

NOTES ON THE HELMINTH PARASITES OF THE OPOSSUM (*DIDELPHIS VIRGINIANA*) IN SOUTHEAST TEXAS, WITH DESCRIPTIONS OF FOUR NEW SPECIES

---

By ASA C. CHANDLER

*Rice Institute, Houston, Tex.*

---

Examination of a series of opossums (*Didelphis virginiana*) caught in the vicinity of Houston, Tex., has brought to light some interesting parasitological information. There were found 3 species of flukes, 2 of them new, and 4 species of nematodes, 2 of them new, and 1 of these of a genus not hitherto found in North America.

**PROALARIA VARIABILIS, new species**

FIGURES 1, 2

*Diagnosis.*—Small flukes, extremely variable in shape and size. In some specimens the body is very clearly divided into anterior and posterior portions, the anterior being considerably the larger in most cases, while in others there is no obvious division at all. When the flukes are flattened the anterior portion of the body may be very broad and flat, but ordinarily the sides of the body are rolled ventrally, the edges of the rolls meeting behind the holdfast organ, and thus forming an overhanging margin. When lying on the side the body is commonly seen to be bent sharply dorsally, the bend being either anterior or posterior to the holdfast organ. The length varies from 0.63 mm to 1.75 mm, while the width varies from only  $325\mu$  in a small specimen to  $828\mu$  in a large, broadly expanded specimen. The measurements of a typical large specimen are about 1.75 mm by 0.69 mm, while one of the smallest specimens, also with eggs in the uterus, measures only  $740\mu$  by  $340\mu$ . The majority of the specimens show conspicuous glandular organs at the sides of the oral sucker, but in some specimens (fig. 1, B, C, F, and H) no trace of them can be found. In some individuals these structures are cup shaped and suckerlike in appearance (fig. 1, A and D), in others they are protruded in an earlike manner (fig. 1, E), and in still others they appear as inconspicuous glands (fig. 1, G). The holdfast organ may be either round or oval; it is somewhat constricted at its junction with the body, thus presenting a mushroomlike appearance. In large

specimens it has a diameter of  $430\mu$ , but in some small specimens the diameter may be no more than half of this. The oral sucker is anterior in position, and measures from about  $60\mu$  to  $100\mu$  in diameter. The pharynx lies immediately behind the oral sucker, and slightly more ventral in position. It is usually elongate in shape; in large specimens it measures  $100\mu$  to  $110\mu$  in length by  $60\mu$  in width, while in small contracted ones it may measure only about  $60\mu$  to  $70\mu$  in each direction. The intestinal caeca fork very shortly behind the pharynx and continue back at least to the region of the sex glands, but their terminations could not be seen with certainty even in sectioned specimens. The ventral sucker lies one-third, or a little less, of the length of the body from the anterior end, and is often partially concealed by the holdfast organ. It is somewhat larger than

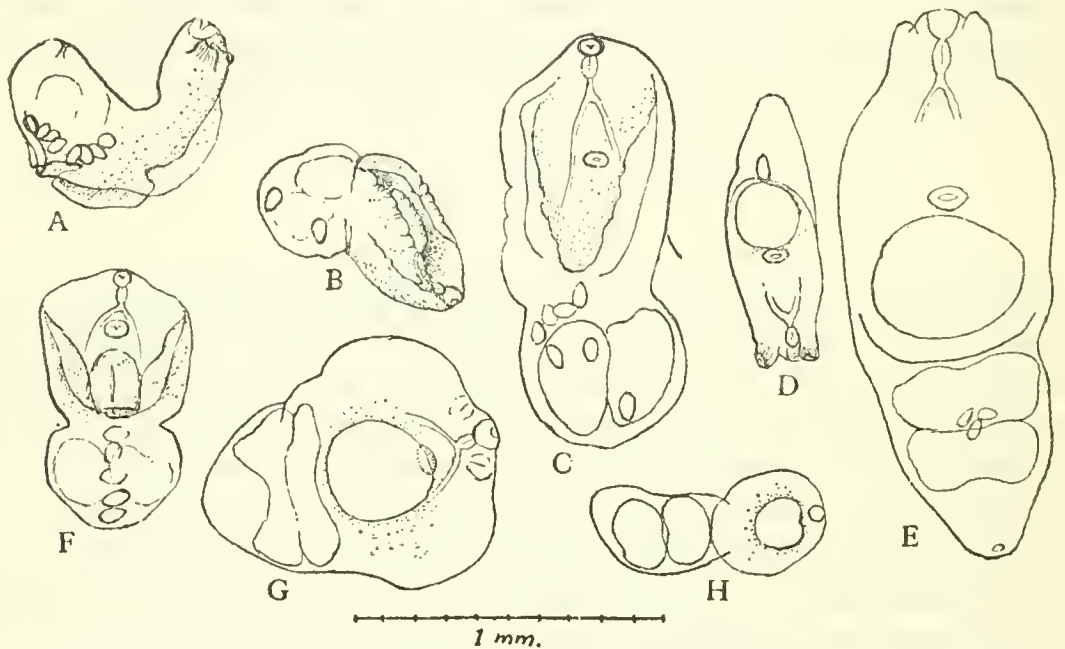


FIGURE 1.—Sketches of eight specimens of *Proalaria variabilis*, new species, showing variations in size, form of body, and tentacular or sucking organs

the oral sucker and is transversely elongated; the measurements vary from  $97\mu$  by  $112\mu$  to  $60\mu$  by  $92\mu$ .

The testes, lying in the posterior portion of the body, vary a great deal both in size and shape. Typically they lie one behind the other, stretching transversely across the body, but in a number of specimens they seem to lie either in a diagonal position or directly beside each other. In a typical large specimen in which the testes lie one behind the other, these organs measure about  $450\mu$  in width by about  $200\mu$  in length. These measurements are, however, of little value, since there is such an extreme variation in shape and size. The sperm duct is enlarged to form a very stout and somewhat coiled tube, which serves as a seminal vesicle. It usually occupies the posterior portion of the body behind the testes. It opens into a genital atrium on the dorsal side near the posterior end of the body. The ovary

lies anterior to the testes, sometimes to the right and sometimes to the left of the median line. The shell gland is inconspicuous in whole mounts; it lies in close proximity to the ovary. The upper part of the uterus is enlarged to serve as a seminal receptacle; from the region of the anterior edge of the ovary the uterus proceeds, as a very broad, thin-walled tube, in almost a straight line to the genital atrium. The vitelline glands occupy a large part of the body, occurring in a considerable part of the anterior portion of the body, forward to the intestinal bifurcation, in the holdfast organ, and in the areas between and around the sex glands; some follicles are found even behind the posterior testis. There is a large yolk reservoir situated on the median line between the testes. The uterus contains only a few eggs, from 1 to 7 or 8; these vary in measurement from  $86\mu$  to  $100\mu$  in length and from  $50\mu$  to  $63\mu$  in width.

*Host*.—*Didelphis virginiana*.

*Location*.—Small intestine.

*Locality*.—Houston, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 8544; paratypes, No. 8545.

*Remarks*.—This fluke is remarkable for the extreme diversity of form that it can assume; for a long time it was difficult to believe that only one species was represented. The problem is further complicated by the fact that LaRue and Bosma (1927) have described another holostome from the opossum in Texas, under the name *Neodiplostomum lucidum*. In spite of the wide variation in form of the species here described, there can be little doubt that *Neodiplostomum lucidum* is specifically distinct. It is described as being unusually transparent after preservation, which is not true of *Proalaria variabilis*. None of seven specimens of the former species showed evidence of lateral sucking cups or tentacular appendages, whereas this condition is exceptional in the present species. LaRue and Bosma's species also differs in its much greater slenderness, in the acetabulum being smaller than the oral sucker, in the shape of the holdfast organ, in the shape of the testes, and in the simple coil of the seminal vesicle. *Neodiplostomum lucidum* has subsequently been found by Dikmans (1931) in opossums in Louisiana.

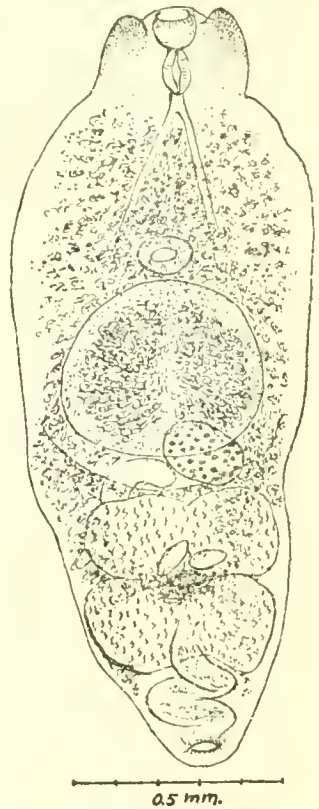


FIGURE 2.—Large specimen of *Proalaria variabilis*, new species



The fact that in both of two infested opossums, worms with all the variations described above were found, and that any division of the specimens into two or more species would appear to be purely arbitrary, leaves little room for doubt that only a single species is represented. Since a single species may show a well-marked division of the body or none at all, and may or may not possess glandular structures, which when present vary astonishingly in appearance, being sometimes in the form of suckorial cups and sometimes in the form of earlike appendages, considerable doubt arises as to the validity of some of the genera into which the old genus *Hemistomum* has been divided. (See LaRue, 1926.) According to LaRue's arrangement of the genera, this species seems to fit best into *Proalaria*, to which it is here assigned, but *Proalaria* may very well have to become a synonym of *Neodiplostomum*.

#### HARMOSTOMUM OPISTHOTRIAS (Lutz, 1895)

Specimens that have been referred to this species were found in three out of four opossums examined. The species has hitherto been recorded from another opossum, *Didelphis aurita*, in southern Brazil by Lutz (1895) and later by Braun (1899). The descriptions differ in several respects, but the species seems to be a very variable one, and there seems to be little doubt that the forms described by Lutz and by Braun are conspecific. More recently Dickerson (1930) has described a form that he considered a variety of the same species, to which he gave the name *Harmostomum opisthotrias* var. *virginianum*. Dickerson's fluke is markedly smaller in size than the forms described from South America, ranging from 1.535 mm to 2.541 mm in length and from  $314\mu$  to  $415\mu$  in breadth, whereas Lutz gives the size as 4 mm by 0.9 mm to 1.1 mm, and Braun as 6 mm to 7 mm by 0.6 mm to 1 mm. The eggs in Dickerson's specimens, on the other hand, are larger, measuring  $16\mu$  by  $31\mu$ , as compared with  $14\mu$  by  $27\mu$  (Braun). Dickerson's specimens have the anterior part of the body provided with blunt rudimentary spines, whereas Lutz describes the body as being spined and Braun as being devoid of spines. It seems likely that this difference may be due to different methods of preservation and treatment.

My own specimens, interestingly enough, bridge the gap between Dickerson's Virginia specimens and the Brazilian forms in so far as size is concerned, since they range from 1.78 mm to 5.33 mm in length and from  $314\mu$  to  $450\mu$  in breadth. The ratio of length to breadth varies from 1:4.4 to 1:10.4. In my specimens I am unable to find any trace of spines either in whole mounts or in sections; in this respect the Texas specimens agree with Braun's description of the Brazilian ones. The ventral sucker in the Texas specimens, as in

the Virginia specimens, is consistently smaller than the oral sucker and falls within the range of measurements given by Dickerson, which is far below that given by Braun. In my specimens the pharynx is separated from the oral sucker by a very distinct prepharynx, which may be as much as  $40\mu$  in length, whereas in the Virginia specimens, Dickerson says, "Anteriorly it [the pharynx] is connected by a very short—almost indistinguishable—gullet with the oral sucker and opens posteriorly directly into the intestine." In most other respects the Texas forms are similar to the Virginia ones, but there is more variation in the anterior extent of the vitelline glands, these frequently reaching to the level of the middle of the ventral sucker at least on one side, and the close size relationship between the ventral sucker and the anterior testis, which Dickerson stresses, does not exist, for the anterior testis is always larger than the ventral sucker.

It is evident that this species is a very variable one, especially with respect to size. It is possible that the species of intermediate host, which is probably different in the three regions (Brazil, Texas, and Virginia) in which this fluke has been studied, may have some influence on the size of the adults. At any rate, it is evident that the Texas forms to a large extent bridge the gap between the very small Virginia forms and the large ones described from Brazil, and it becomes doubtful whether Dickerson's forms should be ranked even as a distinct subspecies.

**RHOPALIAS MACRACANTHUS, new species**

*Diagnosis.*—Body distinctly divided into anterior and posterior portions; the anterior portion is broader and slightly concave toward the ventral side, and is separated from the posterior portion, just behind the ventral sucker, by a waistlike constriction. The posterior portion is about two and one-half times as long as the anterior. Total length, 4 mm to 4.75 mm, with a maximum diameter of the anterior portion of the body of 0.75 mm to 1 mm and of the posterior portion of  $680\mu$  to  $900\mu$ . There is a marked difference in the staining reactions of the two portions of the body. When stained with Delafield's acid hematoxylin the anterior portion takes up the stain much more quickly than the posterior part and takes a deep-blue color, while the posterior part of the body stains slowly and takes on a distinctly red color.

The proboscis sacs are short and end at the level of the pharynx; they measure about  $280\mu$  to  $320\mu$  in length, with a width of about  $160\mu$ . The proboscides seem to be exsertible for only a short distance. They are armed with 10 spines each, arranged in a group near the tip of the proboscis, 5 of them ventral and 5 dorsal, and so arranged that when the proboscis is exserted they point in all



directions—posteriad, mediad, laterad, ventrad, and dorsad. (Fig. 3, C.) The spines are large, the largest ones (posterior) being  $125\mu$  long and  $32\mu$  broad at the base. They are rounded at the base and bluntly pointed at the tip and only very slightly curved. When the proboscides are retracted a row of much smaller spines can be seen on the anterior margin of the body between the proboscis sacs and the oral sucker. (Fig. 3, B.) There are five or six of them on each side, similar in shape to those of the proboscides, but only about  $20\mu$  in length. The anterior

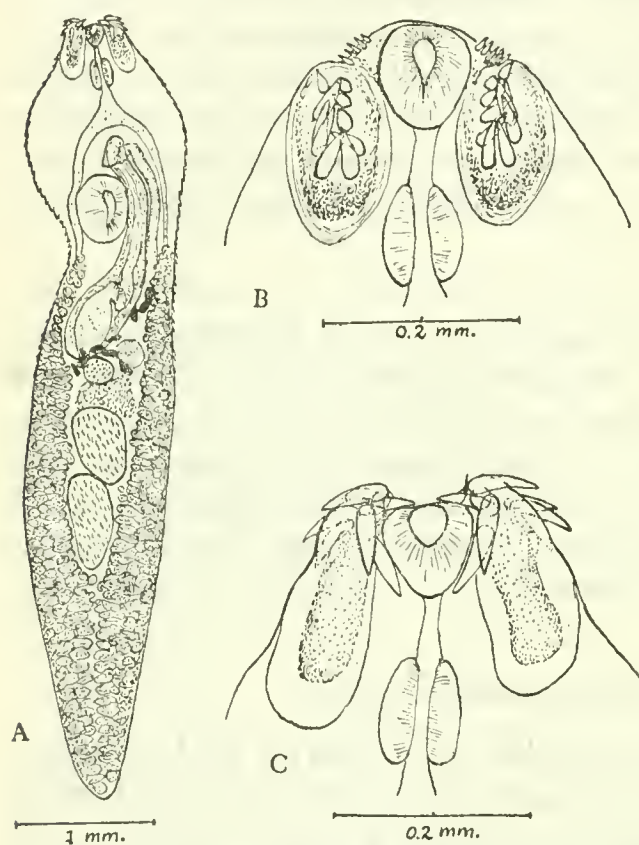


FIGURE 3.—A, *Rhopalias macracanthus*, new species; B, *R. macracanthus*, anterior end with proboscides retracted; C, anterior end with proboscides exerted

portion of the body and the more anterior portion of the posterior part were seen in the fresh specimens to be covered with conspicuous spines, but in the mounted specimens most of the body spines appear to be missing. It seems likely that the corrosive-acetic fluid in which the worms were fixed had a tendency to dissolve them.

The oral sucker is on the ventral side and triangular in shape, measuring  $150\mu$  to  $180\mu$  in length and usually a little less in width. The ventral sucker is large and powerful, measuring  $360\mu$  to  $425\mu$  lengthwise and  $288\mu$  to  $345\mu$  transversely. It is situated at about the junction of anterior and poste-

rior portions of the body, though its center is usually a little anterior to that level. The prepharynx is  $75\mu$  to  $90\mu$  in length, followed by a well-developed pharynx about equal in size to the oral sucker ( $150\mu$  to  $185\mu$  long by  $122\mu$  to  $145\mu$  wide). The intestine forks very shortly behind the pharynx, but this region of the intestine is frequently enlarged so that the posterior margin of the fork may be as much as  $250\mu$  behind the pharynx. The ceca could not be followed after they reach the vitellaria.

The cirrus pouch is very large. It opens in a genital pore situated in the fork of the intestine anterior to the ventral sucker, has one to three twists or loops in this region, then passes on either the right or left side of the ventral sucker, and ends in a gradually enlarging

bottle-shaped structure, which ends at the level of the ovary. The whole pouch is shaped very much like a crook-necked squash. The duct inside the pouch undergoes an S-shaped loop in the posterior portion of the pouch and is distended in one, or sometimes two, places as a seminal vesicle. The distance from the genital pore to the other end of the cirrus pouch is 1.25 mm to 1.55 mm, but, since the pouch is bent or looped anteriorly, it is obviously somewhat larger than this. The greatest width is  $270\mu$  to  $360\mu$ . The testes lie about in the middle of the posterior portion of the body, in the posterior part of the central field left free by the vitellaria; they are rather irregular in shape, and usually both are longer than broad, although the anterior one occasionally measures about the same transversely as longitudinally. The anterior testis measures  $380\mu$  to  $540\mu$  long by  $290\mu$  to  $395\mu$  wide, while the posterior one varies from  $645\mu$  to  $685\mu$  long by  $290\mu$  to  $380\mu$  wide. They always lie in a somewhat tandem position. The ovary lies just behind the end of the cirrus pouch; it is round or slightly oval, and varies in size from  $167\mu$  by  $200\mu$  to  $200\mu$  by  $225\mu$ . It is separated from the anterior testis by an irregularly shaped shell gland, which is frequently twice as large as the ovary. Slightly anterior to the ovary there is a seminal receptacle, usually about as large as the ovary, but sometimes smaller. The vitelline glands consist of unusually large follicles; they occupy the entire body posterior to the testes, broad lateral fields in the region of the reproductive glands, and then narrow down and continue forward to about the level of the posterior margin of the ventral sucker. The course of the uterus could not be traced, but there is a large metraterm, which runs more or less parallel with the outer curve of the cirrus pouch. Only 6 to 10 eggs are visible; these lie scattered in the region just anterior to the ovary and alongside the posterior portion of the cirrus pouch. They measure about  $105\mu$  to  $110\mu$  in length by about  $60\mu$  in width.

*Host.*—*Didelphis virginiana*.

*Location.*—Small intestine.

*Locality.*—Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8547; paratype, No. 8548.

*Remarks.*—Three species of the genus *Rhopalias*, all from South American opossums, have hitherto been described, namely, *R. coronatus* (Rudolphi, 1819), *R. horridus* (Diesing, 1850), and *R. baculifer* Braun, 1901. An undescribed species of the genus has been recorded by Dikmans (1931) from opossums in Louisiana. The genus and its species have been very well reviewed by Braun (1901). The internal anatomy of all the species is much the same, but the species differ markedly in size, proportions of anterior and posterior

divisions of the body, and in size and armature of the proboscides. *R. coronatus* is 6 mm to 9 mm long by 0.8 mm to 1.166 mm wide, with the posterior part of the body four to five times as long as the anterior part. The proboscides are very long, up to 1.3 mm, and may reach to the anterior border of the acetabulum; each is armed with a longitudinal row of 10 to 12 spines, the longest of which measure  $62\mu$  in length. *R. baculifer* is 10 mm to 12 mm long, with the fore body smaller and the hind body much longer than in *coronatus*. The proboscides are only 0.26 mm long, and are provided with a group of seven or eight spines, not arranged in a row, with a length of about  $73\mu$ . *R. horridus* is a much shorter and relatively broader species, only 2 mm to 3 mm long, with a maximum breadth of 0.73 mm; the hind body is about three times as long as the fore body. The proboscides are 0.26 mm long, and are covered with numerous small spines, about  $36\mu$  to  $41\mu$  long. *R. macracanthus*, here described, comes nearest to *horridus* in size and proportions, but the armature of the proboscides is entirely different. The spines in this species are much larger than in any of the others.

ASPIDODERA HARWOODI, new species

FIGURE 4

*Diagnosis*.—Small white worms, tapering at each end. Lips large and distinct; cephalic cordons reach  $170\mu$  to  $220\mu$  from anterior end. Cuticle striated. Esophagus 1.05 mm to 1.3 mm long, ending in a pear-shaped bulb about  $210\mu$  in diameter and  $300\mu$  long. Nerve ring about  $500\mu$  from anterior end. Excretory pore about  $725\mu$  from anterior end.

*Female*, 6.6 mm to 9.5 mm long, with a maximum diameter of  $480\mu$  to  $490\mu$ . Vulva divides body in the proportion of about 2:3. Anus about  $900\mu$  to 1.15 mm from posterior end.

*Male*, 7 mm to 7.5 mm long, with a maximum diameter of  $320\mu$  to  $440\mu$ . Tail  $480\mu$  to  $560\mu$  long. Spicules equal, ending in narrow blunt tips, 1.15 mm to 1.29 mm long and about  $40\mu$  wide at the base. Accessory piece troughlike at base, flattened at tip, about  $170\mu$  to  $195\mu$  long. Sucker, including chitinous rim, about  $100\mu$  in diameter. Cloaca with very prominent lips, each provided with a papilla-like process directed away from the opening. A pair of large mammillate papillae just anterior and just posterior to sucker, another mammillate pair a little farther anterior to the sucker, and another a little behind the posterior lip of the cloaca. These pairs are constant. In addition there are a number of other pairs that



are less constant. There are two pairs of small papillae, ventral in position near the tip of the tail, but in some individuals one of these is barely distinguishable. Slightly in front of the more anterior of these there is a more laterally placed pair of small papillae, usually a little nearer to the tip of the tail than to the cloaca. Between the cloaca and the two pairs of ventral papillae near the tip of the tail there are three or four pairs of very small papillae, situated near the midventral line. In addition to these there are five to seven pairs of more laterally placed papillae in a row beginning posterior to the cloaca and extending to the level of the sucker. These are very difficult to discern, and could not be seen at all in a young specimen examined.

*Host.* — *Didelphis virginiana*.

*Location.*—Cecum.

*Locality.* — Houston, Tex.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8549; paratypes, No. 8550.

*Remarks.*—Five species of the genus *Aspidodera* have hitherto been described, all from the South American opossums and edentates. Two of these, *A. fasciata* and *A. binansata*, are believed by Travassos (1913) to be identical. *A. fasciata* has a large number of caudal papillae, 40 on each side. *A. binansata* has the principal papillae arranged in an identical manner, but it was described from badly preserved material, and not all the papillae could be observed. *A. scoleciformis* has 9 papillae on each side of the male tail, 2 anterior to the sucker, 1 just behind it, 3 near the anus, and 3 on the tail. *A. subulata* has only 3 pairs of caudal papillae on the male, 2 anterior to the sucker and 1 just behind the anus. *A. railletii* has 10 pairs of caudal papillae in the male, 2 pairs anterior to the sucker, 1 pair just behind it, 1 at the level of the anus, 1 pair rather medially situated shortly behind the anus, and 5 pairs on the distal half of the length of the tail. In *A. harwoodi* the arrangement of the larger papillae is very much as in *A. railletii*, but in fully mature specimens there are, as described above, as many as 18 pairs of papillae in all.

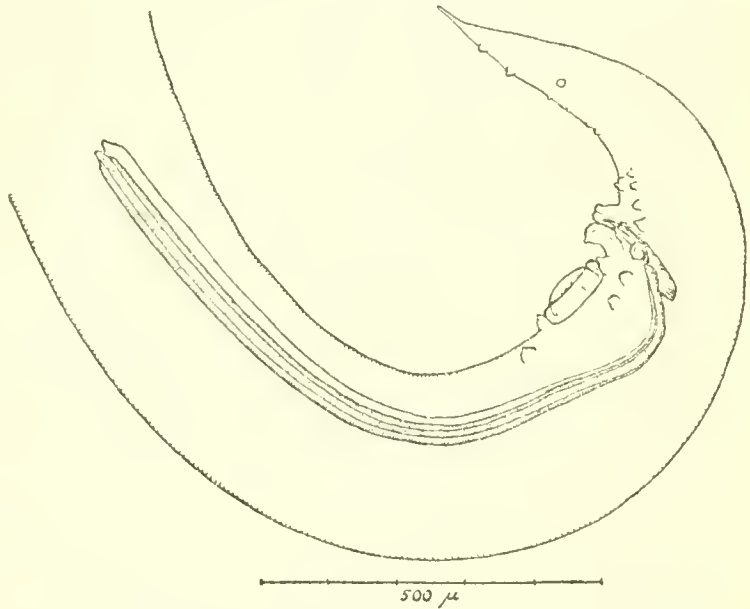


FIGURE 4.—*Aspidodera harwoodi*, new species, tail of male

These species also differ in the length of the spicules; in *A. scoleciformis* they are about  $905\mu$  long, in *A. fasciata* about  $360\mu$  long, in *A. railletii* about  $760\mu$  long, and in *A. harwoodi*, 1.15 mm to 1.29 mm long. In *A. scoleciformis* and *A. railletii* the tail of the male is about  $360\mu$  long, whereas in *A. fasciata* it is only  $270\mu$  and in *A. harwoodi*  $450\mu$  to  $560\mu$ .

**CRUZIA TENTACULATA (Rudolphi, 1819)**

This species has been recorded from a number of species of *Didelphis* in Brazil and also from *D. virginiana* in Pennsylvania, although Travassos (1922) says that it is not impossible that the North American species is different from the South American. The Texas specimens, however, agree very closely with Travassos's description of *C. tentaculata* in anatomical details, and all the measurements fall within or very close to the range given by Travassos. Specimens of the same genus have been found by P. D. Harwood (not yet published) in great abundance in the large intestine of box turtles (*Terrapene carolina triunguis*), and these specimens also agree very closely with *C. tentaculata*; their separation into a distinct species is based on characters of doubtful validity.

**PHYSALOPTERA (TURGIDA) TURGIDA Rudolphi, 1819**

This species has been recorded in a considerable number of species of *Didelphis*, both in North and South America. It is a very common parasite, and has been found absent in only one opossum examined in the vicinity of Houston, Tex.

**GNATHOSTOMA DIDELPHIS, new species**

*Diagnosis.*—Large, stout worms, tapering only slightly at the ends. Length 25 mm to 34 mm, with a maximum diameter of 1 mm to 1.25 mm. Lips large, thick, trilobed. Head bulb  $650\mu$  to  $700\mu$  broad and about  $300\mu$  long, armed with 9 to 11 rows of spines similar in size and shape to those of *G. spinigerum*. Cuticle provided with densely set, comblike spines or scales anteriorly, these disappearing somewhat anterior to the middle of the body. Shortly behind the head bulb the thick basal portion of the scales is  $30\mu$  to  $35\mu$  broad, while the thin projecting portion, or blade, is relatively short and very broad; its truncated distal end,  $55\mu$  to  $65\mu$  broad, is provided with from 8 to 12, sometimes even 14, small irregular points. (Fig. 5, A.) After a few rows the blade begins to elongate in the middle and becomes leaf-shaped, with about eight large, coarse spines. (Fig. 5, B.) Some of these scales have blades  $40\mu$  to  $50\mu$ .

in length, and long enough to reach to the basal portions of the second row of scales following. The scales continue to be of this form, although becoming gradually shorter (fig. 5, C) until very near the region where they begin to dwindle and disappear. Here the points are rather suddenly reduced to three, then to two, and finally there are a few rows of diminutive simple spines, which soon disappear (fig. 5, D and E). In the esophageal region the rows of scales are spaced about  $40\mu$  to  $43\mu$  apart, but behind the esophagus the rows are closer together, about  $28\mu$  to  $30\mu$  apart, and the scales are closer together in the rows, so that this portion of the body has a more densely scaled appearance. Cervical sacs 1.35 mm to 1.55 mm in length, measured from the posterior border of the head bulb. Esophagus club-shaped, 4.2 mm to 4.6 mm long, with a maximum diameter, near the distal end, of about  $800\mu$ .

*Male*, 25 to 31.5 mm long, and 1 to 1.1 mm in maximum diameter, which is near the posterior end of the esophagus. Bursa covered with minute spines along the cuticular striae on the ventral side, except just behind the cloacal opening. There are four large, coarse, caudal papillae on each side, the most posterior one being slightly smaller than the others and spaced a little apart. There is a pair of small ventral papillae near the base of the most posterior lateral papillae, but a second pair of these, as described for *G. spinigerum*, could not be seen. Cloaca about  $400\mu$  from posterior end. The short right spicule,  $700\mu$  to  $800\mu$  in length, tapers gradually for its entire length and has no abrupt narrowing. It is about  $50\mu$  broad at the base and ends in a bluntly rounded tip. The long left spicule is 2.2 to 2.5 mm in length, and it also tapers gradually for its entire length; it is  $110\mu$  broad at the base and ends in a bluntly rounded, almost truncated tip.

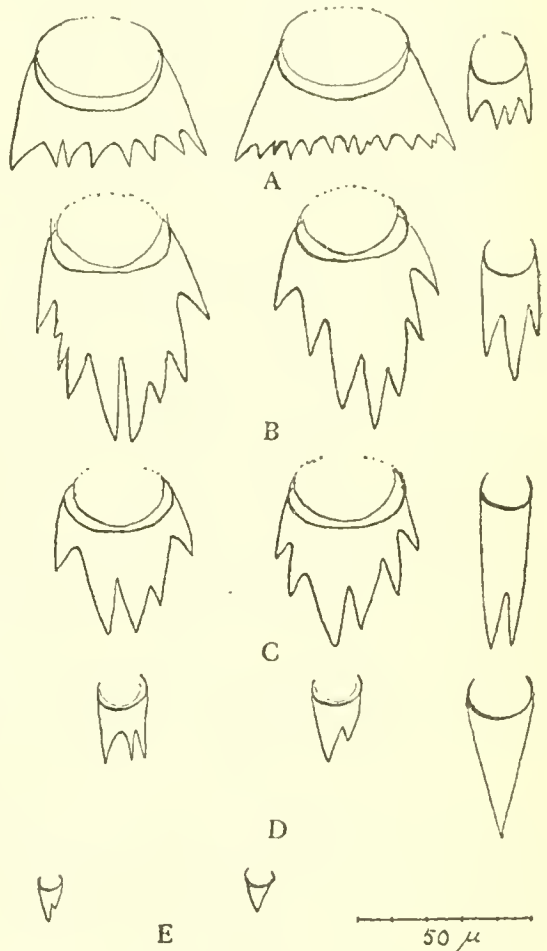


FIGURE 5.—Spines from various parts of body of *Gnathostoma didelphis*, with spines from corresponding parts of body of *Gnathostoma spinigerum* shown at right: A, From shortly behind head bulb; B, from a few rows farther posteriorly; C, from near middle of spiny portion of body; D, from near posterior part of spiny region of body; E, from terminal rows of spines



*Female*, 25 to 34 mm long with a diameter of from 1 to 1.25 mm. The vulva is situated slightly behind the middle of the body. The anus is about  $300\mu$  from the tip of the tail. The tail is bluntly rounded, somewhat flattened ventrally when seen in lateral view. There is a pair of large lateral papillae situated near the end of the tail, about equal in size to the tip of the body projecting beyond them, giving the termination of the body a trilobed appearance. Reproductive organs immature, and no eggs present.

*Host*.—*Didelphis virginiana*.

*Location*.—Liver.

*Locality*.—Houston, Tex.

*Type specimen*.—U.S.N.M. Helm. Coll. No. 8551; paratypes, No. 8552.

*Remarks*.—Gnathostomes have hitherto been recorded from opossums by Stossich (1902), Travassos (1925), and Dikmans (1931). Stossich based his meager description of *Gnathostoma turgidum* on two poorly preserved females taken from *Didelphis azarae* in Argentina. These worms were described as having 10 to 12 rows of spines on the head bulb; cylindrical bodies 23 mm in length, tapering in both directions; and spines of varying shape on the anterior half of the body. Travassos obtained what he considered to be the same species from the stomach of *Didelphis aurita* in Brazil, and re-described it from two males and a female. According to Travassos's description the males were 38 mm and 45 mm in length and the female 58 mm; the males had a diameter of 2 mm and the female 2.5 mm. The body spines reach a maximum length of  $160\mu$ , with numerous teeth, as in the species here described. There are 9 pairs of caudal papillae, 1 pair ventral and adanal, the others lateral, 3 being preanal, 2 adanal, and 3 postanal but unsymmetrical. The shorter spicule is 1 mm long and 0.12 mm broad, while the longer one is 4.2 mm long and 0.2 mm broad. The cloaca is 0.7 mm from the posterior extremity. It will be seen that this form is much larger than those described here as *Gnathostoma didelphis*, with much longer body spines, with longer spicules with more difference in the relative length of the two, and with 9 pairs of caudal papillae instead of 5. Since my specimens are sexually immature and taken from the liver, in which organ they evidently develop before settling in the wall of the stomach, as in the case of *Gnathostoma spinigerum* (Chandler, 1925b), the difference in size is probably of no significance, although the differences in the spicules may be. There can be little question, however, that the difference in the number of caudal papillae proves my species to be distinct from *Gnathostoma turgidum* of Travassos. Since the original draft of this paper was written, Dikmans (1931) records finding a male specimen of a gnathostome in the stomach of *Didelphis*

*virginiana* in Louisiana. This specimen, he says, agrees in general with Travassos's redescription of *G. turgidum*, but like mine differs in the number of caudal papillae. His specimen agrees with mine in this respect and is undoubtedly specifically identical. Dikmans provisionally considered his forms to be *G. turgidum* until more material became available to determine the constancy of the number and position of the caudal papillae. The material here described supplies this need and makes it evident that the species he was dealing with is not *G. turgidum* but a distinct species, which is identical with the one here described as *G. didelphis*. It should be pointed out, in passing, that *G. horridum*, described by Leidy (1856), from the lumen of the stomach of an alligator, may also be identical with *G. didelphis*. It is described as being  $2\frac{3}{4}$  inches long and a line and a half thick (3 mm), anteriorly covered with palmate plates furnished with as many as eight spines and degenerating posteriorly to simple spines. As Baylis and Lane (1920) pointed out, it is quite likely that this worm was really parasitic in some animal, probably a mammal, which was devoured by the alligator. The large size may have been due in part at least to the relaxation of a dead or dying worm, which was beginning to decompose. The mention of eight spines on the scales as a maximum, however, leaves the specific identity of this worm with *G. didelphis* open to question. It is unlikely that the true identity of Leidy's worms will ever be known. *G. gracile* (Diesing, 1838) is another gnathostome, found in the stomach of a large carnivorous fish, which probably did not belong in the animal in which it was found, but it is clearly distinguished from either of the opossum species (*G. turgidum* and *G. didelphis*) by having only five points on the body spines.

All the gnathostomes which I obtained, about a dozen of them, were found burrowing in the liver of an opossum. The liver was severely damaged by the burrowing of the worms and presented the same appearance as that of livers of cats infected with immature *Gnathostoma spinigerum*, as described by Chandler (1925a). In the case of these worms the larval forms, differing from the adults in having only four rows of head spines and in having the body scales represented by minute denticulations, burrow through the walls of the digestive tract after cysts containing the larvae are eaten, and enter the liver from the peritoneum. As shown by the writer (1925b), the worms grow to several times their original size and then assume the adult morphology, presumably following a molt. Some of these sexually immature adults were found still burrowing in the liver, while others had left the liver and were found in the mesentery, diaphragm, and stomach wall. It seems evident that in *G. spinigerum* the stomach is invaded by the parasites from the

peritoneal side after development to the sexually immature adult has taken place in the liver.

In the case of *G. didelphis* it seems likely that there is a similar course of development, for the worms found, although large and with all the features characteristic of adult gnathostomes, contained no eggs. There was, however, no indication of a migration from the liver to the stomach. It might be conjectured, by analogy with *G. spinigerum*, that this would shortly have occurred. It is also possible, however, that the opossum is not the normal host, and that the normal migration out of the liver after the last molt had for that reason failed to occur. There can be little doubt that the occurrence of sexually immature gnathostomes in cysts in various parts of the body of human beings is likewise due to failure of normal migration in a foreign host, in this case resulting in misdirected movements.



## REFERENCES

- BAYLIS, H. A., and LANE, CLAYTON.  
 1920. A revision of the nematode family Gnathostomidae. Proc. Zool. Soc. London, 1920, pt. 3, pp. 245-310.
- BRAUN, M. VON.  
 1899. Über *Clinostomum* Leidy. Wiss. Mitth., Zool. Anz., vol. 22, pp. 485-493.  
 1901. Zur Kenntniss der Trematoden der Säugethiere. Zool. Jahrb., Abt. Syst., vol. 14, no. 4, pp. 311-348.
- CHANDLER, ASA C.  
 1925a. A contribution to the life history of a gnathostome. Parasitology, vol. 17, no. 3, pp. 237-244.  
 1925b. The helminthic parasites of cats in Calcutta and the relation of cats to human helminthic infections. Indian Journ. Med. Res., vol. 13, no. 2, pp. 213-227.
- DICKERSON, L. M.  
 1930. A new variety of *Harmostomum opisthotrias* from the North American opossum, *Didelphys virginiana*, with a discussion of its possible bearing on the origin of its host. Parasitology, vol. 22, no. 1, pp. 37-46.
- DIKMANS, G.  
 1931. A new nematode worm, *Viannia bursobscura*, from the opossum, with a note on other parasites of the opossum. Proc. U. S. Nat. Mus., vol. 79, art. 31, pp. 1-4, pls. 1, 2.
- LARUE, GEORGE R.  
 1926. Studies on the trematode family Strigeidae (Holostomidae), No. II, Taxonomy. Trans. Amer. Micr. Soc., vol. 45, no. 1, pp. 11-19.
- LARUE, GEORGE R., and BOSMA, NELLY J.  
 1927. Studies on the trematode family Strigeidae (Holostomidae). *Neodiplostomum lucidum*, n. sp. Journ. Parasitology, vol. 14, no. 2, pp. 124-125.
- LEIDY, J.  
 1856. A synopsis of Entozoa and some of their ectocongeners. Proc. Acad. Nat. Sci. Philadelphia, 1856, pp. 42-58.
- LUTZ, A.  
 1895. *Distoma opisthotrias*, um novo parasita do gamba. Rev. Mus. Paulista, São Paulo, vol. 1, pp. 181-188.
- STOSSICH, M.  
 1902. Sopra alcuni nematodi della collezione helmintologica del Prof. Dott. Corrado Parona. Boll. Mus. Zool. e Anat. Comp., Univ. Genova, no. 116, pp. 1-16.
- TRAVOSSOS, L.  
 1913. Über die brasilianischen Arten der Subfamilie Heterakinae Railliet u. Henry. Mem. Inst. Oswaldo Cruz, vol. 5, fasc. 3, pp. 271-318.  
 1922. Contributions to the knowledge of the Brazilian helminthological fauna. XVI, *Cruzia tentaculata* (Rud. 1819). Mem. Inst. Oswaldo Cruz, vol. 14, fasc. 1, pp. 66-70.  
 1925. Contribuições para o conhecimento da fauna helmintologica Brasileira, XVIII. Sobre as especies brasileiras do genero *Gnathostoma* Owen, 1836. Sci. Med., vol. 3, no. 8, pp. 508-517.