1990

Binder 015, Azygiidae [Trematoda Taxon Notebooks]

Harold W. Manter Laboratory of Parasitology

AZYGIIDAE Odhner, 1911

Family diagnosis. — Distomes with more or less elongate, occasionally plump, unarmed, muscular body. Oral sucker subterminal. Pharynx present. Esophagus short. Ceca terminating at posterior extremity. Acetabulum in anterior part of body, rarely postequatorial. Testes intercecal, tandem, diagonal or symmetrical, in posterior or anterior half of body or in midregion. Cirrus pouch present. Gential pore median, immediately or some distance in front of acetabulum. Ovary pretesticular or posttesticular, median or submedian. No receptaculum seminis. Laurer's canal present. Vitellaria follicular, in lateral fields of hindbody, may intrude into forebody, leaving some free space at posterior extremity. Uterus between ovary and acetabulum, rarely looped between two suckers, eggs embryonated when laid. Excretory vesicle Y-shaped, with arms united anteriorly or not. Parasites of fishes.

Type genus: *Azygia* Looss, 1899.

Key to subfamilies of Azygiidae

1. Ovary posttesticular ..... Leuceruthrinae
   Ovary pretesticular 2
2. Body plump; vitellaria and uterine coils extending into forebody; testes near posterior extremity ... Proterometrinae
   Body elongate; vitellaria and uterine coils confined to hindbody; testes far apart from posterior extremity. Azygiinae

from Mehra, H.R. 1970

Family Azygiidae Odhner, 1911

Superfamily Bivesiculoidea n. supf.

Azygiata : Oculate. Oral sucker and acetabulum absent. Genital pore median, pretesticular. Testis single, postequatorial. Cirrus sac large, pretesticular containing seminal vesicle and prostatic complex. Vesicula seminalis externa present. Excretory vesicle V- or U-shaped. Cercariae furcocystocercous, developing in rediae with well developed pharynx and gut and cleft posterior end like that of cercaria with excretory pore at the tip of each posterior lobe from which an excretory canal runs anteriorly. Cercariae complete their development in tissues of snail. Excretory system remains separate throughout development of cercaria; the pair of embryonic excretory tubules extend through the tail and open at the tip of furca, consequently the body contains the thin walled excretory vessels, each with its own sphincter (La Zotte, 1954).

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THE MORPHOLOGY AND LIFE-HISTORY OF THE DIGENETIC TREMATODE, AZYGIA SEBAGO WARD, 1910

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THE MORPHOLOGY AND LIFE-HISTORY OF THE DIGENETIC TREMATODE, AZYGIA SEBAGO WARD, 1910[1]

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The genus *Azygia* was erected by Looss (1899) to contain *Fasciola tereticollis* Rudolphi, 1802 (= *Fasciola lucii* Mueller, 1776, renamed). The worms were from the stomach of *Esox lucius*. According to Dawes (1946), this species, *Azygia lucii* (Mueller, 1776) Lühe, 1909, infects a number of different salmonid fishes, and other species of *Azygia* described from Europe are identical with it. The species has been reported in North America as *Distoma tereticolle* by Leidy (1851) from *Esox reticulatus;* by Stafford (1904) from *Esox lucius, Lota maculosa* and *Ameiurus nigricans;* and as *Azygia lucii* by Cooper (1915) from *Lucius lucius* (= *Esox lucius*), *Lucius masquinongy* (= *Esox masquinongy*), *Lioperca* sp., and immature specimens presumably of the same species were found in *Salvelinus namaycush* and *Micropterus dolomieu.*

Meanwhile, other species of *Azygia* were described in the United States and Canada. Leidy (1851) described *Distoma longum* on the basis of six specimens from the stomach of *Esox estor* Lesueur, 1818 (the American pike), collected near Cleveland, Ohio, and received from Professor Spencer F. Baird. The worms measured 30 to 76 mm. (3 inches) in length and as much as 1.6 mm. in breadth; the maximum diameter of the oral sucker was 1.27 mm. and of the acetabulum 1.06 mm. Measurements given by Leidy for specimens from the stomach of *E. reticulatus,* which he identified as *Distoma tereticolle* Rudolphi, were: length up to 17 mm.; width, 1.06 mm.; oral sucker, 0.52 mm.; and acetabulum 0.7 mm. There is some confusion here since Manter (1926) (p. 66) reported, "Leidy's *Dist. tereticolle* (from *Esox reticulatus*) also was compared with them (specimens of *D. longum* from the Leidy and Cooper collections), and in the single specimen available in the Leidy collection, the oral sucker, contrary to Leidy's description, was found to be slightly larger than the acetabulum." Stafford (1904) erected the genus *Megadistomum* to contain specimens from *Esox masquinongy* which he regarded as identical with *Distoma longum* of Leidy and distinct from *Azygia tereticollis.* Specimens of *Megadistomum longum* (Leidy, 1851) measured up to 5 inches in length when fully extended and up to 3 mm. in breadth, whereas those identified as *A. tereticollis* measured 12 mm. in length and 1 mm. in width. Stafford reported that the largest specimens of *A. tereticollis* were smaller than immature specimens of *M. longum.* Furthermore, he described worms from the stomachs of *Lota maculosa* and of *Stizostedion vitreum* as members of a new genus and species, *Mimodistomum angusticaudum.*

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Marshall and Gilbert (1905) described *Azygia loossi* from the large-mouth bass, *Micropterus salmoides;* the pike, *Lucius lucius;* and the bowfin, *Amia calva.* The worms contained only a few eggs and obviously were not fully mature. They measured 5 to 7 mm. in length, 0.5 mm. in width; the acetabulum was near the middle and the gonads in the caudal one-sixth of the body.

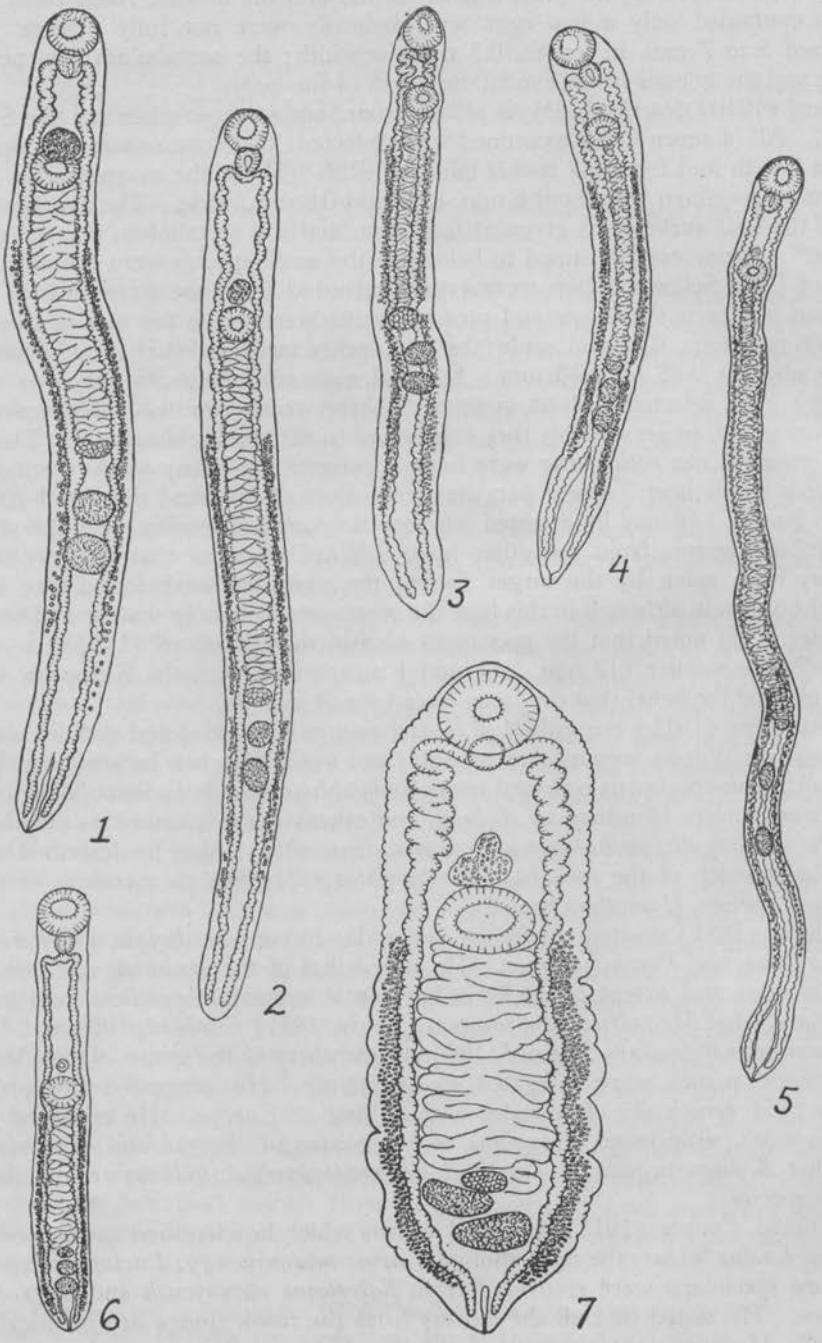
Ward (1910) described *Azygia sebago* from *Salmo sebago* taken at Lake Sebago, Maine. All of seven fishes examined were infected; the worms measured up to 10 mm. in length and from 0.7 to 1.0 mm. in width. From the magnification given, the figured specimen was about 6 mm. long and 0.8 mm. wide. The average diameter of the oral sucker was given as 0.68 mm. and the acetabulum was "distinctly smaller." Specimens presumed to belong to the same species were found in other fishes of Lake Sebago. Two worms were removed from the stomach of a single specimen of *Perca flavescens* and measurements were given for one of them. It was 4.08 mm. long, 0.77 mm. wide; the oral sucker measured 0.51 by 0.57 mm. and the acetabulum 0.35 by 0.40 mm. Four of nine eels, *Anguilla chrysypa* (= *A. rostrata*) were infected with an average of three worms per fish. No descriptive data were given, so presumably they conformed to the specific diagnosis. Eleven of twelve young *Esox reticulatus* were heavily infected; as many as 80 worms were found in a single host. These parasites were more slender and measured 10 to 18 mm. in length. It may be doubted whether they are conspecific with the shorter, more robust worms from the other hosts. Ward reported that smelt, *Osmerus mordax,* were eaten by the larger fishes; the parasites were found also in the stomachs of smelt, although in this host the worms were usually smaller and sexually immature. He noted that the specimens identified by Stafford (1904) as *Azygia tereticolle* are smaller (12 mm. long and 1 mm. wide) than the European species and expressed the belief that they may have been *A. sebago.*

Goldberger (1911) recognized *A. loossi* as a valid species and did not mention *A. sebago,* as Ward's account was probably not available when he wrote his paper. He reported on specimens collected from *Amia calva* taken in Indiana lakes; certain of the worms were identified as *A. lucii,* and others were described as members of two new species, *Azygia bulbosa* and *Azygia acuminata.* Also, he described worms from the stomach of the rock bass, *Ambloplites ruprestris,* as members of a new genus and species, *Hassallius hassalli.*

Odhner (1911) erected the family Azygiidae to contain *Azygia, Otodistomum, Leuceruthrus,* and *Ptychogonimus.* He stated that in the genus *Azygia,* measurements of eggs and extent of vitellaria have little value for specific determination. He declared that *Megadistomum longum* (Leidy, 1851) Stafford, 1904 and *Mimodistomum angusticaudum* Stafford, 1904 are members of the genus *Azygia* and the two generic names were relegated to synonymy. He suggested the probable identity of *A. tereticollis* of America with *A. lucii* of Europe. He criticized Goldberger's work, suppressed *Hassallius* as a synonym of *Azygia,* and expressed the belief that *A. angusticauda, A. loossi, A. acuminata,* and *A. bulbosa* are members of a single species.

As noted, Cooper (1915) described worms which he identified as *A. lucii* from the pike, *Lucius lucius;* the muskellunge, *Lucius masquinongy; Lucioperca* sp.; and immature specimens were recovered from *Salvelinus namaycush* and *Micropterus dolomieu.* He stated that all the worms from the muskellunge are identical with Stafford's *Megadistomum longum* (Leidy) and the smallest one with eggs was 8

PLATE I



mm. long. Cooper noted the variable size of worms at the time of egg production. The smallest gravid specimen from the pike was 6 mm. long, but another from the pike, 14 mm. long, was less mature than the one 6 mm. long; others 6 to 14 mm. in length were fully gravid. All the worms from the trout, *S. namaycush,* and the black bass, *M. dolomieu,* including the largest one, 11 mm. long, were immature. Other young and immature specimens from the stomach of *Perca flavescens* were regarded as possible members of this species. Worms from the pickerel (not named) resembled *A. angusticaudum* (Stafford, 1904) but were too contracted to permit positive identification, and others from the pike had a large, globose excretory vesicle, described by Goldberger as characteristic of *A. bulbosa,* but Cooper stated that the shape of the excretory vesicle as well as the length, extent, and "breaking" of the vitellaria are so variable as to be of little use in the delineation of species. Cooper recognized the validity of *A. acuminata,* since 9 specimens from the stomach of *Amia calva* agreed substantially with Goldberger's description of this species.

Ward (1918) stated (p. 392), "Despite many records of its occurrence, the common European *A. lucii* (= *A. tereticolle*) has not been found in North America. Several species peculiar to this continent occur in *Amia calva, Micropterus salmoides* and *dolomieu, Esox lucius* and *reticulatus, Ambloplites ruprestris, Salvelinus namaycush, Lioperca, Lota lota,* and *Salmo sebago.*"

Manter (1926) gave a systematic review of the family Azygiidae; he agreed with Ward in regarding the American specimens as specifically distinct from those of Europe but admitted (p. 57) that "*Azygia* is the only genus of the family showing taxonomic confusion in its species." Accepting the statements of Odhner and Ward, he distinguished *Azygia longa* from *A. lucii* on the extent of the vitellaria, which in the European species are reported not to extend behind the testes, and on the shape of the pharynx, which in *A. lucii* is reportedly cylindrical and twice as long as wide. After detailed study and tabular comparison of morphological features, Manter recognized only three species of *Azygia* in North America, *viz., A. longa* (Leidy, 1851), *A. angusticauda* (Stafford, 1904), and *A. acuminata* Goldberger, 1911. Manter confirmed the suspicion of Odhner (1911) that *Azygia loossi* is identical with *Mimodistomum angusticaudum* Stafford, 1904. As syno-

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PLATE I

FIGURE 1. *Azygia lucii,* from *Esox lucius;* specimen collected and identified by Prof. M. Braun, Königsberg, 7 July 1902; 23 mm. long, ventral view; U. S. National Museum, Helminthological Collection No. 3359.

FIGURE 2. *Azygia lucii,* from *Amia calva;* 20 mm. long, ventral view, (Ward Collection) U. S. N. M., Helminth. Coll. No. 51,403.

FIGURE 3. *Azygia longa,* from *Esox reticulatus,* identified by Albert Hassall; 12.4 mm. long; U. S. N. M., Helm. Coll. No. 49.

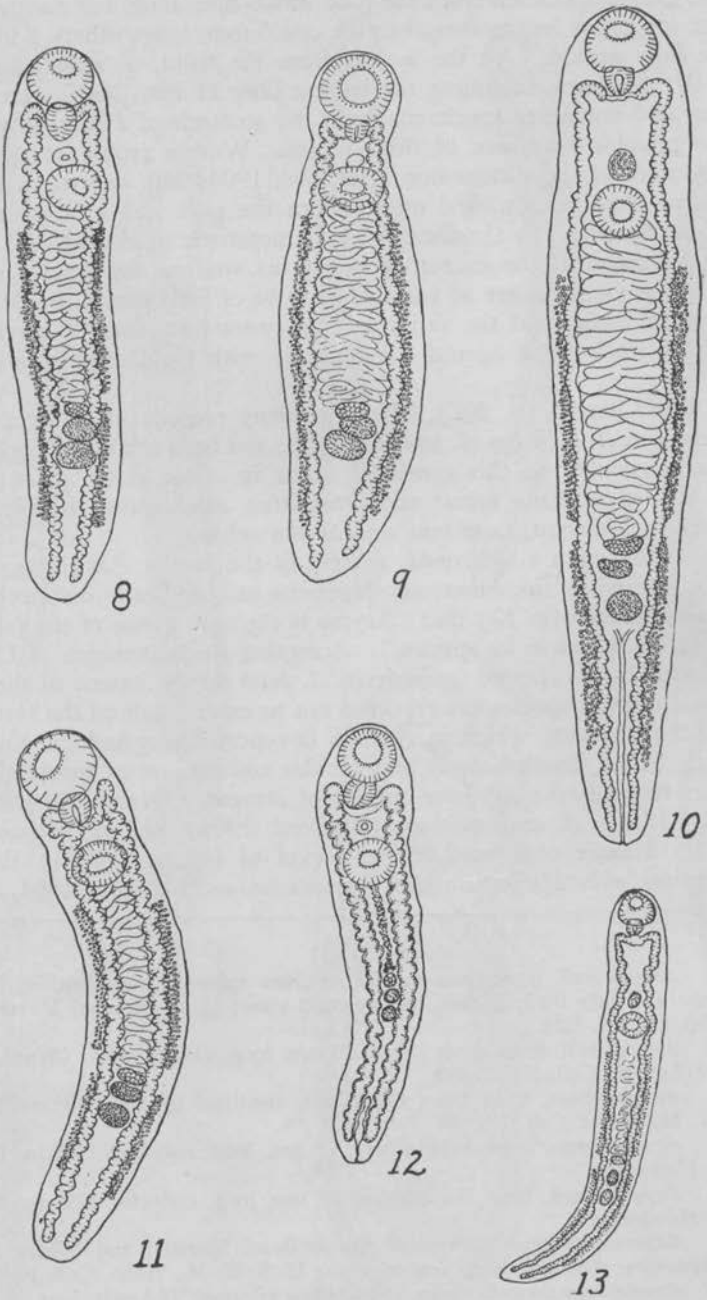
FIGURE 4. *Azygia longa,* from *Esox niger;* 5.2 mm. long, collected 1955 by Paul Krupa, southern New Hampshire.

FIGURE 5. *Azygia longa,* from *Esox niger;* 19 mm. long, collected 1955 by Paul Krupa, southern New Hampshire.

FIGURE 6. *Azygia angusticauda* (type of *Azygia loossi,* Marshall and Gilbert, 1905), from *Micropterus salmoides;* 4.88 mm. long, ventral view; U. S. N. M., Helm. Coll. No. 10,679.

FIGURE 7. *Azygia angusticauda,* from *Stizostedion vitreum;* 10.5 mm. long; ventral view, (Ward Collection) taken by H. W. Manter 4 April 1926, Rock River, Illinois; U. S. N. M., Helm. Coll. No. 51,402.

PLATE II



nyms of *A. longa* (Leidy), Manter listed: *Distomum longum* Leidy, 1851; *Distomum tereticolle* of Leidy, 1851; *Megadistomum longum* (Leidy) of Stafford, 1904; *Azygia tereticolle* of Stafford, 1904; *Azygia sebago* Ward, 1910; *Azygia bulbosa* Goldberger, 1911; *Hassallius hassalli* Goldberger, 1911; and *Azygia lucii* of Cooper, 1915. He discussed the problems of specific determination, noted the bundles of longitudinal muscles which traverse the parenchyma and quoted Leuckart's description of them, and stated that in such elongate and powerfully muscled trematodes, contractions not only alter the general shape of body but the form and relative position of internal organs. Concerning differences in size and sexual maturity, he observed that in the related species, *Otodistomum cestoides,* specimens increase six to seven times in size after attainment of sexual maturity. This fact was used to justify the inclusion in a single species, *A. longa,* of gravid specimens 3.9 mm. long which had been described as *A. bulbosa,* and others which measured up to 3 inches in length and had been described as *A. longum.* It is true that these specimens were from different host species and worms grow larger in larger hosts, but it is doubtful whether host influences can produce such extreme range in size within a single species. Manter's description of *A. longa* was based largely on worms which Ward had described as *A. sebago* and which Manter regarded as identical with *A. longa.* The specific features of *A. sebago* were not clearly defined; there is uncertainty concerning the species, since there is strong probability that material of more than one species was included in the specific diagnosis. According to Manter who studied the Ward collection (p. 64), "*A. sebago* averages about 6 to 8 mm. in length. Specimens were found as small as 1 mm. and no ova were present in forms 2.85 mm. long. . . . Of the other *Azygia* species, *A. bulbosa* Goldberger is most evidently identical with *A. sebago.* Type material of both species was studied. . . . The original type material of *Hassallius hassalli* was also examined for comparison. . . . In fact, after allowance is made for body contraction, this form can not be distinguished from the other common American forms as represented by *A. sebago* and *A. bulbosa.*"

Van Cleave and Mueller (1934) remarked on the variability in fundamental characters, such as the anterior and posterior limits of the vitellaria and the position of the gonads, in the genus *Azygia.* They endorsed the action of Manter in reducing the number of species in North America and went even further in reducing *A. acuminata* to synonymy with *A. longa.* They noted that Manter had listed *A. bulbosa* as a synonym of *A. longa,* and since they regarded *A. acuminata* and *A.*

PLATE II

FIGURE 8. *Azygia sebago,* from *Perca flavescens,* Sebago Lake, Maine, 1907, 4.26 mm. long, ventral view, (Ward Collection); U. S. N. M., Helm. Coll. No. 51,401.

FIGURE 9. *Azygia acuminata,* from *Amia calva,* Indiana, type of Goldberger, 1911, 6.6 mm. long, ventral view; U. S. N. M., Helm. Coll. No. 10,500.

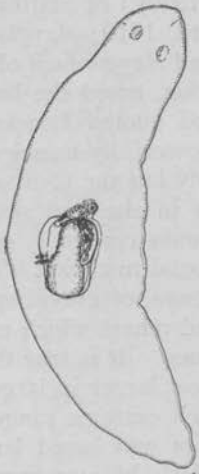
FIGURE 10. *Azygia sebago,* from *Anguilla rostrata,* Falmouth, Mass., 1955, flattened specimen, 12.5 mm. long, ventral view.

FIGURE 11. *Azygia bulbosa,* from *Amia calva,* Indiana, type of Goldberger, 1911, 8.6 mm. long, ventral view; U. S. N. M., Helm. Coll. No. 10502.

FIGURE 12. *Azygia sebago,* from *Anguilla rostrata,* Falmouth, Mass., 1954, immature specimen, 2.66 mm. long, ventral view.

FIGURE 13. *Azygia sebago,* from *Anguilla rostrata,* Falmouth, Mass., 1955, young specimen with 46 eggs in the initial one-half of the uterus, 5.3 mm. long, ventral view.

PLATE III



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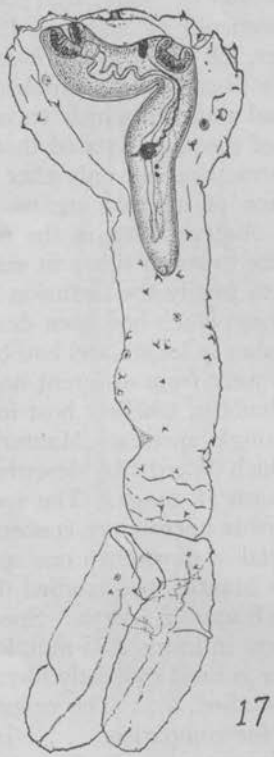

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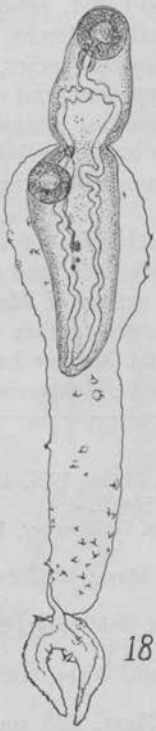

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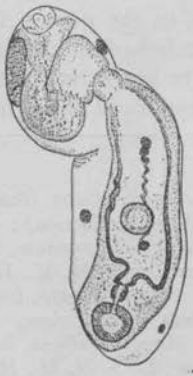

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bulbosa as synonyms, *A. acuminata* should also become a synonym of *A. longa*. The reasoning is sound if the postulates are correct, which now appears doubtful. The specimen shown in their Figure 9 (5) which is referred to *A. angusticauda* and the one Figure 9 (7) referred to *A. longa* are so similar that they are probably conspecific and they may not belong to either *A. angusticauda* or *A. longa*. They closely resemble the worms from the eel, identified in this paper as *A. sebago*.

In other surveys of trematode parasites of fishes, *A. angusticauda* and *A. longa* have been reported in eastern North America but *A. longa* may not extend into the area of Lake Huron and northern Wisconsin and neither species has been found in the fishes of western Canada. Lyster (1939) reported *A. longa* from *Esox lucius* and *Anguilla rostrata* in Canada. The single worm from *E. lucius* is probably a young specimen of *A. longa,* but those from eels are very different. He stated that some of them could be assigned to *A. angusticauda* and specimen No. 1 in his table, which is 4.8 mm. wide at the acetabulum, is probably *A. angusticauda*. The others, which are the same length as the one from *E. lucius* but are twice as wide, are very similar to those from eels on Cape Cod. Miller (1940) reported *A. angusticauda* from *Stizostedion vitreum* and *Micropterus dolomieu* in the central St. Lawrence watershed. Miller (1941) restudied the collection of Stafford. He found a specimen from the muskellunge which he identified as *Megadistomum longum;* it was 18.5 mm. long, 1.2 mm. wide, and there are no eggs in the uterus. Another specimen, from *Lota maculosa* and identified as *A. tereticolle,* is 6.5 mm. long, 0.5 mm. wide, and contains eggs. If these worms belong to *A. longa,* as stated, it is difficult to explain the sexual maturity of the smaller individual. In the Stafford collection Miller found two mature and several juvenile specimens of *Mimodistomum angusticaudum*. One of the mature specimens, 7.25 mm. long and 1.65 mm. wide, shown in his Figure 13, is typical, with the acetabulum near the middle and the gonads in the posterior one-sixth of the body. This account of the original Stafford specimens definitely relegates *Azygia loossi* Marshall and Gilbert, 1905 to synonymy with *A. angusticauda* (Stafford, 1904). Choquette (1951) reported both *A. longa* and *A. angusticauda* from the muskellunge, *Esox m. masquinongy,* in the St. Lawrence watershed. Meanwhile, Bangham (1944) examined 1,330 fishes, representing 38 different species, from 40 different locations in northern Wisconsin. He did not find *A. longa,* but *A. angusticauda* was present in 12 species of fish. Bangham and Venard (1946) examined 676 fishes, belonging to 22 species, from Algonquin Park lakes. Worms from *Anguilla rostrata* were

PLATE III

FIGURE 14. *Dugesia tigrinum,* 7 mm. long, experimental infection, two juvenile *Azygia sebago* in the pharyngeal pockets.

FIGURE 15. *Azygia sebago,* 0.81 mm. long, natural infection, from pharyngeal cavity of *D. tigrinum,* juvenile worm found by J. Louis Bouchard.

FIGURE 16. *Azygia sebago,* juvenile worm from *D. tigrinum,* 1.17 mm. long, natural infection, specimen from J. Louis Bouchard.

FIGURE 17. *Azygia sebago,* cercaria, naturally emerged, a fixed and stained specimen.

FIGURE 18. *Azygia sebago,* cercaria, from a crushed snail, larva not entirely mature and only partially enclosed in the enlarged, basal end of the tail, furci shriveled, a fixed and stained specimen.

FIGURE 19. *Azygia sebago,* miracidium in egg, from sketches made of living larvae.

FIGURE 20. *Azygia sebago,* redia in which the pharynx is recognizable; the body of the cercaria is 0.8 mm. long, the furci 0.18 mm. long; fixed and stained specimen.

identified as *A. longa;* others from *Micropterus dolomieu, Perca flavescens* and *Lepomis gibbosus* were identified as *A. angusticauda.* Bangham and Adams (1954) did not find *Azygia* in the examination of 5456 fishes, belonging to 36 different species, taken in the Columbia, Fraser and other rivers of western Canada. In a survey of parasites from 1667 fishes, representing 53 species, from Lake Huron and Manitoulin Island, Bangham (1955) found *A. angusticauda* in the northern channel catfish, *Ictalurus l. lacustris.* This parasite obviously can infect a large number of species of fish.

Knowledge of the life-history of azygiid trematodes dates from the publication by Szidat (1932) on the developmental cycle of *Azygia lucii,* a common parasite in the stomachs of salmonid fishes, especially species of *Esox,* in Europe. Szidat found that the large, furcocercous, cystocercous larva, *Cercaria mirabilis* Braun from *Lymnaea palustris,* when fed to young pike, *Esox lucius,* developed in ten days into adult *Azygia lucii.* He recalled the statement of Looss (1894), that when small pike are eaten by larger ones, the azygiid parasites leave the stomach of the ingested fish and establish themselves on the stomach of the preditor; and stated (p. 501), "Überdies sind ältere Hechte keine Planktonfresser mehr, so dass für sie die Übertragung auf dem zuletzt geschilderten Wege den vorherrschenden Modus darstellen wird, und die jugendlichen Hechte demnach biologisch doch als Zwischen- oder Hilfswirte zu werten sind." Szidat reported that other small fishes also ingest the cercariae and may serve as transport hosts, but in these species the parasites do not develop to sexual maturity. He found juvenile *A. lucii* in the stomachs of small predacious fishes belonging to the genera *Perca, Lucioperca,* and *Gasterosteus.* Szidat described the cercaria-producing generation as a redia, which lacks a digestive tract but in which the pharynx persists as an organ for ingesting fragments of the digestive gland of the snail host and also as a birth pore. He traced the development of the cercariae and noted their resemblance to those of the strigeids and schistosomes. The cercariae are not encysted in the snail host. The body of the cercaria sits in a narrow depression at the anterior end of the flattened tail-stem. The cercariae mature in the haemocoele of the snail and emerge into the mantle cavity. In water, the proximal portion of the tail begins to swell and the body of the larva, anchored in the base of the depression by the tubule of the excretory system, is enveloped by the base of the tail and enclosed in it. Szidat also described *Cercaria splendens,* believed to represent a second species of *Azygia,* but the adult stage and final hosts were not discovered.

The achievement of Szidat in working out the life-cycle of *A. lucii* disclosed that the furcocercous, cystocercous larvae of the Mirabilis type, originally regarded by Leuckart as free-swimming sporocysts and shown by Braun (1891) to be cercariae when he described *Cercaria mirabilis,* are developmental stages of azygiid trematodes. The first member of the group was found by Wright in a fresh-water aquarium and described (1885) as a free-swimming sporocyst. Ward (1916) named the species *Cercaria wrighti* and described a second species, *Cercaria anchoroides,* collected in top and bottom tow every day from July 25 to August 5, 1893, in Lake St. Clair, Michigan. Subsequent investigators have reported other members of the Mirabilis group; sixteen species have been described, but some of them are identical. Several of the named species were described from immature stages, taken from crushed snails, and can not be identified with certainty. Others were described from free-swimming cercariae and the hosts are unknown. Certain

of them have proved to be larvae of species in the genus *Proterometra,* erected by Horsfall (1933) to contain *Cercaria macrostoma* Faust, 1918. Reviews of the cystocercous cercariae were published by Horsfall (1934), Smith (1936) and Dickerman (1946). Those with forked tails were designated as furcocystocercous by Le Zotte (1954) who showed that members of the family Bivesiculidae also have larvae of this type.

The second report on the life-cycle of azygiid trematodes was given by Stunkard (1950). Larval distomes had been referred to him for identification in the winter of 1949–1950 by Mr. J. Louis Bouchard, then a graduate student at the University of Oklahoma. The worms had been found in planarians, *Dugesia tigrinum,* received from the Marine Biological Laboratory, Woods Hole, Massachusetts. The structure of the larvae indicated that they were azygiids and study of the life-cycle was begun at the Marine Biological Laboratory in the summer of 1950. Records of the Supply Department of the M. B. L. showed that the planarians sent to the University of Oklahoma had been collected in Morse's Pond in Falmouth. Thirty-eight *D. tigrinum* were collected there on July 10, 1950 and a larval trematode, identical with the specimens sent by Mr. Bouchard, was found in the pharyngeal pockets of two of them. Eight additional worms of natural infection were found in 120 *D. tigrinum* examined. To discover the first intermediate host, different species of mollusks were collected from Morse's Pond and isolated. Furcocercous cercariae of the azygiid type emerged from nine of 246 *Amnicola limosa.* Four planarians, examined under the microscope and known to be uninfected, were placed in a finger-bowl with three specimens of *A. limosa* which were shedding these cercariae. After six days exposure, one to four larvae were found in the pharyngeal cavities of each of the planarians. These larvae were identical with those sent by Mr. Bouchard. The tails, in the bases of which the bodies of the cercariae formerly were enclosed, had completely disappeared. Other planarians were subsequently placed in dishes with infected *A. limosa* and larvae found in their pharyngeal pockets. The larvae may persist for several weeks in *D. tigrinum,* but they do not encyst or grow and it is apparent that the planarians serve merely as paratenic or transport hosts. Attempts to feed the cercariae to goldfish and small perch were not successful; the fish would not take the larvae and when introduced into their mouths, the cercariae were expelled. Planarians infected with cercariae were fed, but the results were uncertain and the short period in which the work could be conducted, led to no further information at that time. It was clear that the larvae belonged to a species of *Azygia,* but specific determination could not be established.

Sillman (1953a) reported that in the vicinity of Ann Arbor, Michigan, the mud pickerel, *Esox vermiculatus,* and the bowfin, *Amia calva,* harbor *Azygia longa.* Eggs of the trematode, containing mature miracidia, were fed to both wild and laboratory-raised *Amnicola limosa.* Cercariae producing rediae were found after 21 days and cercariae emerged 42 days after infection. Cercariae fed to *Esox vermiculatus* developed in 20–30 days into egg-bearing worms. Two of 13,500 *Amnicola limosa* were found naturally infected with cercariae which appeared identical with those in experimentally infected snails.

In a thesis submitted for the Ph.D. degree at the University of Michigan, Sillman (1953b) gave further information. He stated that two species of *Azygia* are present in the Ann Arbor area. One species, which he identified as *A. longa,* occurs in both *Esox vermiculatus* and *Amia calva.* The other species, which he iden-

tified as *A. acuminata,* was found only in *Amia calva.* Worms assigned to *A. longa* were somewhat longer, more slender and the suckers were slightly smaller than those of *A. acuminata,* but the measurements of worms and organs overlapped. According to Sillman, the collecting ducts of the excretory system branch from the vesicle behind the testes in *A. longa* and between the testes in *A. acuminata.* Although there was much variation, the average size of eggs in *A. longa* was 55 by 31 microns whereas that of *A. acuminata* was 69 by 38 microns. Furthermore, specimens of *Amnicola limosa* did not become infected when fed eggs of *A. acuminata.*

Investigation of the life-cycle and development of *Azygia* has been continued at the Marine Biological Laboratory, Woods Hole, Mass., during the summer months since 1950. An abstract of the results was presented (Stunkard, 1955). Infected snails were found each year and the morphology of the young distome, especially the details of the excretory system, was studied. Hundreds of fishes, including *Esox niger, Perca flavescens, Morone americanus, Micropterus salmoides, Micropterus dolomieu,* and others, were examined in the attempt to find the sexually mature stage of the parasite. The first to be discovered, a small, immature specimen of *Azygia* (Fig. 12) was found in the stomach of an eel, *Anguilla rostrata,* late in the summer of 1954. During the summer of 1955, 42 eels were examined; 10 of them were infected and many fully mature worms were collected. Continued examination of other fishes, especially the pickerel, *Esox niger,* from the same ponds where the infected eels were taken, has not disclosed infection by members of the genus *Azygia,* and it appears that the eel is the natural and possibly the only host for the species in the Woods Hole region. The larger ponds in the area are under the control of the Division of Fisheries and Game, Bureau of Wildlife Research and Management of the State of Massachusetts, and many of them have been stocked with game fishes from time to time. Through the kind cooperation of Mr. Russell Cookingham, a large number of fishes, belonging to various species, were provided during the summer of 1955, when certain of these ponds were inspected to determine their productivity.

Specific determination of the parasites from the eel has proved difficult. Descriptions are wholly unsatisfactory and accordingly, specimens of *Azygia* in the U. S. National Museum were borrowed through the kindness of Dr. E. W. Price and Mr. Allen McIntosh. The material consisted of 6 specimens in alcohol (bottle M 248-D), the type specimens of *Distomum longum* Leidy, and other specimens mounted on slides and bearing the following labels, U. S. National Museum, Helminthological Collection:

No. 49. *Distomum longum* from *Esox reticulatus,* determined by Albert Hassall; 1 slide. (Plate I, Fig. 3.)

No. 3359. *Azygia lucii* from *Esox lucius,* collected and determined by Professor M. Braun, 7 July 1902, Königsberg, Germany; 1 slide. (Plate I, Fig. 1.)

No. 10500. *Azygia acuminata* from *Amia calva,* type and paratypes; 4 slides. (Plate II, Fig. 9.)

No. 10502. *Azygia bulbosa* from *Amia calva,* type and paratypes; 3 slides. (Plate II, Fig. 11.)

No. 10679. *Azygia loossi* from *Micropterus salmoides,* cotypes; 3 slides. (Plate I, Fig. 6.)

No. 51399. *Azygia sebago* from *Salmo sebago,* 5.2 mm. long, 1 slide, H. B. Ward collection.

No. 51401. *Azygia sebago* from *Perca flavescens,* H. B. Ward collection; 2 slides. (Plate II, Fig. 8.)

No. 51403. *Azygia sebago* from *Amia calva,* 20 mm. long, 1 slide, H. B. Ward collection. (Plate I, Fig. 2.)

No. 51402. *Azygia angusticauda* from *Stizostedion vitreum,* collected by H. W. Manter, 4 April 1926, Rock River, Illinois, 2 slides, H. B. Ward collection. (Plate I, Fig. 7.)

Examination of the specimen of *Azygia lucii,* No. 3359 in the U. S. National Museum, invalidates the criteria used by Ward and Manter to distinguish between *A. longa* and *A. lucii.* In this specimen (Fig. 1) which measures 23 mm. in length, collected and identified by Professor M. Braun, the pharynx is not twice as long as broad; in fact, the organ measures 0.80 mm. long and 0.60 mm. wide. Furthermore, the vitellaria extend far behind the posterior testis; the follicles on the left side about one-half the distance from the testis to the end of the body. In the Ward collection there is a specimen from *Amia calva* (Fig. 2) which measures 20 mm. in length and which resembles the European specimen so closely that I am disposed to regard the two as specifically identical. Leidy, Stafford and Cooper all reported the finding of *A. lucii* and it appears that this species does occur in North America. *Esox lucius,* the type host, is circumpolar in range, and the distribution of its parasites may be expected to parallel that of the host. The dispersal of fishes in the northern hemisphere following the last glacial period has been traced by Walters (1955).

Although the criteria used by Ward and Manter to distinguish *A. longa* from *A. lucii* are inadequate, the two forms are probably distinct. About 100 specimens collected by Mr. Paul Krupa from *Esox niger* in southern New Hampshire during the summer of 1955 are so similar to the six worms in alcohol, now in the U. S. National Museum, which constitute the original material of the species described by Leidy (1851) as *D. longum,* that they must be regarded as identical. A representative example from the Krupa collection is shown (Fig. 5) and a smaller one (Fig. 4). These worms are very slender. The Krupa specimens were dropped in cold Duboscq-Brasil fluid and fixed without narcotization or pressure. Oviferous specimens vary from 4 to 26 mm. in length and 1.1 mm. is the greatest width. The width does not increase very much as the worms grow in length. Comparison of Figure 5 with that of *A. lucii* (Fig. 1) portrays what are believed to be specific differences. Further evidence that *A. longa* is distinct from *A. lucii* is afforded by comparison of the cercariae. *Cercaria mirabilis* Braun, 1891, shown by Szidat (1932) to be the larval stage of *A. lucii,* is very different from the cercaria described by Sillman as the larval stage of *A. longa.* Moreover, in Europe *A. lucii* uses a pulmonate snail, *Lymnaea palustris corvus,* as the first intermediate host, whereas according to Sillman, the asexual stages of *A. longa* occur in the pectinibranchiate snail, *Amnicola limosa.*

Recognition of two distinct species, *A. lucii* and *A. longa,* may resolve certain difficulties and clear up confusion in the literature. The worms from *Esox masquinongy* which Stafford (1904) described as *Megadistomum longum* (Leidy) measured up to five inches in length when extended and probably were not iden-

tical with *A. longa* of Leidy. Stafford reported a specimen 18 mm. long which contained no eggs. Cooper (1915) identified specimens from *E. masquinongy,* which he regarded as identical with those of Stafford, and others from *E. lucius,* as *Azygia lucii.* His specimens from the muskellunge measured 21 to 48 mm. in length and 1.40 to 2.40 mm. in width, whereas those from the pike were 14 to 20 mm. in length and 0.74 to 1.42 mm. in width. Comparison of the small worms from *E. masquinongy* with worms from *E. lucius* led Cooper to regard them as conspecific. But he was unable to account for the variable size at which eggs are produced in different individuals. He reported that a specimen 14 mm. long from *E. lucius* was less mature than another 6 mm. long from the same host species, and that worms from the trout and small-mouthed black bass were all immature although one from *S. namaycush* was 11 mm. long. Discussing the effect of season on sexual maturity, Manter (1926) wrote (p. 67.) ". . . it is certain that what is evidently the same species does not attain sexual maturity at the same time in different hosts in which it occurs. Thus, while average sized forms are producing eggs in such hosts as pike, pickerel, and salmon, specimens fully as large are still sexually immature in such hosts as smelt, trout, small mouthed black bass, and perch." Admittedly, members of a trematode species attain a greater size in a larger host species, and *E. masquinongy* is much larger than *E. lucius,* but present information strongly indicates that *A. longa* is distinct from *A. lucii,* if, indeed, the large American species is actually *A. lucii* of European fishes.

All previous authors have agreed on the identity of *A. angusticauda* (Stafford, 1904) and *A. loossi* Marshall and Gilbert, 1905. A cotype specimen of *A. loossi* (U. S. Nat. Mus., 10,679), shown in Figure 6, is 4.88 mm. long and is obviously young, with only a few eggs in the uterus. A fully mature, gravid specimen (U. S. Nat. Mus., No. 51,402) from the walleye, *Stizostedion vitreum,* collected by Manter in 1926, which measures 10.5 mm. in length, is shown in Figure 7. In both, the acetabulum is near the middle and the gonads are situated in the caudal one-sixth of the body. The distinctness of this species appears to be well established.

The specimens of *Azygia* found in the eel at Woods Hole are clearly distinct from *A. angusticauda* and, as noted, are probably distinct from *A. longa.* Specimens of *A. longa* are slender and much elongate; those from the eel are shorter and more robust. The worms collected by Mr. Krupa from *Esox niger* in New Hampshire and identified as *A. longa* remained well extended when dropped into Duboscq-Brasil killing fluid, whereas those from the eel contracted strongly with the result that the length was only 6 to 8 mm., less than one-half that of *A. longa.* Accordingly, most of the worms from the eel were killed and fixed under pressure, which resulted in longer, wider, and flatter specimens. The size of the suckers increased as a result of the compression but comparison of Figures 10 and 13, which were made from one of the largest and one of the smallest oviferous specimens, with Figures 5 and 4, of comparable specimens of *A. longa,* portrays differences between the two forms which are believed to be specific.

Whereas the worms from the eel differ distinctly from those identified as *A. longa,* they agree almost completely with Goldberger's description of *A. acuminata* and agree almost as well with the descriptions of *A. sebago* as given by Ward and Manter. Certain worms from the eel are very similar to specimens in the Ward collection labelled *A. sebago.* It is probable that Ward had more than one species and that his description of *A. sebago* was based on specimens of both *A. longa* and

A. sebago. The worm from the Ward collection which bears the U. S. Nat. Mus., No. 51,401, shown in Figure 8, is clearly *A. sebago,* and the worm on U. S. Nat. Mus., No. 51,403, from *Amia calva* shown in Figure 2, is so like *A. lucii* (*cf.* Fig. 1), that the two might be regarded as specifically identical. Other specimens of *A. sebago* agree so completely with Goldberger's description of *A. acuminata* (compare Figs. 8 and 9), that I am inclined to regard them as identical. Since Ward probably confused two species in his description of *A. sebago,* the removal of the elongate specimens leaves the description virtually the same as that of *A. acuminata.* Specific determination may be impossible on the basis of adult morphology alone and knowledge of life-cycles and larval stages may be required to finally solve the problem. Why the species occurs only in *Anguilla rostrata* in the Woods Hole area is quite unknown. The larval stages are relatively abundant in the snails of the region, but sexually mature worms have so far been found only in the eel. The chain pickerel, *Esox niger,* is common in these ponds where it has been introduced in stocking operations. Since the worms develop in eels in ponds where pickerel, perch, bass and other fishes are not infected, it appears either that the ecological conditions and food-chain lead to the infection of eels rather than other fishes or else the other fishes do not retain the parasites. In the latter event, a separate species must be involved.

When worms were removed from the stomachs of eels and placed in pond water, the eggs in the terminal coils of the uterus were extruded in a string of mucus. These eggs appeared to be fully embryonated and the miracidium was studied in the egg. Although active, the larvae did not emerge in water and hatching occurred only after the eggs were ingested by the snail host. Empty shells were recovered in the feces of *Amnicola limosa* that had eaten the eggs. Some of these snails were found later to be infected but since they had been collected from locations where previous exposure to infection was liable, it would be difficult if not impossible to distinguish between a natural infection acquired before collection and an experimental one. But the snails laid eggs in the finger bowls and young laboratory-raised specimens were fed eggs of the parasite. These small snails became infected and although emerged cercariae were not obtained before the end of the summer, the developmental stages in these experimental infections were indistinguishable from comparable stages in natural infections. In nature, the eggs of the parasite are passed in mucous material from the intestines of eels and settle on vegetation and on the slimy surfaces of submerged rocks and sticks. The snails rasp these surfaces for the diatoms which form a major constituent of their food and incidentally ingest the eggs. The larvae remain alive for long periods and since the eggs do not hatch until they are eaten, the probability of reaching a suitable host and continuing the life-cycle is much enhanced. The larvae emerge in the intestine of the snail and bore through the wall to reach the haemocoele, where they become sporocysts. Young sporocysts have been found adjacent to the intestinal wall two weeks after eggs of the parasite were added to the finger bowl with the young snails. Older infections with rediae and developing cercariae were found later, which definitely link the experimental and natural infections. However, the rate of development of the parasites and the degree of maturity of the infection are not regarded as significant. It is common knowledge that asexual stages of digenetic trematodes persist but fail to grow or reproduce if the hosts are not fed. Thus, infections overwinter in a quiescent stage in mollusks that are dormant or in

which metabolism is reduced to a low level. In the present instance, although various methods, including those recommended by Moore *et al.* (1953) and by Sandground and Moore (1955) for the rearing of related snails, were employed, it was obvious that the snails, although most of them remained alive, were not properly nourished, did not grow normally, and the tissues had the atrophic appearance typical of inanition.

Cercariae from natural infections were snapped up by guppies and by small bluegill sunfish, *Lepomis macrochirus,* 2 to 4 cm. in length. The young worms were recovered from the stomachs of these sunfish two and three weeks after they were eaten, but there was very little development of the parasites. These small fishes also ate planarians, *Dugesia tigrinum;* so in nature the fishes could contract the infection by eating either the cercariae or infected planarians. The tails of the cercariae cease to beat after about 48 hours and they would then not be attractive to fishes; moreover the larvae die during the next 48 hours. As stated earlier, the young worms live for weeks in the pharyngeal pockets of *D. tigrinum* and this accessory method of employing an additional paratenic or transfer host enhances the likelihood of survival and aids in the completion of the life-cycle. The cercariae are probably not eaten by eels which are at the end of the food-chain that leads to their infection.

Description of Stages in the Life-Cycle

Adult

The worms are only slightly flattened, almost cylindrical, with rounded ends and enormously developed musculature. Because of the ability to extend and retract the entire body or particular regions to an extraordinary degree, measurements of length and width and location of individual organs have limited significance. A specimen may extend to four or five times its length when contracted, and contraction of different regions can make distances between organs so variable that measurements may be very misleading. Ward (1918) wrote (p. 392), "*Azygia* is a powerfully muscular type and is usually much distorted in the process of preservation so that a lot of specimens taken from the same host at the same time present marked external differences in the preserved condition. Such extreme specimens have been the basis for various new genera, *e.g., Megadistomum* of Leidy and Stafford, *Mimodistomum* of Leidy (*sic*) and *Hassallius* of Goldberger. This same factor has lead to the separation of too many as species." Oviferous specimens from the eel, fixed by the shaking method of Looss, are 3 to 9 mm. long and when fixed under pressure measure 4 to 12.5 mm. in length. Because of the variations caused by muscular contractions on the shape of the body and location of organs, dimensions of the suckers and gonads provide the most reliable morphological data, but these organs appear larger in specimens that have been fixed under heavy pressure. Egg sizes vary too much to provide reliable specific criteria. The worms continue to grow after sexual maturity. A large one and a small one are shown in Figures 10 and 13; both were fixed under pressure and are therefore comparable. Measurements in millimeters of the larger one are: length, 12.5; width, 2.2; oral sucker, 0.96; acetabulum, 0.8; pharynx, 0.36 long and 0.32 wide; ovary, 0.54 by 0.23; anterior testis, 0.5 by 0.33; posterior testis, 0.5 by 0.4. Corresponding measurements of the smaller worm are: length, 5.3; width

0.65; oral sucker, 0.41; acetabulum, 0.34; pharynx, 0.19 long and 0.16 wide; ovary, 0.195 by 0.12; anterior testis, 0.195 by 0.143; posterior testis, 0.24 by 0.16. The eggs, alive, averaged 0.06 by 0.034 mm.; under oil immersion and slight pressure, to study the miracidium, they were slightly larger; in fixed and stained worms they were smaller, and averaged 0.055 by 0.030 mm. In such mounted specimens the eggs are usually collapsed and distorted.

Miracidium

The miracidium of *Azygia lucii* was described by von Nordmann (1832), Schauinsland (1883) and Looss (1894) and that of *Azygia acuminata* (possibly a synonym of *A. sebago*) by Manter (1926). The miracidium of the worms identified as *A. sebago,* studied alive in the egg (Fig. 19) and in stained sections of gravid worms, is similar to that of related genera in the family Azygiidae, as reviewed by Manter (1926). Like the others, it lacks cilia and is provided with bristle plates or plaques. It almost fills the egg-shell; the anterior end may be protruded as a conical papilla on which the ducts of the secretory cells open. Radiating from this area, there are five plates or plaques that bear fine bristles arranged in a chevron-like pattern. The anterior ends of the plates are separated by short intervals, which become wider posteriorly. The plaques extend backward about one-third of the length of the larva; the bristles on the anterior portions are larger and longer than those more posteriad. From a naked area at the posterior end of the larva, four bristle-bearing bands extend forward past the middle of the body. The bands are equidistant from each other and both the anterior and posterior ones manifest a spiral tendency, but this aspect may be the result of rotation of the larva within the shell. The appearance of the miracidium is almost identical with that of *Proterometra macrostoma* as reported by Hussey (1945). Hussey described a structure, designated by earlier authors as a "primitive gut", with four nuclei arranged in a linear series. In *A. sebago,* the corresponding structure, which is glandular and probably serves in penetration, consists of four cells which lie side by side rather than in linear series. These cells are disposed as reported by Manter (1926) for the miracidia of *Otodistomum cestoides, Otodistomum veliporum* and *Azygia acuminata.* Manter reviewed previous accounts and presented a strong argument that the organ is not a primitive gut, but a group of unicellular glands. Immediately posterior to the glandular organ there is a bilobed "brain" and the region behind it contains several large, germinal cells. On either side, near the middle of the body, there is a single flame cell from which an excretory tubule leads caudad, but the ducts were not traced to the pores.

Asexual generations

The youngest sporocyst was recovered from a loose network of connective tissue on the somatic side of the intestinal wall of a laboratory-raised snail that had been exposed 12 days previously. It was oval, 0.094 by 0.062 mm., with no lumen; it contained germinal cells but no germ-balls (embryos). Other larger sporocysts were found in older infections; one, 0.126 by 0.08 mm., contained germinal cells and 6 small germ-balls; another, 0.189 by 0.12 mm., contained germinal cells and 9 germ-balls of varying sizes. In a snail killed one month after exposure, the mother sporocyst could not be recognized but there were 26 rediae scattered about

in the haemocoele. The smallest was 0.25 by 0.18 mm., and in addition to germinal cells it had four small spherical to oval germ-balls, 0.02 to 0.04 mm. in diameter. A redia with larger germ-balls but no recognizable cercariae measured 0.57 mm. long and 0.18 mm. wide; the pharynx was 0.08 mm. in diameter and there was a sac-like gut, 0.11 mm. long and 0.032 mm. wide. The largest redia was 1.3 by 0.3 mm. and in addition to smaller embryos, it contained two cercariae, one of which was more than half-grown and had small furci. Whether or not there is a second generation of rediae was not determined.

The cercaria-producing generation of species in the genus *Azygia* was recognized by Szidat (1932) as redial, although the pharynx undergoes reduction to a mere vestige and the intestine completely disintegrates. As noted by Szidat in *A. lucii,* the pharynx, which he termed "rudimentary", serves for the ingestion of bits of the digestive gland of the host and persists as a birth-pore through which the cercariae emerge. The small rediae are vermiform and very active; the pharyngeal end may be inrolled and then everted, while the opposite end may be protruded as a pointed, tail-like structure. Older rediae may extend to a length of 3 mm. and on contraction of the circular muscles, present an annulate appearance. On contraction of the longitudinal muscles they become oval and about 1 mm. in width. The one shown in Figure 20 is bent and as mounted measures 1.12 by 0.325 mm.; in it the pharynx is still distinct. The older, larger, rediae have little mobility but pulsations of one and sometimes two can occasionally be seen through the shell of an infected snail. The number of cercariae in a redia is small; often there is only one and rarely are there more than three recognizable cercariae; other individuals are still in the germ-ball stage, together with a few germinal cells attached to the body wall, chiefly at the posterior end of the redia. Apparently the development of one cercaria restrains the development of others. An infected snail may liberate one or two cercariae each day for a few days and then none for a week or more. The large size of the cercariae is correlated with the slow development and the small number produced.

Cercaria

Developing cercariae are typical furcocercous larvae. As the embryo reaches a length of approximately 0.25 mm., a constriction appears and gradually separates the posterior one-fourth to one-third of the larva as an oval, tail-rudiment. At about this stage, the oral sucker is faintly outlined. When the larva has reached a length of 0.4 to 0.5 mm., the suckers are distinct, the acetabulum is in the posterior half of the body, the tail is about three-eighths of the total length, and the furcal buds are beginning to appear. As development proceeds, the tail increases in length more rapidly than the body; its basal portion, about one-sixth of its length, begins to enlarge and by the time the gonads are recognizable, the anterior end of the tail forms a cup-like ring (Fig. 20), at the base of which the constricted caudal end of the distome is continuous with the tissues of the tail. The cercariae complete their growth in the rediae and emerge into the haemocoele of the snail. While studying the excretory pattern of a redia which was under some pressure, an immature cercaria emerged, tail first, through the old pharyngeal opening. The cercariae mature in the haemal sinuses of the snail, especially the branchial sinus, and emerge through the respiratory opening. During growth, the basal portion of the tail is much en-

larged by the accumulation of spongy, fibro-elastic, alveolar tissue which, when the cercaria emerges from the snail, absorbs water and expands rapidly. As a result, this portion of the tail extends forward, encapsulating the body of the cercaria. If infected snails are crushed and immature larvae are liberated into water, the base of the tail is unable to completely engulf the body of the larva (Fig. 18).

Mature, normally emerged cercariae measure 1.8 to 2.3 mm. in length. The expanded, basal portion of the tail is flattened, 0.5 to 0.75 mm. in width, and slightly more in length. The stem of the tail, that portion from the spongy, rigid, basal part to the furci, is 1.0 to 1.5 mm. in length and 0.26 to 0.46 mm. in width. It tapers slightly from the basal to the distal end. It is distinctly flattened and set at right angles to the dorso ventrally flattened body of the larva, so that when looking at the flat aspect of the tail, the body appears in lateral view (Fig. 17). This stem portion of the tail consists of two bands of longitudinal muscles, one on each of the flat surfaces. These muscles are attached at one end to the rigid, spongy portion of the tail and at the other end to the bases of the furci. The furci are flattened, 0.55 to 0.90 mm. in length and 0.20 to 0.28 mm. in width. Normally they are held almost at right angles to the tail stem, whose muscle bands contract alternately, so that the flapping of the tail from side to side produces a sculling effect that pulls the larva through the water. After the beat of the tail is unable to lift the larva from the bottom, it continues for a day or two and this flapping motion makes the larva an attractive lure for small fishes and perhaps other predators. The basal end of the tail becomes sticky and may lightly attach the larva to the substratum. How the larvae reach the pharyngeal cavity of the planarians is not clear. The body is firmly enclosed in the chamber at the anterior end of the tail and could be liberated only by dissolution of the tail. According to Hyman (1951, p. 107), "The triclads do not swallow their food whole but suck it in by peristaltic action of the protruded pharynx." and (p. 199), "The Turbellaria are as a class carnivorous. . . . Favorite items of food of the smaller species are rotifers, copepods, cladocerans, nematodes, annelid worms, etc.,". Perhaps the planarian seizes the larva, and as the tail is sucked in and digested, the young worm is liberated and attaches to the external surface of the pharynx, whence it is carried into the cavity when the pharynx is retracted.

The tail bears many papillae, scattered somewhat irregularly over the surface except for the distal three-fourths of the furci. Each is about 0.05 mm. in diameter, 0.025 mm. tall, and is surmounted by a recurved hook, 0.012 to 0.015 mm. in length. The tail also has many opaque patches, which on higher magnification are seen to consist of minute spherules. The excretory system of the larval body is continuous with that of the tail and the constricted caudal end of the body contains the common excretory canal which traverses the stem of the tail, bifurcates at the bases of the furci, and the resulting tubules open at the tips of the furci. The pattern of flame cells in the tail was not resolved.

The morphology of the young worm, released from the chamber in the tail, is typically azygiid (Figs. 15, 16). The cuticula is unarmed but the preacetabular region bears many papillae and a bristle has been observed at the tip of certain of them. There are at least a dozen papillae, 0.018 to 0.020 mm. in diameter, around the anterior end of the worm. Living specimens vary from 0.7 to 1.3 mm. in length and 0.16 to 0.28 mm. in width. The acetabulum varies from 0.10 to 0.13 mm., and the oral sucker, 0.11 to 0.14 mm., in diameter. The pharynx measures 0.05

to 0.07 mm. in length and usually slightly less in width. The digestive ceca are filled with yellow material, derived from the digestive gland of the snail. The excretory system is complex but has been worked out completely. The pore is terminal and a common duct leads forward almost to the level of the testes. The posterior one-half of this duct may expand to form a bladder-like enlargement, or if the pore is blocked and fluid accumulates, the enlargement may extend farther forward. Behind the testes the common duct divides, forming two ducts which pass forward, median to the digestive ceca. As the ceca turn mediad to join the pharynx, the excretory ducts pass below them and continue on either side of the oral sucker almost to the anterior end of the body. There is, however, no connection between the ducts of the two sides. Anterolateral to the oral sucker, the duct of each side doubles backward and continues posteriad, giving off eleven branches. Each branch divides three times, forming two primary, four secondary and eight tertiary branches. Each tertiary branch receives the capillaries from four flame cells. The flame cell formula accordingly is 2 (11 × 32) or 704 flame cells in the body. This observation is in agreement with that of Looss (1894) who described the same pattern in *Azygia tereticolle* (= *A. lucii*). He regarded the ascending portions of the excretory system as parts of the excretory vesicle and the descending limb with its branches as the collecting ducts. He suggested the possibility of variation in the number of branches and of anastomoses between collecting ducts; however, I have found a constant number of branches and the apparent anastomoses can be resolved as places where one duct crosses another. Counting backward from the anterior end of the body, the first side branch is located at the level of the oral sucker; the second is at the level of the bifurcation of the digestive tract, *i.e.*, the posterior end of the pharynx; the third branch is anterior to the acetabulum; the fourth is at the middle of the acetabulum; the fifth is at the level of the posterior end of the acetabulum; the sixth and seventh are close together a short distance behind the acetabulum; the eighth, ninth and tenth are almost equally spaced; while the eleventh and last, which is the terminal group of the recurrent limb, is distributed to the extreme posterior end of the body around the excretory bladder. The reproductive organs are represented by groups of deeply staining cells, shown in Figures 15, 16 and 17.

Summary

A chronological account of the genus *Azygia* discloses discordant observations and divergent opinions. Dawes (1946) recognized only a single species, *A. lucii,* in Europe. In it he included *A. robusta* Odhner, 1911, which reaches a length of 47 mm. and *Ptychogonimus volgensis* von Linstow, 1907, which measures 5 to 6 mm. in length and had been transferred to *Azygia* as a valid species by Odhner (1911). In America several species have been described, but there is no agreement on the number that are distinct and valid. In fact, there is no adequate information on the extent of variation that occurs in a natural species, and consequently on the features that can be relied on to distinguished between species. This situation is not peculiar to *Azygia,* but obtains in many genera. It is the natural result of development by members of a parasitic species in different hosts, invertebrate and vertebrate, often of different taxonomic groups, which differ in their nutritional and other physiological conditions, and accordingly influence the development and

morphological features of the parasite. Until the life-cycle is known and the variation that normally occurs in each possible host is measured, the precise limits of specificity will remain uncertain. Comparison of specimens and descriptions indicates that *A. lucii* may be endemic in North America, that possibly it is distinct from *A. longa* (Leidy), that *A. angusticauda* (Stafford) is a valid species, and that the species described by Goldberger (1911) may be identical with *A. sebago* Ward. Information concerning the life-history of species in the genus *Azygia* is meager. Szidat (1932) showed that *Cercaria mirabilis* Braun is the larva of *A. lucii*. He described a second larva, *Cercaria splendens*, presumably another species of *Azygia*, but the adult stage remains unknown. Sillman (1953a) reported the life-cycle of a species that he identified as *A. longa* and the present paper presents data on the morphology and life-history of a species believed to be *A. sebago*. Stages in the cycle are described and figured.

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Azygiinae Lühe, 1909

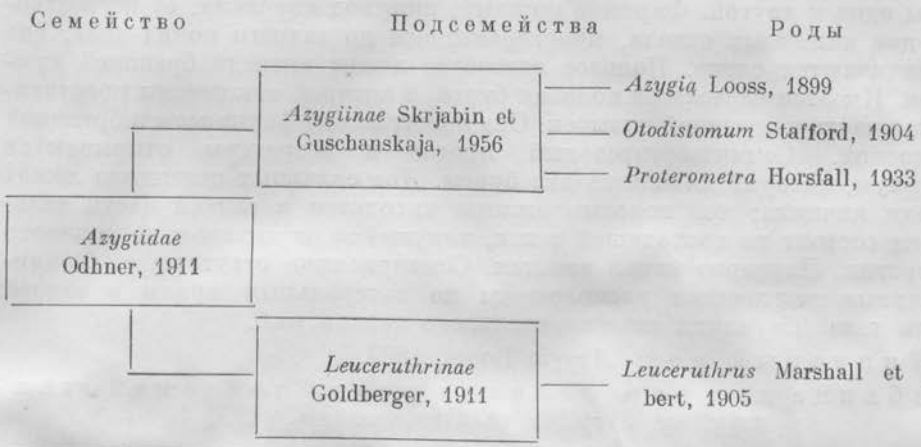
Subfamily diagnosis. — Azygiidae: Body fusiform to cylindrical, smooth. Acetabulum small to moderately large, in anterior or middle third of body. Ceca more or less sinuous, reaching posterior extremity. Testes tandem or diagonal, in middle or posterior third of body. Cirrus pouch small, preacetabular. Ovary median or submedian, pretesticular. Vitellaria extending along ceca from behind acetabulum to testicular or posttesticular zone. Uterus winding in intercecal field between ovary and acetabulum. Excretory vesicle bifurcating behind posterior testis or ovary.

Key to genera of Azygiinae

Vitellaria extending into posttesticular median area; acetabulum moderately large, close to anterior extremity; excretory arms united anteriorly ..... ***Otodistomum***

Vitellaria not occupying posttesticular median area; acetabulum small, well apart from anterior extremity; excretory arms not united anteriorly ..... ***Azygia***

Система семейства *Azygiidae* Odhner, 1911
(по К. И. Скрябину и Л. Х. Гушанской, 1958)



FROM SKRJABIN, VOL XIV

Таблица для определения подсемейств семейства *Azygiidae* Odhner, 1911

1 (2). Семенники лежат позади яичника. Пищевод имеется . . . . . *Azygiinae* Skrjabin et Guschanskaja, 1956.

2 (1). Семенники лежат впереди яичника. Пищевод отсутствует . . . . . *Leuceruthrinae* Goldberger, 1911.

Azygiidae Odhner

More or less elongate and little flattened distomes with a thick muscular body of 5 to 75 mm. in length. Suckers very strongly developed, near each other. Skin unarmed, with thick cuticula, which assumes irregular cross-folds in contraction. Digestive system with strong pharynx, very short esophagus, and ceca reaching to hind end; a pre-pharynx is lacking. Ex. bladder Y-shaped with very long forks reaching into the head end. Genital pore median, between the suckers. End part of the sex passages characteristic. Genital sinus well developed; the male passageway consists of ejaculatory duct, pars prostatica and seminal vesicle, the two latter tube-like and , except in Ptychogonimus, surrounded by a cirrus sac; the entire complex lies directly in front or over the ventral sucker. Ovary and testes median, directly behind one another in the hind body (except Leuceruthrus) Uterus leads foward from the ovary. L. canal present. Sem. rec lacking. Vitellaria follicular, in the sides of the hind body not reaching to the extreme hind end. Metraterm present. Eggs about 45-55 u long, operaulated; they contain at laying a mture unciliated miracidium. Usually stomach parasites of fishes.

Azygia Looss
Otodistomum Stafford
Leuceruthrus
Ptychogonimus
Eurostomum

Azygia Looss, 1899

Syn. *Megadistomum* Stafford, 1904
Mimodistomum Stafford, 1904
Hassallius Goldberger, 1911
Eurostomum MacCallum, 1921 [1])

Generic diagnosis. — Azygiidae, Azygiinae: Body medium to large, much elongated, strongly muscular, unarmed. Oral sucker subterminal, moderately large, pharynx longer than broad or globular, esophagus very short, ceca more or less sinuous, terminating at posterior extremity. Acetabulum not very large, in anterior or middle third of body. Testes tandem or diagonal, in posterior third of body or a little more anteriorly. Cirrus pouch subglobular to pyriform, immediately in front of acetabulum or overlapping it. Genital pore pre-acetabular. Ovary immediately pretesticular. Uterus closely coiled in intercecal field between ovary and acetabulum, containing numerous eggs. Vitellaria commencing at varying levels posterior to acetabulum, terminating some distance short of posterior extremity. Excretory stem bifurcating behind posterior testis or ovary; arms long, reaching to near anterior extremity but not united together. Parasitic in stomach or intestine of freshwater and marine fishes. Giant cysticercous cercariae, especially *C. mirabilis* Braun and *C. splendens* Szidat, 1932, from *Planorbis planorbis* develop in stomach of predacious fish to adults of *Azygia* sp. — Szidat (1932).

Genotype: *A. lucii* (Mueller, 1776), syn. *A. tereticollis* Rud., 1802, (Pl. 14, Fig. 174), in *Esox lucius;* Europe. Also in *Lota maculosa, Ameiurus nigricans, Leuciscus, Thymallus, Perca, Acerina, Lucioperca, Micropterus, Stenodus, Salmo, Trutta, Anguilla;* N. Siberia, Russia, Finnland, Switzerland.

Other species:

A. acuminata Goldberger, 1911, syn. of *A. longa* (Leidy, 1851) — Van Cleave and Mueller (1934), in stomach of *Amia calva;* N. America.

A. amuriensis Zmeev, 1936, in *Ophiocephalus argus;* Biro-Bidzhana.

A. anguillae Ozaki, 1924, in stomach of *Anguilla japonica;* Japan.

A. angusticauda (Stafford, 1904) (syn. *Mimodistomum a.* S., *Azygia loossi* Marshall et Gilbert, 1905), in *Lota maculosa, Stizostedion vitreum;* Canada. Also in *Micropterus salmoides, Perca flavescens, Lepomis, Ambloplites, Amia, Esox, Eupomotis, Boleosoma,* etc.; N. America. Also in *Mastacembelus pancalus;* India.

A. hwangtsinyi Tsin, 1933, in *Ophiocephalus argus;* Shantung, China

A. longa (Leidy, 1851), syn. *Megadistomum longum* (Leidy) Stafford, 1904, *Distomum tereticolle* of Leidy, 1851, or of Stafford, 1904; *Azygia sebago* Ward, 1910; *A. bulbosa* Goldberger, 1911; *Hassallius hassalli* Goldberger, 1911; *Azygia lucii* of Cooper, 1915, in *Esox estor;* Cleveland, Ohio. Also in *Salmo sebago, Osmerus mordax, Esox reticulatus, Anguilla* spp., *Perca flavescens, Esox lucius, E. niger, E. masquinongy, Amiatus calvus, Salvelinus namaycush, Lucioperca* sp., *Micropterus dolomieu, Trichiurus lepturus,* etc.; U. S.A., Canada.

Embryonated eggs fed to laboratory bred *Amnicola limosa,* from which cystocercous cercariae began to emerge 42 days after infection. Cercariae fed to specimens of *Esox vermiculatus* developed directly into egg-bearing worms 20 to 30 days later. — Sillman (1953).

Planarians and small fishes which are eaten by eels serve as paratenic hosts for *A. Sebago* Ward — Stunkard (1955).

[1]) At Dr. Price's suggestion I examined MacCallum's type specimen deposited in Zoological Division, Agricultural Research Center, Beltsville, Md., and found the terminal genitalia to be similar to those of *Azygia lucii.* MacCallum's original description that there is no cirrus pouch misled me (1954) to assign his genus to the Opisthorchiidae.

A. micropteri (MacCallum, 1921), syn. *Eurostomum m.* M. (Pl. 36, Fig. 461), in *Micropterus salmoides;* New York Aquarium.

A. perryi Fujita, 1918, in stomach of *Hucho perryi;* Hokkaido, Japan.

A. pristipomai Tubangui, 1928, in intestine of *Pristipoma hasta;* Philippines. Also in *Glossogobius giurus;* Luzon.

A. robusta Odhner, 1911, in *Salmo hucho* and *S. fario;* Wiener Hofmuseum. Also in *Lota lota;* Lake Baikal — Layman (1933).

A. volgensis (v. Linstow, 1907) Odhner, 1911 (syn. *Ptychogonimus v.* v. L.), in *Lucioperca sandra*, Volga; *Liocassis trazhnikovi*, Amour.

AZYGIA Looss

Skin unspined, thick, forming irregular cross folds in contraction. Pharynx well-developed/ Esophagus very short, ceca reaching to hind end. Cirrus sac almost spherical, not very muscular, lying in front of ventral sucker with much coiled seminal vesicle and short cirrus. Testes round in front of the forking of the excretory bladder. Ovary likewise spherical and nearly median.

Type species : Azygia lucii

From Luhe 1909

A key to the species of Azygia (including the several doubtful European species which might represent the single form, *A. lucii*) follows:

Vitellaria not extending appreciably posterior to the hind testis
- Body length about 6 mm.; sexually mature at 2 mm..... *A. volgensis* (v. Linst.)
- Body length up to 30 mm. or more
  - Pharynx elongate, twice as long as wide; eggs 45 by 23μ..... *A. lucii* (Muell.)
  - Pharynx globose; eggs?..... *A. robusta* Odhner
    - Eggs 58 by 33μ..... *A. perryii* Fujita

Vitellaria extending considerably posterior to the hind testis, usually at least half way between this point and posterior end of body
- Acetabulum near middle of body; gonads near posterior tip.. *A. angusticauda* (Staff.)
- Acetabulum distinctly nearer the anterior end; gonads anterior from posterior tip by about 1/3 ot 1/4 the body length
  - Body relatively wide; vitellaria beginning close behind acetabulum; neck usually constricted; internal parenchyma muscles weak; eggs about 64 by 33μ.... ..... *A. acuminata* Goldberger
  - Body often extremely elongate; vitellaria usually beginning some distance posterior to acetabulum; internal parenchyma muscles strongly developed; eggs variable in size (up to 63μ in length), usually about 48 to 55μ by 28 to 30μ..... ..... *A. longa* (Leidy)

Azygia lucii

Azygia lucii (Müller, 1776) Lühe, 1909

(Рис. 186)

Синонимы (по Гольдбергеру, 1911): *Fasciola lucii* Müller, 1776; *Planaria lucii* (Müller, 1776) Goeze, 1782; *Distoma lucii* (Müller, 1776) Zeder, 1800; *Fasciola tereticollis* Rud., 1802; *Distoma tereticolle* (Rud., 1802) Rud., 1809; *Distoma rosacoeum* Nordmann, 1832; *Azygia tereticollis* (Rud., 1802) Looss, 1899; *Azygia lucii johanseni* Pavlov, 1931

Хозяева: рыбы — *Esox* (=*Lucius*) *lucius*, *Esox reticulatus*, *Esox reicherti*, *Salmo alpinus*, *Salmo fario*, *S. hucho*, *S. salvelinus*, *S. trutta*, *S. trutta morpha lacustris*, *S. salar morpha relictus*, *S. umbla*, *Thymallus thymallus*, *T. vulgaris*, *Lota lota*, *L. maculosa*, *L. vulgaris*, *Lucioperca lucioperca*, *L. sandra*, *Acerina cernua*, *Perca fluviatilis*, *P. flavescens*, *Ameiurus nigricans*, *A. lacustris*, *Nemachilus barbatulus*, *Salvelinus lepechini*, *S. alpinus*, *Squalus cephalus*, *Acerina cernua*, *Rutilus rutilus lacustris*, *Pygosteus pungitius*, *Acipenser* sp., *Trutta variabilis*.

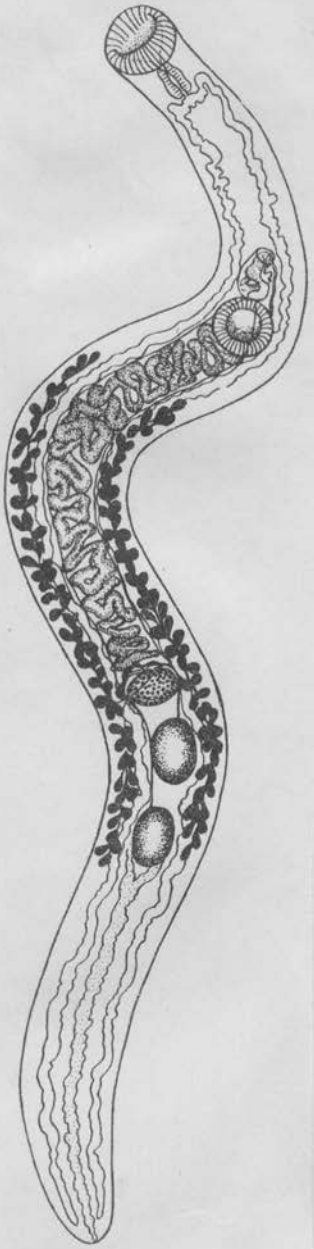
Локализация: ротовая полость, пищевод, желудок.

Места обнаружения: СССР, Польша, Чехословакия, Германия, Англия, Северная Америка.

Историческая справка. В 1776 году Мюллер (Müller) описал новый вид трематоды *Fasciola lucii*.

FROM SKRJABIN, VOL. 14

"AZYGIA TERETICOLLIS R. ACTER VAN BENEDEN FROM BRINN" FROM PRATT, 1902



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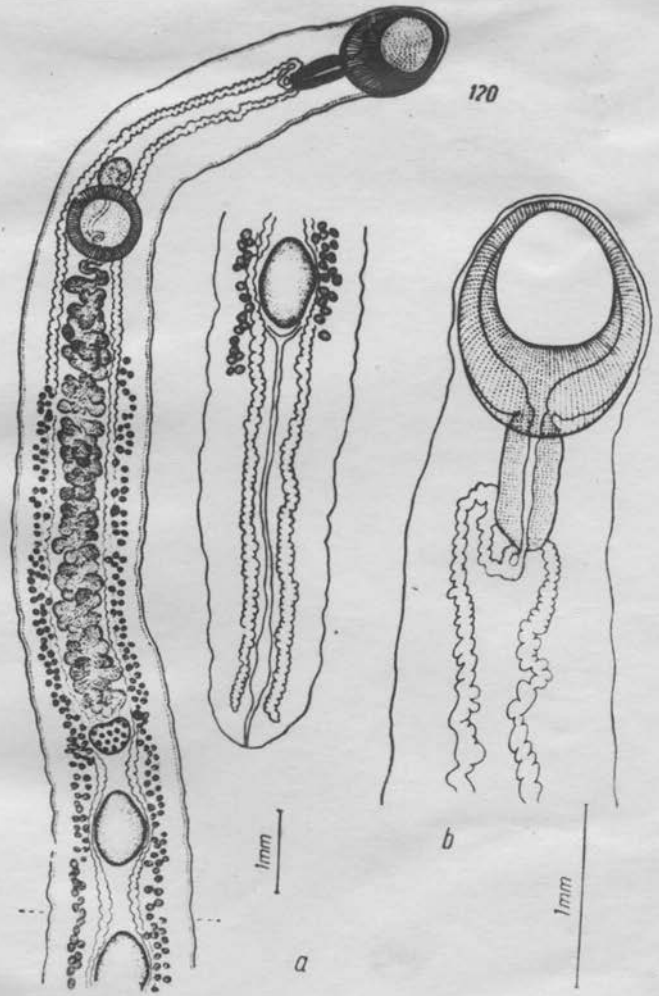
186. *Azygia lucii* (Müller, 1776) (по Лооссу, 1894)



Rys. 120. *Azygia lucii* (O. F. Müller, 1776) z żołądka *Salmo trutta* L. z Ujścia Wisły: a — od strony brzusznej w dwóch częściach, b — koniec przedni.
Azygia lucii (O. F. Müller, 1776) from the stomach of *Salmo trutta* L. of the Mouth of Vistula: a — ventral view (in two parts), b — anterior end.

From Slusarski

Azygia Looss, 1899, a genus of digenetic trematode (Azygiidae), has been reported from Europe, North America, Japan, India, China and the Philippines. The genus seems to present a great deal of confusion. Manter (1926)

in his key to the American species of *Azygia* containing several doubtful European species was of the opinion that they might represent a single species, *A. lucii* (Muell. 1776). Belozerova-Sypliakova (1937) has shown the variability in the distribution of the vitellaria in *Azygia lucii*. Stunkard (1955) in his studies on the life cycle of *Azygia sebago* Ward compared the worms from the eel (*Anguilla rostrata*) with published descriptions and with specimens from the U. S. National Museum and stated "Ward's description may have included material of more than one species." He further stated that the three species, *A. acuminata, A. bulbosa* and *Hassallius hassalli*, described by Goldberger (1911) may be identical with *A. sebago*. However, Manter (1926) had synonymized *A. sebago* Ward with *A. longa* (Leidy) It is evident that a direct comparison of specimens referred to the various species of *Azygia* should be made in order to resolve this confusion.

While going over the literature, two species, *Eurostomum micropteri* MacCallum, 1921, and *Gomtiotrema attu* Gupta, 1953, were noted to present characteristics of *Azygia*. The description of *Eurostomum micropteri* was based on a single specimen taken from *Micropterus salmoides*. This species was placed by Yamaguti (1953) in the family Opisthorchiidae. Fortunately, I was able to study MacCallum's type specimen which is deposited in the U. S. National Museum collections (No. 36094). The general characteristics of the body and body measurements (Table I) show that it is congeneric with *Azygia*. The cirrus sac which MacCallum failed to see is definitely present

and similar to that in other Azygiidae. Comparison of the type specimen of *Eurostomum micropteri* and specimens labeled *A. longa* (Leidy) by Linton in the U. S. National Museum Helminthol. Collection (Nos. 8302 and 8303) seems to indicate that the two species are rather similar in shape of body, in other proportions, and position of the genital organs. Leidy's type specimens were unstained and hence not available for comparison except for the relative size. Linton's (1940) description agrees with the characteristics of *Eurostomum micropteri*. See Table I for comparative measurements. In view of the above facts I conclude that *E. micropteri* is an objective synonym of *A. longa*. Skrjabin and Gushanskaia (1956) correctly placed *Eurostomum* in the family Azygiidae.

Gupta (1953) erected the genus *Gomtiotrema* for the species *attu*, placed this genus in the sub-family Gomtioteminae, family Opisthorchiidae. Unfortunately, no specimens are available to me for critical study. The presence or absence of the cirrus sac needs rechecking. Gupta did not show one and stated that it was absent. The nature of the excretory bladder as described is characteristic of the family Azygiidae not of the Opisthorchiidae. *Gomtiotrema* Gupta is a homonym of *Gomtiotrema* Sinha, 1934, erected for a blood fluke belonging to the family Spirorchiidae. Mehra (1939) pointed out that *Gomtiotrema* Sinha, 1934, was a synonym of *Plasmiorchis* Mehra, 1934, which had priority. Byrd (1939) in turn reduced *Plasmiorchis* Mehra (1934) to synonymy with *Spirorchis* MacCallum, 1918. Comparison of the description of *Gomtiotrema attu* Gupta with specimens of *Azygia* forces me to conclude that *Gomtiotrema* is congeric with *Azygia*. See Table I for comparative measurements. Consequently, the genus *Gomtiotrema* falls as a synonym of *Azygia*.

Azygia acuminata Goldberger, 1911

(Рис. 187)

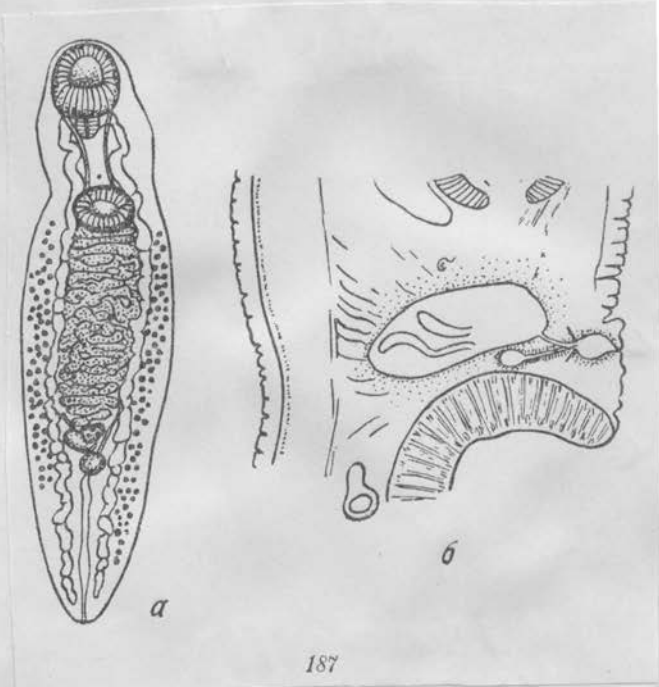
Хозяин: ильная рыба — *Amia calva*.

Локализация: желудок.

Место обнаружения: США.

Историческая справка. Гольдбергер (1911) описал от рыбы *Amia calva* новый вид рода *Azygia* — *A. acuminata*.

FROM SKRJABIN, VOL. 14



187. *Azygia acuminata* Goldberger, 1911 (по Гольдбергеру, 1911)

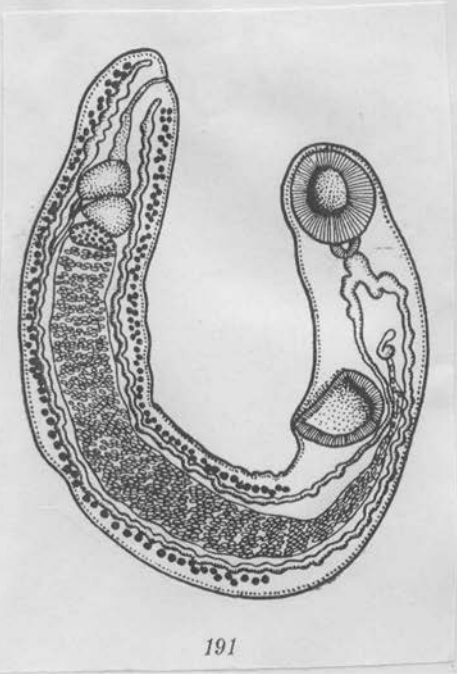
а — марита; *б* — сагиттальный срез через концевой половой аппарат

Azygia amuriensis Zmejev, 1936

(Рис. 191)

Хозяин: рыба — змееголов китайский — *Ophiocephalus argus.*
Локализация: кишечник.
Место обнаружения: СССР (Дальний Восток — река Амур в районе Биро-Биджана).

FROM SKRJABIN, VOL. 14



191

191. *Azygia amuriensis* Zmejev, 1936 (по Змееву, 1936)

Azygia anguillae Ozaki, 1924

The following report is from Yamaguti, 1924

64. *Azygia anguillae* Ozaki, 1924

This trematode was found in the stomach of *Anguilla japonica* from Kasumiga-ura. It is 8.7 mm long by 1.34 mm broad, with almost parallel sides. The cuticle is 0.012 mm thick throughout. The subcuticular musculature, particularly the parenchymatous longitudinal muscles, are well developed. There is a prominent preoral lip 0.063 mm long. The oral sucker is 0.73 × 0.8 mm and the pharynx about 0.18 mm in diameter. The acetabulum, about 0.65 mm in diameter, lies just behind the middle of the anterior third of the body. The ceca terminate a little in front of the hind end of the body.

The testes, 0.26–0.28 × 0.21–0.3 mm, are situated one behind the other in the anterior part of the posterior third of the body. The small cirrus pouch extends a little farther backwards than the anterior border of the acetabulum. The genital atrium, 0.1 × 0.075 mm, opens just in front of the acetabulum. The ovary is about 0.2 mm in diameter. The shell gland complex lies in front of the ovary. The not very numerous vitelline follicles are distributed in the lateral fields along the longitudinal vitelline ducts, extending from the hind end of the anterior third of the body to about 1.0 mm in front of the posterior extremity. The eggs are elongate oval and measure 0.06–0.066 × 0.034–0.037 mm.

Reference: Ozaki, Y. 1924
On a new species of Azygia.
Dobutu Gaku Zassi, vol.36:426-435

Azygia angusticauda (Stafford, 1904)

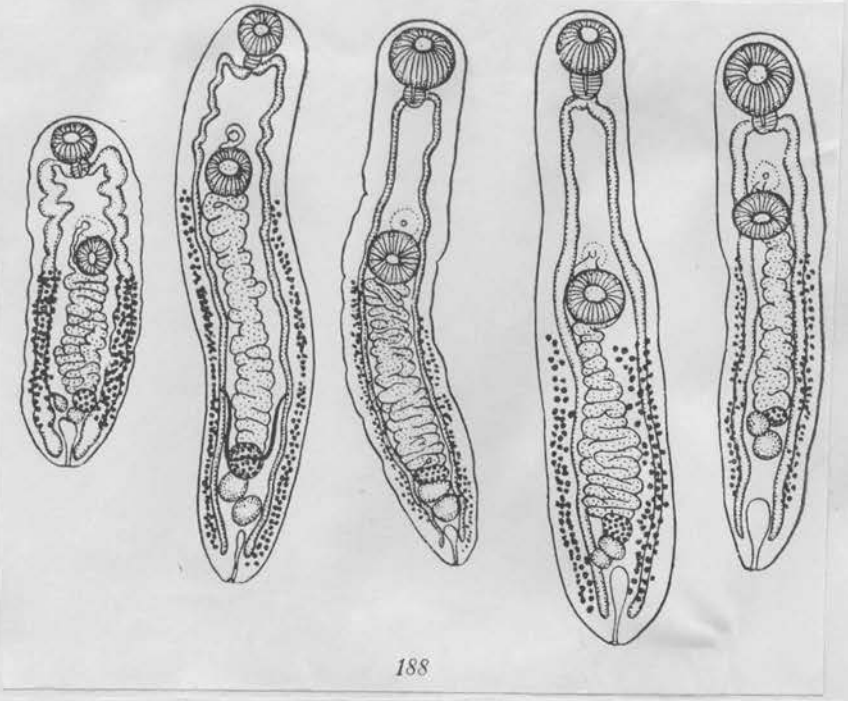
(Рис. 188—190)

Синонимы: *Mimodistomum angusticaudum* Stafford, 1904; *Azygia loossi* Marshall et Gilbert, 1905

Хозяева: рыбы — *Lota maculosa*, *Stizostedion vitreum*, *Amia calva*, *Esox lucius*, *Micropterus salmoides*.

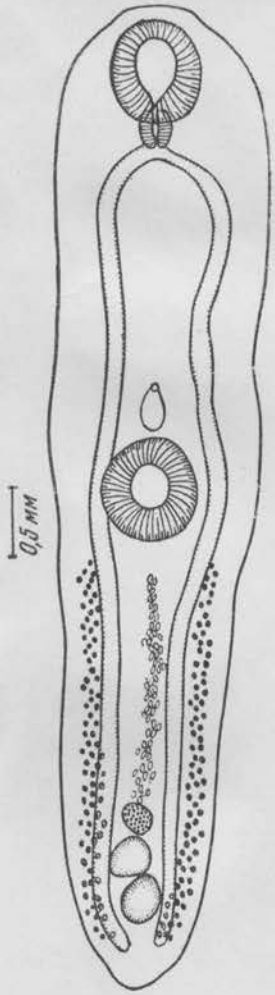
Локализация: рот, глотка, пищевод, желудок.

Места обнаружения: Канада, США.



188

188. *Azygia angusticauda* (Stafford, 1904) (по Ван Кливу и Мюллеру, 1934)



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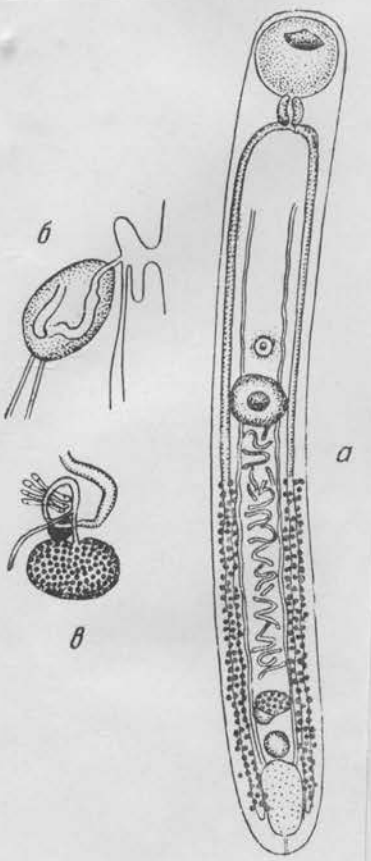
189. *Azygia angusticauda* (Stafford, 1904) (по Миллер, 1941)



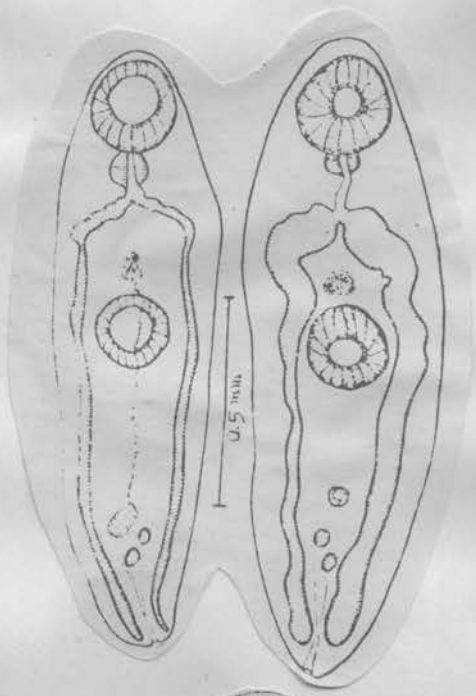
190

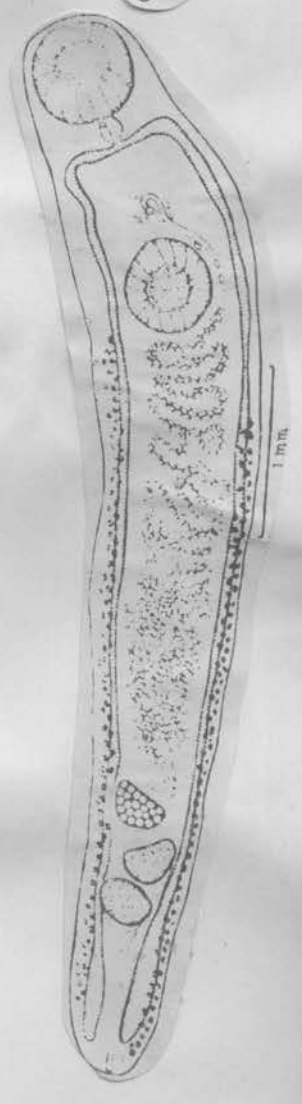
190. *Azygia angusticauda* (Stafford, 1904) (синоним: *Azygia loossi* Marshall et Gilbert, 1905) (по Маршаллу и Гильберту, 1905)

а — марита; *б* — выводные протоки половых желез; *в* — схема женской половой системы

AZYGIA ASIATICA ~~n. sp.~~ Simha and Pershad, 1964

The flukes obtained from the first fish (fig. 1), measuring 1.24 — — 1.26 x 0.4 — 0.48 mm. The cuticle covering the body surface is smooth The instainal caeca are simple, extending into the caudal region of the body. The excretory vesicle is « Y » shaped. The two excretory limbs extend into the pharyngeal region and curve on themselves to run in a posterior direction. The ovary and the testes are differentiated and lie in the 3rd. quarter of the body. The formation of the uterus appears as a small wavy tube, opening at the genital pore, and anterior to the acetabulum. The second set of flukes (fig. 2), obtained after 28 days, from the fish which died, are similar to the first set, except for some minor differences. The intestinal caeca are well developed, coiled and reaching the posterior end of the body. The excretory system is similar to that of the first set. The ovary and testes are rounded and situated in the fourth quarter of the body. The cirrus pouch is well formed and anterior to the acetabulum; it contains a coiled seminal vesicle. The mature specimens obtained from the third infected fish are well developed: a detailed description is given below.





These flukes (fig. 3, 4, 5) were recovered from the intestine of an experimentally infected fresh water fish. *Ophicephalus punctatus*, in the month of June 1963. They have an elongate and elliptical body with rounded anterior and posterior ends. The cuticle is thin and devoid of any armature. The worms measured 6.32 — 8.6 mm in length and attain a maximum width of 1.06 — 1.7 mm at the region of the acetabulum. The oral sucker is large and sub-terminal, measuring 0.64 — 0.80 x 0.62 — 0.77 mm. The acetabulum, which is situated between the 1st and 2nd quarter of the body, mesaures 0.58 — 0.64 x x 0.51 — 0.7 mm. The mouth, surrounded by the oral sucker, leads into a very small prepharynx, not discernible in the mounted specimen, which communicates with the pharynx, measuring 0.1 — 0.14 x 0.17 — — 0.2 mm. The oesophagus is small, measuring 0.07 — 0.09 mm, bifurcates into two simple intestinal caeca, and extends into the caudal region of the body. The excretory bladder is « Y » shaped and the median stem divides into two arms, just posterior to the testes; the length of the median stem being 1.44 mm. The two limbs of the excretory canal extend into the region of the pharynx, where they curve on themselves so as to run into a posterior direction.

The gonads are situated in the anterior region of the posterior 4th of the body, and are in tandem position, the ovary being anterior to the testes. The anterior and the posterior testes are rounded, with the entire margins measuring 0.21 — 0.36 x 0.26 — 0.36 mm and 0.242 — 0.30 x 0.27 — 0.33 mm respectively. The vasa efferentia, arising from the anterior margin of each testis, join anteriorly to the acetabulum and the vas deferens thus formed communicates with the seminal vesicle, which is inside the subglobular cirrus pouch. The genital pore is preacetabular and is guarded by the sphincter muscle.

The ovary, measuring 0.21 — 0.36 x 0.26 — 0.36 mm, is anterior to the testes, and the oviduct arises from the inner margin of the ovary. The shell gland is found in close proximity of the ovary. The receptaculum seminis and the Laurer's canal was not discernible even in the live specimens. The uterus ascends up, describing transverse loops, intercaecally, and opens at the genital pore anterior to the acetabulum.

(over)

The vitellaria consist of small rounded follicles distributed along the lateral margins of the body. They extend from the posterior border of the acetabulum to the posterior end of the body, up to the caecal tips. The distribution of the vitellaria of the two sides is not exactly identical, the vitelline zone of the left side being slightly in advance of that of the opposite side. The uterus is filled with numerous eggs measuring 0.055 — 0.062 x 0.024 — 0.033 mm.

Morphological variations in *Azygia asiatica*, n. sp.

The three mature flukes obtained from the intestine of experimentally infected Dhokes, *Ophicephalus punctatus*, show morphological variations. Some of the important variations are:

1. The ovary in one specimen (fig. 5) occupies a position to the left of the anterior testis.

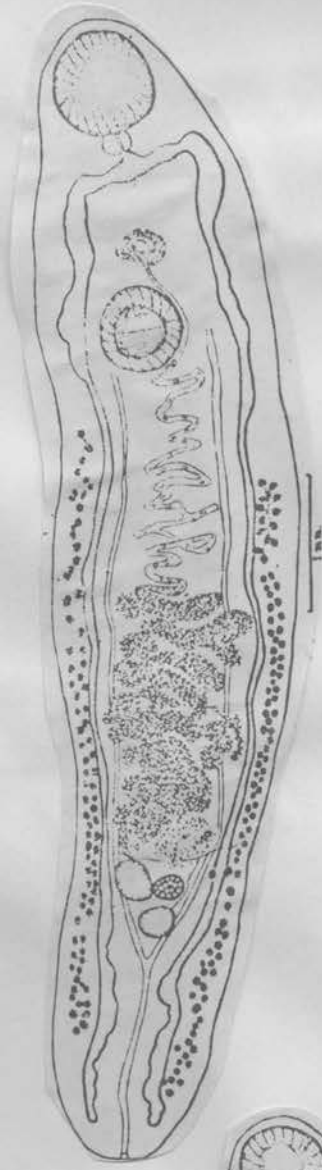
2. The gonads are in the extreme caudal position in the second specimen (fig. 4) and the median excretory stem is also very much reduced. The vitellaria also extend into the caudal region of the body.

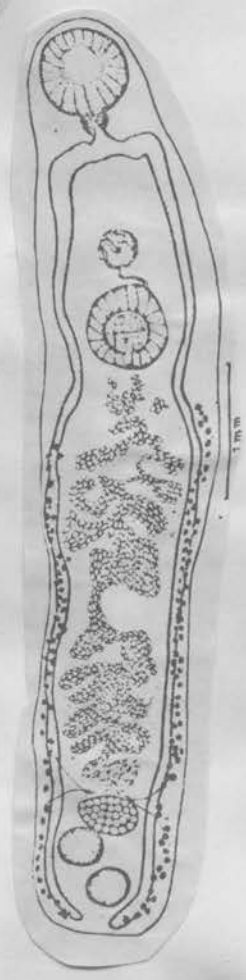
Discussion

The only record of the genus *Azygia* from India, is by Bhalerao (1942, 1943). He described *Azygia augusticauda* (Stafford, 1904) from the intestine of *Mastacembelus pancalus* (Ham). The present communication, dealing with a new species obtained experimentally by the authors, is the first new species of the genus *Azygia* from India. The present form reveals close affinities with *A. perryi* Fugita 1918 and *A. microteri* (McCallum, 1921) Yamaguti, 1958, in the general form of the body and in the disposition of the gonads; but can be readily differentiated in the following characters.

In *A. augusticauda* the suckers are almost equal and the acetabulum is situated in the 2nd quarter of the body, whilst in the new species it is always at the level of the 1st and 2nd quarter of the body, and the suckers are sub-equal. In *A. micropteri* (McCallum, 1921) Yamaguti, 1958, the ventral sucker is situated in 2nd quarter of the body. The new species also differs from it in the distribution of vitellaria, which extend between the 2/5th and 4/5th of the body, whilst they extend to the caudal region in the new species. The gonads in *A. perryi* are situated in the 3rd quarter of the body, whereas in the new species they are situated in the last quarter of the body. The distribution of the vitellaria in *A. perryi* extends from the posterior level of acetabulum to the posterior level of the posterior testis, whereas in new species it extends from the posterior level of the acetabulum to the caudal end.

In view of these differences the writers consider it necessary to establish a new species for the fluke described here. The name *Azygia asiatica* is proposed.





SOUTHWELL, 1913

Allocreadium annandalei, ~~sp. nov.~~

(Pl. ix, figs. 15—16.)

A large number of specimens of this Trematode were obtained from the stomach of a specimen of *Rhynchobatis djeddensis* measuring 5 feet, caught in Portugal Bay, Ceylon, on February 2nd, 1911. The parasites were cylindrical in shape, slightly flattened dorso-ventrally and measured on an average 13 mm. in length (alcoholic specimens) and 3 mm in breadth. The oral sucker is situated ·5 mm. from the anterior end and is subventral. The ventral sucker is situated 5·5 mm. from the anterior extremity and is raised above the general surface of the worm. The diameter of both suckers is 1·1 mm. and each sucker is very strongly developed. The genital aperture is situated nearer the oral than the ventral sucker, and is so minute that it cannot be seen except in sections. The excretory aperture is situated at the posterior extremity, which is pointed. The portion of the worm anterior to the oral sucker is flattened dorso-ventrally, and is also pointed. The external surface of the worm is marked by a series of both annular and discontinuous concentric rings.

Viewed *in toto*, cleared in clove oil, the edges of the worm appear serrated. No spines, however, are present, the spinose appearance being due entirely to the wrinkled cuticle. The muscular system is strongly developed, the thickness of the muscular wall of the body being ·3 mm. in spirit specimens.

Digestive system.—The mouth is situated at the base of the oral sucker, and leads directly into a strong muscular pharynx. The two rami of the intestine immediately succeed the pharynx and run laterally close up to the body-wall, to the extreme posterior end.

Reproductive system.—There are a pair of large testes, situated one in front of the other, at the extreme posterior end. They each measure roughly 1·4 mm. long and are squarish or oblong in shape and flattened dorso-ventrally. The vas deferens consists of a pair of extremely delicate tubes running laterally (one on each side) to a point just dorsal to the anterior rim of the ventral sucker, where they unite and open into the cirrus sac. This is large, muscular and conspicuous.

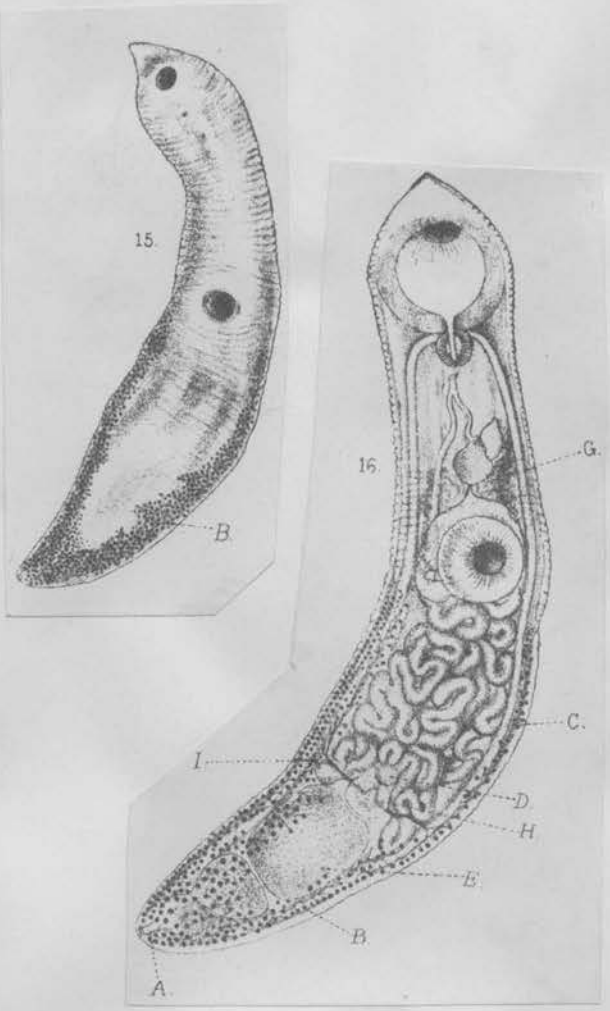
The cirrus is an irregularly coiled organ lying midway between the cirrus sac and the large seminal vesicle. The seminal vesicle abuts on the pharynx.

The ovary is single and is situated just in front of the testes in the middle line, 4·5 mm. from the posterior end. Between the ovary and the testes is the shell gland. The uterus is a coiled tube lying between the ovary and the ventral sucker. Portions of the uterus extend forward on each side of, and dorsal to, the ventral sucker, and it eventually opens at the genital pore. The vitteline glands consist of a series of grape-like follicles, situated laterally between the ventral sucker and the extreme posterior end. The ducts connecting the follicles are clearly visible. In cross sections, the vitteline glands seem to be sunk in the muscular body-wall, and when this wall is removed the vitteline glands come away with it. The main ducts of the vitteline glands run transversely, one on each side, and, uniting in the middle line, open at the junction of the shell gland and the germarium, 4·4 mm. from the posterior extremity of the worm.

Excretory system.—As sections were not made, no details of this system could be made out.

Habitat.—The stomach of *Rhynchobatis djeddensis*. Sixty-seven specimens. Pearl Banks, Ceylon. February 2nd, 1911.

This species appears to fall naturally into the genus *Allocreadium*, Looss, of which the type species is *Distomum isoporum*, Looss. I have pleasure in naming my specimens in honour of Dr. Annandale, Superintendent of the Indian Museum.



1970- Yamaguti seems to retain this sp. in Allocreadium

Azygia hwangtsiyüi Tsin, 1933

Хозяин: рыба — *Ophiocephalus argus.*
Локализация: кишечник.
Место обнаружения: Китай.
В нашем распоряжении работы Тзин (Tsin) не имелось.

FROM SKRJABIN, VOL. 14

Azygia longa (Leidy, 1851)

(Рис. 192—194)

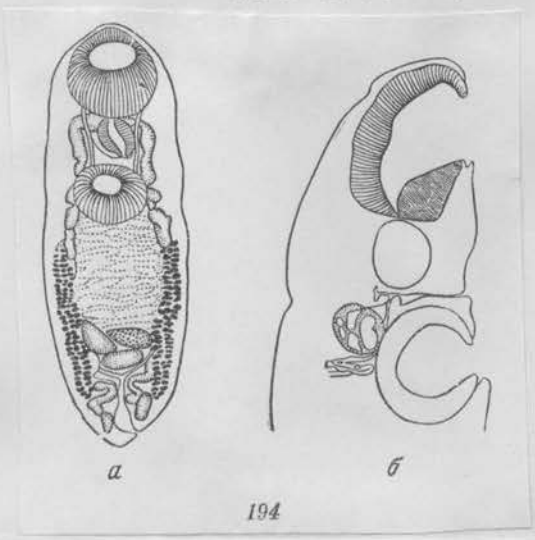
Синонимы (по Мантеру, 1926): *Distomum longum* Leidy, 1851; *Megadistomum longum* (Leidy, 1851) Stafford, 1904; *Distomum tereticolle* в понимании Leidy, 1851; *Azygia tereticolle* в понимании Stafford, 1904; *Azygia sebago* Ward, 1910; *Azygia bulbosa* Goldberger, 1911; *Hassallius hassalli* Goldberger, 1911; *Azygia lucii* в понимании Cooper, 1915

Хозяева: рыбы — *Esox lucius* (=*E. estor*), *E. masquinongy*, *E. niger*, *E. reticulatus*, *Lota maculosa*, *Ameiurus nigricans*, *Amia calva*, *Micropterus dolomieu*, *Trichiurus lepturus*, *Salmo sebago*, *Osmerus mordax*, *Anguilla chrysipa*, *Perca flavescens*, *Salvelinus namaycush*, *Lucioperca* sp.

Локализация: рот, фаринкс, пищевод, желудок.

Места обнаружения: Канада, США.

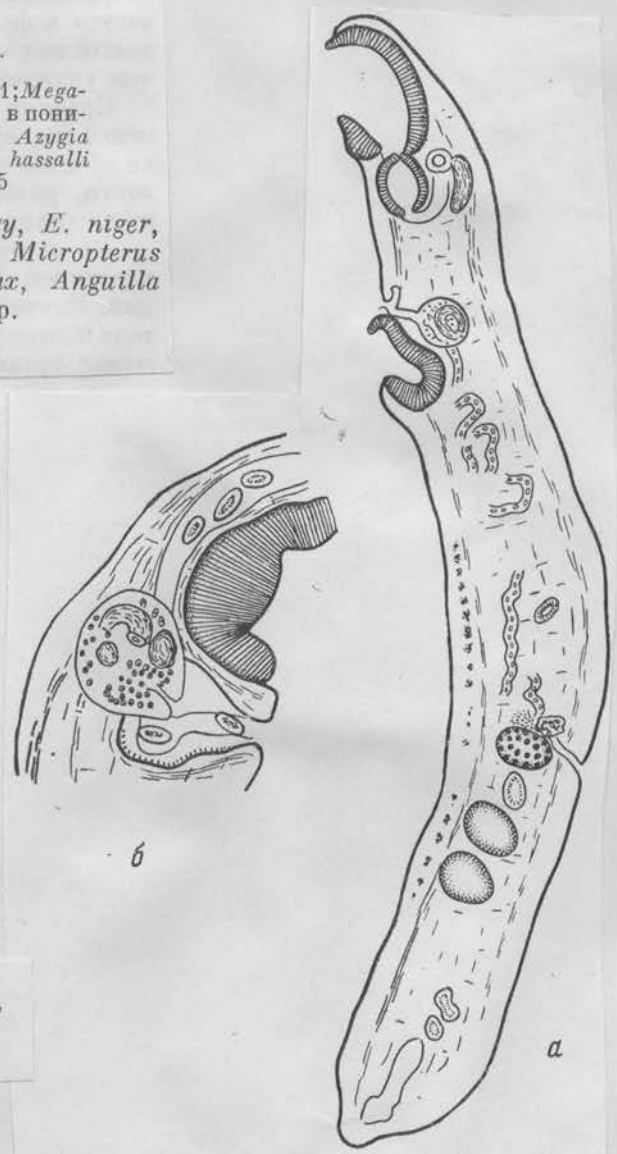
FROM SKRJABIN, VOL. 14



194

194. *Azygia longa* (Leidy, 1851) (синоним: *Hassallius hassalli* Goldberger, 1911) (по Гольдбергеру, 1911)

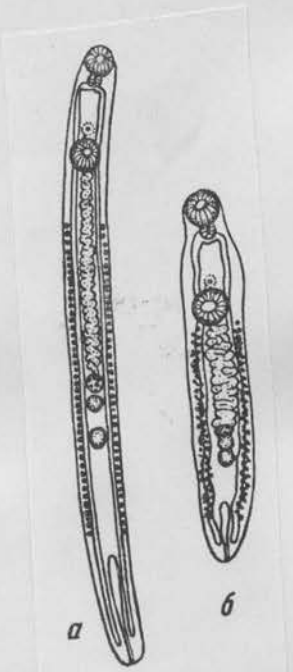
а — марита; *б* — сагиттальный срез в области половой бурсы



193

193. *Azygia longa* (Leidy, 1851) (по Линтону, 1940)

а — сагиттальный срез мариты; *б* — сагиттальный срез в области половой бурсы



192

192. *Azygia longa* (Leidy, 1851) (по Мюллеру, 1934)

а — от угря; *б* — от форели

Azygia micropteri (McCallum, 1921)

(Рис. 195)

Синоним: *Eurostomum micropteri* McCallum, 1921

Хозяин: рыба — *Micropterus salmoides.*
Локализация: кишечник.
Место обнаружения: Северная Америка (Нью-йоркский аквариум).

From SKRJABIN, VOL. 14

Eurostomum micropteri, ~~sp. nov.~~ MAC CALLUM 1921

(Fig. 79)

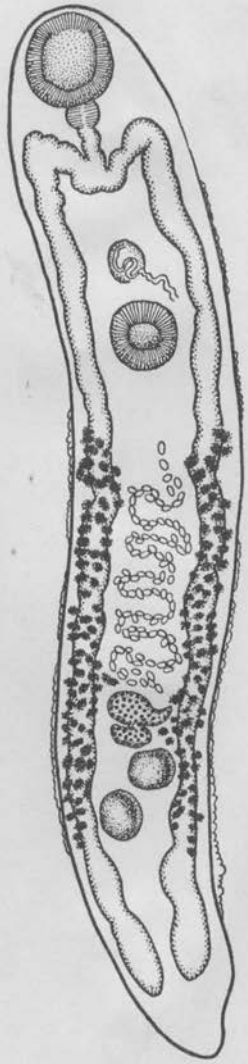
Host—*Micropterus salmoides.*
Habitat—Intestine.
Locality—New York Aquarium.

This worm was a solitary specimen in the intestine of a large-mouthed black bass. It was obtained on April 6, 1915, and as it is a parasite of a game food fish, it should be recorded.

The mouth is usully large, much larger than the acetabulum, and this prominent feature has determined the name. The pharynx is relatively large and is somewhat urn-shaped—no prepharynx and a rather short post-pharynegeal oesophagus which empties into wide coeca. These latter recurve irregularly for some distance before extending to near the posterior end of the body. The genital pore is large and is situated just anterior to the acetabulum. The cirrus can be seen overlaying the pore, but no cirrus sac or even vasa deferentia can be traced. The ovary is a coiled tubular structure and is situated in front of the testes, which are one in front of the other and all three organs are situated toward the posterior end of the worm. The uterus is not very voluminous but is filled with eggs. The vitellaria extend over the middle half of the body. The skin is smooth and unarmed.

Measurements of E. micropteri

Length	4.00 mm.
Width	.80 mm.
Diameter of mouth	.480 mm.
Diameter of acetabulum	.280 mm.
Egg	.040 × .024 mm.



195

195. *Azygia micropteri* (McCallum, 1921) (по Мак Кэллуму, 1921) (синоним: *Eurostomum micropteri* McCallum, 1921)

O. VELIPORUM LEPTOTHECA (Fig. 25-27). DOLLFUS, 1937

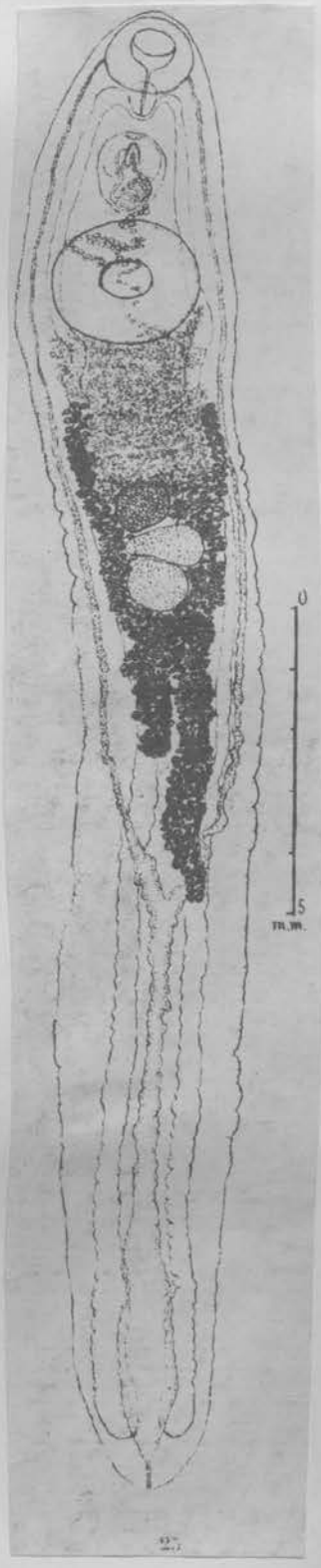
Matériel étudié : *a*) 1 exemplaire monté in toto et quelques coupes ayant servi à A. Villot (1878) (1) pour sa description de « *Distoma insigne* Diesing » (2) et provenant de l'estomac d'un *Echinorhinus spinosus* (Gmel.), de Roscoff (Finistère).

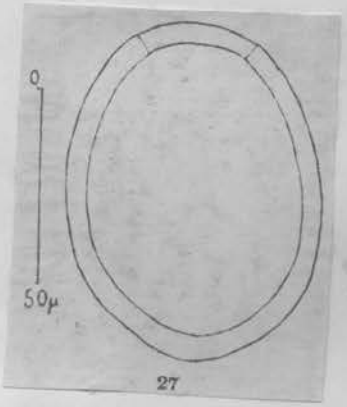
b) 2 exemplaires provenant de l'estomac de *Torpedo marmorata* Risso, de Casablanca (Maroc). *Ipse leg.*, 5-6-1924.

Comme dimensions, Villot (1878, p. 3) a indiqué 40 à 50 mm. de long et 6 à 10 mm. de large, disant « les échantillons conservés en alcool sont ordinairement réduits à la moitié de leur longueur naturelle ». L'exemplaire original que j'ai sous les yeux, monté dans la glycérine, est long de 35 mm., large de 5 mm. 5. Pour les œufs, Villot (1878, p. 13) a donné 90 $\mu \times 70$ μ, avec une épaisseur de coque de 4 μ, mais j'ai obtenu des mesures un peu différentes, par exemple 93×62, 96×66, 97×62, avec une épaisseur de coque de 6 à 7 μ.

Les exemplaires que j'ai récoltés à Casablanca étaient d'une taille peu différente ; en alcool le plus grand mesure 35 mm. de long sur 5 mm. 5 de large (1), les œufs mesurent 86×68 μ (j'ai aussi trouvé, par exemple, 82×67.5, $85 \times 65,5$, $85 \times 68,5$, 86×70, 87×67, $87,5 \times 62$, 88×65), l'épaisseur de la coque, mesurée près du pole postérieur, est de 6 μ 5 environ, je n'ai pas trouvé d'épaisseur inférieure à 6 μ.

Les vitellogènes, selon Villot (1878, p. 12), débutent de chaque côté du corps en avant des glandes génitales et se réunissent postérieurement, formant un V. Chez l'exemplaire de Villot que j'ai sous les yeux, le début des vitellogènes est un peu en arrière du milieu de la masse





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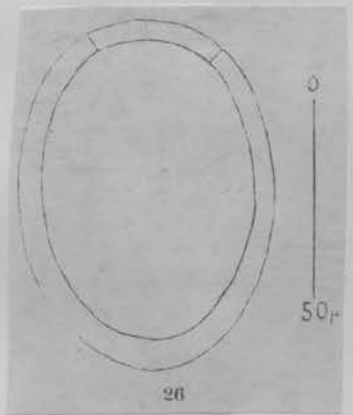

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FIG. 25. — *Otodistoma veliporum leptotheca* n. s. sp., de *Torpedo marmorata* Risso. Casablanca (Maroc), 5-6-1924, ipse leg. Exemplaire *in toto* vu par la face ventrale, coloration au carmin. Remarquer que les vitellogènes sont en follicules très serrés et s'étendant à peine en arrière de la bifurcation de la vessie ; ce caractère permet immédiatement de reconnaître qu'il ne s'agit pas de *restoidex*.

FIG. 26-27. — Œufs de la forme *leptotheca*, de *Torpedo marmorata* Risso. Casablanca (Maroc), 5-6-1924.

(over)

utérine et la réunion en arrière des glandes génitales forme un Y.

La description donnée d'*O. veliporum* (Crepl.) par G. Mühlschlag (1914, pp. 204-217, fig. texte A-D, pl. IX, fig. 1-3) d'après des exemplaires de provenance inconnue, correspond à ma forme *leptotheca*; le plus petit exemplaire contenant des œufs, étudié par Mühlschlag mesurait 12 mm. de long sur 3 mm. 5 de large, le plus grand 55 mm. sur 5 mm. 5. Pour les œufs, Mühlschlag (1914, p. 216) a trouvé 90×53 avec une épaisseur de coque de 7 μ. Mühlschlag a observé les vitellogènes s'étendant du côté gauche presque jusqu'au niveau de l'acetabulum et, du côté droit, pas tout à fait si loin en avant ; il a indiqué qu'ils deviennent confluents un peu en arrière du testicule postérieur, puis (d'après la figure 1 de la pl. IX) se séparant à nouveau, forment deux branches postérieures très inégales, l'une cessant au niveau de la bifurcation de la vessie, l'autre s'étendant un peu au delà. Chez mes exemplaires de Casablanca (voir fig. 25) le début des vitellogènes a lieu vers la mi-hauteur de la masse utérine, il y a réunion en arrière des testicules, mais les deux branches, inégales, ne s'étendent pas tout à fait aussi loin, postérieurement, que chez l'exemplaire figuré par Mühlschlag, ne dépassant pas la bifurcation de la vessie, néanmoins la disposition est semblable.

Si la réunion des vitellogènes en arrière du testicule postérieur est constante chez *veliporum leptotheca*, elle n'est cependant pas particulière à cette forme, je l'ai constatée chez tous les spécimens de la forme *pachytheca* que j'ai examinés et elle peut se rencontrer aussi chez *cestoides* ! Miss M. V. Lebour (1908, p. 39, pl. III, fig. 5), qui a étudié *cestoides* sous le nom de *veliporum*, a figuré les vitellogènes débutant, antérieurement, un peu en avant du niveau du milieu de la masse utérine, par une bande de follicules de chaque côté et se réunissant en arrière du testicule postérieur en une masse remplissant toute la moitié antérieure de l'espace situé entre ce testicule et l'extrémité postérieure du corps (1).

(1) E. M. Layman et M. M. Borovskov (1926, p. 12, fig. 1) ont figuré un *Otodistoma*, chez lequel les follicules vitellogènes, plutôt clairsemés, commencent beaucoup en avant de la moitié de la masse utérine, se réunissent en arrière du testicule postérieur, puis se séparent plus ou moins distinctement, la branche droite étant un peu plus longue que la gauche et s'étendant jusqu'à une petite distance en avant de la terminaison du cœcum droit.

Cet *Otodistoma*, provenant de *Raia radiata* Donov. de la côte Mourmane, a été considéré comme *cestoides* par E. M. Layman et M. M. Borovskov, qui ont donné, pour les œufs 98 μ 54 à 82 μ 15 de long sur 49 μ 17 de large (sans indiquer l'épaisseur de la coque). Par une coïncidence curieuse, Layman (1930, p. 76) a aussi donné 98 μ de long sur 49 μ de large (sans indiquer l'épaisseur de la coque), pour les œufs d'un *Otodistoma* provenant de *Squalus acanthias* L., de la région de Vladivostock et qu'il a rapporté à *veliporum*.

Je suppose que, pour rapporter leurs *Otodistoma* à *cestoides* et à *veliporum*, les auteurs russes ont surtout tenu compte de l'hôte : *cestoides* chez *Raja*, *veliporum* chez *Squalus*.

J'aurais désiré réexaminer leur matériel pour mesurer l'épaisseur des coques et les dimensions des œufs, car, chez aucune des formes de *veliporum* qui me sont connues, la largeur des œufs n'est aussi faible que celle indiquée par Layman (49 μ).

Ma demande de communication des *Otodistoma* étudiés par Layman et Layman et Borovskov est restée sans réponse.

T. Odhner (1911, pp. 515-517) avait considéré que la disposition des vitellogènes pouvait permettre de distinguer *veliporum* de *cestoides*, indiquant que, chez *veliporum*, les vitellogènes formaient de chaque côté du corps une très étroite bande de follicules serrés, débutant en arrière de la mi-longueur de la masse des sinuosités utérines, alors que, chez *cestoides*, les follicules moins serrés, débutaient au niveau de la mi-longueur de la masse utérine ou même généralement en avant. Ni pour *veliporum* ni pour *cestoides*, Odhner n'a parlé d'une réunion des vitellogènes en arrière des testicules ; à propos de l'extension postérieure du vitellogènes, il dit seulement que, chez *cestoides*, des follicules peuvent anormalement se trouver jusqu'à l'extrémité postérieure du corps.

Justin Poirier (1885, pp. 569-570), Edw. Linton (1898, p. 522), A. R. Cooper (1915, p. 184), etc., n'ont pas non plus noté cette réunion postérieure des vitellogènes : Poirier a dit seulement, à propos de « *D. insigne* » : glandes en grappe très nombreuses situées de chaque côté du corps et s'étendant en avant, très peu au delà de l'ovaire et, en arrière, très loin jusque dans le tiers postérieur de la longueur du corps ». Linton (1901, p. 421) a simplement noté : vitellogènes latéraux ne s'étendant pas jusqu'à l'extrémité postérieure de l'intestin. Par contre, Manter (1926, pp. 152-154) a insisté sur la disposition des vitellogènes, disant que les rangées latérales de follicules, occupant chacune un côté, restent, ordinairement distinctement séparées et que des dispositions telles que celle figurée par Miss Lebour sont des variations peu communes. On trouve communément, rapporte Manter, des interruptions ou espaces dépourvus de follicules, mais elles n'ont certainement pas de signification spécifique dans le genre *Otodistoma* et, en ce qui concerne le niveau où débutent les follicules, auquel Odhner a prêté une importance pour la distinction des espèces, il ne peut pas être pris en considération. La réunion en arrière des testicules a été observée plusieurs fois par Manter, qui l'a considérée comme « unusual » et a noté qu'elle pouvait n'avoir lieu que sur quelques millimètres ; il arrive aussi, remarque Manter, que la bande unique résultant de la réunion, ne soit pas médiane, mais sur un des côtés.

Rappelons encore que, d'après S. J. Johnston (1902, p. 328 et pl. XIII, fig. 1) les vitellogènes de *pristophori* débutent très peu en arrière du niveau du milieu de la masse utérine, se réunissent immédiatement en arrière du testicule postérieur, se séparent ensuite en deux branches d'égale longueur (disposition en H). Remarquons que ces vitellogènes, en follicules arrondis, sont peu serrés et s'étendent postérieurement assez loin au delà de la bifurcation de la vessie (1).

Cette rapide revue des renseignements publiés sur la disposition des vitellogènes chez les *Otodistoma* semble bien prouver qu'aucune des dispositions observées ne peut être invoquée comme critérium permettant de séparer régoureusement les diverses formes les unes des autres ; cependant on peut dire que, si le niveau antérieur auquel débutent les vitellogènes n'est pas caractéristique, le niveau postérieur atteint est très généralement différent chez *veliporum* et *cestoides* : chez *cestoides* les vitellogènes s'étendent beaucoup plus loin et dépassent de beaucoup la bifurcation de la vessie ; il est en outre certain qu'à maturité les vitellogènes de *veliporum* sont en follicules beaucoup plus serrés et nombreux que chez *cestoides*.

(1) Par ses follicules vitellogènes plus clairsemés et s'étendant plus loin postérieurement que ceux de *veliporum*, l'espèce de S. J. Johnston s'apparente à *cestoides*, mais elle s'en sépare par l'épaisseur de la coque des œufs, qui correspond à celle des œufs de *veliporum*.

O. VELIPORUM PACHYTHECA (Fig. 31-39). DOLLFUS, 1937

Matériel étudié : *a*) 4 exemplaires provenant de *Torpedo narce* Risso, 1re croisière du S. S. « Savoie », côte de Mauritanie, Théodore Monod *leg.* (février 1923).

b) 1 exemplaire provenant de *Torpedo marmorata* Risso, 1re croisière océanographique du S.S. « Vanneau », côte atlantique du Maroc (Station IV, 8° 22 E., 33°30 N., prof. 47 m., fond de sable vasard à *Brissopsis*, 29-6-1923). J. Liouville et R. Ph. Dollfus *leg.*

c) 2 exemplaires trouvés fixés à la paroi de l'estomac de *Torpedo marmorata* Risso, croisière océanographique du S. S. « Pourquoi pas ? », Saint-Jean-de-Luz (Basses-Pyrénées), Station CXIII, 4-7-1914. *Ipse legi.*

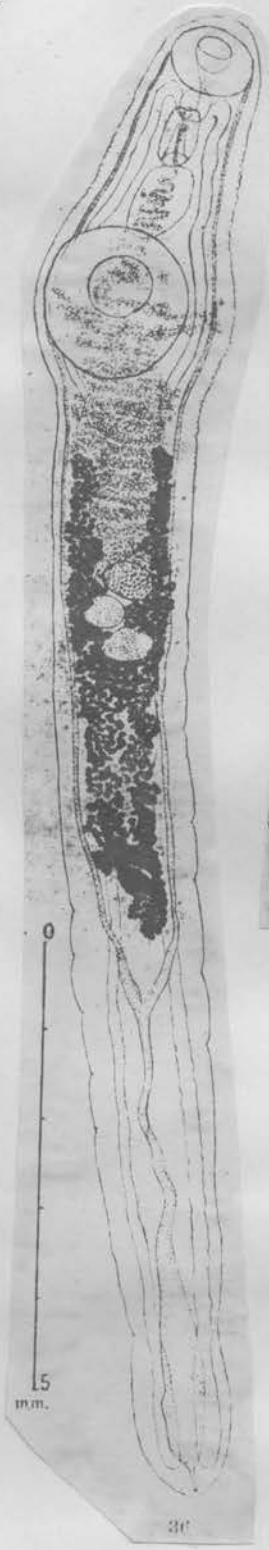
Des quatre spécimens récoltés par Th. Monod chez *Torpedo narce* Risso et conservés en alcool, deux sont courts et larges (env. 11 mm. de long sur 5 mm. 5 de large et 12 mm. sur 5), un long et étroit (env. 14 mm. sur 3 mm. 5) et un intermédiaire (fig. 32), cela tient évidemment dans une certaine mesure à leur état de contraction ou d'extension au moment de la mort, mais cela montre que l'habitus des individus de *veliporum* varie beaucoup et que si l'on est en présence d'un individu dont toute la partie du corps située en arrière de l'acetabulum est large et linguiforme, on ne peut reconnaître à première vue qu'il s'agit d'un *Otodistoma*.

Le spécimen de *Torpedo marmorata* Risso, de la Station IV du « Vanneau » est relativement court et large (long. env. 20 mm., largeur 6 mm.), ceux de *T. marmorata* Risso de Saint-Jean-de-Luz ont cette forme longue et étroite qui est la plus habituelle pour les *Otodistoma* ; le plus grand est long de 29 mm., large de 4 mm. 5 ; le plus petit est long d'environ 16 mm. 6, large de 2 mm. 1 (par suite d'aplatissement, la largeur se trouve exagérée sur la figure 36, au niveau de l'acetabulum).

Dans les lots *a*, *b*, *c*, le rapport des diamètres des ventouses est à très peu près le même et correspond à 3 : 5.9 ; les vitellogènes débutent un peu en avant de la mi-longueur de la masse utérine, se rejoignent en arrière du testicule postérieur, restent unis sur une longueur très variable et se séparent à nouveau en deux bandes latérales généralement très inégales, parfois extrêmement courtes ; le plus souvent les vitellogènes cessent au voisinage de la bifurcation de la vessie, soit un peu en deçà, soit un peu au delà.

Les dimensions des œufs diffèrent chez les individus des lots *a*, *b* et *c*. Chez ceux du lot *a* (Mauritanie) j'ai trouvé, pour la longueur, de 83 à 105 μ ; pour la largeur de 55 à 70 μ (par exemple 83×55, 83×57, 85×56,5, 85×66,5, 85×67, 97×71, 99×66, 100×69, 105×70. Le maximum d'épaisseur de la coque était, selon les œufs, de 8 à 10 μ, près du pôle postérieur ; je n'ai pas constaté d'œuf dont la région la plus mince ait moins de 7 μ et la région la plus épaisse moins de 8 μ.

Chez l'individu du lot *b* (Maroc), j'ai trouvé, pour la longueur des œufs, de 112 à 130 μ ; pour la largeur, de 62 à 75 μ (par exemple 112×62, 115×73, 118,5×68, 118,5×70, 120×62, 121×75, 124×75, 125×70, 125×75, 125×76, 130×75). Le maximum d'épaisseur de la coque n'était, pour aucun œuf, inférieur à 9 ou supérieur à 10 μ.



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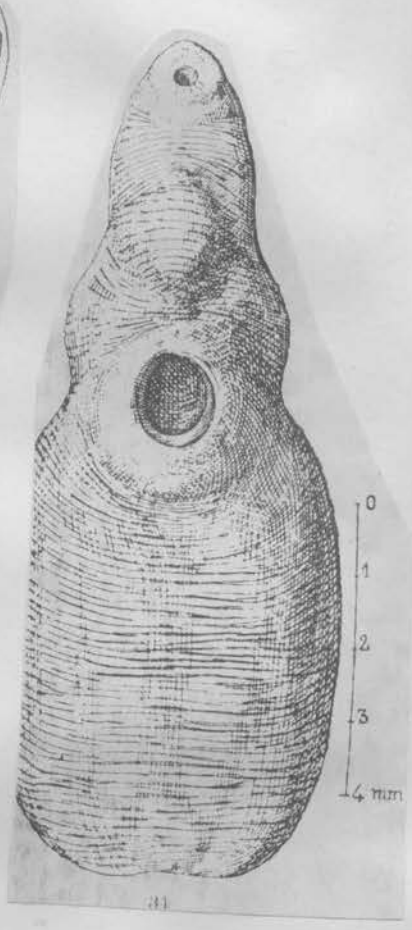

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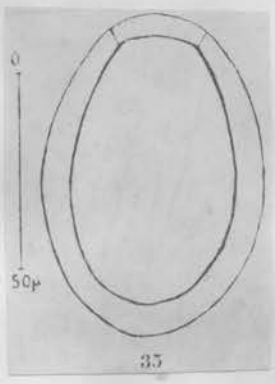

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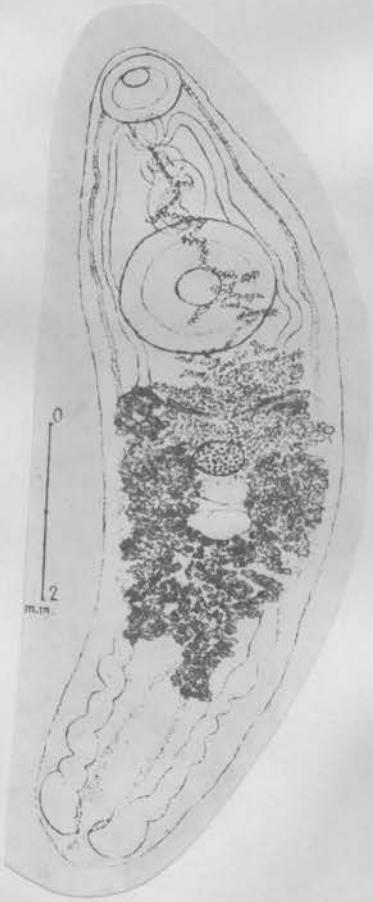

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œufs à coque brun foncé, prêts à être pondus (contenant déjà, pour la plupart, un miracidium) et d'autre part des œufs à coque non colorée, un peu moins âgés (contenant un embryon inachevé) mais ayant déjà leurs longueur et largeur définitives.

J'ai noté les dimensions suivantes (mesures dans l'eau après conservation en eau formolée), par exemple, pour les œufs à coque brun foncé :

Long.	Larg.	Epaiss^{r} équatoriale de la coque	Epaiss^{r} au pôle postérieur
		—	—
101,25	×62,5	6,25	7,5
102,5	×62,5	6,25	8,75
106,25	×61,25	5,	7,5
102,75	×62,5	6,25	6,25
112,50	×68,75	5,	8,75
pour les œufs à coque claire :			
98,75	×61,25	7,5	7,5
106,25	×60,	6,25	7,5
106,25	×62,5	6,25	8,75
107,5	×62,5	6,87	6,87
108,75	×62,5	6,25	6,25

Quelques coques atteignaient une épaisseur de 10 μ au pole postérieur.

Si on examine côte à côte un grand nombre d'œufs ayant, les uns la coque brun foncé, les autres la coque presque incolore, avec tous les passages entre les deux, il apparaît que, à mesure que les œufs deviennent plus âgés, leur coque, en devenant plus dure et plus foncée, diminue légèrement en épaisseur, sauf au pôle postérieur ; c'est pourquoi j'ai tenu compte de l'épaisseur maximum de la coque (au pôle postérieur) et pas seulement de l'épaisseur moyenne ou de l'épaisseur équatoriale.

Par leur habitus (comme par la longueur, la largeur, l'épaisseur de la coque des œufs), les spécimens récoltés à Biarritz chez *Scymnus* se rapprochent beaucoup des *pachytheca* récoltés à Saint-Jean-de-Luz (localité voisine de Biarritz) chez *Torpedo* ; comme leurs œufs sont, en moyenne, sensiblement plus petits que ceux de *veliporum veliporum*, j'estime qu'il s'agit d'une forme plus voisine de *pachytheca* que de *veliporum veliporum*, mais cependant intermédiaire.

Chez les individus du lot *c* (Saint-Jean-de-Luz), les dimensions des œufs étaient intermédiaires à celles notées pour *a* et *b* ; la longueur variait de 95 à 100 μ, la largeur de 61 à 67 μ (par exemple 95 ×61, 96 ×62, 97 ×66, 100 ×67). Le maximum d'épaisseur de la coque était, selon les œufs, de 8 μ 5 à 9 μ. Aucun œuf examiné n'avait dans sa partie la plus mince, moins de 7 μ et dans sa partie la plus épaisse plus de 9 μ.

Après comparaison et vérification de mes mesures d'épaisseur de la coque des œufs, j'estime possible de considérer les *veliporum* à œufs dont la coque atteint 8 à 10 μ d'épaisseur, comme constituant une forme particulière ou sous-espèce, avec le nom de *pachytheca* (1).

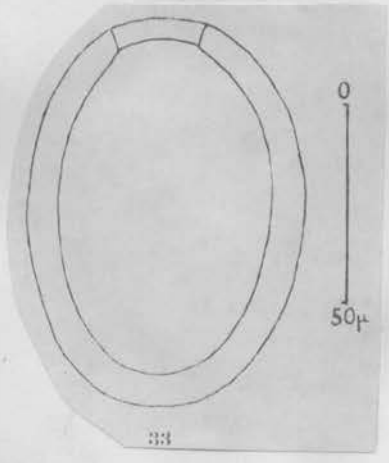
— Spécimens intermédiaires à *veliporum pachytheca* et *veliporum veliporum*. — Ainsi qu'il ressort de ce qui précède, il n'y a pas de coupure très accentuée entre les trois formes : *veliporum*, *leptotheca* et *pachytheca*. Je l'ai constaté plusieurs fois et je pense utile de mentionner ici que je l'ai vérifié encore récemment par l'étude de spécimens mis aimablement à ma disposition par Paul Arné, directeur du Musée de la Mer, à Biarritz (Basses-Pyrénées). Ces spécimens avaient été récoltés dans l'estomac d'un *Scymnus lichia* Bonnaterre pêché près de Biarritz (16-5-1935) ; ils mesurent, par exemple : 52 52 mm. sur 5 mm., 32 mm. sur 6 mm., 25 mm. sur 4 mm.

Chez un même spécimen, j'ai prélevé d'une part des

(1) La mesure des œufs présente de réelles difficultés et n'est que rarement tout-à-fait précise : si l'on compare plusieurs micromètres, on constate généralement qu'ils ne concordent pas exactement. En dehors des erreurs d'évaluation tenant aux instruments de mesure, il y a celles tenant à la déformation des œufs. Il ne faut mesurer que des œufs en bon état : il arrive souvent que des œufs qui, sous une certaine incidence, paraissent en bon état, se montrent « collapsed » sous une incidence différente. Le choix des œufs à mesurer est très important et il ne faut pas se fonder sur les dimensions des premiers œufs produits ou des œufs proches de l'ovaire. Manter (1926, p. 152) a remarqué que, au début de la maturité sexuelle, chez des *Otodistoma* de *Raja* de l'Atlantique, les 15-20 premiers œufs (les plus antérieurs dans l'utérus) mesuraient seulement la moitié de la longueur des autres : de 22 μ 8 à 30 μ env. (le plus petit œuf étant le plus antérieur), avaient une coque très mince et une forme presque sphérique ; plus près de l'ovaire, les œufs plus récemment formés étaient plus grands, mais sans dépasser 68 μ et aussi à coque mince ; l'exemplaire (long. 11 mm. 5) était encore trop jeune pour que l'on puisse faire état des dimensions de ses œufs.

Pour toutes mes mesures d'œufs d'*Otodistoma*, j'ai employé le même micromètre et je ne me suis adressé qu'à des individus complètement adultes dont j'ai prélevé, chaque fois que c'était possible, des œufs dans l'utérus, en pratiquant une incision sur le bord de l'acétabulum.

Se fonder sur des mesures d'œufs pour distinguer les diverses formes d'*Otodistoma*, semble bien incertain ; j'estime néanmoins que si, après avoir mesuré une vingtaine d'œufs mûrs, normaux, je trouve constamment une épaisseur de coque de 9 à 10 μ (évidemment il ne faut pas mesurer l'épaisseur de l'opercule, généralement bien plus faible), je suis en droit de considérer qu'il s'agit d'une forme d'*Otodistoma* distincte de celle pour laquelle, par exemple, Cooper (1915, p. 184) a indiqué une épaisseur de coque de l'œuf de 2 μ 8.



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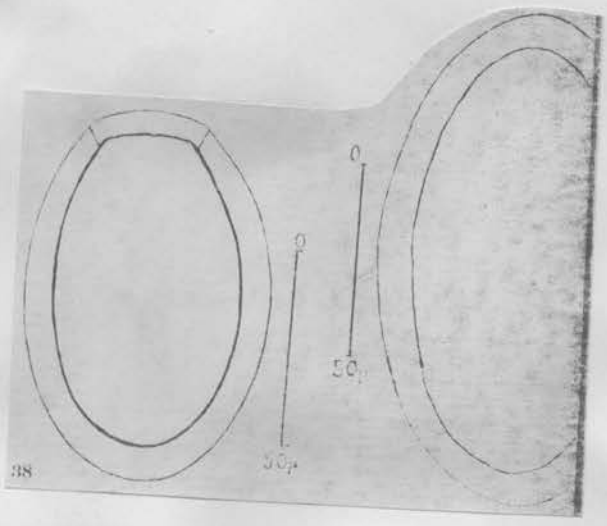

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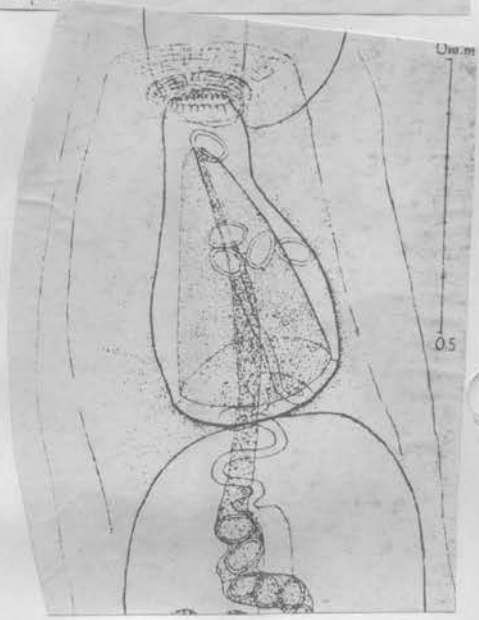


Otodistomum veliporum veliporum Dollfus, 1937

Matériel étudié : *a*) 2 exemplaires récoltés à Arcachon (Gironde), fixés sur la région branchiale d'un *Hexanchus griseus* (Bonnaterre). (L. Cuénot leg., mars 1902).

b) 3 exemplaires trouvés dans l'estomac d'un *Hexanchus griseus* (Bonnaterre), pêché sur la côte française de l'Atlantique, par 17°20 de latitude N. (à peu près par le travers de Belle-Ile). P. Desbrosses leg., 19-4-1934.

Les exemplaires du lot *a* mesurent respectivement : 65 mm. de long sur 5 mm. de large et 50 mm. sur 5 ; je les considère comme correspondant à la forme type de l'espèce de Creplin.

Les œufs mesurent 110 à 120 μ sur 69 à 75 μ (j'ai mesuré, par exemple : 110 × 70, 110 × 72, 111 × 71, 112 × 69, 112 × 73, 112 × 75, 113,5 × 72, 120 × 71). L'épaisseur de la coque de l'œuf atteint 8 μ au voisinage du pole postérieur ; dans les parties les plus minces de la coque, l'épaisseur est toujours d'au moins 6 μ. Chez le deuxième exemplaire, la ventouse orale mesure 1 mm. 77 de diamètre, la ventrale environ 3 mm. 1, ce qui correspond à peu près à 3 : 5,7. Les vitellogènes forment, de chaque côté du corps, une étroite bande débutant un peu en arrière du milieu de la masse des sinuosités utérines ; les deux bandes, en arrière du testicule postérieur, se rapprochent jusqu'à venir en contact, tout en restant indépendantes, puis s'éloignent l'une de l'autre et accompagnent chacune un caecum, pour se terminer un peu en avant de la bifurcation de la vessie.

Les exemplaires du lot *b* sont, je crois, les plus grands connus ; ils mesurent, après fixation à chaud par l'eau formolée de 98 à 101 mm. de long sur 5 mm. 2 à 5 mm. 5 de largeur maximum.

Les œufs mesurent en moyenne 124 μ sur 86 ; j'ai mesuré, par exemple : 118 × 88, 119 × 86, 120 × 86, 122 × 88, 124 × 82, 124 × 85, 125 × 88, 126 × 88, 126 × 90, 126 × 92, 128 × 88, 128 × 90, 130 × 86. L'épaisseur de la coque, à peu près égale à tous les niveaux, est presque partout de 7 μ ; au moins 6 μ 4, au plus 7 μ 5. Il s'agit d'œufs à maturité, contenant déjà le miracidium complètement formé ; ce miracidium, un peu plasmolysé, mesure 80 μ de long sur 40 à 50 μ de large.

Les exemplaires du lot *b* se rapprochent de la forme *leptotheca* par l'épaisseur de leur coque et de la forme *pachytheca* par la longueur des œufs, si l'on considère le plus grand nombre des œufs et non pas quelques œufs isolés aberrants par leurs dimensions ou l'épaisseur de leur coque. C'est ainsi que je n'ai pas tenu compte d'œufs plus petits (116 μ 25 × 76 μ 25) à coque épaisse de 10 μ, trouvés à côté d'œufs à coque d'épaisseur normale (6 μ 4 à 7 μ 5), ni d'œufs beaucoup plus grands (135 × 92 μ) à coque relativement mince (6 μ 2).

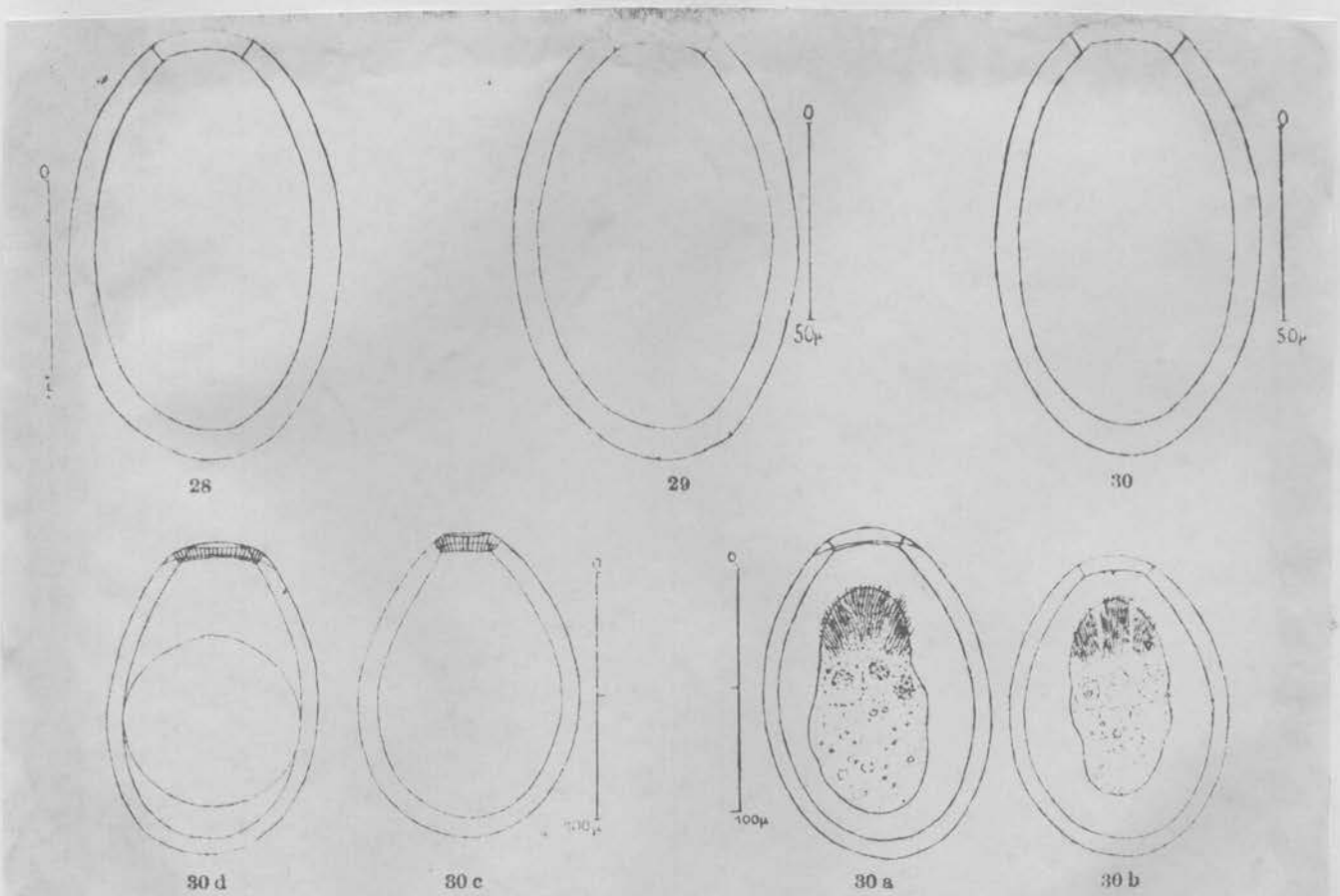


Fig. 28, 29, 30. — *Otodistoma veliporum* (Creplin) *veliporum* n. s. sp., d'*Hexanchus griseus* (Bonnaterre). Arcachon (Gironde), mars 1902, L. Cuénot leg. Œufs.

Fig. 30*a*-30*b*-30*c*-30*d*. — *Otodistoma veliporum* (Creplin) *veliporum* n. s. sp. d'*Hexanchus griseus* (Bonnaterre). Golfe de Gascogne, 47°20' lat. N. (travers de Belle-Ile) P. Desbrosses leg., 19-4-1934. Œufs. — *a*) Œuf de taille dépassant la moyenne ; *b*) œuf de taille à peu près moyenne ; *c-d*) œufs ayant perdu leur opercule, remarquer les cannelures de la surface de déhiscence.

Azygia perryii FUJITA, 1918

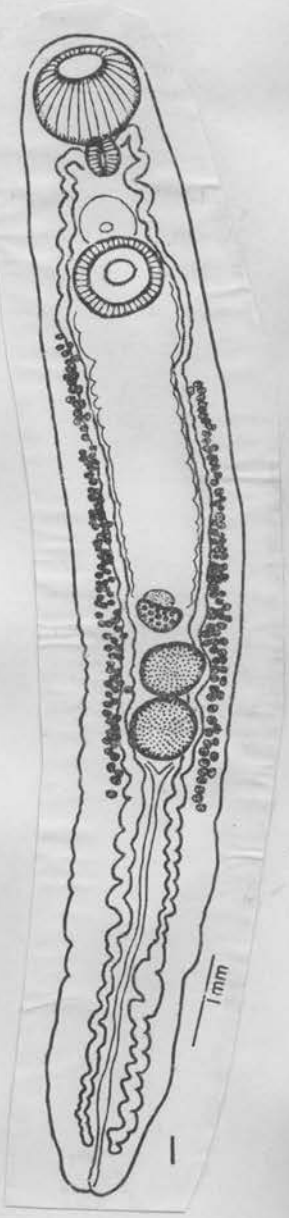
(Figs. 1-4)

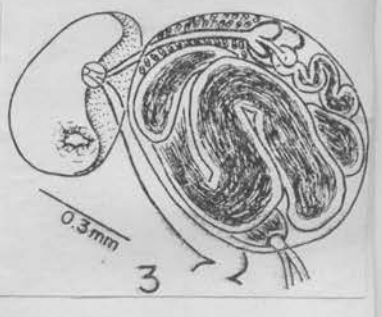
Hosts. *Hucho perryi*, from the stomach, esophagus, buccal cavity and branchial cavity; and *Salvelinus leucomaenis*, from the buccal cavity. This parasite was found in *H. perryi* from the Ashibetsu (May 10, 1977), Hororo (June 17, 1969), Kottaro (February 15, 1976), Kushiro (April 24, 1966), Numahoro (April 24, 1977), Settsuri (April 10, 1976), Bekanbeushi (December 1, 1968) and Toraibetsu (May 30, 1976) rivers. The number of worms in each fish was not always counted. A single *H. perryi* from the Bekanbeushi River harbored 40 flukes in the stomach and 6 in the buccal cavity. One *S. leucomaenis* from the Ashibetsu River (May 10, 1977) contained two worms only in the buccal cavity. Trematode specimens which were recovered from frozen fish and fixed in ethanol were liable to melt into shapeless masses while being stained with carmine, and so such useless ones were thrown away before observation.

Specimens. NSMT—Pl 2177-2185 from *H. perryi*; and 2186 from *S. leucomaenis*.

Description. Measurements based on 10 unflattened oviferous specimens in balsam from *H. perryi*. Body large, elongate-cylindrical, bluntly rounded at both ends, nonspinose, very extensile and contractile and reddish in life, 6.02-14.28 mm long by 1.63-2.10 mm wide. Oral sucker subterminal, 0.73-1.22 mm long by 0.90-1.43 mm wide. Ventral sucker smaller than oral sucker, situated about one-fifth of body length from anterior extremity, 0.69-1.02 mm long by 0.79-1.22 mm wide; sucker width ratio 1: 0.81-0.89. Prepharynx practically lacking. Pharynx ellipsoidal, 0.38-0.49 mm long by 0.26-0.37 mm wide, with ratio of length to width being 1: 1.04-1.35; ratio of oral sucker length to pharynx length 1:2.00-2.50. Esophagus very short, inverted T-shaped. Intestinal ceca sinuous, terminating a little apart from posterior end of body. Ovary usually reniform, near middle of body, 0.20-0.47 mm long by 0.41-0.61 mm wide. A thin muscular capsule just preovarian, enclosing distal portion of oviduct, distal portion of common vitelline duct, ootype complex and proximalmost coils of uterus, connected to ovary. LAURER's canal long, opening through a single pore. Seminal receptacle absent. Uterus folding transversely in intercecal field from capsule to ventral sucker; metraterm well developed. Eggs operculate, fully embryonated when laid, 50-57 by 28-32 μm in formalin. Testes spheroidal, almost tandem, slightly postovarian, 0.31-0.92 mm long by 0.49-0.82 mm wide. Cirrus pouch globular, thin-walled, in front of ventral sucker or a little overlapping it, containing long voluminous convoluted tubular seminal vesicle and prostatic complex; pars prostatica thick-walled, dilated at its proximal end to divide into 4 to 6 compartments. Ejaculatory duct and metraterm running side by side through a low conical genital cone to open on its top; hermaphroditic duct almost lacking. Genital atrium very spacious. Genital pore median, anterior to ventral sucker. Vitelline follicles extracecal in hindbody, extending between level of posterior edge of ventral sucker or slightly behind it and anterior third to half of distance from hind testis to posterior end of body in unflattened specimens. Excretory vesicle Y-shaped, divided just posterior to hind testis.

Notes. Some of sexually mature worms, when flattened and mounted in balsam, measured up to 40 mm long by 3.3 mm wide; their eggs, 42 to 51 by 25 to 28 μm. The vitelline glands always began some distance posterior to the ventral sucker. The parasite proved to tend, as does *A. sebago* WARD, 1910[1], to leave the host's stomach, its primary habitat, soon after the death of the host, to migrate actively up the esophagus into the buccal or branchial cavity, and at times even to the exterior to crawl on the skin. This may be the reason why FUJITA's material came from unusual sites, such as the buccal and branchial cavities and pectoral fin(s), of *H. perryi*[2].



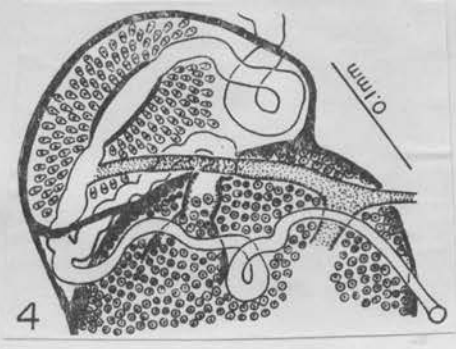


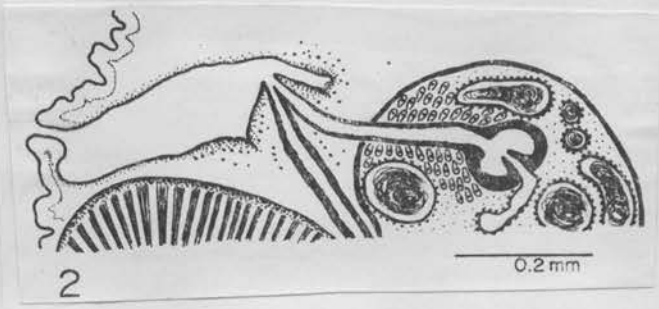
eastern Hokkaido

-OVER-

Discussion. *A. perryii* was described by FUJITA[2] in 1918 as a new species from formalin-preserved flukes obtained from *H. perryi* taken in Lake Kussharo, from which the Kushiro River originates. No trematodes have since been recorded under the name of *A. perryii* in Japan. FUJITA's specific description with scanty measurements given is not completely adequate. I was unable to locate any of FUJITA's original specimens in Japan. Available to me were two cotypes of the species in a vial (USNM Helm. Coll. No. 50017) loaned from the National Parasite Collection, U. S. D. A., Beltsville, Maryland, U. S. A. However, they were tinged too dark gray to permit detailed studies of their morphology, which therefore must rest on the previous brief observations of them by MANTER[3]. Comparison of the present specimens from *H. perryi* and *S. leucomaenis* and FUJITA's and MANTER's descriptions, as combined with considerations of the host fish species and localities, leads to the conclusion that they should be *A. perryii*. They also agree substantially with the form of the same species, as seen in BYKHOVSKAYA[4], from *H. perryi* in Sakhalin Island, U. S. S. R. The present observations suggest that FUJITA's specific diagnosis should be partly emended as follows: (1) the ootype is present; (2) a thin muscular capsule encloses the distal portion of the oviduct, distal portion of the common vitelline duct, ootype complex and proximalmost coils of the uterus; and (3) the cluster of Mehlis' glands within the capsule is just anterior to the ovary. MANTER[3] observed an elongate pharynx (0.24 mm long by 0.11 mm wide) in the smaller one (5.6 mm long) of the above-mentioned cotypes. I failed to ascertain this. The present specimens all had an ellipsoidal pharynx.

SEKI[5] reported trematodes, which he assigned to *A. lucii* (MÜLLER, 1776) LÜHE, 1909, from *S. leucomaenis* caught in Panketo, near Kushiro. I reexamined some of his whole-mounted (No. 373) and sectioned specimens borrowed from the collection of the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University, Sapporo. His parasite with a round pharynx is identical in morphology with the present one, *A. perryii*. SEKI's identification seems to have based largely on the egg size of his material (44 to 56 by 20 to 28 μm, most frequently 44 by 24 μm[5]), which is smaller than that (58 by 33 μm) given by FUJITA[2] for *A. perryii*. However, the present study shows wide variation in egg size of *A. perryii* (50 to 57 by 28 to 32 μm in formalin, and 42 to 51 by 25 to 28 μm in balsam), and the range of variation includes SEKI's measurements in it. Presumably *A. perryii* can be readily separated from *A. lucii* by a combination of an ellipsoidal pharynx (the ratio of length to width being 1: 1.04 to 1.35) and a larger sucker width ratio (1: 0.81 to 0.89); *A. lucii* has an oblong pharynx (the ratio, 1: 1.4 to 2.1) and a smaller sucker width ratio 1:0.71 to 0.77)[6]. The ratio of oral sucker length to pharynx length may constitute one of other differences. The ratio was 1: 2.00 to 2.50 in the present *A. perryii*, but it was 1: 1.25 to 1.78 in nine flattened adult whole-mounts of *A. lucii* about 8 to 22 mm long (NSMT—Pl 2190) from natural infection of *Esox lucius* in the G. D. R., identified and sent to me by Dr. ODENING.





Figs. 1-4. *Azygia perryii.* 1: entire body, ventral view. 2: sagittal section through terminal genitalia. 3: terminal genitalia, ventral view. 4: ootype complex, dorsal view.

From SHIMAZU, 1981

Azygia perryii Fujita, 1918

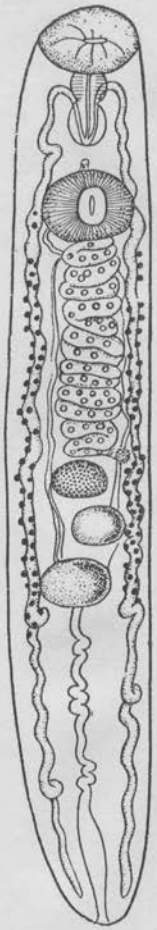
(Рис. 196)

Хозяин: пресноводная рыба — *Hucho perryi* Breevoort.

Локализация: полость рта, наружная и внутренняя поверхности жаберной крышки, жабры.

Место обнаружения: Япония.

FROM SKRJABIN, VOL. 14



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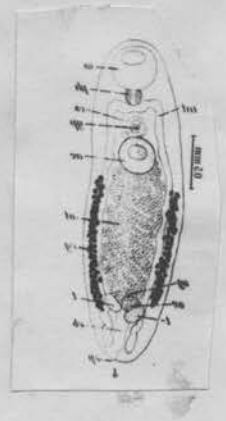
196. *Azygia perryii* Fujita, 1918 (по Фужита, 1918)

Azygia pristipomai Tubangui 1928

Related to Azygia (Hassallius) hassalli Goldberger 1911 but the vitellaria do not extend posteriorly beyond the level of the second testis.

Length 1.93 to 3.20 mm. by 0.86 to 1. mm.
Plump, short to long oval, rounded at both ends.
Oral sucker 0.34 to 0.45 mm.
Ventral sucker 0.31 to 0.38 mm., between anterior and middle thirds.
Prepharynx absent, pharynx 0.16 to 0.18 mm. across; esophagus absent; ceca in moderate zig-zags to posterior end.
Genital pore median, immediately preacetabular.
Testes entire, oval, intercecal but slightly overlapped by ceca, asymmetrical, at middle of last body fourth, left testis usually more advanced anteriorly than the right. Cirrus sac circular, thinwalled, 0.23 to 0.25 in diameter; incloses slightly coiled and dilated seminal vesicle, pars prostatica and ejaculatory duct.
Ovary entire, transversely oval, intertesticular, on a level with left testis and slightly to one side of median line; 0.18 by 0.12 mm. Shell gland compact at anterior border of ovary. Uterus in transverse coils between ovary and acetabulum.
Vitellaria in rounded follicles, extracecal, extending from immediately behind posterior level of acetabulum to testes. Eggs yellowish, oval, operculated, 66 to 68 by 40 to 44 u.
Excretory pore caudoterminal; bladder moderately dilated reaching to region of testes or beyond at which point it bifurcates.
Host: Pristipoma hasta Bloch
Location: Intestine
Locality: Los Banos, Laguna Province, Luzon



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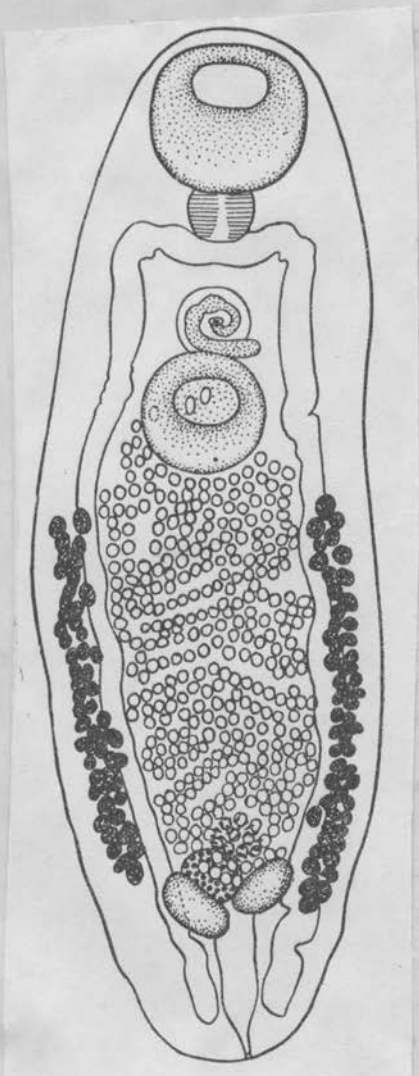

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197. *Azygia pristipomai* Tubangui, 1928 (по Тубангуи, 1928)

FROM SKRJABIN, VOL. 14

Velasquez 1938

Study of specimens shows that they are identical with ***Azygia pristipomai*** Tubangui, 1928. Unfortunately, Tubangui's type specimen was destroyed during the Japanese Occupation, World War II. Since Tubangui's report no additional record of this species has been presented, not because of its rarity but rather because of the paucity of workers in the field.

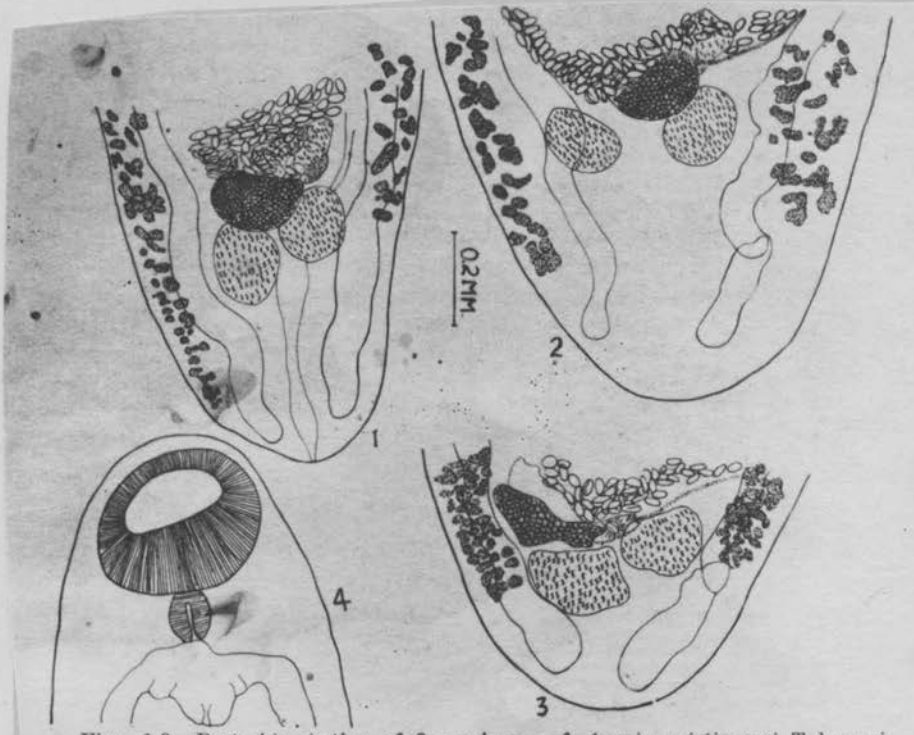
This species is here reported for the second time in a new host from the same lake but from a locality different from that of Tubangui's. Additional data on organs infected are also presented together with the variability of certain characters.

The general shape of the body, body measurements and relative proportions fall within the range of *Azygia pristipomai*, including the egg size (Table I).

It was noted that the extent of the vitellaria and the relative position of the genital organs were variable (Plate I, figs. 1-3). The presence of the oesophagus which Tubangui failed to see is shown in Fig. 4. A receptaculum seminis uterinum, not seen by Tubangui, was noted just above the ovary (Figs. 1 and 2). In one specimen (Fig. 3), the oötype was clearly discernible.

TOPOTYPES: U. S. Nat. Mus. Helm. Coll. No. 38305; and

Department of Zoology, University of the Philippines' Helm Coll. Nos. 480 (1) f_2; 500 (1) f.



Figs. 1-3. Posterior portion of 3 specimens of *Azygia pristipomai* Tubangui showing the variation in the relative position of the genital organs and vitellaria.
Fig. 4. Anterior portion of a worm showing the oesophagus.
All figures drawn with the aid of a camera lucida.

TABLE I. Comparative measurements of *Azygia pristipomai* Tubangui and related genera in mm.

	Azygia pristipomai Tubangui 1928			*Azygia longa* (Leidy)**	*Eurostomum micropteri* MacCallum 1928	*Gomtiotrema attu* Gupta 1953
	Tubangui	Velasquez	Mean*			
Length	1.93-3.2	1.4-3.42	2.452	2.10-7.0(9)	4.00	5.7-12.4*** 11.96
Width	0.86-1.00	0.35-1.4	0.829	0.42-0.91(9)	0.80	1.42-2.2*** 2.1
Oral sucker diameter	0.34-0.45	0.25-0.595	0.381	0.31-0.63(7)	0.480	1.00
length		0.22-0.5	0.318	0.28-0.6(7)		0.89
Acetabulum diameter	0.31-0.38	0.2-0.52	0.321	0.25-0.46(9)	0.280	0.88
length		0.18-0.385	0.256	0.25-0.45(7)		0.74
Acetabulum to anterior end		0.425-1.32	0.777			1.9
Pharynx diameter	0.16-0.18	0.065-0.19	0.101	0.11-0.25(7)		0.26
length		0.05-0.15	0.096	0.14-0.28(7)		0.24
Genital pore to anterior end		0.41-1.0	0.679			0.58
Eggs	0.066-0.068 by 0.040-0.044	0.056-0.065 by 0.035-0.039		0.042 by 0.025(36)	0.040 by 0.024	0.048-0.06 by 0.030-0.032

*Mean of 15 specimens.
**_Azygia longa_ (Leidy) based on Linton's description. Parentheses indicate number of specimens measured.
***Range. Other measurements in this column are from the type specimen as given by Gupta.

Azygia robusta Odhner, 1911

(Рис. 198)

Хозяева: лососи — *Salmo hucho*, *S. fario*, таймень, нельма, щука, налим, ерш.

Локализация: желудок, кишечник.

Места обнаружения: Венский музей, СССР (оз. Байкал, реки Енисей, Обь, Лена, Иртыш).

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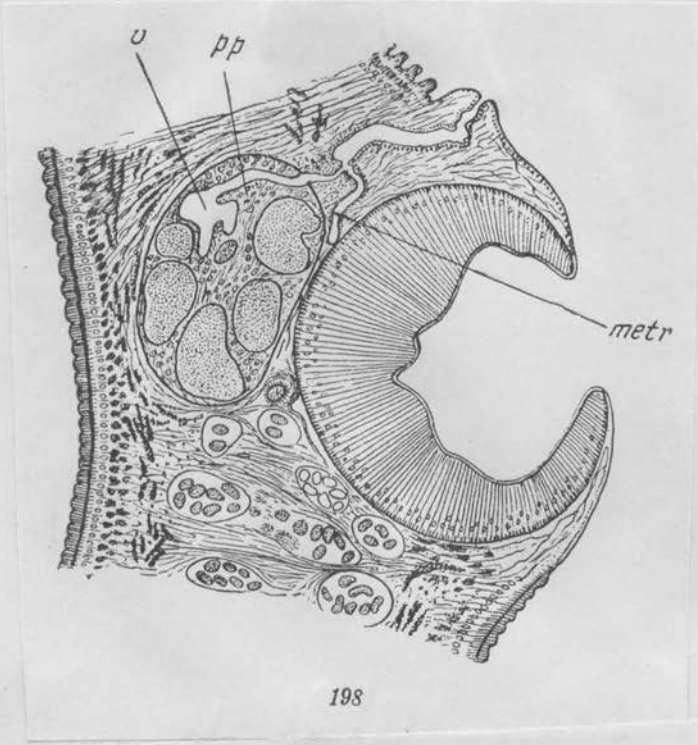

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198. *Azygia robusta* Odhner, 1911 (по Однеру, 1911)

Продольный срез концевого участка полового аппарата: *metr* — метратерм; *pp* — простатическая часть; *v*—verschlußapparat

Azygia stunkardi ~~sp.nov~~. S.L.RAI, 1964

DIAGNOSIS. The worms in the living condition are reddish brown and show movements of contraction and expansion. They measure 6·52–7·28 × 1·66–1·94 mm. Cuticle non-spinous. Oral sucker 0·75–0·87 × 0·74–0·85 mm., bigger than ventral sucker. Ventral sucker lies in the first third of body and measures 0·58–0·72 × 0·07–0·78 mm. A very small prepharynx is present (observed only in the living condition). Pharynx globular, 0·23–0·27 × 0·23–0·25 mm. Oesophagus notched posteriorly 0·25–0·39 × 0·17–0·53 mm. Intestinal caeca sinuous, extending to posterior end of body. Excretory pore at the posterior extremity; stem of excretory bladder bifurcates into two arms opposite middle of ovary. Testes tandem, oval, located at the extreme posterior end of body. Anterior testis measuring 0·23–0·40 × 0·48–0·52 mm. lies at a distance of 6·56 mm. from the anterior end of a worm measuring 7·28 mm. in length. Posterior testis measures 0·27–0·33 × 0·40–0·55 mm. and its posterior face either touches the posterior body wall (as in the type specimen) or lies 0·19 mm. away from it. Cirrus sac preacetabular measuring 0·20 × 0·21 mm. It contains a coiled vesicula seminalis measuring 0·148 × 0·06 mm., a pars-prostatica and a small cirrus. Genital pore median just in front of ventral sucker (Figs. 1, 2). Ovary transversely oval, 0·19–0·23 × 0·53–0·55 mm. lying 5·83–5·92 mm. from the anterior end. Receptaculum seminis present just in front of ovary; it measures 0·204 × 0·314 mm. Mehlis' gland on the left side just in front of ovary, measures 0·099 × 0·085 mm. Eggs oval, yellow in colour, 0·073–0·077 × 0·029–0·036 mm. Vitelline follicles commencing opposite posterior border of ventral sucker or a little behind (Fig. 1), may or may not overlap the intestinal caeca; they extend to posterior end of body. The vitelline follicles measure 0·091–0·15 × 0·029–0·075 mm. A small prominent vitelline reservoir is present.

HOST. *Chana* (*Ophicephalus*) *striatus* Bloch.

LOCATION. Stomach.

LOCALITY. Jabalpur.

DISCUSSION

Azygia stunkardi sp.nov. resembles *A. longa* (Leidy, 1851), *A. volgensis* (V. Linstow, 1907), *A. sebago* Ward (1910), *A. perryi* Fujita (1918), *A. micropteri* (syn. *Eurostomum micropteri* MacCallum, 1921) and *A. amuriensis* Zmeev (1936) in the posterior extent of the vitelline follicles, i.e. the vitelline follicles extend beyond the posterior testis. It differs from all other known species of the genus *Azygia* Looss, 1899, in the position of the gonads at the extreme posterior end of the body, the size of the eggs and the fact that the vitellaria reach the posterior extremity. Other differences of less significance are the notch at the end of the oesophagus and the coiled vesicula seminalis. It is doubtful if these are constant features; the latter may be correlated with age or with the number of sperms present. The species is named in honour of Dr H. W. Stunkard.

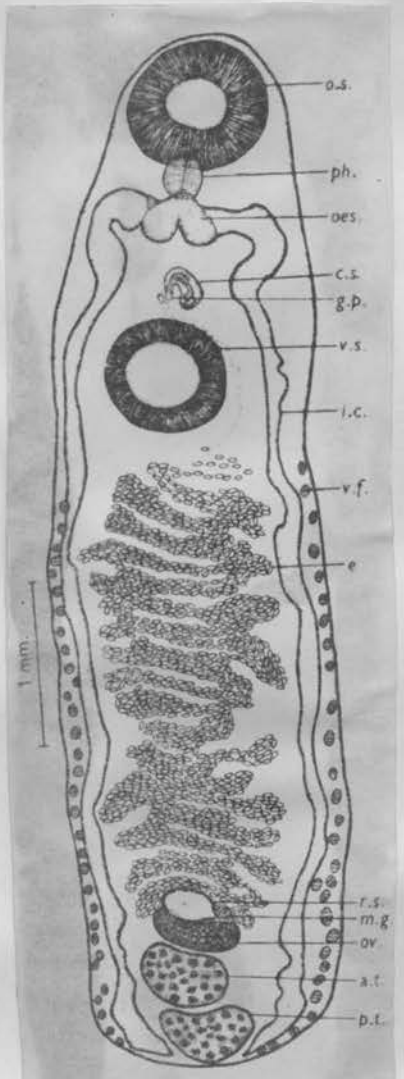

Fig. 1. *Azygia stunkardi* sp.nov., dorsal view.

Fig. 2. *Azygia stunkardi* sp.nov.; sagittal section of anterior region showing cirrus sac.

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of Cyclorchis, but latter has op

Azygia volgensis (Linstow, 1907) Odhner, 1911

(Рис. 199)

Синонимы: *Ptychogonimus volgensis* Linstow, 1907; *Distomum volgensis* (Linstow, 1907) Lühe, 1909

Хозяева: судак — *Lucioperca sandra*, сом — *Silurus glanis*, щука — *Esox lucius*, косатка Бражникова — *Liokassis brazhnikowi*.

Локализация: кишечник.

Место обнаружения: СССР (реки Волга и Амур).

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199. *Azygia volgensis* (Linstow, 1907) (по Змееву, 1936)

Azygia sp. Milicer, 1938

Хозяин: окунь — *Perca fluviatilis.*
Локализация: кишечник.
Место обнаружения: Польша.

Найденные экземпляры отличаются от *A. lucii* тем, что они, по сравнению с этим видом, короче и соответственно шире. Яичник и семенники лежат близко друг к другу, тогда как у *A. lucii* семенники одинаково удалены от заднего конца тела и от яичника. Размеры внутренних органов и присоски такие же, как у *A. lucii*, но яйца меньше. Милицер говорит, что имела в своем распоряжении очень большой материал (230 экземпляров) *A. lucii*, найденных у щук, полученных с варшавского рынка, и на основании этого материала она утверждает, что два экземпляра, о которых идет речь, к этому виду не принадлежат. Однако малое число найденных трематод не позволяет ей установить новый вид и описать его, тем более что отличительные признаки очень трудно уловить.

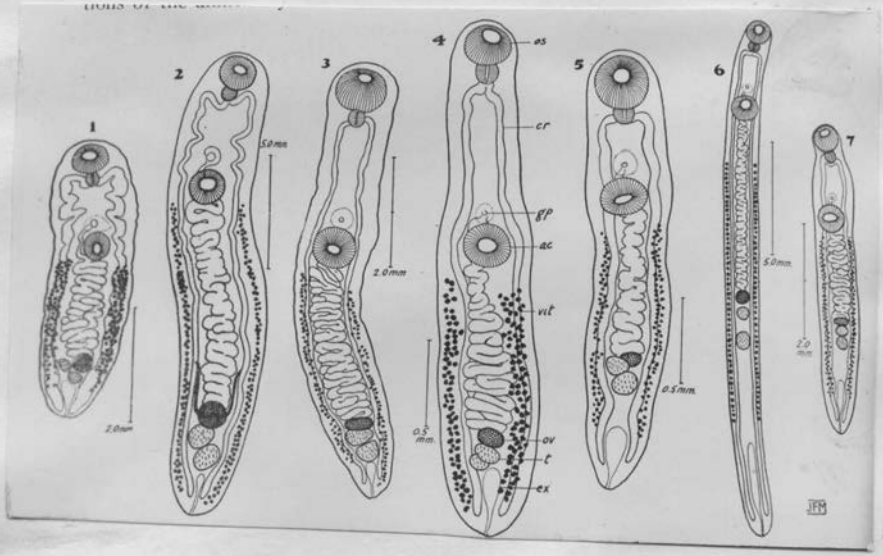
Литература: Milicer, 1938, стр. 107—108.

FROM SKRJABIN, VOL. 14

From VanCleave & Mueller 1934

Figs. 1-5. Azygia angusticauda

Figs. 6-7. Azygia longa



APHANHYSTERIDAE ~~n. fam.~~ YAMAGUTI, 1958

Family diagnosis. — Large elongate distomes, covered with thick cuticle. Oral sucker surmounted by preoral lobe. Pharynx absent. Intestine produced anteriorly at the angle of its backward bending. Acetabulum enclosed in body fold, near anterior extremity. Testes postacetabular; cirrus pouch pre-acetabular. Genital pore postbifurcal. Ovary pretesticular, postacetabular. Uterus dorsal to acetabulum. Vitellaria Y-shaped, enclosing ovary and testes between its two arms. Excretory vesicle tubular. Parasites of fishes.

Type genus: *Aphanhystera* Guiart, 1938.

Aphanhystera Guiart, 1938

Generic diagnosis. — Aphanhysteridae: Body fairly large, flattened, cuticle very thick, transversely wrinkled. Oral sucker subventral, with distinct preoral lobe, followed immediately by intestinal bifurcation. Pharynx absent. Ceca turned back on themselves before running backwards, terminating at posterior extremity in contact with excretory vesicle. Acetabulum enclosed in a body fold with anterior opening, near anterior extremity. Testes obliquely tandem, postacetabular. Cirrus pouch oval, large, between two suckers, bulging ventrally. Genital pore behind intestinal bifurcation. Ovary postacetabular, pretesticular; shell gland preovarian. Vitellaria Y-shaped, on each side of ovary and testes and confluent from behind posterior testis to level of posterior third of body. Uterus dorsal to acetabulum. Excretory vesicle reaching to posterior end of vitellaria. Parasitic in stomach of selachians.

Genotype: *A. monacensis* Guiart, 1938 (Pl. 34, Fig. 445; Pl. 36, Fig. 465), in *Centroscymnus coelopepis;* Mediterranean.

Aphanhysteridae Yam, 1938 — perhaps = Azygiidae. ?

Genre **Aphanhystera** n. g. Guiart, 1938

(de ἀφανής, invisible et ὑστέρα, utérus)

9. **Aphanhystera monacensis** n. g., n. sp.

(Pl. A, fig. 4 ; Pl. II, fig. 22-23)

Campagne de 1894 : Stn. 376. Entre le 28 mars et le 1er avril 7 *Centroscymnus cœlolepis* (dont 5 femelles et 2 mâles) mesurant seulement 23 à 32 centimètres de longueur, sont capturés dans la grande nasse, à 2230 mètres de profondeur, au large de Monaco[1].

Dans leur estomac on recueille trois grands Distomes, qui sont conservés en alcool, aussi ne sont-ils pas dans un excellent état de conservation. Ils mesurent respectivement :

20mm	de longueur,	5mm	de largeur et	1mm5	d'épaisseur
17mm	» ,	3mm5	»	1mm	»
16mm	» ,	3mm5	»	1mm	»

La moyenne est donc de $17^{mm}6 \times 4^{mm} \times 1^{mm}1$. Il s'agit donc d'un Distome assez grand, mais de forme très aplatie.

A première vue il se distingue par son aspect extérieur : l'extrémité antérieure est assez allongée, presque pointue, la ventouse buccale est subventrale ; la ventouse ventrale saillante est beaucoup plus grande et entourée d'une large région mamelonnée à la façon de certains Distomes du genre *Hirudinella*. D'ailleurs, comme chez ceux-ci, la cuticule très épaissie est fortement plissée transversalement ; l'extrémité postérieure est de forme arrondie.

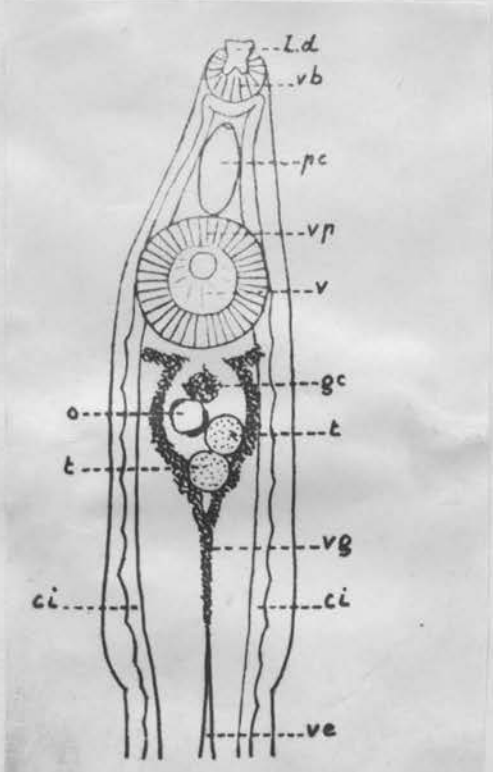
Le plus petit exemplaire ayant été monté en préparation microscopique, nous a montré certaines caractéristiques de sa structure malgré son mauvais état de conservation (Pl. II, fig. 23).

La bouche présente une lèvre dorsale très nette ; la ventouse buccale est immédiatement suivie par la bifurcation intestinale, sans interposition de pharynx ; les culs-de-sac se replient assez fortement en avant, avant de se diriger en arrière où ils arrivent au contact de la vésicule excrétrice sans que nous ayons pu voir

[1] L'étiquette du flacon portait *Spinax niger*, toutefois les Poissons ont été déterminés par le professeur Roule comme étant des *Centroscymnus cœlolepis* (Fasc. LII, p. 120).

s'ils communiquent avec elle ; la région intermédiaire entre les ventouses est occupée par une volumineuse poche du cirre ovalaire, qui fait nettement saillie sur la face ventrale ; à son extrémité antérieure s'ouvre le pore génital, en arrière de la bifurcation digestive ; la ventouse ventrale est en partie fermée par un voile, qui ne laisse qu'un petit orifice vers la partie antérieure ; en arrière de cette ventouse se voient d'avant en arrière, sur la ligne médiane, la glande coquillière, l'ovaire et les deux testicules. Le champ qu'occupent ces organes est entouré par les deux glandes vitellogènes, qui commencent sur les côtés et en arrière de la ventouse pour venir se fusionner en arrière du testicule postérieur, le vitellogène impair continuant jusqu'au niveau du tiers postérieur du corps ; les vitellogènes ont donc ici une forme en Y. La vésicule excrétrice s'étend de là jusqu'à l'extrémité postérieure. En somme les principaux caractères sont jusqu'ici le manque de pharynx, la grande longueur de la poche du cirre et la forme des glandes vitellogènes, mais le caractère le plus important est le peu de visibilité de l'utérus, d'où le nom que nous avons donné au genre ; l'utérus en effet est presque entièrement caché par la ventouse ventrale ; ceci le distingue nettement des genres *Azygia* et *Otodistoma*, où il existe un vaste utérus, situé entre la ventouse ventrale et l'ovaire, aussi bien que du genre *Ptychogonimus*, où l'utérus n'ayant pas la place pour se développer entre l'ovaire et la ventouse ventrale se replie latéralement pour aller occuper la région postérieure du corps.

Nous avons donné à cette espèce le nom de *monacensis* pour rappeler qu'elle fut trouvée chez un Sélacien des grandes profondeurs au large même de Monaco.



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