

STUDIES ON THE TREMATODES OF THE MEXICAN INDIGO
SNAKE (*DRYMARCHON CORAIS MELANURUS*) WITH
DESCRIPTIONS OF TWO NEW SPECIES¹

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INTRODUCTION

From June through August, 1958, and from January through June, 1959, field collections of trematodes from reptiles were made in the state of Tabasco, Mexico. Most of the reptiles were obtained in an area near the Teapa river about 15 miles south of Villahermosa.

Among the reptiles examined were 25 specimens of *Drymarchon corais melanurus* (Duméril, Bibron, and Duméril). The indigo snake was among the most heavily parasitized snakes encountered. Five species of trematode were recovered from this snake representing the four families; Plagiorchiidae, Dicrocoeliidae, Acanthostomidae, and Proterodiplostomidae.

MATERIALS AND METHODS

Trematode specimens were killed with gentle heat, fixed in alcohol-formalin-acetic acid solution, stained with Mayer's carmalum, and cleared in methyl salicylate. In some instances large series of one species were studied by placing the worms in depression slides immersed in the clearing reagent. These worms had been stained, dehydrated, and cleared in groups by passing them through the reagents in gauze-covered vials.

Representative collections of reptile hosts were fixed in ten percent formalin and preserved in 85 percent alcohol for later determination.²

The geographic ranges given in the present paper are those of the parasites. All measurements are given in millimeters.

Family Plagiorchiidae Lühe, 1901

Subfamily Styphlodorinae Dollfus, 1937

Styphlodora horrida (Leidy, 1850)

Hosts in Tabasco: *Drymarchon corais melanurus*, *Spilotes pullatus mexicanus*, *Bothrops atrox aspera*, *Coniophanes quinquevittatus*, *Constrictor constrictor imperator*, *Dryadophis melanolomus ceracecrucis*, *Lampropeltis triangulum polyzona*, *Natrix rhombifera werleri*.

Location: ureters, pelvis of kidney, cloaca.

Geographic range: probably throughout the neotropical region from southern Mexico to southern Brazil, and to Trinidad.

Representatives of the genus *Styphlodora* were found in nine (36 percent) of the indigo snake examined. Numerous specimens of this trematode were collected also from each of the other above host snakes. The largest infections were consistently encountered in *Spilotes pullatus*. The largest single infection (160) was from that host. A series of about 300 worms has been stained, cleared, and studied. These studies have led to the conclusion that only a single species is represented.

¹This report was taken from a dissertation submitted to Louisiana State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

²The 1958 collection of reptile hosts was determined by Dr. Edward Taylor of the University of Kansas, and the 1959 collection was identified by Dr. Hobart Smith of the University of Illinois.

These worms show close morphological affinity to *S. horrida* (Leidy, 1850), *S. lachesidis* MacCallum, 1921, and *S. condita* Gomes de Faria, 1911. Each of these forms was described from a neotropical snake. The holotype of *S. horrida* was from a specimen of *Constrictor constrictor* that died in captivity in Philadelphia. The exact site of geographic origin of the material is unknown. *S. condita* was described from *Spilotes pullatus* in Brazil, and *S. lachesidis* came from *Bothrops atrox* on the island of Trinidad. Present material most closely resembles the description of *S. lachesidis*. Dawes (1942) placed the latter in synonymy with *S. horrida* on the basis of his knowledge of the effect of growth on the position and size relationships of the various organs. The only apparent difference between *S. lachesidis* and *S. horrida* is the smaller testes of the latter. It is not known if small testes were constant throughout the 26 specimens examined by Leidy as he only described and figured the holotype. Present material tends to bear out Dawes' contention that the two names are synonymous. Several specimens in the Tabasco material have small testes that closely approximate the condition as illustrated by Leidy.

Ochetosoma ellipticum (Pratt, 1902)

Hosts in Tabasco: *Drymarchon corais melanurus*, *Bothrops atrox aspera*, *Clelia clelia clelia*, *Coniophanes bipunctatus biserialatus*, *C. imperialis clavatus*, *C. quinquevittatus*, *Dryadophis melanolomus veraecrucis*, *Drymobius margaritiferus margaritiferus*, *Leptodeira septentrionalis polysticta*, *Leptophis mexicana mexicana*, *L. occidentalis praestans*, *Micrurus affinis alienus*, *Pliocercus elapoides elapoides*, *Thamnophis sauritus chalceus*.

Location: mouth and oesophagus; sometimes trachea and lung.

Geographic range: United States, Mexico, Panama.

O. ellipticum was the commonest trematode encountered in the snakes of Tabasco. In many of the host species the infection rate was at or near 100 percent, and individual infections of from 200 to 500 worms were often seen. This species was found in 23 (92 percent) of the indigo snakes examined. Studies of a large series from the various hosts have led to the conclusion that only a single species is represented. Present material closely agrees with the descriptions of Pratt, 1902, and Flores-Barroeta and Grocott, 1952.

The most reliable criteria for the determination of this species are the position of the genital aperture and the relative length of the oesophagus. Although the apparent position of the genital pore varies with the amount of contraction or compression of a specimen, it is usually to the left of the mid-line at the level of the oesophagus. This character serves to separate *O. ellipticum* from *O. crotali* (Self, 1945) and *O. grandispinum* (Caballero, 1938). The latter two species have the genital pore at the level of the pharynx.

The oesophagus is always a prominent structure in *O. ellipticum*. Contracted specimens show the oesophagus as relatively short and wide while extended specimens have an elongate and slender oesophagus. Whatever the state of contraction of the worm, this character can be used to separate *O. ellipticum* from several described species that have a short oesophagus.

Whether *O. ellipticum* is separable from *O. ancistrodontis* (MacCallum, 1921) could not be determined. The latter is morphologically quite similar to present material, but MacCallum's species shows a separation of the metraterm and cirrus sac. This single character was used by Byrd and Denton (1938), to distinguish these species. MacCallum based his description on a single specimen so the constancy of the above character is unknown.

The present paper reports *O. ellipticum* in Mexico for what is believed to be the first time, and adds 14 ophidian species to the list of known hosts.

Family Dicrocoeliidae Odhner, 1911

Subfamily Dicrocoeliinae Looss, 1899

Infidium similis Travassos, 1916. Figure 1.

Hosts in Tabasco: *Drymarchon corais melanurus*, *Bothrops atrox aspera*,
Clelia clelia clelia, *Coniophanes bipunctatus biseriatus*, *C. quinquevittatus*,

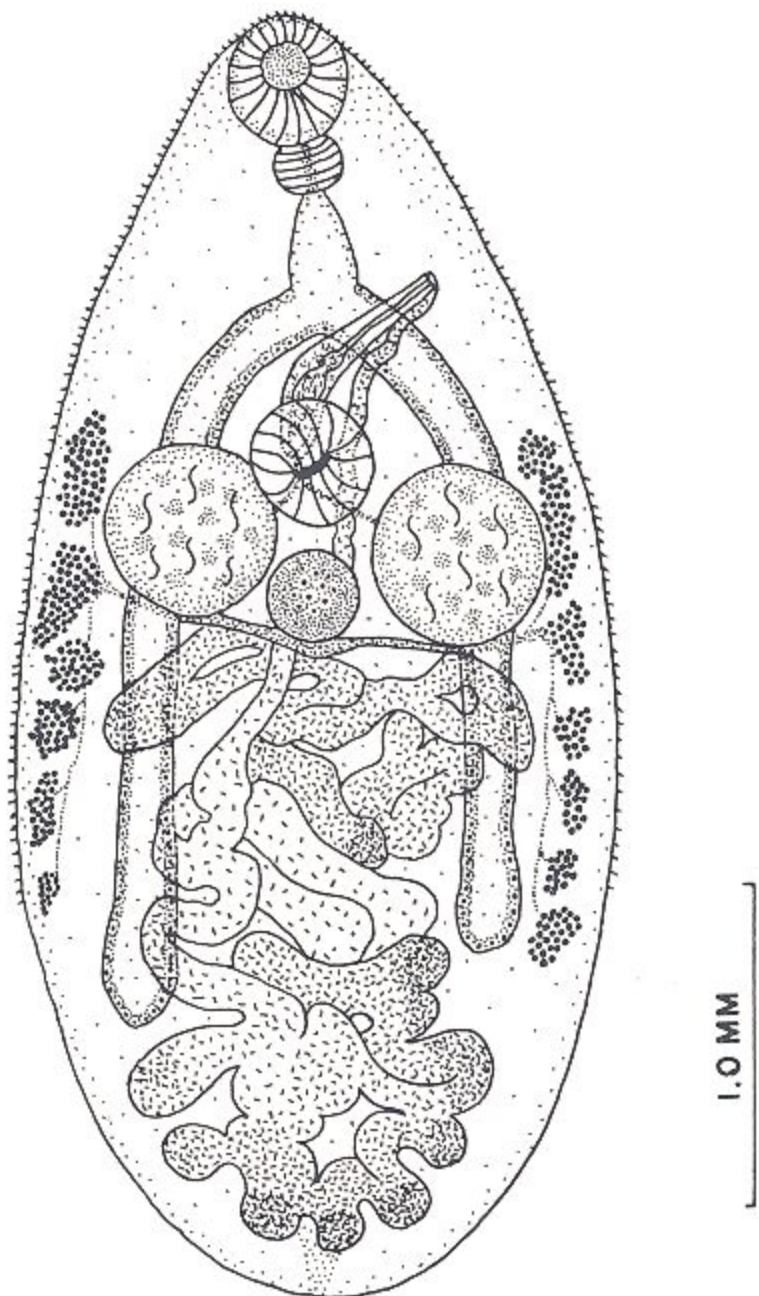


FIG. 1. Camera lucida drawing of the ventral aspect of *Infidium similis* Travassos, 1916, from the indigo snake.

Leptodeira septentrionalis polysticta, *Leptophis occidentalis praestans*,
Micrurus affinis alienus, *Natrix rhombifera werleri*, *Thamnophis sauritus*
chalcus, *Staurotypus triporeatus*.

Location: common bile duct and gall bladder.

Geographic range: Paraguay and Brazil to Tabasco, Mexico.

Representatives of the genus *Infidum* were among the most commonly encountered trematodes of this study. Several thousands were seen during the course of the field collecting. These worms were found in ten different species of snakes and in one species of carnivorous turtle. A series of about 3000 specimens was retained, and more than 2000 of these were stained, cleared, and comparatively studied. Several worms were also studied in serial section.

Infection rates for *Infidum* were found to be high, and heavy individual infections were often seen. The host of preference in Tabasco seemed to be the Mexican indigo snake. This worm was found in 24 (96 percent) of the indigo snakes examined. Massive infections of from 200 to 400 worms were common, and one infection of more than 600 individuals was encountered. In such massive infections, the common bile duct was seen to be greatly convoluted, irregularly distended, and somewhat discolored. Sometimes the gall bladder was distended with a clear watery fluid indicating blockage of the common bile duct.

The gall bladder has been listed as the site of infection of *I. similis*, but it was found that the common bile duct is the more common locus. Sometimes the worms could be found in the gall bladder, but in that location they were never so numerous as in the common bile duct. No specimens of *Infidum* were encountered in the lumen of the intestinal tract.

Comparative studies of worms from the several hosts have revealed much variation. It is believed, however, that only a single highly variable species is involved. All the Tabasco specimens are thought to be conspecific with *Infidum similis* Travassos, 1916.

Travassos (1916) described *I. similis* from Brazilian material. Ruiz and Leão (1943) published the description of *I. intermedium* from the same country. Travassos (1944) published an extensive monograph on the Dicrocoeliidae in which he pointed out the extreme variability of *I. similis*, and placed *I. intermedium* in synonymy with it.

The present study can add little to the descriptions of Travassos. However, neither *I. similis* nor *I. intermedium* were reported as spinous. The majority of specimens in the present collection have cuticular spines that extend from the anterior end to about level with the ends of the intestinal caeca. These spines are small, and apparently they are easily lost.

Travassos, 1944, reported the occurrence of a single specimen in his series that had both sets of vitelline glands on the same side of the body. Similarly, in the present series from Mexico, one specimen has been found with the same arrangement of vitelline structures. The low incidence of this anomaly and the normal appearance of the worm in other respects suggest that a mutation may be involved.

From the present series it appears likely that host physiology is a factor in some of the variability. Specimens from *Coniophanes bipunctatus biseriatus*, for example, were invariably small (1.12-2.25 mm.). Although these worms were mature, they had testes about half the diameter of the acetabulum. Specimens from *Thamnophis sauritus chalcus* and the turtle, *Staurotypus triporeatus*, showed the same size relationship of testes to acetabulum, but they ranged in over-all length from 4 to 4.5 mm. Specimens from *Drymarchon corais melanurus* were nearly all in the latter size range, but they had testes that were from 1.5 to 2.0 times the diameter of the acetabulum. Significantly, the specimens having the largest relative testis size in Brazil, as reported by Travassos, were those from *Drymarchon corais corais*. Specimens having large testes were encountered in

Leptodeira septentrionalis polysticta, *Leptophis occidentalis praestans*, and *Micrurus affinis alienus* as well as in the indigo snake.

Studies of a growth series taken from a light infection in an indigo snake, have led to the conclusion that normal growth does not account for the variability in organ size. An immature specimen in the growth series which measured about 1 mm. in length had relatively larger testes than mature individuals from *Coniophanes bipunctatus biseriatus*. The smallest mature specimen in the growth series, although of about the same size as specimens from *C. bipunctatus*, had a testiculo-acetabular ratio typical of larger specimens from *Drymarchon corais*.

Travassos 1944 briefly reported the occurrence of a microsporidian hyperparasite in *Infidum similis*. Curiously, the material from Mexico also has been found to be infected with microsporidia. This hyperparasitic organism was the apparent cause of much variation.

High infection rates of the microsporidian were often encountered, especially in trematodes from massive infections. Although it has not been possible to observe all of the stages in the life cycle of the hyperparasite, a comparison of certain stages with the descriptions of Dissanaïke (1957) indicates that a species of *Nosema* is probably involved.

Stages of *Nosema* sp. were first seen in the gut of a specimen of *I. similis* that otherwise appeared normal. These stages closely resembled the sporogony of *Nosema helminthorum* as reported by Dissanaïke. They appeared as small, spherical envelopes containing from two to eight or more spores. Subsequently, it was noted that specimens of *I. similis* from massive infections nearly all contained various stages of *Nosema* sp. These were found most often in the gut, but involvement of other structures was also seen. In many specimens the walls of the oesophagus had been completely broken down leaving a large vacuole in the parenchyma. In a few specimens the pharynx had been partially destroyed, and in one individual the oral sucker had been reduced to a funnel-like opening.

Travassos mentioned the involvement of the vitellaria in infected worms. Several specimens in the present group showed similar vitelline destruction. Quite often the structure of the testes and ovary also appeared to have been affected. In many individuals the testes appeared as multiple units. These were most often dorso-ventrally situated multiples of the original two testes. Such specimens appeared to have three or four testes instead of two. This multiplication of testes may be the result of a weakening of the testicular capsule by the microsporidia which caused testicular material to flow out into the parenchyma and form additional lobes. In some cases one or both testes showed internal destruction that left the capsule intact with the contents withdrawn towards the center. In a few examples, the ovary showed a similar internal destruction. A few specimens have been seen in which both testes appeared to be normally encapsulated, but one was very small and the other three times the normal size. This anomaly may be the result of a light infection of *Nosema* sp. that inhibited the growth of the testis of one side.

Apparently, *I. similis* has not been reported previously outside of Brazil. The present report adds ten new host species for a total of 15 known hosts of the trematode. As far as could be determined, no species of *Infidum* has been reported previously from a turtle.

Family Acanthostomidae Poche, 1926

Subfamily Acanthostominae Nicoll, 1914

Acanthostomum Looss, 1899

Specimens of an apparently undescribed species of *Acanthostomum* were recovered from five (20 percent) of the Mexican indigo snakes examined. This form was present in collections from both 1958 and 1959. The largest infection encountered numbered more than 50.

The present diagnosis is based on studies of 35 stained and cleared specimens, 23 whole mount preparations, and serial sections of one specimen. The measurements in the diagnosis are of the holotype followed by the size ranges in parentheses.

***Acanthostomum megacetabulum* sp. nov.**

Figure 2

Host: *Drymarchon corais melanurus*.

Location: upper intestinal tract

Locality: 15 miles south of Villahermosa, Tabasco, Mexico.

Holotype: U.S.N.M. Hel. Coll. No. 60307.

Paratypes: Hel. Coll. Instituto de Biología, Mexico D. F.; Dept. of Zoology, Louisiana State University; Author's collection.

Diagnosis: With the characters of the genus. Body moderately elongate, cylindrical, spinous, 2.87(1.8-3.9) long by 0.54(0.39-0.60) wide; spination extending to posterior extremity; body spines attaining maximum length of 0.01 near anterior end; acetabulum large, 0.19(0.19-0.20) in diameter.

Oral sucker funnel-shaped, 0.32(0.25-0.32) in diameter by 0.27(0.27-0.32) in length; oral spines long, straight, 19-21 in number, measuring 0.069 in length by 0.017 in lateral width at base; prepharynx 0.09(0-0.13) long; pharynx barrel-shaped, 0.15(0.14-0.16) long by 0.13(0.13-0.14) wide; oesophagus not apparent; intestinal crura of variable diameter, attain maximum diameter of 0.075 near bifurcation; anal apertures present.

Testes spherical, tandem, in posterior one-fifth of body; anterior testis 0.19(0.19-0.23) long by 0.19(0.14-0.22) wide; posterior testis usually larger than anterior one, measuring 0.22(0.14-0.25) long by 0.19(0.19-0.23) wide; seminal vesicle large, convoluted, situated posterior to acetabulum; ejaculatory duct present; cirrus and cirrus sac lacking; genital pore on mid-line immediately anterior to acetabulum; gonotyl lacking.

Ovary spherical, immediately anterior to anterior testis and usually contiguous with that structure, 0.19(0.19-0.20) long by 0.16(0.14-0.18) wide; seminal receptacle large, often overlaps ovary ventrally, measuring 0.22(0.22-0.28) long by 0.14(0.14-0.18) wide; ootype and Mehlis' gland medial or anterior to ovary; uterus highly convoluted, filling intercrural region from anterior margin of ovary to seminal vesicle; vitelline follicles lateral, dorsal to crura, extending from equatorial region to level of middle of anterior testis; vitelline follicles 0.024-0.069 in diameter.

Eggs small, operculate, numerous, 0.014-0.015 x 0.031-0.033.

Excretory vesicle Y-shaped, branches extend anteriorly to vicinity of oral sucker.

Discussion: *A. megacetabulum* resembles *A. caballeroi* Pelaez and Cruz, 1953, but it differs from the latter in being smaller, in having a relatively larger acetabulum, and in lacking a gonotyl. Also, the eggs of the new species are larger than those of *A. caballeroi*.

Family Proterodiplostomidae Dubois, 1936

Subfamily Proterodiplostominae Dubois, 1936

Numerous examples of an apparently undescribed species of holostome were recovered from nine (36 percent) of the indigo snakes examined in Tabasco. An additional infection was noted in an eight-foot indigo snake that was brought back from Tabasco and maintained alive in Baton Rouge, Louisiana. The presence of numerous eggs in the feces of this snake indicated a heavy infection which lasted until an anthelmintic drug was administered at the end of five months. Recovery of several of the adult holostomes confirmed the assumption that the same species was present. The largest infection found in Tabasco numbered more than 300.

The diagnosis is based on studies of about 500 stained and cleared specimens, 20 whole mount slides, and serial sections of one specimen. Since relatively little size difference occurs in the series, only measurements of the holotype are given.

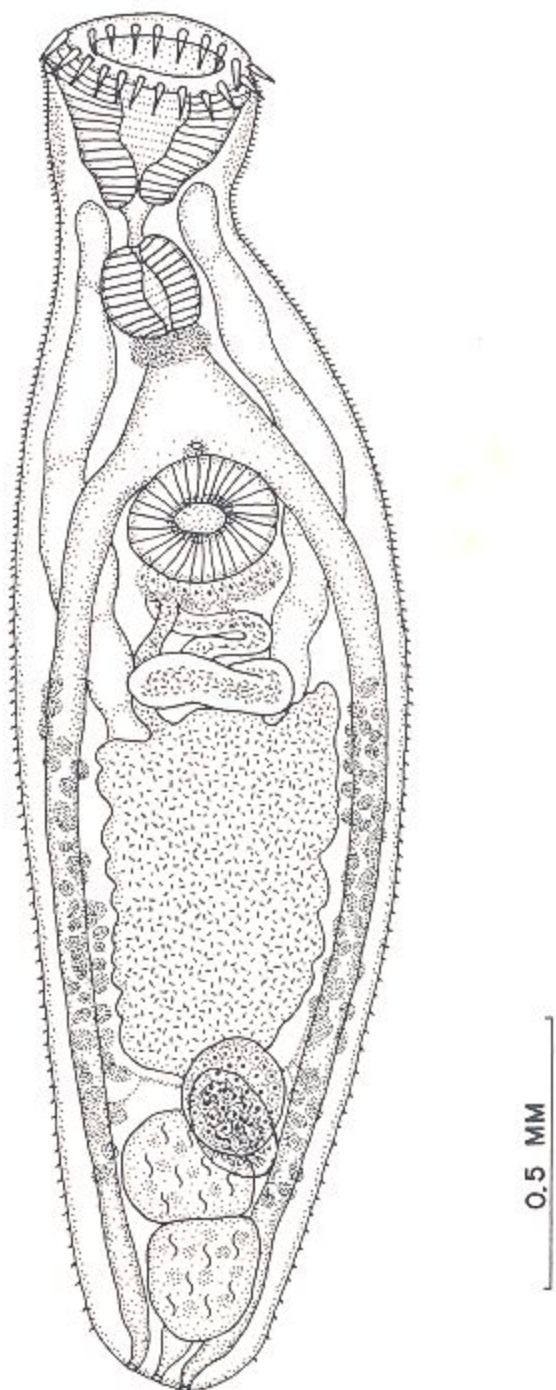


FIG. 2. Camera lucida drawing of the ventral aspect of *Acanthostomum megacetabulum*.

Proterodiplostomum ophidum sp. nov.

Figure 3

Host: *Drymarchon corais melanurus*.

Location: upper intestinal tract.

Locality: 15 miles south of Villahermosa, Tabasco, Mexico.

Holotype: U.S.N.M. Hel. Coll. No. 60308.

Paratypes: Hel. Coll. Instituto de Biología, Mexico D. F.; Zoology Dept., Louisiana State University; Author's collection.

Diagnosis: With the characters of the genus. Body slender and attenuate; cuticle unarmed; forebody thin and spatulate; hindbody slender and cylindrical, slightly longer than forebody; total body length, 4.88; forebody 2.24 long by 0.755 wide; hindbody 2.64 long by 0.34 in diameter.

Oral sucker small, 0.073 in diameter; prepharynx absent; pharynx 0.076 long by 0.056 wide; oesophagus conical, 0.21 long. Intestinal caeca wide, extend to near posterior extremity; caeca attain maximum width of about 0.14 at level of tribocytic organ.

Acetabulum larger than oral sucker, 0.11 in diameter, situated slightly posterior to middle of forebody; tribocytic organ elliptical, 0.255 long by 0.156 wide; situated centrally in posterior one-third of forebody; central aperture of tribocytic organ surrounded by eight papillae.

Testes tandem in middle of hindbody; anterior testis 0.312 long by 0.225 wide; posterior testis 0.35 long by 0.236 wide; *vasa efferentia* uniting near posterior testis; *vas deferens* expanding to form seminal vesicle which proceeds posteriorly. A short distance from posterior extremity seminal vesicle narrows to form ejaculatory duct which opens at tip of genital cone in conjunction with the opening of paraprostate gland; paraprostate elongate, sac-like, surrounded by glandular cells; 0.0635 in maximum width by 0.56 long; genital cone protruding into prominent genital atrium the aperture of which is subterminal.

Ovary small, ovoid, situated a short distance anterior to anterior testis, 0.15 long by 0.11 wide; oviduct passes posteriorly from ovary to ootype, located between testes; vitelline reservoir and spherical seminal receptacle located in same region; vitellaria extensive, variable in shape and size, dorsolateral to caeca, extending from region of acetabulum to near posterior extremity of body; uterus leaves ootype and passes anteriorly to well ahead of ovary before looping posteriorly to open in the genital atrium; eggs large, few in number, 0.059-0.066 x 0.115-0.122.

Excretory pore situated at level of genital atrium, a short distance from the pore the excretory system dividing to send two main channels forward to anterior extremity of body, these main channels lying lateral to caeca in forebody, giving rise to numerous lateral branches, forming flame-like pattern in forebody.

Discussion: According to Skrjabin (1960), there are four other species in the genus *Proterodiplostomum*. These are: *P. longum* (Brandes, 1888), *P. tumidulum* Dubois, 1936, *P. medusae* (Dubois, 1936), and *P. brasiliensis* (Ruiz and Rangel, 1954). These species were all described as parasites of Brazilian crocodilians. *P. tumidulum* and *P. medusae* also have been reported from Panama (Caballero, Hidalgo, and Grocott, 1957). As far as could be determined, no species in the genus has been reported previously from an ophidian host.

P. ophidum differs from the other species in the genus in having a forebody and hindbody of almost equal length. The other species have a hindbody that is considerably longer than the forebody. The tribocytic organ of *P. ophidum* is much smaller than that of the other species.

P. tumidulum and *P. brasiliensis* are robust forms with large tribocytic organs and slender intestinal caeca. The new species on the other hand, is quite slender, with a small tribocytic organ and wide caeca.

P. longum is a moderately stout form with a very short forebody and a large genital atrium.

P. medusae is a slender form, but it has a forebody only about one-third the length of the hindbody. Also, *P. medusae* has a tribocytic organ that is larger than that of the present species. The tribocytic organ of *P. medusae* has 16 central papillae in contrast to the eight papillae of *P. ophidum*. The vitellaria of the present species extend anteriorly to the level of the acetabulum while those

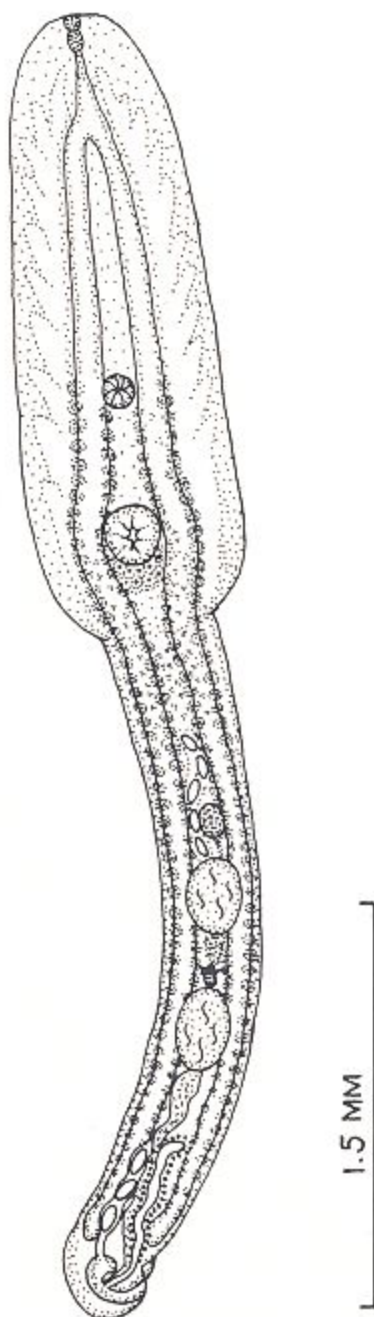


FIG. 3. Camera lucida drawing of the ventral aspect of *Proterodiplostomum ophidum*.

of *P. medusae* terminate between the tribocytic organ and the acetabulum. *P. ophidum* also has wider caeca, a longer oesophagus, and larger eggs than does *P. medusae*.

SUMMARY

Five species of digenetic trematode are reported from the Mexican indigo snake (*Drymarchon corais melanurus*) from Tabasco, Mexico. Of the 25 indigo snakes examined, nine were found infected with *Styphlodora horrida* (Leidy, 1850), 23 with *Ochetosoma ellipticum* (Pratt, 1902), and 24 with *Infidum similis* Travassos, 1916. The other hosts of these species in Tabasco are listed. Intraspecific variation seen in *Infidum similis* is discussed.

Additionally, *Acanthostomum megacetabulum* (Acanthostomidae) and *Proterodiplostomum ophidum* (Proterodiplostomidae) are described as new species.

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