined, and doubtless it will be found in other reptiles of these groups.

In the structure of the mouth region this species can be distinguished from *P. phrynosoma* by the presence of the inner teeth, and

it is readily distinguished in both sexes by the structure of the caudal regions.

PHYSALOPTERA PHRYNOSOMA Ortlepp, 1922

This parasite has been taken from the stomach of *Phrynosoma cornutum* both at Houston and at Anderson, Tex. Judged by these and other records, it is a frequent and widespread parasite of *Phrynosoma* sp.

Genus THUBUNAEA Seurat, 1914

This small genus is closely related to *Physaloptera*. Hitherto it has been known by only three species, one from Africa and the other two from South America. The following account adds a new species, and extends the known geographic range of the genus to North America.

THUBUNAEA LEIOLOPISMAE, new species

PLATE 5, FIGURE 8

*Specific diagnosis.*—*Thubunaea*: A white worm with a very finely striated cuticula. The lips exhibit the usual three teeth, and around the base of the lips there is a slight thickening of the cuticula that is reminiscent of the cephalic collarete of the closely related genus *Physaloptera*. The nerve ring lies near the cephalic margin of the last fifth of the muscular esophagus, and the cephalic papillae lie at about the same level. The excretory pore lies near the union of the two parts of the esophagus.

*Male*: Length 8.7 to 9.9 mm, width 0.21 to 0.3 mm. The vestibule is about 42 $\mu$  long, the muscular esophagus 0.21 to 0.27 mm long, and the glandular esophagus 1.55 to 1.75 mm long. The nerve ring and excretory pore are 0.21 and 0.25 to 0.265 mm, respectively, from the anterior end. The male tail is 0.145 to 0.22 mm long. The caudal alae are well developed, and as usual for the genus the inner side of the alae is strongly tuberculated. This makes the papillae very difficult to distinguish, and I am far from certain that the three pairs of stalked papillae and the five pairs of sessile papillae that are figured are the only ones present. Those papillae that are figured, however, could be seen fairly clearly. The spicules are unusually well cutinized for this genus. The right spicule is longer than the left, but the ratio varies in different individuals. The measurements are 84 $\mu$  to 93 $\mu$  for the right spicule and 50 $\mu$  to 72 $\mu$  for the left spicule.

*Female*: Length 13.4 to 14.8 mm, width 0.31 to 0.34 mm. The vestibule is 0.2 to 0.24 mm long, the muscular esophagus 0.31 to 0.34 mm long, and the glandular esophagus 2.36 to 2.45 mm long. The nerve ring and excretory pore are 0.285 and 0.31 mm to 0.34 mm,

respectively, from the anterior end. The vulva is 1.4 to 1.6 mm from the anterior end. From it the vagina runs posteriorly for about 1.3 mm, where it divides into the two convergent uteri. The egg-filled uteri occupy the middle third of the body. Following the uteri are two elongate saes, the seminal receptacles, which are about 0.5 mm long and 0.11 mm wide. The ovaries lie coiled in the body, caudal to the seminal receptacles. The eggs measure  $23\mu$  by  $38\mu$ . The female tail is blunt and only 0.11 to 0.13 mm long.

*Host*.—*Leiolopisma laterale*.

*Habitat*.—Stomach.

*Locality*.—Houston, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 31712.

*Remarks*.—Two immature specimens of *Thubunaea* taken from the stomach of *Acris gryllus* may belong to this species. They possess a short vestibule, three teeth on the lips, and a cephalic collarete as the above species does, but, as the sexual organs have not yet begun to develop, it is impossible to be sure of their identity.

This species is easily separated from *Thubunaea pudica* and *T. parkeri* by the well-cutinized spicules and the cephalic collarete.

## Family CAMALLANIDAE Railliet and Henry, 1915

### Genus CAMALLANUS Railliet and Henry, 1915

This genus is represented in North America by several species that are parasitic in fishes and turtles. For our purpose only those parasitic in the latter hosts need be considered. Several species have been erected by Leidy, Magath, and MacCallum for these forms, but in the present state of our knowledge it seems best to include them all under one species.

#### CAMALLANUS TRISPINOSUS (Leidy, 1851)

Synonym: *Camallanus americanus* MAGATH, 1918.

A number of nematodes taken from turtles are tentatively referred to this species. The hosts are *Chelydra serpentina*, *Kinosternon subrubrum hippocrepis*, *Pseudemys elegans*, *Deirochelys reticularia* (?), and *Amyda ferox* (?) from Houston, Tex.; and *Chrysemys picta* from Newfane, N. Y. The worms from *Deirochelys reticularia* are all females, and those from *Amyda ferox* are immature, and therefore these two records must be regarded as doubtful. Among the worms of my material there seems to be a variation in the length of the spicules that is associated with the host. These spicule measurements are given in Table 2.

Table 2 shows that in length of spicules my parasites fall closer to *Camallanus americanus* Magath than to *C. trispinosus* Leidy. Wal-

ton (1927), however, has shown that the supposed differences in the mouth capsules of these forms are not reliable, which is substantiated by my material; and the spicules vary so widely as to be of little systematic value in this case. Furthermore, as the spicules are very difficult to measure, there is the possibility that Leidy's measurements are inaccurate. For these reasons it seems best to allow Magath's name to sink into synonymy as Walton has already suggested.

TABLE 2.—Length of spicules in *Camallanus trispinosus* from five different hosts

Host	Number of specimens	Length of long spicule	Length of short spicule
		Microns	Microns
<i>Chelydra serpentina</i> .....	5	580-650	264-300
<i>Kinosternon subrubrum hippocrepis</i> .....	5	542-615	310-263
<i>Pseudemys heiroglyphica</i> .....	5	667-771	310-340
<i>Pseudemys elegans</i> .....	5	833-880	215-245
<i>Chrysemys picta</i> .....	5	750-835	210-220

### Family GNATHOSTOMIDAE Railliet, 1895

#### Subfamily SPIROXYINAE Baylis and Lane, 1920

#### Genus SPIROXYS Schneider, 1866

At present three species of this genus are known to parasitize North American reptiles. These are *Spiroxys constricta* (Leidy), *S. contorta* (Rudolphi), and *S. amydae* Cobb. Furthermore, Walton (1927) states that *S. contorta* (Leidy) is not synonymous with *S. contorta* (Rudolphi), but Leidy's description seems to me to be too inadequate to warrant any definite conclusion on this point. Two of these are represented in my collection.

#### SPIROXYS CONTORTA (Rudolphi, 1819)

Walton (1927) reports finding representatives of this species in the existing Leidy collection. The specimens that he refers to this species were taken from the stomach of *Chrysemys picta*. I have taken a *Spiroxys*, which I tentatively refer to this species, from *Pseudemys elegans* and *Deirochelys reticularia* at Houston, Tex., and from *Sternotherus odoratus* at Huntsville, Tex. These worms agree very closely with the description of *S. contorta* (Rudolphi) given by Baylis and Lane (1920), except that they all possess a thickened, cuticular plate at the base of the lips on both the dorsal and ventral aspects. The cephalic margin of each plate bears three protuberances, which closely resemble papillae when the worm is viewed from the lateral aspect.

## SPIROXYS AMYDAE Cobb, 1928

In spite of one important difference between my material and the original description of this species a number of parasites from the stomach of *Amyda ferox* are referred to it. Cobb (1928) states that there are only four teeth on each lip ("eight odontia in the pharynx"), while all my material plainly shows six teeth on each lip. But since Cobb has stated that his material was both immature and poorly preserved, and since both lots of material are from the same host, it seems probable that this difference is due to the condition of the type material.

## Family TRICHINELLIDAE Stiles and Crane, 1910

## Subfamily TRICHURINAE Ransom, 1911

## Genus CAPILLARIA Zeder, 1800

This large and cosmopolitan genus has species parasitic in all the principle vertebrate groups, but in North American reptiles and amphibians only a single form, *C. recurva* from the American crocodile, has been reported. The following account adds two new species:

## CAPILLARIA SERPENTINA, new species

## PLATE 5, FIGURES 9, 10

*Specific diagnosis.*—*Capillaria*: A slender, white worm, with an unstriated cuticula. The females are 12 to 14 mm long and  $88\mu$  to  $103\mu$  wide (no males were found). The esophagus is 4 or 5 mm long and runs for the greater part of its length through the usual row of circular cells. These cells are peculiar in that some are clear and others are crowded with many fine granules. The clear and granulated cells occur in alternating groups composed of two to five cells each. The anterior 0.5 to 0.6 mm of the esophagus is not encircled by cells. Presumably the nerve ring occurs in this region, but it could not be located, even with the use of an oil immersion lens. The intestine narrows rather suddenly at the beginning of the rectum, which is about 0.5 mm long. The anus is terminal and opens between two liplike protuberances, of which the ventral one is the smaller.

The genital system is of the usual type for the genus, with the vulva a short distance posterior to the posterior end of the esophagus. Only the eggs call for additional comment. They have two shells, the outer of which seems to be membranous and somewhat wrinkled. The inner one, which is much heavier, contains the usual plug in the end and seems to be slightly constricted at the middle. Both

of the egg coverings are colorless. The eggs measure  $67\mu$  to  $72\mu$  by  $25\mu$  to  $34\mu$ .

*Host.*—*Chelydra serpentina*.

*Habitat.*—Rectum.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 31709.

*Remarks.*—The foregoing description is based on two female specimens taken from the common snapping turtle. It seems to be remarkably similar to *Capillaria recurva* Solger, 1877, from the American crocodile. Both parasites are from reptilian hosts that inhabit fresh waters, but differences appear that make specific identity seem unlikely. *C. chelydrae* is only one-fifth as large and has a colorless intestine and egg covering, whereas in *C. recurva* the intestine is yellowish to dark brown and the eggs are also colored. Furthermore, Solger does not mention any peculiar mottling of the esophagus.

CAPILLARIA HETERODONTIS, new species

PLATE 5, FIGURES 11–13

*Specific diagnosis.*—*Capillaria*: A very slender, white nematode, with a smooth cuticula. The length of the male varies from 16.5 to 22.5 mm, and the maximum width from  $45\mu$  to  $80\mu$ . The esophagus is 7 to 11.5 mm long and does not show any very exact correlation with the total length. The posterior end bears a small bursalike expansion of the cuticula, which is supported by a short sharp tail on the dorsal side. The spicule is 2.55 to 3.25 mm long and blunt at the tip. The spicule sheath is without spines, and therefore this worm belongs to the subgenus *Capillaria* (Zeder) Travassos.

Length of the female varies from 24 to 26 mm, the width from  $100\mu$  to  $115\mu$ . The esophagus measures from 7.4 to 8.4 mm in length. The anus is subterminal, and the body ends bluntly. A rectum 0.35 to 0.8 mm long shows plainly. The vulva is 0.12 to 0.18 mm posterior to the end of the esophagus. The eggs are typical for the genus and seem to be inclosed in two shells with a plug at each end. The outer shell is thin but smooth. They measure  $45\mu$  to  $55\mu$  long by  $25\mu$  to  $30\mu$  wide.

*Host.*—*Heterodon contortrix*.

*Habitat.*—Rectum.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 31710.

*Remarks.*—This species is easily distinguished from the other two species of *Capillaria* from North American reptiles by its size and by the shape of the caudal end of the female. The males of the other two species are unknown.

## Class ACANTHOCEPHALA

Family NEOECHINORHYNCHIDAE Ward, 1917

Genus NEOECHINORHYNCHUS Stiles and Hassall, 1905

This genus is represented in North America by a number of species that are parasitic in fishes and turtles. There appears to be only one member of the genus parasitic in North American reptiles.

## NEOECHINORHYNCHUS EMYDIS (Leidy, 1852)

This common parasite of terrapins has been encountered several times in the intestine of *Pseudemys elegans*. Frequently these worms were so numerous as to fill the lumen of the undistended intestine.



TABLE 3.—Parasites of Amphibia and Reptilia included in this paper, listed systematically by hosts

Host	Number examined	Parasite	Per cent infested
<b>AMPHIBIA:</b>			
<i>Triturus meridionalis</i> .....	8	<i>Cosmocercoides dukae</i> .....	62.5
		<i>Brachycoelium meridionalis</i> .....	37.5
		<i>Mesocoelium americanum</i> .....	12.5
		<i>Manodistomum occultum</i> .....	12.5
<i>Ambystoma microstomum</i> .....	4	<i>Cosmocercoides dukae</i> .....	25
		<i>Brachycoelium daviesi</i> .....	25
<i>Ambystoma talpoideum</i> .....	4	<i>Cosmocercoides dukae</i> .....	25
<i>Siren lacertina</i> .....	1	Negative.....	—
<i>Bufo terrestris</i> .....	2	<i>Cosmocercoides dukae</i> .....	100
		<i>Oswaldocruzia pipiens</i> .....	50
<i>Bufo valliceps</i> .....	49	<i>Cosmocercoides dukae</i> .....	77+
		<i>Oswaldocruzia pipiens</i> .....	4+
<i>Acris gryllus</i> .....	32	<i>Cylindrotaenia americana</i> .....	16—
		<i>Thubunaea leiopismae</i> (?).....	6+
		<i>Cosmocercoides dukae</i> .....	62—
<i>Pseudacris triseriata</i> .....	26	<i>Cylindrotaenia americana</i> .....	7+
		<i>Brachycoelium daviesi</i> .....	7+
		<i>Megalodiscus temperatus</i> .....	7+
		<i>Oswaldocruzia pipiens</i> .....	25
<i>Hyla cinerea</i> .....	4	<i>Brachycoelium daviesi</i> .....	25
		<i>Megalodiscus temperatus</i> .....	25
		<i>Cosmocercoides dukae</i> .....	18+
<i>Hyla squirella</i> .....	11	<i>Cylindrotaenia americana</i> .....	9+
<i>Hyla versicolor</i> .....	1	Negative.....	—
<i>Rana areolata</i> .....	8	<i>Megalodiscus temperatus</i> .....	37.5
		<i>Cosmocercoides dukae</i> .....	25
		<i>Falcooustra catesbeiana</i> .....	50
		<i>Gorgodera amplicava</i> .....	35
		<i>Haematoloechus floedae</i> .....	20
		<i>Megalodiscus temperatus</i> .....	15
		<i>Rhabdias ranae</i> .....	15
		<i>Glyphelmims subtropica</i> .....	10
		<i>Cosmocercoides dukae</i> .....	5
		<i>Proteocephalus magnus</i> .....	5
<i>Rana clamitans</i> .....	5	<i>Megalodiscus temperatus</i> .....	80
		<i>Cosmocercoides dukae</i> .....	40
		<i>Haematoloechus floedae</i> .....	20
		<i>Proteocephalus magnus</i> .....	20
<i>Rana palustris</i> .....	1	<i>Oswaldocruzia pipiens</i> .....	100
		<i>Cosmocercoides dukae</i> .....	100
		<i>Megalodiscus temperatus</i> .....	37+
		<i>Cosmocercoides dukae</i> .....	37+
<i>Rana sphenoccephala</i> .....	27	<i>Rhabdias ranae</i> .....	29+
		<i>Brachycoelium hospitale</i> .....	22+
		<i>Oswaldocruzia pipiens</i> .....	18+
		<i>Megalodiscus americanus</i> .....	4—
		<i>Haematoloechus uniplexus</i> .....	4—
		<i>Glyphelmims subtropica</i> .....	4—
<i>Gastrophryne areolata</i> .....	6	<i>Cosmocercoides dukae</i> .....	66½
<b>REPTILIA:</b>			
<i>Anolis carolinensis</i> .....	30	<i>Oochoristica anolis</i> .....	3+
<i>Sceloporus undulatus</i> .....	3	<i>Proteocephalus</i> sp.....	3+
		<i>Oswaldocruzia pipiens</i> .....	33+
<i>Phrynosoma cornutum</i> .....	7	<i>Diocetus phrynosomatis</i> .....	57+
		<i>Physaloptera phrynosomata</i> .....	43—
<i>Ophisaurus ventralis</i> .....	4	<i>Cosmocercoides dukae</i> .....	25
<i>Cnemidophorus sexlineatus</i> .....	4	<i>Pharyngodon warneri</i> .....	50
		<i>Cylindrotaenia americana</i> .....	37—
		<i>Brachycoelium daviesi</i> .....	23+
		<i>Thubunaea leiopismae</i> .....	20—
		<i>Mesocoelium americanum</i> .....	5—
		<i>Oswaldocruzia pipiens</i> .....	5—
		<i>Physaloptera squamatae</i> .....	4—
		<i>Cosmocercoides dukae</i> .....	4—
		<i>Cysticercus</i> sp.....	2—
		<i>Oswaldocruzia pipiens</i> .....	22+
<i>Eumeces fasciatus</i> .....	9	<i>Oochoristica eumecis</i> .....	11+
		<i>Mesocoelium americanum</i> .....	11+
		<i>Cysticercus</i> sp.....	11+
<i>Eumeces septentrionalis</i> .....	1	<i>Cosmocercoides dukae</i> .....	44+
		Negative.....	—

TABLE 3.—Parasites of Amphibia and Reptilia included in this paper, listed systematically by hosts—Continued

Host	Number examined	Parasite	Per cent infested
REPTILIA—Continued			
<i>Farancia abacura</i> .....	2	<i>Stomatrema pusilla</i> .....	50
		<i>Oochoristica americana</i> .....	50
		<i>Proteocephalus faraneiae</i> .....	50
		<i>Kalicephalus agkistrodontis</i> .....	50
<i>Heterodon contartrix</i> .....	4	<i>Cosmocercoides dukae</i> .....	50
		<i>Lechriorchis validus</i> .....	25
		<i>Renifer tezanus</i> .....	25
		<i>Rhabdias vellardi</i> .....	25
<i>Opheodrys oestivus</i> .....	7	<i>Capillaria heterodontis</i> .....	25
		<i>Brachycoelium</i> sp.....	14+
		<i>Kalicephalus agkistrodontis flagellus</i> .....	50
<i>Coluber constrictor flaviventris</i> .....	2	<i>Ophidascaris</i> sp.....	50
		<i>Polydelphis</i> sp.....	50
		<i>Kalicephalus rectiphilus</i> .....	50
<i>Coluber flagellum</i> .....	2	<i>Kalicephalus agkistrodontis flagellus</i> .....	50
<i>Elaphe obsoleta lindheimerii</i> .....	1	<i>Oochoristica elaphis</i> .....	100
<i>Pituophis sayi</i> .....	1	<i>Kalicephalus agkistrodontis</i> .....	100
<i>Lampropeltis calligaster</i> .....	3	Negative.....	.....
<i>Lampropeltis getulus holbrooki</i> .....	3	<i>Kalicephalus agkistrodontis</i> .....	33.3
		<i>Lechriorchis validus</i> .....	33.3
<i>Natrix rhombifera</i> .....	2	<i>Oochoristica natricis</i> .....	50
		<i>Kalicephalus agkistrodontis</i> .....	50
		<i>Renifer aniarum</i> .....	50
<i>Natrix sipedon fasciata</i> .....	6	<i>Dasymetra conferta</i> .....	33+
		<i>Kalicephalus agkistrodontis</i> .....	17-
		<i>Cosmocercoides dukae</i> .....	83+
<i>Storeria dekayi</i> .....	6	<i>Mesocoelium americanum</i> .....	33+
		<i>Brachycoelium storeriae</i> .....	17-
		<i>Rhabdias vellardi</i> .....	17-
<i>Potamophis striatulus</i> .....	7	<i>Rhabdias vellardi</i> .....	43-
<i>Thamnophis proximus</i> .....	7	<i>Kalicephalus agkistrodontis</i> .....	57+
		<i>Rhabdias vellardi</i> .....	43-
<i>Micrurus fulvius</i> .....	3	<i>Kalicephalus agkistrodontis</i> .....	33+
		<i>Cosmocercoides dukae</i> .....	33+
		<i>Kalicephalus agkistrodontis</i> .....	100
<i>Agkistrodon mokasen</i> .....	14	<i>Renifer kansensis</i> .....	14
		<i>Physaloptera squamatae</i> .....	7
<i>Sistrurus miliarius</i> .....	2	<i>Renifer kansensis</i> .....	50
<i>Sternotherus carinatus</i> .....	2	<i>Cercorchis bairdi</i> .....	50
		<i>Spirozys contorta</i> .....	50
<i>Kinosternon subrubrum hippacrepis</i> .....	16	<i>Heronimus chelydrae</i> .....	31+
		<i>Camallanus trispinosus</i> .....	25
		<i>Polystoma hassalli</i> .....	12.5
		<i>Falcaustra chelydrae</i> .....	100
		<i>Camallanus trispinosus</i> .....	100
<i>Chelydra serpentina</i> .....	9	<i>Polystoma hassalli</i> .....	33+
		<i>Auridistomum chelydrae</i> .....	22+
		<i>Henotosoma chelydrae</i> .....	14+
		<i>Capillaria serpentina</i> .....	14+
		<i>Falcaustra affinis</i> .....	92+
<i>Terrapene carolina triunguis</i> .....	14	<i>Cruzia testudinis</i> .....	92+
		<i>Atractis carolinae</i> .....	92+
		<i>Cosmocercoides dukae</i> .....	50
		<i>Oswaldoeruzia pipiens</i> .....	15+
		<i>Polystoma terrapenis</i> .....	8-
<i>Terrapene ornata</i> .....	2	<i>Cosmocercoides dukae</i> .....	50
		<i>Oswaldoeruzia pipiens</i> .....	50
		<i>Camallanus trispinosus</i> .....	87.5
		<i>Neocchinorhynchus emydis</i> .....	69-
		<i>Polystoma megacotyle</i> .....	44-
<i>Pseudemys elegans</i> .....	16	<i>Spirozys contorta</i> .....	25
		<i>Polystoma orbiculare</i> .....	19-
		<i>Falcaustra procera</i> .....	19-
		<i>Cercorchis tezanus</i> .....	19-
		<i>Cercorchis robustus</i> .....	12.5
<i>Deirochelys reticularia</i> .....	1	<i>Heronimus chelydrae</i> .....	6+
		<i>Protenes chapmani</i> .....	6+
		<i>Camallanus trispinosus</i> .....	100
<i>Amyda ferox</i> .....	4	<i>Spirozys contorta</i> .....	100
		<i>Spirozys amydae</i> .....	75
	4	<i>Falcaustra chelydrae</i> .....	50
		<i>Camallanus trispinosus</i> .....	50

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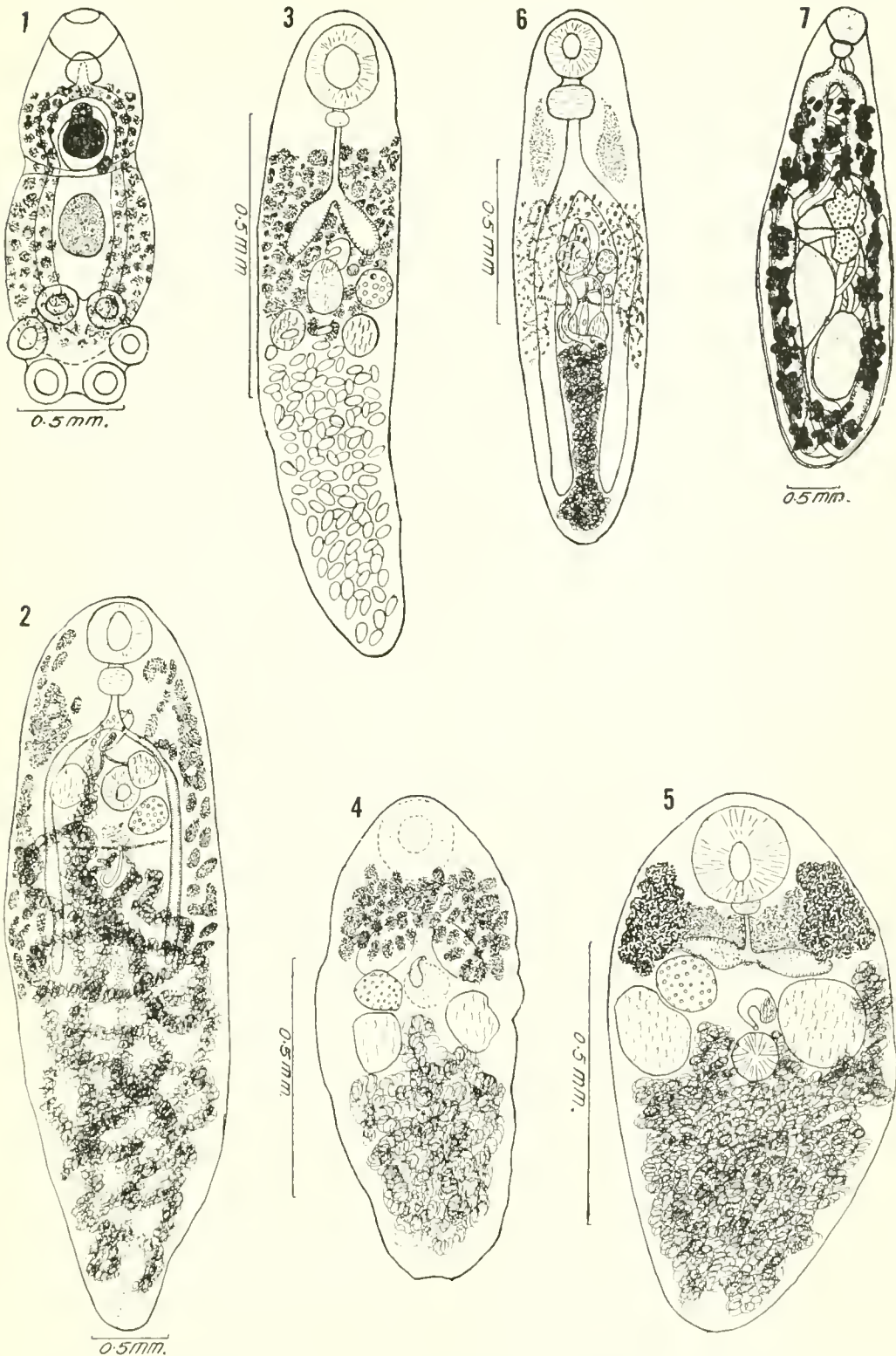
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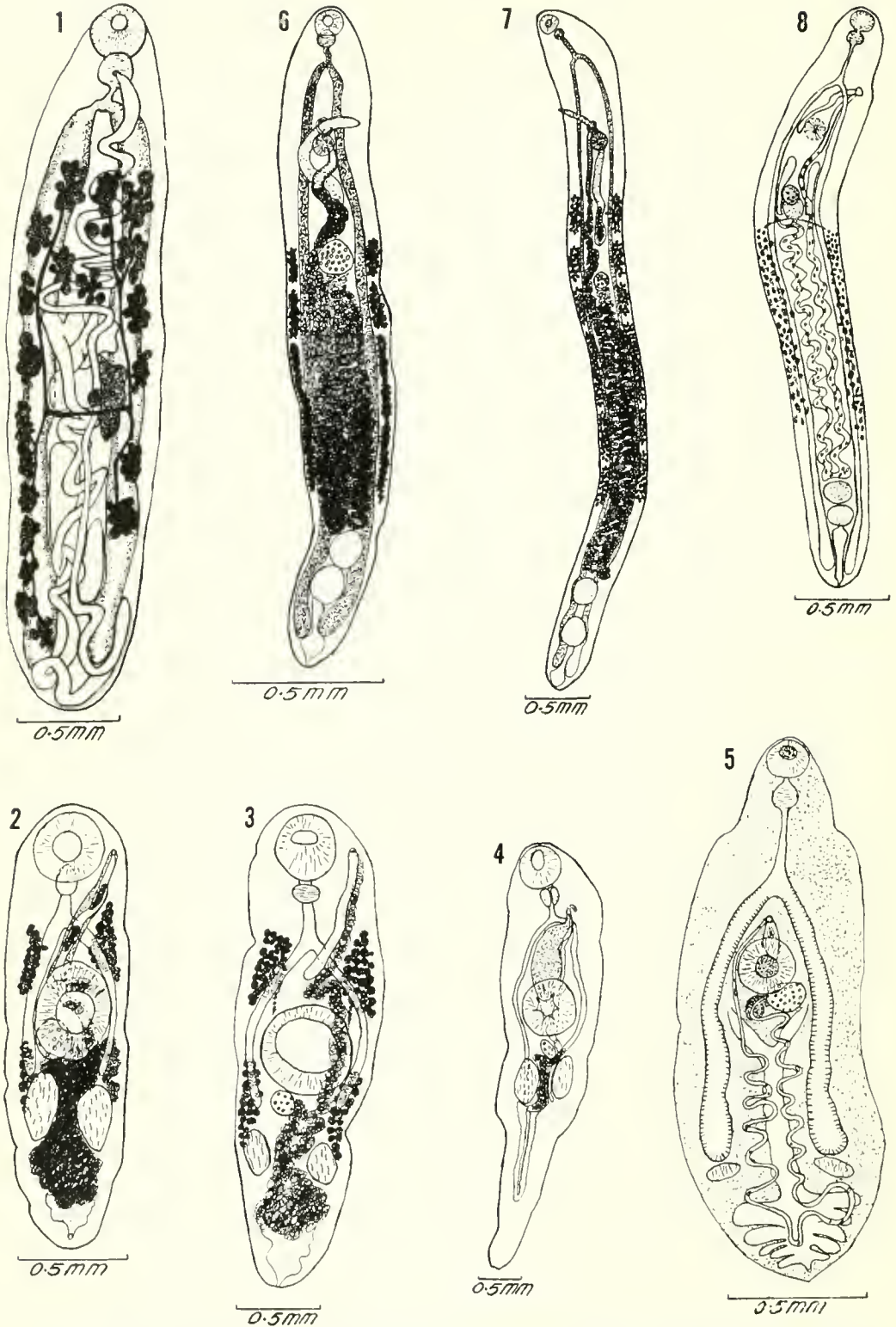
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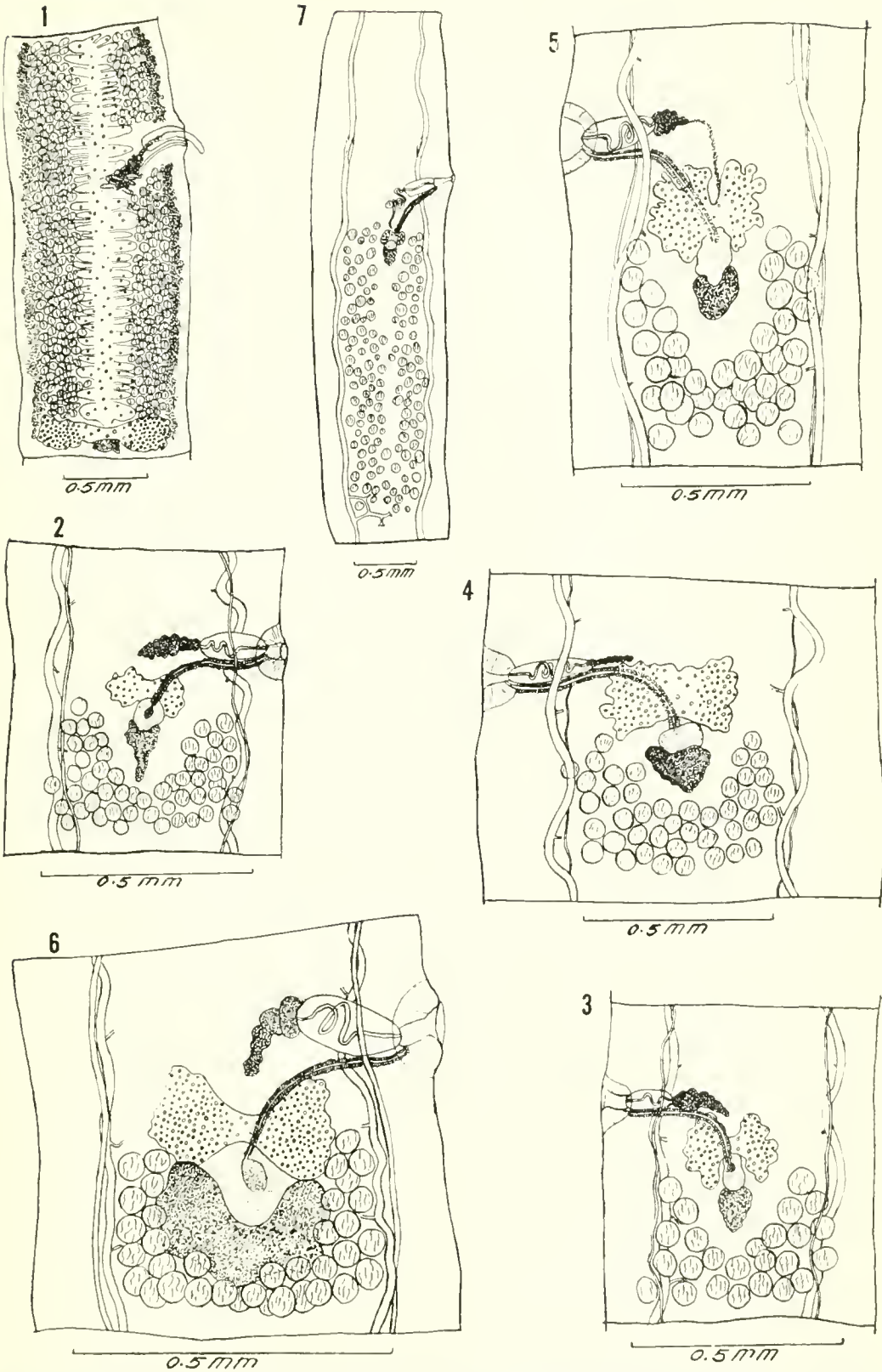




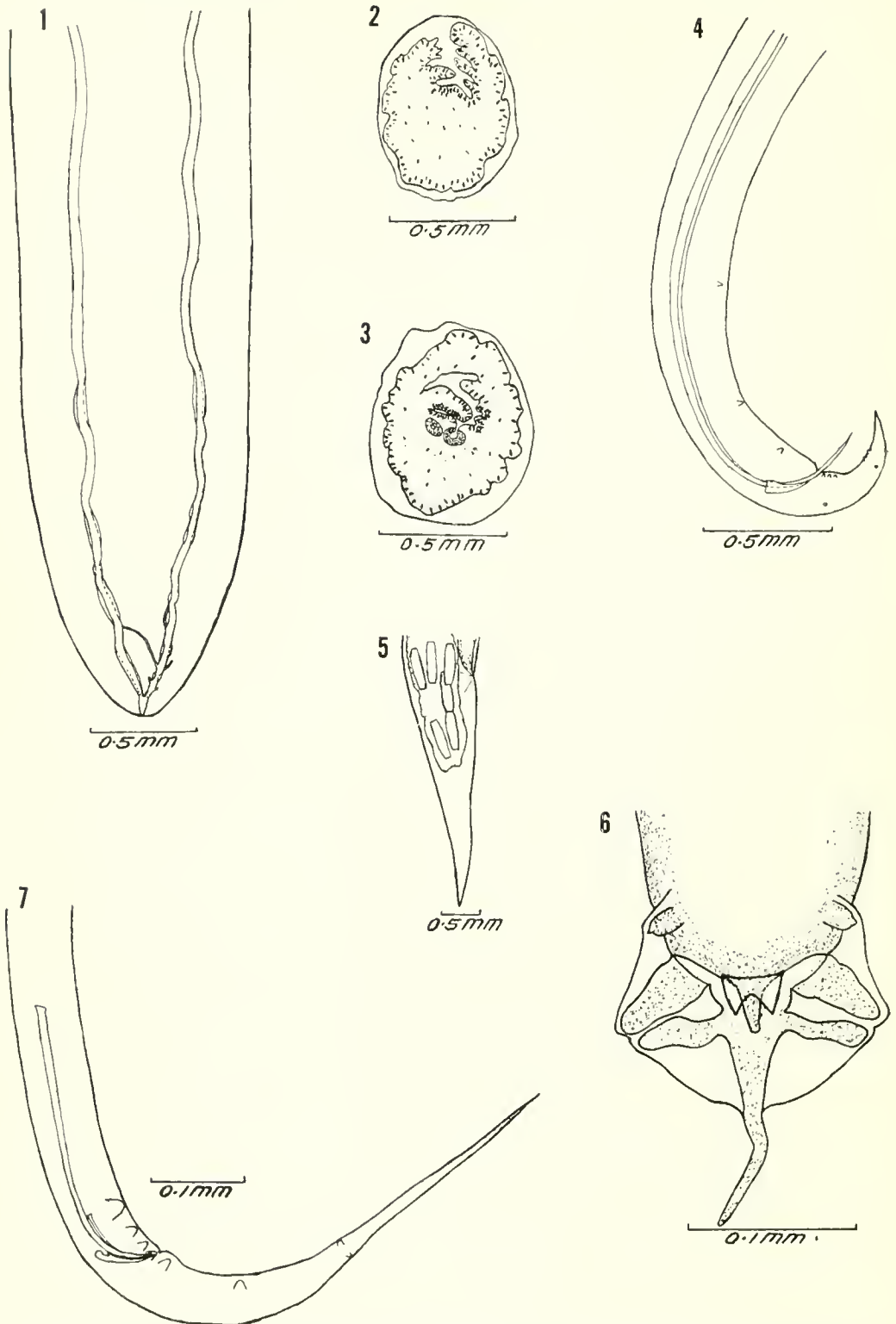
1, *Polystoma terrapenis*, ventral view; 2, *Mesocoelium americanum*, ventral view, somewhat flattened; 3, *Brachycoelium storckii*, ventral view; 4, *B. meridionalis*, dorsal view; 5, *B. daviesi*, ventral view; 6, *Glyphelmis subtropica*, ventral view with vitellaria drawn in; 7, *Hacmatolochus floedai*, dorsal view



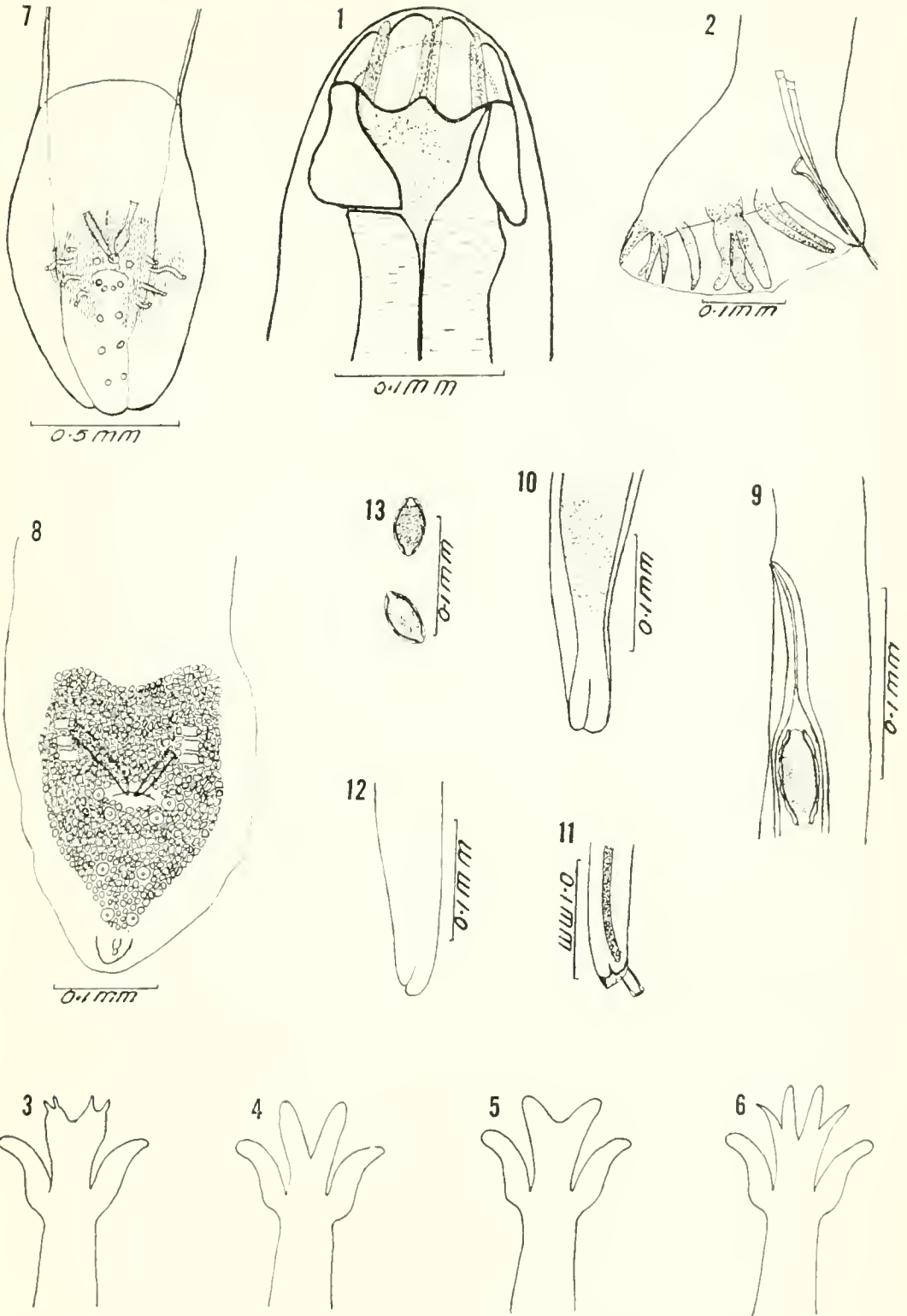
1, *Haematolocchus uniplexus*, ventral view with vitellaria drawn in; 2, *Renifer texanus*, ventral view; 3, *R. aniarum* (Leidy), ventral view; 4, *Lechriorchis validus*, ventral view; 5, *Manodistomum occultum*, ventral view; 6, *Cercorchis texanus*, ventral view; 7, *C. bairdi*, ventral view; 8, *Protneis chapmani*, dorsal view



Mature segments of. 1, *Protocephalus jaranciai*; 2, *Oochoristica natricis*; 3, *O. anolis*; 4, *O. eumecis*; 5, *O. americana*; 6, *O. claphis*, 7, *Diochetos phrynosomatis*



1, *Diochetos phrynosomatis*, a reconstruction of the excretory system of a terminal segment; 2, oblique section through a *Cysticercus* sp.; 3, oblique section through the same *Cysticercus* sp. but showing the suckers; 4, *Falcaustra chelydrae*, posterior end of male, but showing only a portion of the spicule; 5, *Pharyngodon warneri*, caudal end of female; 6, *P. warneri*, caudal end of male; 7, *Atractis carolinae*, caudal end of male



1, *Kaliocephalus agkistrodontis*, lateral view of cephalic extremity; 2, *K. rectiphilus*, bursa; 3, 4, *Osu aldocruzia pipiens*, dorsal ray pattern of specimens from *Leiopisma laterale*; 5, 6, *O. pipiens*, dorsal ray pattern of specimens from *Terrapene carolina triunguis*; 7, *Physaloptera squamata*, caudal extremity of male; 8, *Thubunca leiopismae*; 9, *Capillaria serpentina*, vulva region of female; 10, *C. serpentina*, caudal extremity of female; 11, *C. heterodontis*, caudal extremity of male; 12, *C. heterodontis*, caudal extremity of female; 13, *C. heterodontis*, eggs