1990

Binder 052, Didymozobidae C-D [Trematoda Taxon Notebooks]

Harold W. Manter Laboratory of Parasitology

Coeliodidymocystis n. g.
Yamaguti, 1970

GENERIC DIAGNOSIS: Didymozoidae, Didymozoinae. Complete hermaphrodite, encysted in pairs in thin-walled sac. Body divided into a slender forebody and a large oval hindbody flattened on the side on which the two occupants are pressed against each other; on this flat side of the type species is an elliptical, dark grey excavation some distance away from the point where the forebody is attached. Oral sucker globular or longer than wide. Pharynx entirely absent in the type species, but cylindrical and muscular in *C. abdominalis*. Esophagus very short in the type speices. Ceca narrow and parallel in forebody, but divergent as they enter the hindbody, and running arcuately toward posterior end of hindbody. Testes consisting of two long, often irregularly winding tubules contiguous end to end, and extending along boundary between flat and convex sides. Vas deferens running in median field of forebody alongside metraterm. Genital pore ventral to oral sucker. Ovary tubular, branched, confined to anterodorsal region of hindbody. Seminal receptacle present. Vitellaria tubular, irregularly branched, extending along almost entire convex side of hindbody not occupied by ovary, ending in a large number of tubules. Uterus occupying all available space of hindbody, clearly divided into structurally different portions. Egg reservoir long, wide, with large deeply-staining cells in its wall; last portion differentiated into strongly muscular metraterm. Mature eggs embryonated, slightly asymmetrically oval. Excretory system unknown. Parasitic on serosa side of pyloric ceca or small intestine of marine teleosts.

TYPE SPEICES: *C. kamegaii* n. sp., in *Katsuwonus pelamys*; Hawaii.

OTHER SPECIES: *C. abdominalis* (Yamaguti, 1938) n. comb., syn. *Didymocystis abdominalis* Yamaguti, 1938, in *Katsuwonus pelamys*; Japan.

226. ***Coeliodidymocystis kamegaii*** n. g., n. sp.
(Fig. 228) Yamaguti, 1970

HABITAT: Encysted in pairs on serosa of pyloric ceca of *Katsuwonus pelamys;* Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63802.

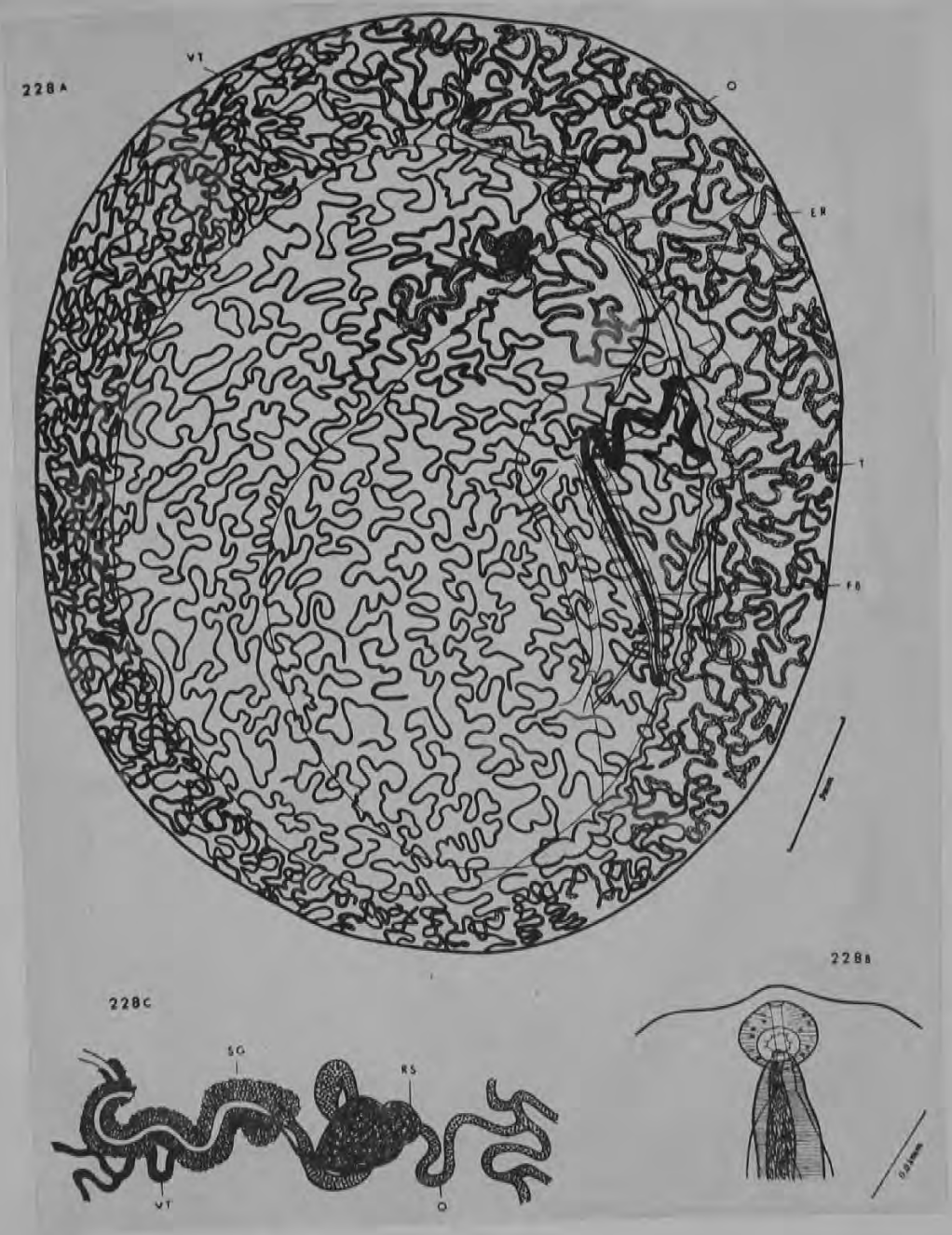
DESCRIPTION (based on 20 strongly flattened whole mounts): Cyst subglobular, thin-walled, up to about 20 mm in diameter. Forebody flattened cylindrical, 5.5-6.0 mm long by 0.35-0.45 mm wide, blunt-conical anteriorly, attached to flat surface of hindbody opposite genital junction across egg reservoir. Hindbody rounded saccular, 20-21.5 × 15-17.5 mm, flat on ventral side on which the forebody is attached; this flat surface is clearly delimited from the convex side by a circular to oval line. On the right side of the flat surface is an elliptical excavated area. In the fresh state this area is very conspicuous on account of its dark gray color, but no special structure can be detected on stained mounts. Oral sucker globular, terminal, 23-35 μ in diameter, weakly muscular, directly followed by very short (20-80 μ) esophagus, the anterior end of which shows a distinct cuticular thickening. There is no muscular pharynx. Ceca narrow in forebody, but wider in hindbody, where they widely curve round sinuously and appear to terminate at the posterior extremity. No acetabulum.

Testes two, tubular, often irregularly winding, contiguous end to end, exceptionally partly overlapping distally, about 22 mm in combined length in the type, extending arcuately along the boundary delimiting the flat surface from the convex area. Vas deferens running alongside metraterm in median field of forebody. Genital pore ventral to oral sucker.

Ovary tubular, consisting of a long winding trunk which divides dichotomously several times (four times in the type), extending largely to anterodorsal region of hindbody not occupied by vitellaria. Seminal receptacle large, saccular, 1.0-1.2 × 0.8-0.9 mm, divided into two unequal portions, connected by a narrow duct with genital junction, where the ovarian trunk joins the vitelline trunk and which lies in the type about 5 mm from the right end of the hindbody. The initial winding portion of the uterus, which is provided with a dense coat of shell gland cells, is more strongly winding; the longest third portion of the uterus, extending throughout the convex side of the hindbody, is a little wider than the second portion and contains yellowish, unstainable, maturing eggs, with its wall cells well stainable with hematoxylin as it approaches the fourth portion represented by the egg reservoir. This fourth portion, characterized by a prominent outer wall of large and small cells deeply stainable with hematoxylin, consists of a narrow proximal portion, a main middle portion functioning as the egg reservoir, and a tapering distal portion; the proximal portion is enlarged in the form of a funnel as it unites with the egg reservoir near its posterior end; the egg reservoir proper, up to 5.5 mm wide at its rounded blind posterior end in the type, extends from the left end of the hindbody, swerving toward the right anterior part of the hindbody, where it turns back on itself to be continued into the distal portion. The distal portion curves inwards and tapers to the same width as the metraterm, into which it passes near the base of the forebody. Metraterm sigmoid, 0.2-0.3 mm wide, provided with very thick inner wall of coarse circular muscles projecting prominently into the lumen; its distal portion running in the median field is narrower and less muscular, up to 0.2 mm wide at the base of the forebody, and tapers gradually toward the genital pore. Eggs embryonated when mature, slightly asymmetrically oval, 14-17 × 10-12 μ; contained miracidium with an apical group of minute spines, as in other *Didymocystis* species. Vitelline trunk winding, 1.7 mm lineally in the type, in which it runs first along the initial uterine duct, near the distal end of which it bifurcates several times, making a total of about 45 terminal branches. Excretory system not made out.

DISCUSSION: This genus is characterized by the habitat, the body shape, and the distribution of the male and female reproductive organs. The attributive of the compound generic name refers to the habitat. This species differs from *Coeliodidymocystis abdominalis* (Yamaguti, 1938) n. comb., (=*Didymocystis abdominalis* Yamaguti, 1938) from the body cavity of *Katsuwonus pelamys* of Japan, in the complete absence of a pharynx and in the very short esophagus. In *C. abdominalis* the oral sucker is longer than wide (90-114 × 75-84 μ), the pharynx is cylindrical and muscular, measuring 0.12-0.15 mm long by 75-78 μ wide, and the esophagus is definitely longer (0.8 mm). The present species is named for my technical assistant, Mr. Shunya Kamegai, in acknowledgment of his excellent service.

From Yamaguti, 1970
over


228A
VT
O
ER
T
FB
228B
228C
SG
RS
VT
O

Coelio didymocystis

Coeliotrema Yamaguti, 1938

Generic diagnosis. — Didymozoidae, Koellikeriinae: With marked sexual dimorphism. Encysted in pairs. Male: Body divided into a scoop-shaped forebody and reniform hindbody. Oral sucker and pharynx present. No acetabulum. Ceca terminating in voluminous tubes near posterior end of hindbody. Testes single, tubular, winding along convex side of hindbody. Vas deferens winding, uniting with uterus, opening outside ventral to oral sucker. Rudimentary female genitalia (rounded or elongate pyriform or long slender ovary, small tubular vitelline gland, long slender uterus and shell gland complex) may be observed in hindbody. Excretory vesicle voluminous, close to ventral side in hindbody, but narrow in forebody and reaching as far as postbifurcal point. Female: Body consisting of a scoop-shaped forebody and a large flattened hindbody which is doubled upon itself and encloses its own forebody as well as the whole male body at the middle of the flexure. Oral sucker and pharynx present. No acetabulum. Ceca terminating near posterior extremity of hindbody. Ovary and vitellarium tubular, branched, extending sinuously in dorsal and ventral parts of hindbody. Shell gland and receptaculum seminis near pre-equatorial lateral margin (usually right) of hindbody. Uterus filling up all available space of hindbody. Excretory system? Parasitic in body cavity of marine fishes.

Genotype: *C. thynni* Yamaguti, 1938 (Pl. 27, Fig. 353), in mesentery of *Thynnus thynnus;* Suruga Bay, Japan.

COELIOTREMA

Colocyntotrematinae ~~n. subfam.~~ Yamaguti, 1958

Subfamily diagnosis. — Didymozoidae: Complete hermaphrodites. Body divided into two regions. Forebody slender, free; hindbodies completely fused and forming a pumpkin-like or claviform body with a number of meridional furrows. The posterior extremity of this body assumes a dome-, mushroom- or disk-shape.

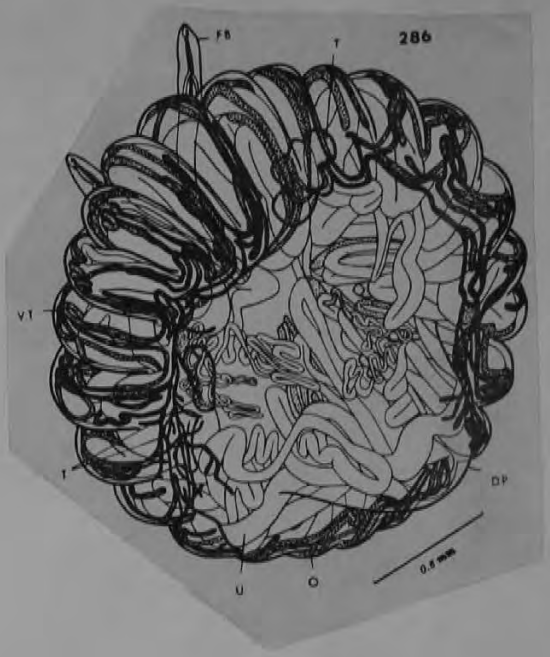
Key to genera of Colocyntotrematinae

Cyst pumpkin-shaped, with dome-like posterior extremity *Colocyntotrema*
Cyst inverted claviform, with discoid or mushroom-like posterior extremity ..... *Phacelotrema*

286. *Colocyntotrema auxis* Yamaguti, 1958
(Fig. 286) Yamaguti, 1970

HABITAT: Encysted on inner wall of intestine of *Auxis thazard* (local name "keokeo"); Hawaii.

DESCRIPTION (based on 15 whole mounts): Forebody flattened subcylindrical, 0.3-0.5 X 0.07-0.12 mm (0.4-2.0 mm long in my original description). Oral sucker pyriform to elliptical, 46-63 X 37-46 μ; pharynx globular, 21-42 μ in diameter; esophagus 60-110 μ long. Testes in two sets of two each, 0.13-0.4 mm long, each constricted into two rounded lobes, situated near ventral surface of fused hindbody. Genital pore ventral to oral sucker. Ovary, uterus, and vitellaria are not so clearly traceable on flattened mounts as on sections, on which the original description was based. Eggs bean-shaped, 11-14 X 8-9 μ.



Colocyntotrema Yamaguti, 1951

Generic diagnosis. — Didymozoidae, Colocyntotrematinae: Cyst round, depressed in front but projecting behind in form of dome, containing two completely hermaphroditic individuals, which are exactly equal in size, symmetrical in shape and fused completely at the hindbody. Cyst membrane thin and transparent. Blood capillaries from the host fish forming network over the surface of the hindbodies. Forebody slender, somewhat enlarged anteriorly. Fused hindbodies forming a pumpkin-like globe with a number of meridional furrows. Oral sucker and pharynx present. No acetabulum. Ceca extending into hindbody. Testes two-lobed, crooked, near anterior surface of hindbody. Ovary and vitellaria long, tubular, winding, branched, occupying peripheral area of hindbody. Receptaculum seminis and shell gland near posterior end of middle lobule of hindbody. Uterine coils occupying greater central part of hindbody; metraterm well differentiated. Common genital pore ventral to oral sucker. Excretory vesicle voluminous, in dome-like posterior lobe, apparently without external opening. Parasitic in pyloric ceca of marine fishes.

Genotype: *C. auxis* Yamaguti, 1951 (Pl. 28, Figs. 368—370), in pyloric ceca of *Auxis thazard*; Taizi, Wakayama Prefecture, Japan.

COLOCYNTOTREMA

Dermatodidymocystis n. g.
Yamaguti, 1970

GENERIC DIAGNOSIS: Didymozoidae, Didymozoinae. Complete hermaphrodite, encysted in pairs. Forebody slender, long, swollen in esophageal region, attenuated posteriorly, attached to hindbody subterminally. Hindbody semicircular, flattened laterally. Oral sucker terminal; weakly muscular; pharynx present; esophagus narrow; ceca more or less inflated and winding in hindbody, terminating near posterior extremity, often containing pgiment granules. Testes paired, near anterior end of hindbody; vas deferens straight. Genital pore ventrolateral to oral sucker. Ovary single, tubular, narrow, winding longitudinally between anterior end of hindbody and shell gland, or between shell gland and posterior extremity; seminal receptacle present. Vitellarium tubular, single, extending along convex margin of hindbody, recurved anteriorly. Uterus occupying all available space of hindbody; no egg reservoir; eggs bean-shaped, small, numerous, hatching *in utero*, especially in distal portion of uterus in hindbody and/or metraterm in forebody. Encysted in pairs in skin of marine teleosts.

TYPE SPECIES: *D. vivipara* n. sp., in *Parathunnus sibi* (local name "poonui") (type host) and *Neothunnus macropterus* (local name "ahi" or "sibi"); Hawaii.

OTHER SPECIES: *D. viviparoides* n. sp., in *Neothunnus macropterus* (type host) and *Parathunnus sibi*; Hawaii.

227. *Dermatodidymocystis vivipara* n. g., n. sp.
(Fig. 225) Yamaguti, 1970

HABITAT: Encysted in pairs in skin, especially on dorsal side, of *Neothunnus macropterus* (type host, local name "ahi" or "sibi") and *Parathunnus sibi* (local name "poonui"); Hawaii.

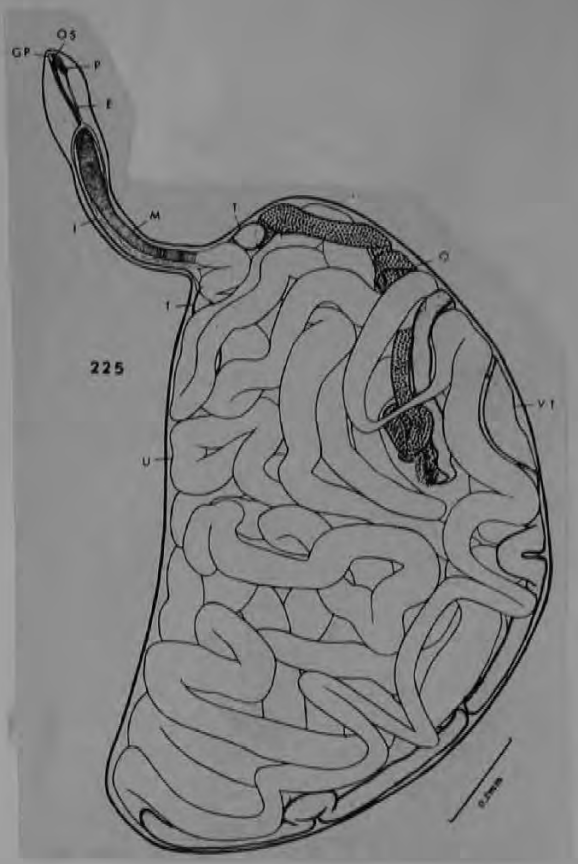
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63803.

DESCRIPTION (based on 36 whole mounts): Cyst round, flattened, about 0.8 X 0.7 mm. Forebody slender, 0.24-1.2 mm long, attenuated posteriorly, with maximum width of 30-110 μ in esophageal region, whence it tapers gradually toward blunt-pointed head end. Hindbody flattened semicircular, or flattened reniform, 0.36-1.5 X 0.17-0.7 mm, giving off forebody near anterior end of its flat margin, without distinct longitudinal furrow at anterior flat surface; flat edge by which the two partners are in direct contact with each other, usually somewhat concave; posterior end may be more attenuated than anterior end and curved toward flat margin. Oral sucker terminal, weakly muscular, barrel-shaped, 20-42 X 16-28 μ, directly followed by rudimentary pharynx 9-19 μ long by 10-28 μ wide. Esophagus narrow, 35-130 μ long. Ceca narrow in forebody, but more or less inflated and winding in hindbody, terminating near posterior extremity, often containing melanin-like pigment granules. No acetabulum.

Testes approximately sausage-shaped, paired, close to flat margin near anterior end of hindbody; vas deferens running straight forward in median field. Genital pore ventrolateral to oral sucker.

Ovary tubular, winding, up to 58 μ wide, extending from near distal end of vitelline gland to near base of forebody. Shell gland well developed close to distal ends of ovary and vitellarium. A small retort-shaped seminal receptacle present. Vitellarium single, slender, 0.65-1.3 mm long by 14-50 μ wide, extending along convex edge of hindbody from posterior extremity to beyond level of shell gland, where it is constantly recurved toward the shell gland. Uterus running back and forth longitudinally or transversely and occupying all available space of hindbody, not forming egg reservoir; metraterm not well developed; eggs bean-shaped, 13-17 X 9-12 μ; embryos hatching *in utero*, especially in terminal portion of uterus in hindbody and metraterm in forebody.

DISCUSSION: The present genus is characterized by being viviparous instead of ovoviviparous, by the vitellarium being simple and constantly recurved anteriorly, and by the hindbody being flattened semicircular, without a distinct longitudinal furrow at the anterior end of the hindbody, in strong contrast with *Didymocystis* or *Didymozoon*. This species closely resembles *Dermatodidymocystis viviparoides* (described below) in general anatomy, but differs from it in the testes being divergent, in the ovary being confined in the anterior half of the hindbody, in the vitelline gland not forming conspicuous inward loops, and, moreover, in the pronounced viviparousness. The attributive of the compound generic name refers to the peculiar habitat.

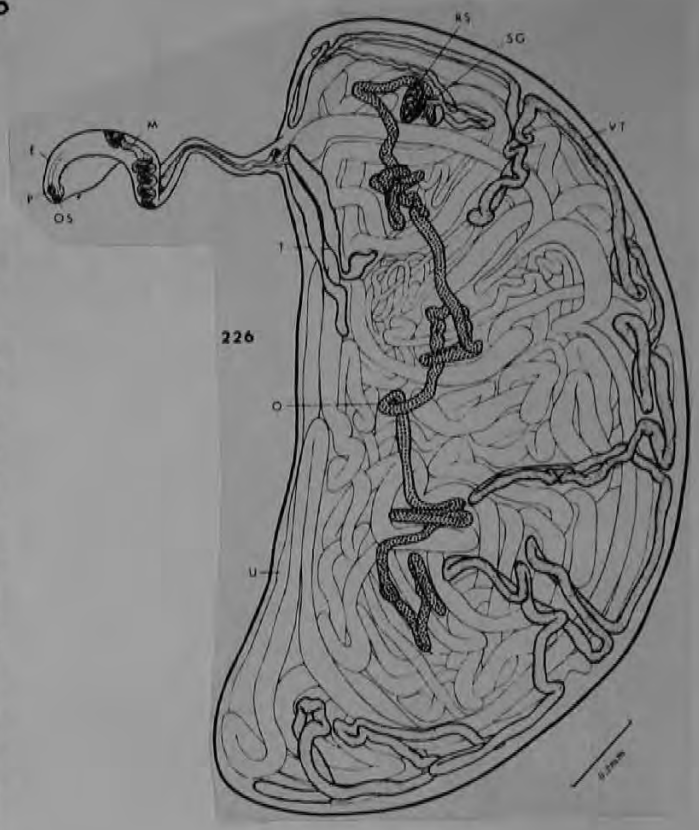


228. ***Dermatodidymocystis viviparoides*** n. sp.
(Fig. 226) Yamaguti, 1970

HABITAT: Encysted in pairs in skin of *Neothunnus macropterus* (type host) and *Parathunnus sibi*; Hawaii.
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63804.
DESCRIPTION (based on eight flattened whole mounts): Cyst round, flattened, larger than that of *Dermatodidymocystis vivipara*. Forebody spatulate, enlarged in esophageal region, 0.45-0.7 X 0.08-0.16 mm, attached to ventral side of hindbody near its anterior end. Hindbody flattened hemispherical, 1.2-2.7 mm long, 0.6-1.5 mm dorsoventrally; ventral edge by which the two partners are in direct contact flat or concave, with thin cuticle, not provided with longitudinal furrow or paired lobes anteriorly; dorsal side convex, covered with thick cuticle and provided with compact subcuticular parenchyma markedly thickened as compared with ventral side. Oral sucker 23-35 X 21-23 μ, directly followed by pharynx nearly as wide; esophagus narrow, 70-120 μ, long; ceca not traceable in hindbody.

Testes sausage-shaped, 0.2-0.5 mm long, 35-80 μ wide, directly juxtaposed close to ventral side of hindbody, with their distal ends at base of forebody. Vas deferens running straight forward along with metraterm, up to 10-16 μ wide. Genital pore ventrolateral to oral sucker.

Ovary tubular, single, long, 30-50 μ wide, extending windingly along longitudinal axis of hindbody, a little more ventrally than dorsally from shell gland to near posterior extremity. Seminal receptacle oval, 80 X 40 μ, situated together with shell gland at a distance of 0.17 mm from nearest dorsal surface. Vitelline gland tubular, single, long, 20-40 μ wide, extending along convex side of hindbody between two extremities, describing several conspicuous inward loops among uterine coils, connected with germiduct by a narrow passage. Initial portion of uterus localized in the type in the central area near the two most strongly convoluted portions of ovary, next portion of uterus largely transversely coiled and occupying subperipheral area of hindbody; distal portion, however, mostly in peripheral area of hindbody. No distinct egg reservoir. Metraterm not very muscular. Eggs bean-shaped, embryonated, 13-17 X 9-12 μ; some embryos may hatch in metraterm. Excretory system unknown.
DISCUSSION: In external and internal anatomy this species bears a definite resemblance to *Dermatodidymocystis vivipara*, but differs from it in the testes being juxtaposed, in the ovary not being confined to the anterior part of the hindbody, in the vitelline gland sending conspicuous inward loops, and in a much less pronounced viviparousness. The specific name refers to the close relationship to *D. vivipara*.



226

Dermatodidymocystis

Subfamily ***DIDYMOCODIINAE*** n. subfam.

Yamaguti, 1970

SUBFAMILY DIAGNOSIS: Didymozoidae. Completely hermaphroditic, with two separate slender forebodies and two hindbodies which are completely fused into a seacodium-like formation or a similar formation with primary, secondary and tertiary lobes. Testes tubular, in two close sets of branched lobes, opposite each other. Ovary and vitellaria tubualr, branched or unbrnached, extending into lobes of hindbody along with uterus. Enclosed in thin connective tissue membrane of host origin in pyloric region of marine teleosts. Including *Didymocodium* and *Allodidymocodium*.

Didymocodium n. g.

Yamaguti, 1970

GENERIC DIAGNOSIS: Didymozoidae, Didymocodiinae. Cyst wall thin, made up of connective tissue of host origin, without appreciable capillary network from host, closely applied to branched hindbody of worm. Two forebodies free, enclosed at base in oval slit on midventral surface of hindbody. Two hindbodies completely fused and divided into several primary lobes which in turn divide dichotomously into a number of secondary and tertiary lobules. Oral sucker and pharynx present, but no acetabulum. Ceca terminating blindly in hindbody. Testes in two sets of several, tubular, branched lobes each; each set situated lateral to base of forebody of its own side. Common genital pore immediately behind oral sucker. Ovary and vitellaria long, tubular, very narrow, irregularly branched; former strongly winding around testicular area and extending into every secondary and some tertiary lobules; latter largely in peripheral subcuticular area of each lobule, encircling uterine coils. Seminal receptacle present, giving off apparently nonfunctional Laurer's canal. Genital junction and shell gland just lateral to outer end of testes. Uterus coiled mostly longitudinally in each lobule, leaving central testicular area free. No circumscribed egg reservoir. Eggs numerous, bean-shaped, embryonated. Parasitic in subserosa of pyloric ceca of marine teleosts.

TYPE SPECIES: *D. euthynni* n. sp., in *Euthynnus yaito*; Hawaii.

TABLE 4 Yamaguti, 1970

IMPORTANT DIFFERENCES BETWEEN *Didymocodium* AND *Allodidymocodium*

CHARACTER	*Didymocodium*	*Allodidymocodium*
FOREBODIES	porjecting out of ventral pit	arising away from ventral pit
HINDBODY LOBES	branched dichotomously	branched irregularly
TESTES	lobed, close together, in central portion of hindbody	unlobed, far away, in peripheral portion of hindbody
OVARY	branched	unbranched
VITELLINE GLAND	branched	unbranched
GENITAL JUNCTIONS	separated by testes	not separated by testes

290. *Didymocodium eutłynni* n. g., n. sp.
(Fig. 290) Yamaguti, 1970

HABITAT: Subserosa of pyloric ceca of *Euthynnus yaito* (local name "kawakawa"); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63849.

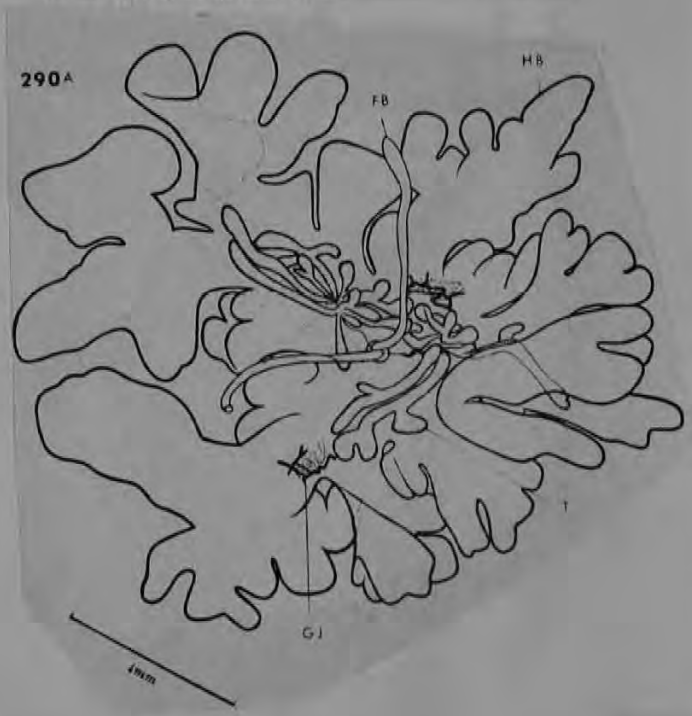
DESCRIPTION (based on a single whole mount): Body enclosed in a comparatively thick connective tissue capsule of host origin with network of blood capillaries from the host. It consists of two slender forebodies 3.9-4.5 mm long and two completely fused hindbodies 13 mm by 15 mm as fixed in formalin under moderate cover glass pressure. Forebody enlarged slightly (0.28-0.3 mm) near its blunt head end, with nearly uniform width of 0.1-0.15 mm elsewhere; two forebodies projecting alongside each other from oval pit which is 0.6 mm by 0,5 mm and lies near the center of the trunk portion of the fused hindbody. Hindbody consisting of central trunk portion and seven primary lobes, each of which is divided irregularly dichotomously like a sea-codium into a number of apically rounded, flattened, secondary and tertiary lobules of different sizes. Oral sucker terminal, pyriform, about 80 × 80 μ, musculocellular, with very minute oral aperture, directly followed by globular, muscular pharynx 50-60 μ by 60-70 μ; esophagus simple, very narrow, 0.33-0.4 mm long; ceca narrow in forebody, but wider in hindbody, in which they terminate blindly, without reaching apical margin of secondary or tertiary lobule. No acetabulum.

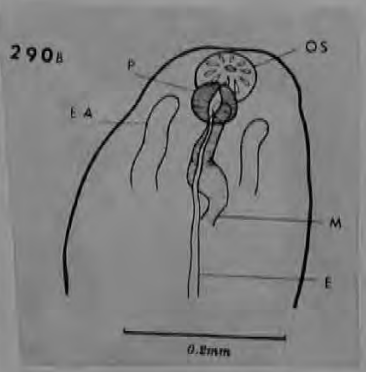
Testes divided into several short or long, cylindrical, primary lobes 0.25-0.4 mm wide. These lobes with or without side branches are close together in two subsymmetrical groups of four or five each and are situated near the central pit, from which the two forebodies project outside. Vas deferens distended with sperm in some places, running alongside metraterm, which it joins just before opening immediately behind the oral sucker.

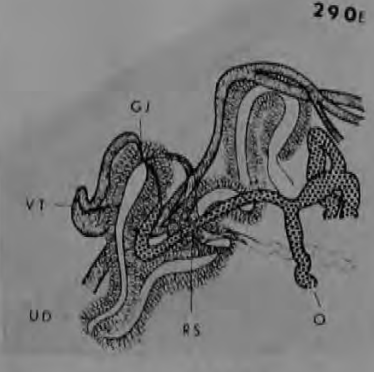
Ovary tubular, narrow, strongly winding, branched, mainly confined in hindbody around testicular area, sending loops into secondary and tertiary lobules to their apex; germiduct joining vitelline stem to lead into winding uterine duct densely provided with shell gland cells. This genital junction lies just external to the outer end of the testes of its own side on the same level as its fellow of the other side across the central pit and testes, about 0.45 mm apart from each other. Seminal receptacle oval, 0.24 × 0.16 mm, near genital junction, giving off a rudimentary, apparently non-functional Laurer's canal opposite origin of seminal duct. Uterus variable in width, strongly convoluted in primary and secondary lobes, thus filling up entire hindbody except for central area occupied by testes; initial portion of uterus containing deeply stained ova; uterus proper extending into almost every lobule. No circumscribed egg reservoir. Metraterm moderately well developed in forebody. Eggs bean-shaped, embryonated, 13-17 × 9-12 μ in balsam mounts.

Vitellaria tubular, narrow, branched, winding round uterine coils irregularly, occupying most peripheral subcuticular layer. Excretory vesicle terminating in paired arms reaching to near anterior extremity.

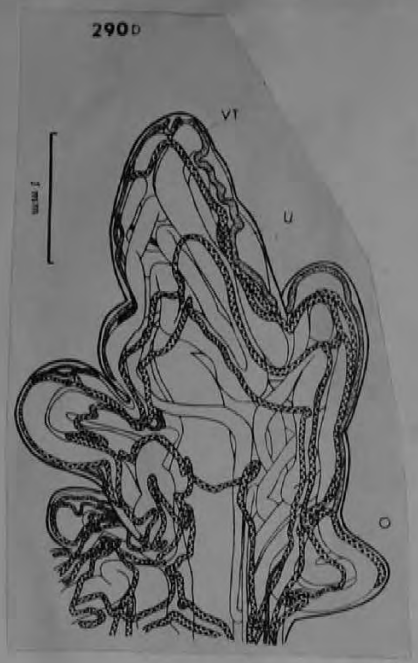
DISCUSSION: This genus is characterized by possessing two separate forebodies and by the two hindbodies being completely fused and divided irregularly dichotomously into a number of codium-like lobes. In general anatomy it bears a certain resemblance to *Sicuotrema*, especially in the two separate forebodies, the fused hindbodies, and the branched ovary and vitellaria, but differs fundamentally in the shape of the fused hindbodies and in the shape and location of the testes. On the basis of these characteristics, I prefer ro propose a new subfamily Didymocodiinae.

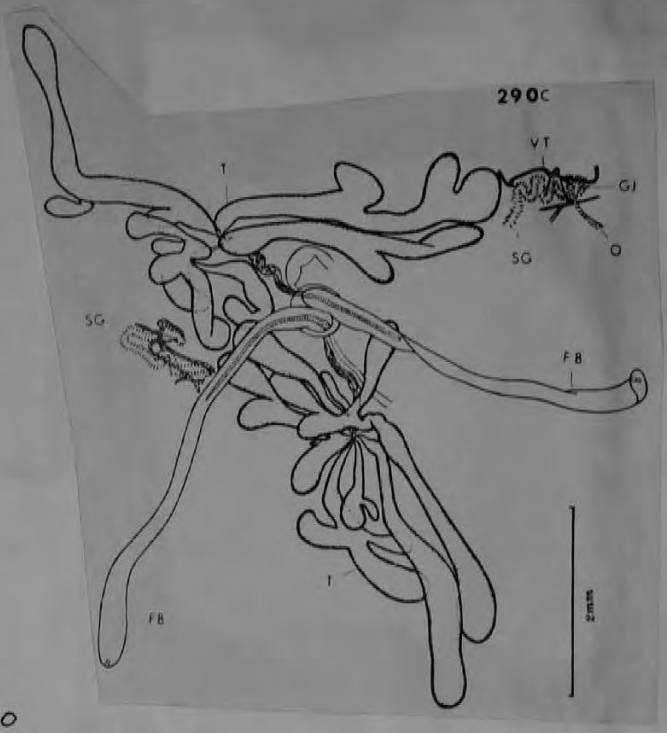






oven





From Yamaguti, 1970

DIDYMOCODIUM

Didymocylindrus Ishii, 1935

Generic diagnosis. — Didymozoidae, Didymozoinae: Complete hermaphrodite, enclosed in pairs in a long tubular cyst. Body divided into a slender forebody and a thicker cylindrical hindbody; forebody joining hindbody at about its middle. Pharynx present. No acetabulum. One cecum runs to one end of the hindbody, while the other runs to the other end. Testes narrow, paired, situated divergently in hindbody at base of forebody. Genital pore close to oral sucker. Ovary tubular, consisting of two branches directed oppositely toward extremities. Vitellaria divided into two branches reaching to extremities. Shell gland complex at or near middle of hindbody. Uterus filling up all available space of hindbody. Parasitic in marine fishes.

Genotype: *D. filiformis* Ishii, 1935 (Pl. 28, Fig. 372), on gills of *Euthynnus pelamys* and *Thynnus orientalis;* Pacific, Japan.

Embryo elongate oval to elliptical, measuring 27μ long by 10μ when relaxed, covered with very minute spines; its protrusible anterior end provided with a crown of acicular spines, more or less distinctly constricted off from rest of body, seving as borer and holdfast organ. Neither oral sucker nor tail. No digestive or generative Anlagen. Excretory system unknown.

229. *Didymocylindrus filiformis* Ishii, 1935

(Fig. 229) Yamaguti, 1970

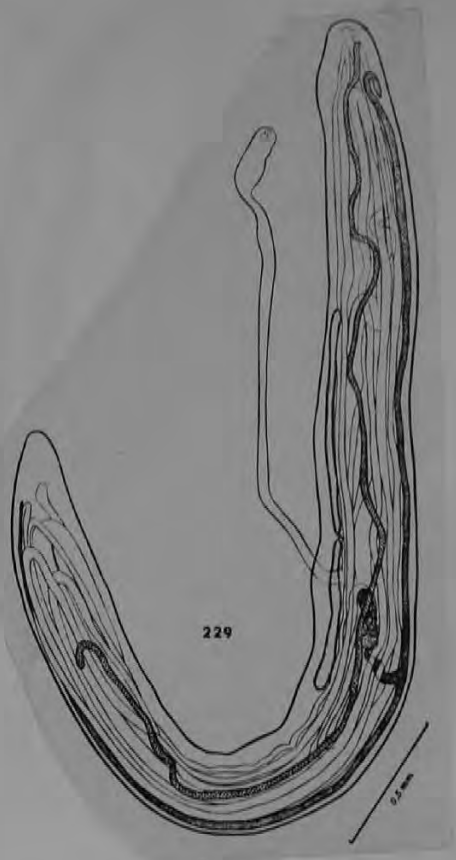
HABITAT: Encysted in pairs in gill lamellae of *Katsuwonus pelamys;* Hawaii.

DESCRIPTION (based on 19 whole mounts): Fellow occupants similar in shape and size. Forebody slender, very variable in length, 2.2-7.5 mm long, more or less enlarged in region of esophagus, 0.04-0.3 mm wide, attached to hindbody, usually anterior to its middle, exceptionally posterior to it. Oral sucker terminal, 16-28 μ (24-33 μ after Ishii) in diameter; pharynx spherical or longer than wide, 30-46 X 25-42 μ; esophagus 0.08-0.25 mm long. Ceca could not be traced, but it seems certain that one of them terminates at the broader posterior end of the hindbody. Hindbody cylindrical, 4-29 mm long, 0.35-0.8 mm wide, more attenuated at anterior end than at posterior end.

Testes double, cylindrical, unequal in length, meeting together a little posterior to base of forebody; anterior testis 1.0-2.5 mm long, posterior 1.2-3.8 mm long. Vas deferens opening with metraterm ventral to oral sucker.

Ovary tubular, long, divided near genital junction into two unequal branches. Ishii illustrated in his figure (No. 28) two unequal parallel anterior branches, but I have never found such parallel anterior branches. Elongate receptaculum seminis and shell gland usually situated anterior to base of forebody. Uterus first running back and forth in hindbody, forming 2-5 anterior, and 3-6 posterior, terminal loops in addition to some intermediate ones. It seems certain that in the posterior end of the hindbody there is usually one more uterine loop than in the anterior end. From this fact I venture to interpret that the uterus first runs posteriad and, after forming several loops at the two extremities, finally enters the forebody from behind. In one specimen out of 19 I have observed the egg reservoir near the base of the forebody. Eggs bean-shaped, 11-16 X 9 μ (17-19 X 9 μ after Ishii). Vitelline gland tubular, running along hindbody on the side opposite testes, divided into two divergent branches.

DISCUSSION: In the specimens I have examined, the anterior ovarian branch never divides into two, in strong contrast with Ishii's observation. It is worth noting that our egg measurements are also slightly different from Ishii's.



230. ***Didymocylindrus simplex*** (Ishii, 1935) n. comb.
Syn. *Didymocystis simplex* Ishii, 1935
(Fig. 230)

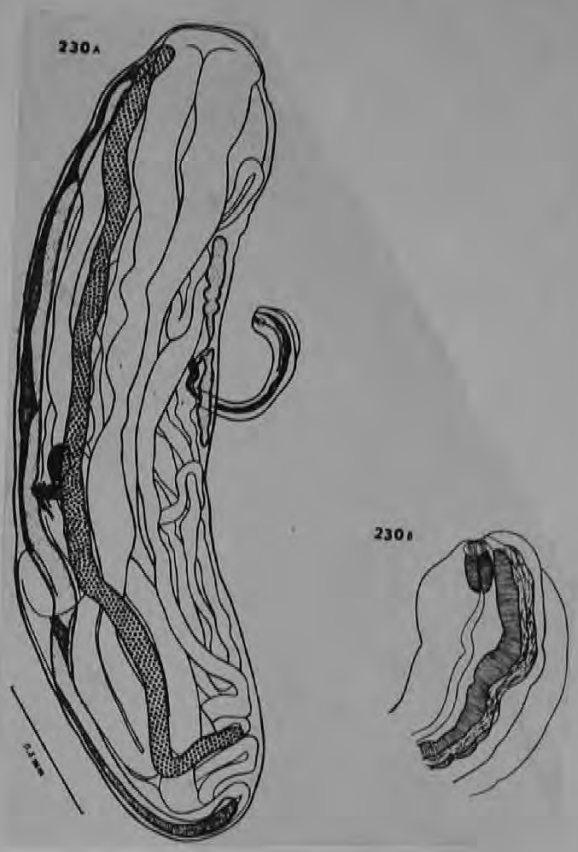
HABITAT: Encysted in pairs on gill plates adjacent to gill arch of *Katsuwonus pelamys*; Hawaii.

DESCRIPTION (based on 20 whole mounts): Forebody flattened dorsoventrally, 0.35-0.9 mm long, up to 0.08-0.14 mm wide in esophageal region, whence it tapers posteriorly, attached to hindbody at its middle or a little anterior or posterior to it. Hindbody bean-shaped, with rounded ends, concave ventrally and convex dorsally, 1.25-3.2 mm long, a little wider (0.4-0.65 mm) at anterior end than at posterior end, longitudinally grooved at anterior extremity, rounded or depressed at posterior extremity. Oral sucker terminal, 13-23 × 16-35 μ, weakly muscular, directly followed by muscular pharynx 21-42 μ long by 21-35 μ wide. Esophagus varying in length from 40 μ to 250 μ according to state of contraction or extension of forebody. Intestinal limbs narrow in forebody, terminating short of posterior extremity, maintaining considerable width in hindbody, containing granular ingesta.

Testes two, elongate, usually unequal in length, 0.14-0.32 × 0.03-0.08 mm, juxtaposed or tandem in same ventral plane, with the point of union of vasa efferentia a little anterior or posterior to base of forebody. Vas deferens running along metraterm; genital pore ventrolateral to pharynx or oral sucker.

Ovary tubular, single, 0.08-2.3 mm long, 40-80 μ wide, extending from near anterior end of hindbody to near its posterior end, almost parallel to vitelline gland on its ventral side, with its anterior end usually bent backward, exceptionally bent back on itself, giving off germiduct toward its middle. Genital junction and shell gland anterior to middle of hindbody in the type, may be equatorial or a little postequatorial. Seminal receptacle retort-shaped. Vitelline gland tubular, single, 40-70 μ wide, extending along convex dorsal side from extreme anterior end of hindbody to posterior extremity, usually curved along margin of both extremities, always slightly longer than ovary; vitelline duct apparently originating at level of shell gland opposite origin of germiduct. Uterus running back and forth in hindbody, forming 3-6 long loops anteriorly and 4-5 long loops posteriorly, in addition to shorter intermediate loops; no distinct egg reservoir in hindbody. Metraterm moderately strongly muscular. Eggs bean-shaped, embryonated, 11-16 × 7-10 μ. Excretory system not made out.

DISCUSSION: Our specimens agree well with Ishii's description and figure, provided that Ishii has mistaken the ovary for the vitelline gland, and *vice versa*.



DIDYMOCYLINDRUS

Didymocystis Ariola, 1902

Generic diagnosis. — Didymozoidae, Didymozoinae: Complete hermaphrodite, enclosed in pairs in a more or less flattened, round, oval or elliptical cyst. Body divided into a slender, sometimes scoop-shaped forebody and a round, oval, hemispherical, reniform, U- or comma-shaped, or two-lobed hindbody. Forebody attached to hindbody near its anterior end on the flattened side on which the two hindbodies are pressed against each other, or in the groove, in which the caudal portion of the other fellow occupant fits. Pharynx present. Ceca narrow in forebody, but wider, sometimes vesicular and close to contact face, in hindbody. No acetabulum. Testes tubular, paired in hindbody near base of forebody. Genital pore near oral sucker or pharynx. Ovary slender, long, single or double, branched or not, extending along convex side posterior to testes. Vitellaria also tubular, single or branched, extending in peripheral area on convex side of hindbody. Uterus occupying all available space of hindbody; egg reservoir sometimes conspicuous. Parasitic on gills or operculum, in mouth cavity, esophagus, stomach, body cavity, etc., of marine fishes.

Genotype: *D. thynni* (Taschenberg, 1879), syn. *Didymozoon t.* T. *Didymocystis reniformis* Ariola, 1902, in gill and operculum of *Thynnus vulgaris;* Naples, Triest, Genoa, Nice.

Other species:

- *D. abdominalis* Yamaguti, 1938, in body cavity of *Euthynnus pelamys;* Pacific coast of Japan.
- *D. acanthocybii* Yamaguti, 1938, at base of gill arch of *Acanthocybium sara;* Pacific, Japan.
- *D. alalongae* Yamaguti, 1938, on gills of *Thynnus alalonga;* Pacific, Japan.
- *D. bilobata* Ishii, 1935, on gills of *Euthynnus pelamys;* Pacific, Japan.
- *D. coatesi* Nigrelli, 1939 (?syn. of *D. acanthocybii* Yamaguti, 1938), in *Acanthocybium solandri;* Florida.
- *D. crassa* Ishii, 1935, in *Thynnus orientalis;* Pacific, Japan.
- *D. dissimilis* Yamaguti, 1938, in esophagus and stomach of *Euthynnus pelamys;* Pacific, Japan.
- *D. lanceolata* Guiart, 1938, in *Thynnus alalonga;* Atlantic.
- *D. macrorchis* Guiart, 1938, in *Thynnus alalonga;* Atlantic.
- *D. miliaris* Yamaguti, 1938, at base of gill arch of *Acanthocybium sara;* Pacific, Japan.
- *D. opercularis* Yamaguti, 1938, on inner surface of operculum of *Thynnus alalonga;* Pacific, Japan.
- *D. ovata* Ishii, 1935, in mouth cavity of *Thynnus orientalis* and *Euthynnus pelamys;* Pacific, Japan.
- *D. scomberomori* (G. A. et W. G. MacCallum, 1916), syn. *Koellikeria* s. G. A. et W. G. MacCallum, in gill lamella and stomach of *Scomberomorus maculatus;* Atlantic.
- *D. semiglobularis* Ishii, 1935, on gills of *Seriola quinqueradiata* and *Thynnus orientalis;* Pacific, Japan.
- *D. simplex* Ishii, 1935, on gills of *Euthynnus pelamys,* Pacific, Japan.
- *D. soleiformis* Ishii, 1935, on gills of *Euthynnus orientalis; Euthynnus pelamys* and *Seriola quinqueradiata;* Pacific, Japan.
- *D. submentalis* Yamaguti, 1938, in submental region of *Euthynnus pelamys;* Pacific, Japan.
- *D. wedli* Ariola, 1902, syn. *Wedlia katsuwonicola* Okada, *Didymocystis kobayashii* Dollfus, 1926, *Didymozoon* sp. of Kobayashi, 1921 (Pl. 27, Fig. 359) in *Thynnus vulgaris;* Naples, Nice, Genoa. Also on gills of *Euthynnus pelamys* from Pacific and Toyama Bay, Japan.
- *D. xiphiados* (G. A. et W. G. MacCallum, 1916), syn. *Koellikeria x.* G. A. et W. G. MacCallum, in gill cavity and muscle of *Xiphias gladius;* Woods Hole.

Key to species of *Didymocystis* from Hawaiian fishes

1. Parasitic on gills 2
   Parasitic in nasal cavity; testes unusally long and irregularly winding; uterus and vitellaria markedly moniliform . . . . . *D. nasalis*
   Parasitic in teeth of palate, gill arch, or other places 3
   Parasitic in orbital adipose or connective tissue or other parts of head 4
2. Ovary with main branches directed backward; vitellaria with 4-7 terminal branches . . . . . *D. bifurcata*
   Ovary with 4-8 terminal branches; vitellaria with 21-38 terminal branches, parasitic exclusively on gill filaments. . . . . *D. philobranchia*
   Ovary with 5-10 terminal branches; vitellaria with 6-13 or more terminal branches; parasitic exclusively on rudimentary gill rakers of gill arch . . . . . *D. philobranchiarca*
3. Ovary with 3-4 undivided main branches; vitellaria with 10 terminal branches . . . . . *D. poonui*
   Ovary with 2 main branches, one of which may have a side branch; vitellaria with 3-4 undivided main branches. . . . . *D. palati*
   Ovary with 10 or more terminal branches; vitellaria with over 16 terminal branches . . . . . *D. irregulairs*
   Ovary with 7-9 terminal branches; vitellaria with 15-20 terminal byanches. . . . . *D. superpalati*
4. Posterior extremity of hindbody spirally twisted; pharynx absent, ovary with 12 terminal branches; vitellaria with 12 terminal branches . . . . . *D. spirocauda*
   Posterior extremity of hindbody not spirally twisted 5
5. Ovary with 7 terminal branches confined to testicular region; vitellaria with numerious (over 30) short terminal branches, confined to greater posterior part of hindbody . . . . . *D. acanthocybii*
   Ovary with 3-4 long, undivided, terminal branches extending, two on each side, almost entire length of hindbody; vitellaria with 9-19 terminal branches extending almost entire length of hindbody . . . . . *D. orbitalis*

From Yamaguti, 1970

231. ***Didymocystis acanthocybii*** Yamaguti, 1938*
Syn. *Didymocystis coatesi* Nigrelli, 1939
(Figs. 231 and 336) Yamaguti, 1970

The following account is to supplement my original description as well as Nigrelli's description of *Didymocystis coatesi*, which is a synonym of *D. acanthocybii*. The extreme measurements of the hindbody recorded by Nigrelli are 4.5-9.0 X 1.9-3.0 mm, and the average length of the forebody is 1.63-3.19 mm. Ten of our specimens collected in the buccal wall and the periorbital tissue surrounding the eyes or somewhere else in adipose or connective tissue of the head of *Acanthicybium solandri* from Hawaii gave wider ranges of variation in measurements than those given by Nigrelli and me, the specimens from the subcutis of the hyoid arch being the smallest.

Forebody 1.0-11.0 X 0.12-0.46 mm, hindbody 1.75-13 mm long, up to 11 mm wide under strong cover glass pressure. Oral sucker and pharynx somewhat varying in shape according to age; former 23-60 X 30-58 μ, latter 21-70 X 17-58 μ. Esophagus 0.15-0.35 mm long. Testes tubular, 1.0-9.0 mm long lineally, 0.04-0.24 mm wide (1.25-2.1 X 0.045-0.106 mm after Nigrelli), extending from base of forebody along lateral edges of cup-shaped hindbody. Ovary tubular, branched dichotomously, situated laterally and dorsally outside of uterus, largely in testicular zone. Vitelline gland long, slender, tubular, branched dichotomously, extending outside of ovary, partly among uterine coils, in greater posterior portion of hindbody as figured by Nigrelli. Uterus strongly coiled, first occupying middle third, then lateral anterior third, and then posterior third, finally forming an elongate or cylindrical egg reservoir up to 10 X 2 mm. This reservoir arises in the central axis of the hindbody some distance away from the posterior end and reaches to the base of the forebody, where it narrows abruptly to lead into the metraterm running straight forward in the intercecal field. Nigrelli neither described nor figured this egg reservoir which is too conspicuous in larger specimens to be overlooked. Genital pore ventrolateral to oral sucker. Eggs 16-18 X 10-13 μ in life (16 X 8-11 μ after Nigrelli).

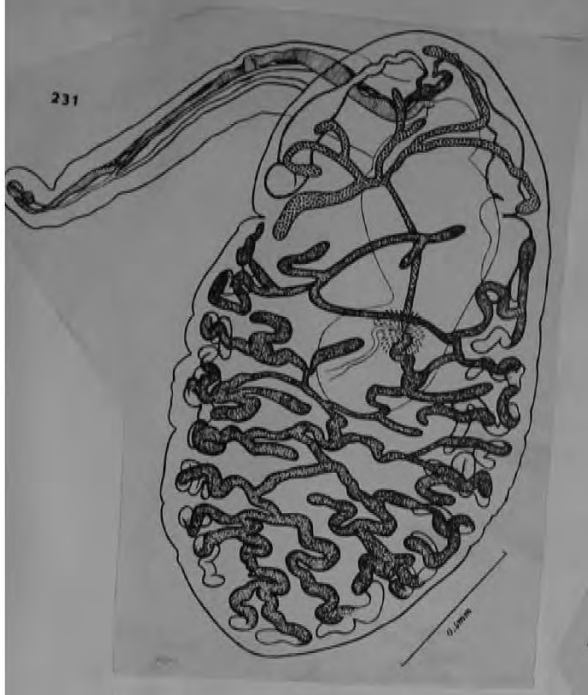
This is a good example of the same species occurring in the same host species of the Pacific and Atlantic oceans.

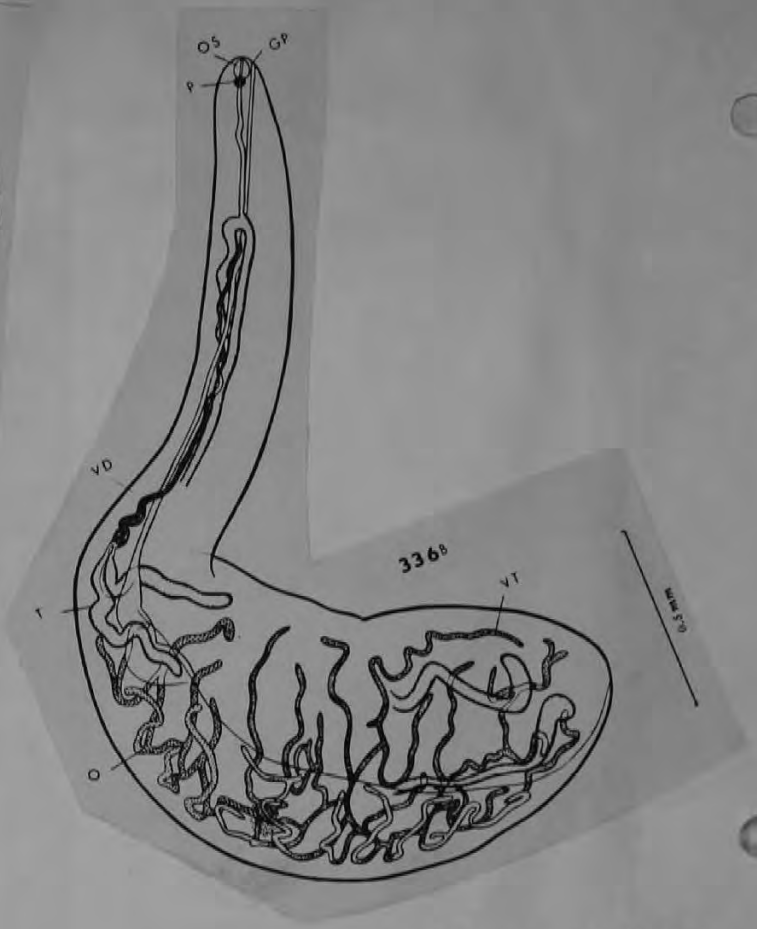
DEVELOPMENT: Some ten juvenile specimens of this species were found in the washings of the tissue of the head of *Acanthocybium solandri*. They showed graded larval development; the youngest *Posttorticaecum* form (Fig. 336 A, 2.36 X 0.33 mm) resembles *Torticaecum* Yamaguti, 1942 only differing from it in lacking acetabulum, in the greater posterior part of the body being distinctly swollen, and in the intestinal limbs being narrow and less tightly coiled. In a more advanced stage (Fig. 336 B) which is 3 mm long by 0.7 mm wide and appears to have just started egg production, the body is more distinctly divided into two portions at the level where the tubular testes join together; the forebody 1.3 mm long is subcylindrical, 0.3 mm wide at the base, and slightly narrowed anteriorly; the hindbody 1.7 mm long is elongate elliptical, curved ventrad a little and rounded at the posterior end where the excretory pore is located. Immediately behind the terminal oral sucker a rudimentary rounded pharynx 28 μ in diameter has already developed, though not provided with distinct outer limiting membrane. Esophagus about 0.35 mm long; ceca swollen and sinuous in hindbody and terminating at different levels close to posterior extremity. Testes somewhat sinuous, 0.35 mm long lineally, 40 μ wide, situated in form of inverted V at anterior end of hindbody; vas deferens already containing sperm, winding forward alongside uterus. Genital pore ventrolateral to oral sucker. Ovary tubular, narrow; its stem bifurcating four times and extending largely in dorsal area between testes and genital junction which lies about midlevel of hindbody. Vitellaria also tubular, narrow, dichotomously branched, occupying whole convex peripheral area between ovary and posterior extremity. Uterus containing eggs traceable from intertesticular field to genital pore; eggs bean-shaped, 14-16 X 9-10 μ.

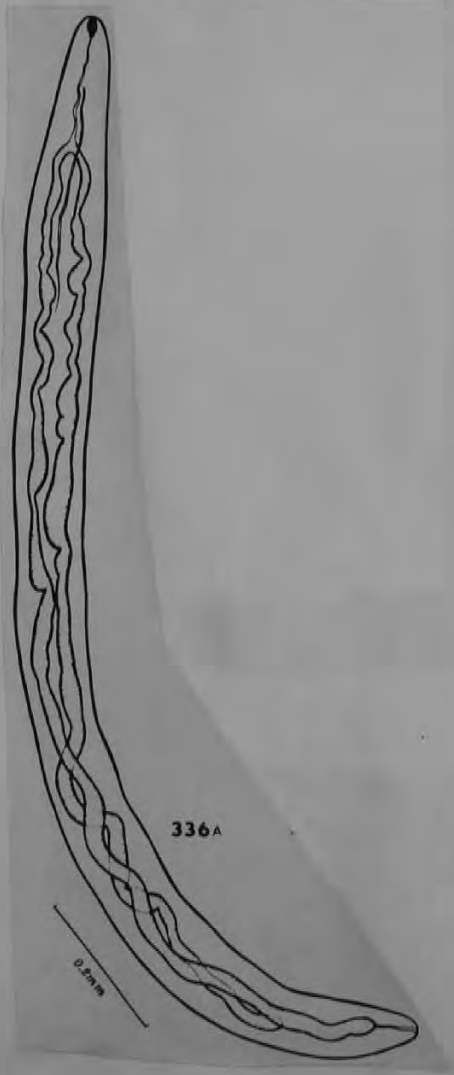
From the above observation it seems likely that *Didymocystis acanthocybii* develops from *Torticaecum* form

*Ten selected specimens fixed in 10% formol solution for 24 hours without cover glass pressure gave the following measurements in mm: Forebody 13.5-19.5 x 0.3-0.6; hindbody 15.5-23 x 21-35.5; ventral longitudinal furrow 16-29 x 7.5-13.

ovea







From Yamaguti, 1970

232. *Didymocystis bifurcata* n. sp.

(Fig. 232) Yamaguti, 1970

HABITAT: Encysted in pairs on inner surface of gill opening of *Parathunnus sibi* (local name "poonui"); Hawaii.

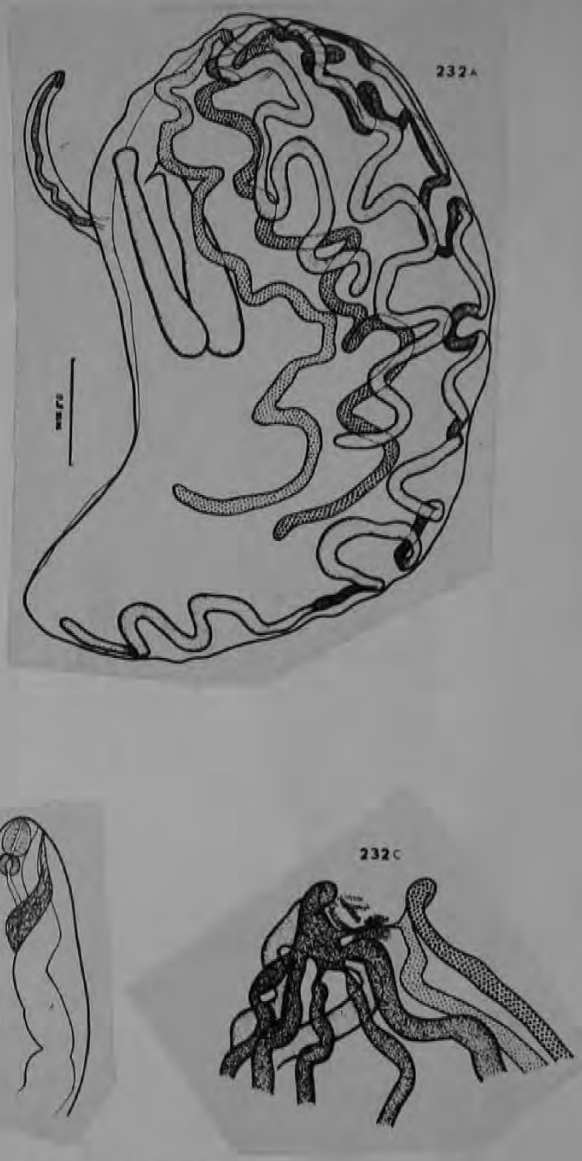
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63805.

DESCRIPTION (based on 11 whole mounts): Forebody slender, without cervical dilatation, subacute anteriorly, 0.55-1.25 mm by 0.07-0.1 mm, up to 0.15 mm wide at somewhat enlarged base, arising from between two lobes of hindbody. Hindbody curved ventrad, tapering posteriorly, bilobed anteriorly, with distinct median longitudinal groove on ventral surface, by which the two partners are in direct contact. Oral sucker terminal, 23-40 X 20-30 μ, directly followed by pharynx 11-16 μ long by 14 μ wide. Esophagus short, only 45-95 μ long; ceca not traceable in hindbody.

Testes sausage-shaped, 0.46-0.7 X 0.08-0.12 mm, close parallel to each other in hindbody near base of forebody. Vas deferens alongside metraterm. Genital pore ventrolateral to oral sucker.

Ovary bifurcating near genital junction into two long winding branches which are directed posteroventrad to terminate short of the posterior extremity. Initial portion of uterus containing immature eggs deeply stainable with hematoxylin is strongly convoluted near anteroventral corner of hindbody, obscuring genital junction. Vitellarium divided close to its stem into several (4 in the type, 4-7 in paratypes) branches extending along convex side (mainly on left side in the type), terminating at different levels, the longest one reaching to posterior extremity of hindbody. Uterus proper occupying all available space of hindbody; metraterm in forebody weakly muscular, frequently distended with eggs. Eggs bean-shaped, small, 13-16 X 8-11 μ. Excretory system not made out.

DISCUSSION: This species differs from the most closely related *Didymocystis philobranchia* n. sp. from the gills of the same host species of Hawaii in the number and distribution of the vitelline branches and in its smaller eggs. It is interesting to note that *Didymocystis* species are specifically different according to their location even in the same host species. The specific name refers to the bifurcate ovary.



From Yamaguti, 1970

DIDYMOCYSTIS COATESI, A NEW MONOSTOME FROM THE EYE MUSCLES OF THE WAHOO, *ACANTHOCYBIUM SOLANDRI* (C. & V.)

ROSS F. NIGRELLI
New York Aquarium

The monostomes here described were taken from the eye muscles of a wahoo fish which was caught off the coast of Florida. The parasites are "dipper-shaped," the "cup" part forming the hindbody, the "handle" the forebody. The worms are encysted in pairs; the hindbody of both organisms is surrounded by a thin, transparent membrane (host connective tissue) while the forebody of each individual protrudes free from the covering. Three pairs and one single specimen were recovered.

Nigrelli, 1939

Didymocystis coatesi n. sp.

Forebody. The elongate thread-like forebody is cylindrical in shape and more or less even in diameter. It is from 1.63 to 3.19 mm. in length and from .19 to .27 mm. in width; averaging about 2.5×.225 mm. The oral sucker is spherical and sub-terminal, measuring .033 mm. in diameter. This is immediately followed by a slightly muscular pharynx, oval in shape and measuring .020×.025 mm. The esophagus is .243 mm. in length and .030 mm. in width; the two intestinal branches average about .038 mm. in width at the proximal ends and extend to the posterior end of the anterior fifth of the hindbody. At the posterior ends the intestinal cecae are slightly dilated. The forebody also contains the terminal portion of the uterus, which winds along the intercecal region ending in a pore at the anterior tip of the worm, in front of and a little to one side of the oral sucker. This pore is muscular and measures about .016 mm. in diameter. The vas deferens follows along with the terminal part of the uterus and also opens into the genital pore.

Hindbody. In stained parasites, the hindbody averages 6.3 mm. in length and 3.02 mm. in width. It must be mentioned that in these mounted preparations the hindbody is folded somewhat so that the measurements given for the width are slightly smaller than actually given. The extreme measurements recorded for this species are as follows: 4.5×1.9 mm. to 9.0×3.0 mm.

Male organs. The testes are elongate, tubular and slightly dilated at the tips. They are situated in the anterior region of the hindbody, near the junction of this structure and the forebody. They average 1.63 mm. in length and .066 mm. in width, with the extreme measurements as follows: length 1.25 to 2.1 mm., width .045 to .106 mm. There is no seminal vesicle present, but occasionally a slight swelling may be found at the proximal end of either one or both testes that superficially might appear as a seminal vesicle. The vasa efferentia unite to form the vas deferens, the latter proceeding directly to the genital pore.

Female organs. The ovary is long, thread-like and branched. It measures about .034 mm. in width. When stained with paracarmine it is not easily distinguished from the vitellarium, as both are similarly colored. The ovary is situated in the anterior third of the hindbody, while the vitellarium is found in the posterior two-thirds. The latter is also thread-like, branched and measures approximately .035 mm. in diameter. Both ovary and vitellarium wind among the many folds of the uterine coils. The ovarian complex is situated dorsally, centrally and at the posterior end of the anterior third of the hindbody, some distance behind the testes. It is composed of a seminal receptacle, ootype and shell gland. The ootype measures about .083×.058 mm.

The receptaculum seminis is spherical in shape, measuring .076 mm. in diameter. Under low power lens the shell gland appears as a spherical mass, but when seen under oil immersion the gland cells appear to be more or less scattered around the initial portion of the uterus. The details of the ovarian complex are shown in Figure 3. The eggs in the ovary possess a large nucleus and clear cytoplasm. As they pass into the ootype they are fertilized and the yolk substance from the vitelline gland is deposited in each ovum in the form of granules. As the fertilized, yolk-filled eggs pass into the initial part of the uterus, they are arranged in single file. It is in this region of the uterus which is surrounded with gland cells, that the shell is formed around each egg.

The uterus passes to the extreme posterior end and then winds anteriorly, filling practically the entire hindbody. The anterior part of the uterus in some forms (Fig. 1) passes straight into the forebody and only takes a slightly sinusoidal course to the genital pore. In others it winds continuously to the middle of the forebody and then follows a direct course to the pore. The uterine coils are filled with an exceptionally large number of operculated eggs which measure from .008×.016 to .011×.016 mm. By the time they leave the genital pore the eggs are fully embryonated. No Laurer's canal is present.

The above description agrees substantially with the diagnostic features of the genus *Didymocystis* Ariola (1902) as given by Ishii (1935): "Didymozoöinae encysted in pairs. Forebody slender, elongated. Hindbody swollen, reniform, comma-shaped or semi-globular. Oral sucker present or absent. Pharynx present. Ventral sucker absent. Intestine present. Genital pore near oral sucker. Testes tubular, more or less elongated, in hindbody, near the base of forebody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Uterus long, with millions of eggs. Type species, *Didymocystis thynni* (Taschenberg, 1879).

Larva. When paired worms are removed from the cyst covering and

placed in sea-water (sp.g. 1.028), the entire reproductive organs (uterus, ovary, vitellarium and testes) fall out from the hindbody. The eggs continue their development for a time but under no circumstances do they hatch. These eggs are relatively heavy and slightly adhesive, for when kept in petri dishes containing pure sea-water they drop to the bottom and can be removed for study only after scraping. Such eggs, containing active larvae, have been kept in these dishes for more than three months without hatching. Marine snails and fish (*Cyprinodon variegatus*) kept in dishes containing many thousands of eggs have not become infected.

Microscopically, the larvae are non-ciliated, oval in shape, and show granules of various sizes in the cytoplasm. In certain stages, minute spicule-like structures are observed on one side of the larvae. In these forms each spicule terminates in a granule, while in others there is a fibril-like extension from each spicule and these in turn converge to a number of granules at one point. In later stages, there is a rosette of these spicules at the anterior or operculated end of the egg. At this stage a slight pressure on the cover slip will release the egg caps and the larvae can be partly forced out of the shells. Such forcibly hatched larvae usually show slight amoeboid movements for a few minutes but they eventually die and disintegrate.

Comparisons

Ishii (1935) separates the members of the genus *Didymocystis* into three groups. (1) Those with the forebody projecting from the middle of the hindbody: *D. xiphiados* (MacCallum and MacCallum, 1916) (= *Koliikeria xiphiados* MacCallum and MacCallum, 1916) and *D. simplex* Ishii (1935). (2) Those with the forebody projecting from the middle of one end of the hindbody: *D. scomberomori* (MacCallum and MacCallum, 1916) (= *Koliikeria scomberomori* MacCallum and MacCallum, 1916) and *D. bilobata* Ishii (1935). (3) Those with the forebody projecting from the tip of one end of the hindbody: *D. thynni* (Taschenberg, 1879) (= *Didymozoon thynni* Taschenberg, 1879) (= *Didymocystis reniformis* Ariola, 1902) (= *Monostoma bipartita* Wedl, 1855), *D. semiglobularis* Ishii (1935), *D. crassa* Ishii (1935), *D. ovata* Ishii (1935), *D. soleiformis* Ishii (1935), *D. wedlia* Ariola (1902), and *D. katsuwonicola* (Okada, 1926) (= *Wedlia katsuwonicola* Okada, 1926) (= *Didymocystis kobayashii* Dollfus, 1926) (= *Didymozoon* sp. Kobayashii, 1926). *Didymocystis coatesi** belongs in this last mentioned group. The members of this group are further distinguished by the shape of the hindbody. Thus, in *D. thynni* it is kidney-shaped; in *D. crassa*, *D. katsuwonicola*, *D. soleiformis* and *D. wedlia* it is shaped like a mammalian stomach, while in *D. semiglobularis*, *D. ovata* and *D. coatesi* it is semiglobular in form. However, *D. coatesi* differs from *D. ovata* and *D. semiglobularis* in several respects, some of which are best shown in Table I.

Fig. 2

Fig. 3

	Forebody		Hindbody		Testes		Ovary W	Vitel.	Sem.	Recep.	Eggs
	L	W	L	W	L	W					
D. coatesi	1.63–3.19	.19–.27	4.5–9.0	1.9–5.7	1.25–2.05	.045–.106	.023–.045	.028–.045	.076–	.116	.008–.011×.016
D. semiglobularis	1.11–1.27	.207–.223	2.178–3.657	1.829–2.862	1.113	.038–.141	.047	.071	.071–.118	.061–.094	.016–.010×.009–.011
D. ovata	.795–.875	.043–.048	1.256–1.352	.906–1.049	.398–.636	.056	.019	.025	.108–.188	.071	.013–.014×.010–.011

Didymocystis coatesi also differs from *D. semiglobularis* and *D. ovata* in that the ovary and vitellarium are much more branched and quite distinctly separated. In *D. coatesi* the ovary is limited to the anterior third of the body and the branches spread out towards the lateral edges, but never extend posteriorly to mingle with branches of the vitellarium as they do in other species of *Didymocystis*, and especially in *D. semiglobularis* and *D. ovata*.

The position and morphology of the genital pore is likewise different in *D. coatesi*. As was mentioned previously, this pore lies in front of and only slightly to one side of the oral sucker. It is muscular and terminates in a lip-like protuberance. In all other species of *Didymocystis* the genital opening is described and figured as a simple pore usually to one side of the oral

Didymocystis coatsi Nigrelli, 1939
(continued)

HOST-PARASITE RELATIONSHIPS

Didymocystis xiphiados, *D. scomberomori* and *D. coatesi* are the only members of the genus so far described from fishes of the Western Atlantic.

* Named for C. W. Coates, Aquarist at the New York Aquarium

All the other species have been described from either the Mediterranean region or the Pacific. Table II shows clearly the host-parasite relationships.

TABLE II

Parasite	Host	Site of Infection
Didymocystis thynni (Tasch.)	*Thunnus thynnus*	gill, gill covers, gill arch
	Euthynnus alleteratus	gill lamella
D. wedli Ariola	*T. thynnus*	gill, gill lamella
D. xiphiados (MacC. & MacC.)	*Xiphias gladius*	gill cavity, body muscle
D. scomberomori (MacC. & MacC.)	*Scomberomorus maculatus*	gill lamella, intest., stomach
D. katsuwonicola (Okada)	*Scomber japonicus*	gill
	Katsuwonus pelamis	gill, esophagus, stomach
	K. vagans	gill epidermis
	Thunnus orientalis	gill epidermis
	Seriola quinqueradiata	gill epidermis
D. semiglobularis Ishii	*Thunnus orientalis*	gill arch
	Seriola quinqueradiata	gill arch
D. ovata Ishii	*Thunnus orientalis*	mouth cavity
	Katsuwonus vagans	mouth cavity
D. soleiformis Ishii	*Thunnus orientalis*	gill arch, mouth cavity
	Seriola quinqueradiata	gill arch, mouth cavity
	Katsuwonus vagans	gill arch, mouth cavity
D. bilobata Ishii	*Katsuwonus vagans*	gill (interlamellar space)
D. simplex Ishii	*Katsuwonus vagans*	gill epidermis
D. crassa Ishii	*Thunnus orientalis*	gill arch
D. coatesi Nigrelli	*Acanthocybium solandri*	eye muscles

All of the above host species are closely related phylogenetically and may be classed as Scombriformes (after Boulenger, 1904). Their movements in water are characteristic and very similar. During certain periods of the year they invariably swim close to the surface, while at other times they seek the lower depths. Such fishes, therefore, might be expected to feed on a variety of forms. Beebe (1936) has shown that in the case of certain tunas, the food items of the stomach contents varied from Siphonophores, Mollusca (Gasteropods, Pteropods, Cephalopods), crustaceans (shrimps, crabs and copepods) to fishes of various sorts. In the case of the Giant Tuna (*Thunnus thynnus*), Crane (1936) has shown that an occasional squid or shrimp was encountered in the stomach, although the majority of the forms recovered were fishes. Since invertebrates and especially, Molluscs, do form part of the diet for the above hosts, it is altogether possible that any one of these may act as an intermediate host for the parasites. In the case of *Didymocystis coatesi*, at least, a bottom living invertebrate would probably be the intermediate host, for the eggs of this parasite are

Didymocystis dissimilis Yamaguti, 1938

Рис. 7, 8

Хозяева: *Thunnus thynnus*, *Euthynnus affinis*, *Auxis thazard*.

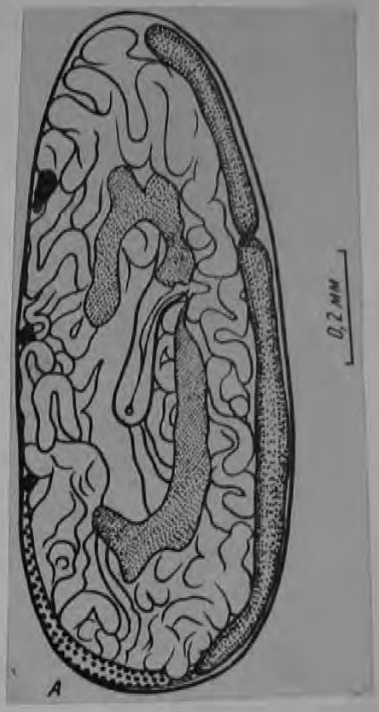
Локализация: стенки пищевода, желудка и начальной части кишечника.

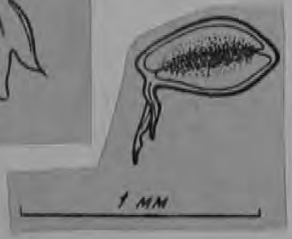
Ямагути, описавший этот вид, отмечает, что трематоды, заключенные попарно в одной цисте, имеют разную величину: одна особь всегда крупнее другой (это отражено и в названии вида). Однако, как мы убедились, этот признак не является постоянным, встречается много цист с совершенно равными по величине паразитами. Вообще следует заметить, что многие дидимозоиды [illegible] зитируя в тканях, эти трематоды, заключенные в соединительнотканную цисту, очевидно, в течение всей своей жизни не могут выделять яйца во внешнюю среду, а только накапливают их в своем теле. Яйца дидимозоид очень мелкие. В результате матка паразитов сильно разрастается и заполняет все тело, которое при этом постепенно увеличивается в размерах и под давлением окружающих тканей хозяина может принимать различную форму (Ошмарин и Мамаев, 1963). В нашем материале встречались цисты *D. dissimilis* овальные, веретеновидные, круглые, иногда неправильной округлой формы, даже цисты с перетяжкой посередине, имеющие вид гантелей. Соответственно и тела паразитов, заключенных в эти цисты, имели различную форму. Однако наиболее типичными следует считать цисты овальной формы, в которых заключены молодые еще трематоды, имеющие вид двух семядолей желудя. Более старые паразиты имеют обычно форму полушара, а циста шарообразна. Типичная форма у трематод лучше сохраняется в тех цистах, которые не погружены глубоко в ткани, а выдаются в просвет желудочно-кишечного тракта.

Приводим размеры молодых паразитов типичной формы (рис. 8).

Длина передней части тела 0,20—0,35 *мм*, максимальная ширина 0,06—0,10 *мм*. Длина (высота) задней части тела 0,27—0,34 *мм*. Ширина задней части тела (по наибольшей оси) в латеральном направлении — 0,8—1,3 *мм*, ширина в дорзо-вентральном направлении 0,30—0,40 *мм*. Ротовая присоска 0,023—0,034 *мм* в диаметре, глотка такой же величины. Яйца 0,014—0,019×0,008—0,010 *мм*.

У крупных старых экземпляров передняя часть тела может достигать в длину 1,4 *мм* и 0,30 *мм* в ширину, задняя часть тела по наибольшей оси — 4,8 *мм*.





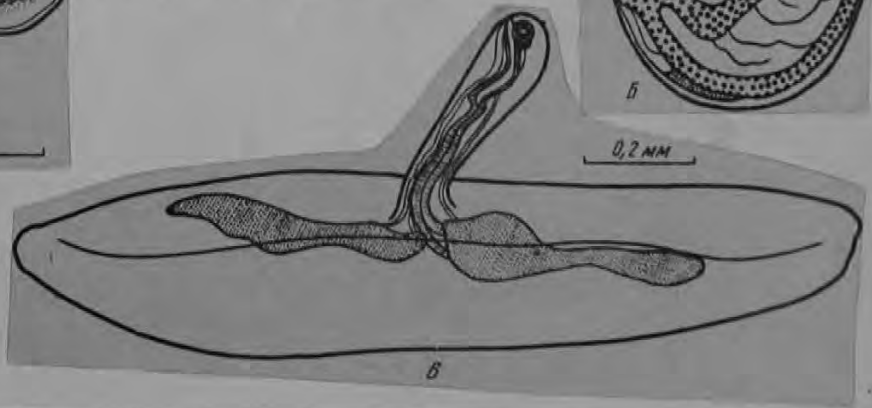


Рис. 7. *Didymocystis dissimilis* Yamaguti, 1938
Общий вид гельминта: *А* — сверху, *Б* — снизу, *В* — сбоку

[illegible] цисты *Didymocystis dissimilis*, нормальная форма

233. *Didymocystis irregularis* n. sp.

(Figs. 233 and 339)

Yamaguti, 1970

HABITAT: Encysted in pairs in teeth overlying glossohyal and in tooth plate on gill arch of *Neothunnus macropterus*: Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63806.

DESCRIPTION (based on 15 flattened whole mounts): Cyst round, with hard sclerotized walls of host origin. Forebody subcylindrical, 0.6-2.0 X 0.17-0.33 mm, attached to hindbody in its ventral furrow near anterior extremity. Hindbody 2.0-6.0 X 1.2-2.2 mm, curved ventrad, two-lobed anteriorly, with distinct longitudinal furrow on concave ventral side. In all the full-grown specimens the hindbody may be somewhat spirally distorted and irregular in outline. Head end blunt-pointed; oral sucker subelliptical or pyriform, 46-75 X 39-60 μ; pharynx globular, weakly musuclar, 28-56 μ in diameter. Esophagus slender, 0.25-0.9 mm long; ceca narrow in forebody, but may be strongly inflated and twisted in hindbody, containing dark ingesta.

Testes tubular or cylindrical, winding or not, 0.4-0.9 X 0.06-0.15 mm, almost symmetrical at anterior end of hindbody. Vas deferens narrow, winding, not forming distinct seminal vesicle. Genital pore ventral to oral sucker.

Ovary consisting of a rather short stem 20-100 μ wide and long or short, branched arms, situated on dorsal side near seminal receptacle which is oval, 0.25 X 0.15 mm, and lies close to dorsal surface 1.8 mm from anterior extremity of hindbody in the type. Number of terminal ovarian branches about ten in the type. Vitelline gland consisting of 7-8 main branches radiating from cistern which lies dorsally immediately posterior to genital junction. There are over 16 terminal vitellarian branches. Uterine coils irregular, occupying all available space of hindbody, forming indistinct egg reservoir. Eggs bean-shaped, embryonated, 16-19 X 8-10 μ.

DISCUSSION: This species was found associated with *Didymocystis palati* n. sp. from which, however, it differs in the number of ovarian and vitellarian branches, as shown in the differential key. The specific name refers to the irregular body shape attained in full maturity owing to the irregularity of the space available.

DEVELOPMENT (Fig. 339): Juvenile forms of this species in various developmental stages were found associated with the adults. For convenience of reference these are divided into three stages as follows:

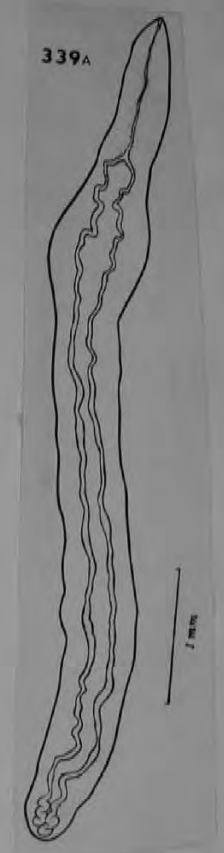
First stage *(Posttorticaecum)*: A selected specimen 6.2 mm long by 0.7 mm wide shows an incipient dilatation up to 0.7 mm wide a little behind intestinal bifurcation. It bears a marked resemblance to *Torticaecum* mihi (1942) except for the presence of cervical swelling and absence of the acetabulum; oral sucker 37 μ by 92 μ wide; esophagus about 1 mm long, bifurcating just anterior to body swelling, whence the body tapers anteriorly, but remains nearly uniformly wide posteriorly. "Stomach" portion degenerate.

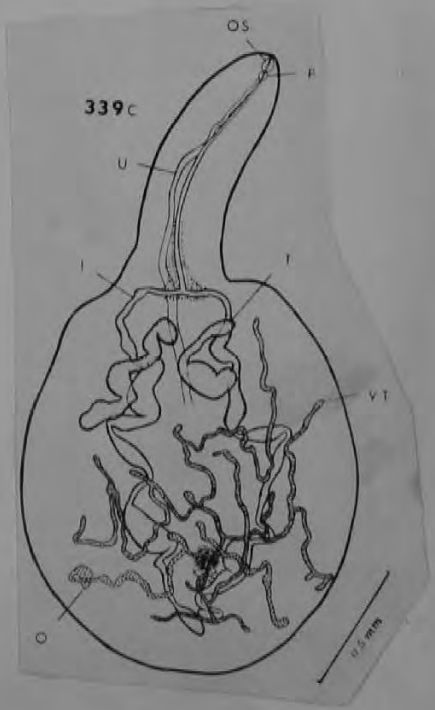
Second stage: A selected specimen is distinctly bipartite; forebody flattened subcylindrical, blunt-pointed, 0.78 mm long by 0.34 mm wide; hindbody curled up ventrally, 2.5 X 0.94 mm after straightened out while in water; oral sucker 42 X 42 μ; esophagus 0.65 mm long, bifurcating at junction of two body regions. "Stomach" portion degenerating, but still recognizable; ceca wider and more twisted than they were in the first stage, terminating at different levels at posterior extremity. No genital anlagen detected.

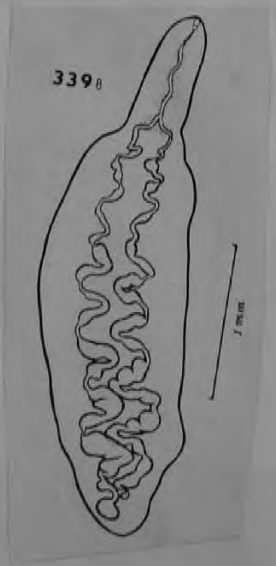
Third stage (juvenile stage of *Didymocystis*): A selected specimen 2.29 mm long is distinclty divided into blunt-pointed subcylindrical forebody 0.84 mm long and 0.35 mm wide at base and an oval flat hindbody 1.45 mm long by 1.22 mm wide. Oral sucker 49 X 44 μ; a small pharynx 28 μ in diameter is clearly discernible immediately behind the oral sucker; esophagus 0.85 mm long; "stomach" portion atrophied; ceca still inflated, though contracted at places, and more irregular in course, terminating close to each other at posterior extremity. Two winding testes 0.4-0.5 X 0.1 mm, well developed at anterior part of hindbody; vas deferens very narrow, hardly recognizable even under an immersion lens. Genital pore clearly defined ventral to oral sucker. Ovarian trunk joining vitelline trunk near posterior extremity, divided into paired Y-shaped branches, of which two short arms are directed forwards, whereas the other two longer arms are directed laterally. Vitelline trunk united with spherical reservoir containing many large and small yolk cells as it crosses dorsal to the ovarian trunk, terminating posteriorly into two branches after giving off a short side branch; bifurcating anteriorly three or four times into ten terminal branches, the longest of which reaches to near the anterior end of the right testis. The initial portion of the uterine duct is provided with a coat of shell gland cells; this portion as well as the beginning of the uterus proper winding irregularly near genital junction, containing round abortive eggs 9-10 μ by 6-7 μ; remaining portion of uterus proper irregularly winding posterior to ovary and between ovary and testes; metraterm already well differentiated, much wider than uterus proper, originating between two testes and running almost striaght forward in forebody, containing only one egg at its very beginning. No seminal receptacle observed.

From agreement in the disposition of the genitalia it seems very likely that this third stage represents a juvenile form of *Didymocystis irregularis*, although the posterior part of the hindbody still remains underdeveloped. Of course as this part becomes elongated the ovarian and vitellarian branches must be elongated accordingly. It is interesting to note that a spherical vitelline reservoir reminding us of the vitelline cistern of the adult develops in the third stage.

over







From Yamaguti, 1970

234. *Didymocystis nasalis* n. sp.

(Fig. 234)

Yamaguti, 1970

HABITAT: Encysted in pairs and hanging on inner wall of nasal cavity of *Parathunnus sibi*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63807.

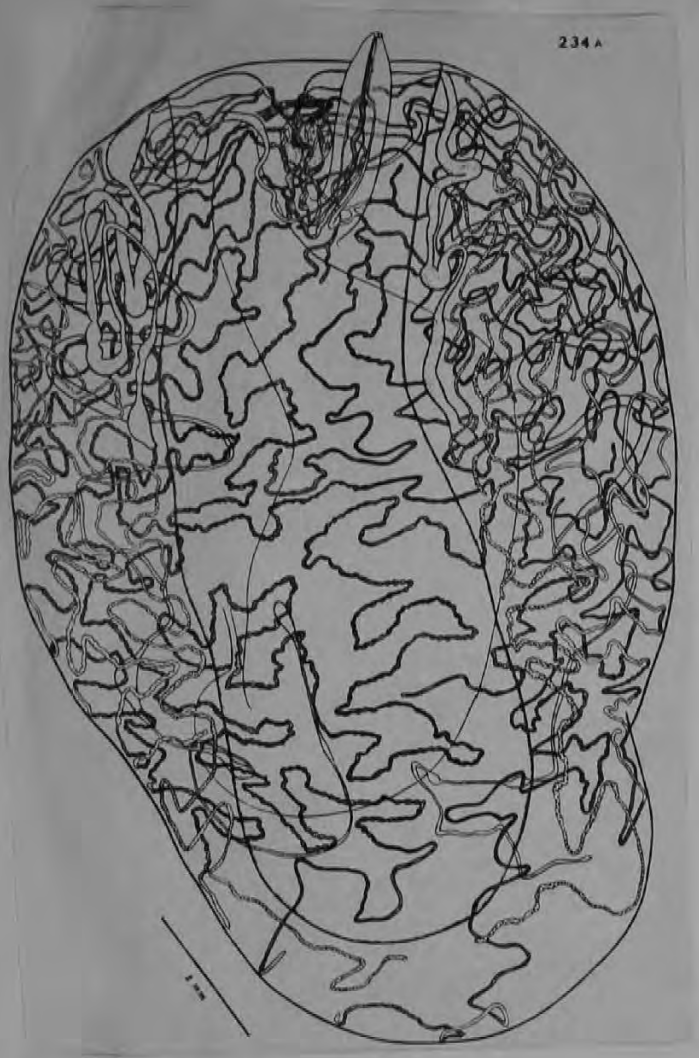
DESCRIPTION (based on a single, strongly flattened whole mount): Forebody flattened subcylindrical, tapered anteriorly, 3.1 mm long by 0.65 mm wide, attached to midventral furrow of hindbody at a distance of 2.7 mm from its anterior end; hindbody convex-concave, with posterior end curved ventrad, furrowed in ventral median line, with lateral margins folded inwards ventrally, 13 mm long, widest (9 mm) at one-third level. Oral sucker muscular, 60 μ in transverse diameter; pharynx barrel-shaped, weakly muscular, 46.6 μ in transverse diameter; esophagus slender, 0.8 mm long, surrounded throughout its length by gland cells, some of which appear vesicular owing to retention of secretion. Ceca with a dense coat of compact gland cells at very beginning, narrow and straight in forebody, but swollen (up to 0.36 mm wide) and winding in hindbody, in which they terminate at level of posterior end of egg reservoir.

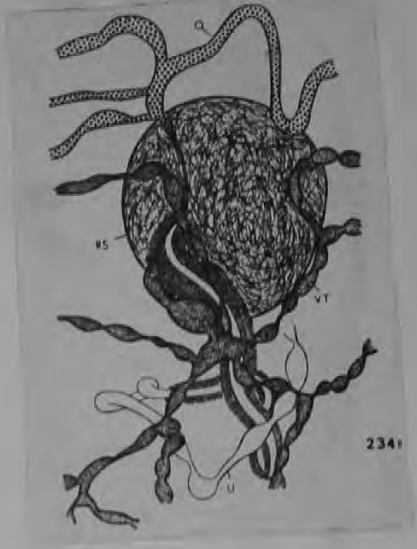
Testes paired, very long, one on each side of body; right one 10.5 X 0.3 mm, very irregularly winding; left one 6.8 X 0.25 mm, not so much winding as right one, reaching to near midlevel of hindbody. Vas deferens apparently straight alongside metraterm, though not distinct. Common genital pore ventral to pharynx immediately behind oral sucker.

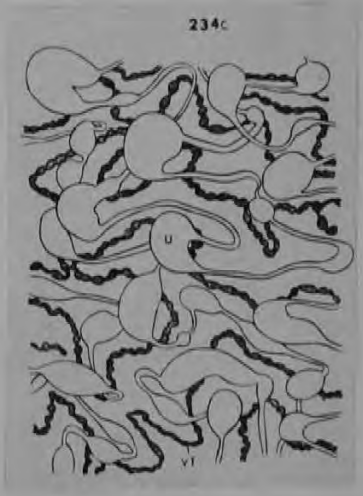
Ovary divided shortly posterior to anterior end of left testis into four main tubular branches, the right one of which soon divides again into two terminal branches and the remaining three of which are directed toward the left, the anterior one being divided into two terminal branches, but the other two being undivided. The total number of the irregularly winding ovarian terminal branches is, therefore, six. Genital junction nearly median, 1.2 mm from anterior end of hindbody. Uterine duct densely surrounded by shell gland cells for a length of about 1.0 mm, passing longitudinally dorsal to cistern of main vitelline branches. Uterus winding irregularly throughout hindbody, forming moniliform swellings at many places (Fig. 234 C); egg reservoir 3.2 mm wide. Metraterm well differentiated, especially in region of forebody posterior to intestinal bifurcation. Eggs bean-shaped, 16-18 X 9-11 μ. Vitellaria narrow, tubular, moniliform at many places (Fig. 234 B & C), extending throughout hindbody. Five main vitelline branches joining convergently 0.5 mm posterior to genital junction, to form an elongate cistern which narrows in form of a funnel and leads into a fusiform vitelline reservoir 0.12 mm wide, the attenuated distal end of which is produced toward the genital junction to meet the germiduct. All the main vitelline branches, except for two undivided ones, bifurcate one to five times, making a total of 22, irregularly winding, terminal branches of different lengths; longest terminal branches originating from sinistroposterior main branch and reaching posterior extremity.

DISCUSSION: This species is characterized by the unusual location, to which the specific name refers, the unusually long testes, and the moniliform dilatation of the vitelline gland and uterus. In general anatomy the present species closely resembles *Didymocystis orbitalis* n. sp. from the same host species, though it is different in body size and location in addition to structural details. It may turn out to be identical with *D. orbitalis*, but I am not quite sure of this identity at the present time owing to lack of material.

over







From Yamaguti, 1970

235. *Didymocystis orbitalis* n. sp.

(Fig. 235)

Yamaguti, 1970

HABITAT: Encysted in pairs in elliptical cyst in periorbital connective and adipose tissue of *Neothunnus macropterus* (type host) and *Parathunnus sibi*; Hawaii.

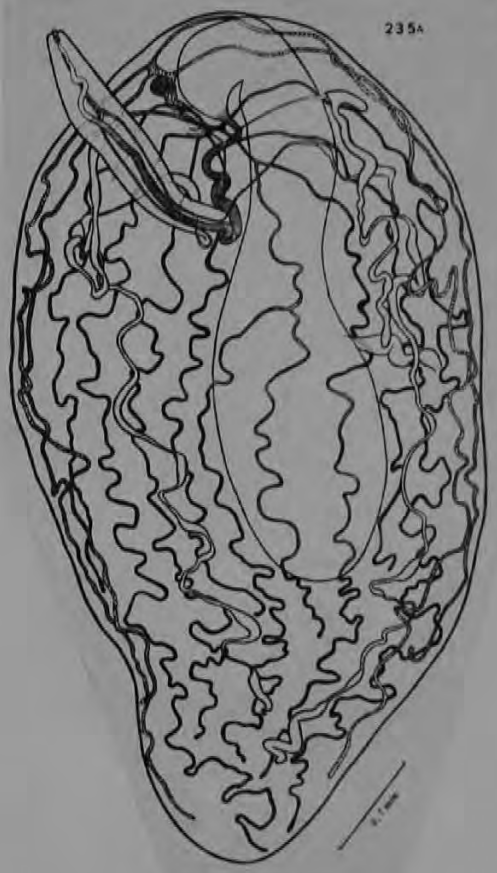
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63808.

DESCRIPTION (based on 15 flattened whole mounts): Forebody flattened subcylindrical, blunt-pointed in front, 1.0-2.0 X 0.25-0.45 mm, attached to near anterior end of hindbody on its ventral side. Hindbody 2.9-5.9 mm long, 1.7-3.2 mm wide, with longitudinal ventral furrow, two-lobed in front, and blunt-pointed and curved ventrad posteriorly. Oral sucker pyriform, 32-46 X 25-39 μ, directly followed by globular to subelliptical pharynx 30-58 μ long by 23-51 μ wide. Esophagus narrow, usually straight, 0.25-0.67 mm long, surrounded throughout by prominent gland cells; ceca narrow, straight in forebody, but undulating and slightly inflated at some places in hindbody, reaching to near its posterior end.

Testes symmetrical, tubular, 1.2-3.0 mm long, 30-100 μ wide, extending along anterior dorsolateral margins of hindbody; vasa efferentia united near base of forebody; vas deferens running alongside metraterm. Genital pore ventral to oral sucker, sometimes projecting beyond mouth aperture.

Ovary consisting of a common stem swollen at its distal end near anterior extremity and 3-4 unbranched main branches which extend, one on one side, and two on the other, or two on each side, in ventrolateral fields as far back as posterior extremity in the type. Occasionally there may be, however, 3-9 irregular branches of ovary. Seminal receptacle oval, 0.13-0.18 X 0.11-0.17 mm, situated close to trunk of ovary. Vitelline gland consisting of cistern connected with germiduct by a narrow passage and receiving several primary branches which are simple or divided dichotomously one to six times, making a total of 9-19 terminal branches; these branches wind their way backward near dorsal and dorsolateral surface of hindbody and terminate at different levels, some branches reaching to extreme posterior end of hindbody. One primary branch or two, or secondary or tertiary branch may divide at the same point into three terminal branches. In short, there is a marked irregularity in the branching of the vitelline gland. Uterus coiled transversely from side to side from anterior extremity to posterior, finally leading into elongate median egg reservoir 0.4-1.0 mm wide; metraterm swollen and winding as it enters the forebody, in which it is moderately muscular as far forward as the intestinal bifurcation; anterior to this point the metraterm possesses very delicate walls. Eggs bean-shaped, embryonated, 16-19 X 9-12 μ.

DISCUSSION: This species is characterized by the peculiar location and rather irregular branching of the ovary and vitelline gland. It is regrettable that in most of the previously reported *Didymocystis* species the branching of the ovary and vitelline gland is not sufficiently described to admit of comparison with the present species, but as far as I am aware, all the species found in different locations of *Neothunnus macropterus* and *Parathunnus sibi* are specifically different. Due to these considerations the new species in question is named after the location where it was found.



236. *Didymocystis palati* n. sp.

(Fig. 236)

Yamaguti, 1970

HABITAT: Encysted in pairs in hard denticled palate, partly in tooth plate on gill arch of *Neothunnus macropterus*; Hawaii.

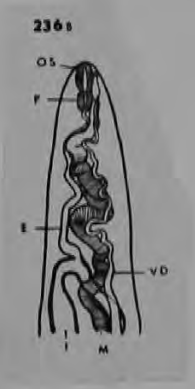
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63809.

DESCRIPTION (based on 22 flattened whole mounts): Cyst round, with sclerotized capsule of host origin. Forebody flattened subcylindrical, tapered or blunt-pointed anteriorly, 0.35-0.8 X 0.12-0.2 mm, attached to hindbody between two anterior lobes of hindbody; hindbody rolled up, 1.2-2.5 mm long, 0.5-1.3 mm thick dorsoventrally, with two distinct anterior lobes and a distinct median ventral furrow, often angular at the point where the anterior lobes pass into the convex dorsal surface; posterior extremity curved ventrad, pointed or not. Oral sucker musculocellular, terminal, 25-40 X 21-93 μ; pharynx 16-33 X 18-30 μ; esophagus 70-140 μ long; ceca narrow in forebody, but tortuous and inflated in hindbody, ending at different levels near posterior extremity.

Testes sausage-shaped, somewhat arcuate, 0.22-0.6 mm long by 40-120 μ wide. Vas deferens running alongside metraterm as usual. Genital pore ventrolateral to oral sucker.

Ovary divided into two tubular main branches, one of which has a side branch; the branches, originating at varying distances from the posterior extremity, wind their way gently in the lateral fields, mostly external, partly internal, to the uterus; both main branches uniting together at the front end near the base of the anterior lobes. Seminal receptacle oval. Shell gland between junction of two ovarian branches and that of vitellarian tubules near anterior extremity. Vitellarian tubules three or four, undivided, 25-40 μ wide, extending along convex side of hindbody dorsal to ovary as far back as posterior extremity where they curve ventrad or turn around, one branch terminating short of posterior extremity. Uterus occupying all available space of hindbody, coiling at first in anterior part of hindbody, then winding backward to posterior extremity where it turns forward, thus filling most of middle and posterior thirds of hindbody; egg reservoir often distinctly oval, 0.3-0.45 mm wide; eggs bean-shaped, 16-21 X 8-11 μ.

DISCUSSION: This species is characterized by three terminal ovarian branches and three or four undivided main vitellarian branches. It is to be noted that the cysts of this species become irregualr in outline as they grow because of space restriction due to the complex structure of the palatal teeth surrounding them.



237. *Didymocystis philobranchia* n. sp.

(Fig. 237)

Yamaguti, 1970

HABITAT: Encysted in pairs on gill filaments of *Neothunnus macropterus* (type host), *Parathunnus sibi*, and *Thunnus alalonga*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63810.

DESCRIPTION (based on 64 flattened whole mounts): Cyst elliptical, very thin-walled. Forebody flattened subcylindrical, 0.5-2.0 mm long, 0.07-0.4 mm wide at base, attached to near anterior end of hindbody between two anterior lobes, with head end acutely or bluntly pointed. Hindbody comma-shaped, distinctly furrowed longitudinally on concave side, with two prominent lobes anteriorly, blunt-pointed posteriorly, with or without conical prominence dorsoterminally, 2.5-10 mm long, 0.8-2.5 mm thick near its anterior end. Oral sucker terminal, pyriform, 23-46 × 18-46 μ, directly followed by subglobular to elliptical pharynx 14-51 μ in diameter; esophagus very variable in length (0.1-0.48 mm) according to state of contraction; ceca narrow and parallel to each other in forebody, winding and more or less atrophied posteriorly in hindbody, probably terminating some distance from tail end.

Testes subcylindrical, 0.45-2.0 × 0.05-0.2 mm, symmetrical at anterior end of hindbody. Vas deferens running forward in forebody along with metraterm. Genital pore ventrolateral to oral sucker or pharynx.

Ovary consisting, in the type, of two stems, each stem dividing into three branches on the right side and five branches on the left side, making a total of eight terminal branches; the longest main branch of each stem directed backward near concave ventral side and terminating at varying levels anterior to posterior extremity, whereas the shortest last branch originating from the main branch terminates at about the middle of the hindbody. In the paratypes the ovarian branches vary from four to six. The whole organ is largely confined to the anterior half of the hindbody. A round seminal receptacle is present near the shell gland which is situated a little anterior to the middle of the hindbody close to the dorsal cuticle. Vitellaria 20-90 μ wide, usually narrower than ovary, extending on convex lateral and dorsal sides external to uterus from testicular zone to posterior extremity of hindbody, dichotomously branching several times, so that a large number (21-38) of blind ends can be seen. Uterine coils occupying most of available space of hindbody internal to testes, ovary, and vitellaria. Egg reservoir not always conspicuous, 0.25-1.1 mm wide; eggs bean-shaped, embryonated, 16-20 × 8-12 μ. Excretory pore terminal, on top of conical protuberance when the latter is present.

DISCUSSION: This species differs from the most closely related *Didymocystis philobranchiarca* n. sp. in the location and branching of the ovary and vitelline gland, as shown in the key to the species of *Didymocystis*. The specific name refers to the predilection of the parasite for the gill filaments.

238. *Didymocystis philobranchiarca* n. sp.

(Fig. 238)

Yamaguti, 1970

ABITAT: Encysted in pairs on rudimentary gill rakers gill arch of *Neothunnus macropterus* (type host) and *thunnus sibi*; Hawaii.

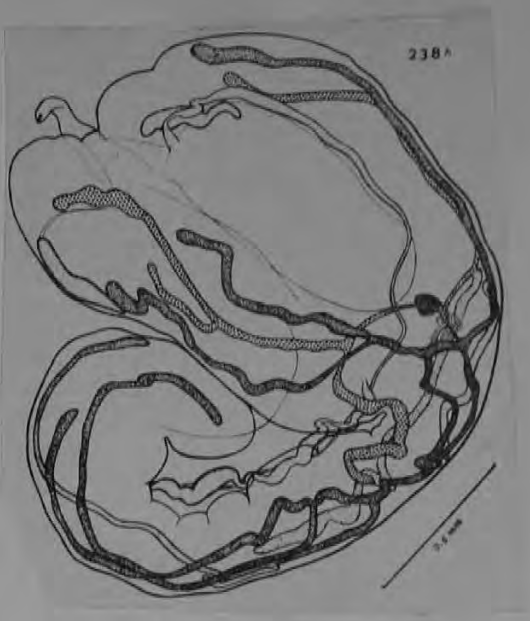
OTYPE: U. S. Nat. Mus. Helm. Coll., No. 63811.

SCRIPTION (based on 38 flattened whole mounts): body tapering anteriorly to acute or blunt point, .2 mm long, 80-250 μ wide at base or at intestinal cation; hindbody rolled up, approximately soleiform, distinctly two-lobed anteriorly, with medain longitudinal groove on concave ventral side, often showing angular flexure on convex side a short distance anterior to its blunt-pointed posterior extremity, 2.2-8.3 mm long, 0.5-2.0 mm wide near anterior extremity. Mouth terminal; oral sucker pyriform, 16-40 × 18-30 μ; pharynx subcylindrical to spherical, 11-35 × 14-37 μ; esophagus simple, 0.15-0.3 mm long; ceca narrow in forebody, one of them may be completely atrophied, the other tubular, reaching to near posterior extremity.

Testes sausage-shaped, curved, 0.2-1.0 × 0.05-0.15 mm, situated almost symmetrically in anterior lobes of hindbody; vas deferens running alongside metraterm in forebody and opening together with latter ventral to oral sucker.

Ovary divided into four main branches, two anterior and two posterior; left anterior branch giving off a short side branch. In the paratypes up to ten ovarian branches have been counted. A distinct seminal receptacle 90 × 70 μ was observed in the type. Vitelline gland consisting of a short stem and three main branches, of which the anterolateral bifurcates near the origin, but the middorsal bifurcates twice into three terminal branches which are directed backwards to terminate at or near the posterior extremity. In the paratypes the number of the terminal vitelline branches varies from 6 to 13. In the type the initial portion of the uterus ascends first on the left of the egg reservoir, then descends on the right of it to the posterior extremity, where it turns back on itself; the next recurrent loop on the left side of the hindbody empties into the egg reservoir at its posterior end, thus occupying all available space of hindbody internal to ovary and vitellaria. Metraterm well differentiated in forebody. Eggs bean-shaped, 14-19 × 9-12 μ. Excretory vesicle tubular, dilated in hindbody, with terminal pore.

DISCUSSION: This species differs from the most closely related *Didymocystis soleiformis* Ishii, 1935 in the dichotomous branching of the vitellaria and in the larger egg size. In *D. soleiformis* from *Euthynnus* and *Seriola* of Japan there are fewer vitellarian branches, and the eggs are about 14 μ by 9 μ. The specific name refers to the predilection of the parasite for gill arches.



239. *Didymocystis poonui* n. sp.

(Fig. 239)

Yamaguti, 1970

HABITAT: Encysted in pairs in teeth of palate of *Parathunnus sibi* (local name "poonui"); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63812.

DESCRIPTION (based on ten selected whole mounts): Forebody 0.3-0.8 mm long, widened posteriorly to 0.1-0.15 mm, pointed anteriorly. Hindbody curved ventrad and distinctly two-lobed in front; 1.7-2.9 X 0.4-0.9 mm; posterior extremity sometimes spirally twisted, rounded at tip. Oral sucker terminal, acorn-shaped, 23-30 X 20-27 μ; pharynx 16-23 X 13-21 μ; esophagus 0.13-0.22 mm long; ceca comparatively narrow and winding in hindbody, terminating near posterior end of body.

Testes 30-100 μ wide, variable in length, each longitudinally elongated, in anterior lobe of hindbody. Genital pore ventrolateral to oral sucker.

Ovary divided into three tubular, more or less winding lobes 30-80 μ wide and unequal in length; anterior two situated one on each side of hindbody, with proximal anterior ends overlapping testicular zone; other lobe directed almost straight backwards. Seminal receptacle oval. Genital junction near anterior end of hindbody. Vitelline gland consisting of a single tubular trunk which bifurcates several times (seven times in the type) and terminates at or near posterior extremity; one of the lateral branches given off from the main trunk is simple, others bifurcating once or more. All the vitellarian tubules 20-60 μ wide, extending mostly longitudinally on convex side of hindbody posterior to ovarian zone and external to uterus. Uterine coils occupying all available space of hindbody; egg reservoir moderately large, on ventral side of anterior half of hindbody; metraterm winding in ventral median field of forebody. Eggs bean-shaped, 16-19 X 10-12 μ.

DISCUSSION: This species differs from *Didymocystis superpalati* n. sp. from the same location of *Neothunnus macropterus* in the extent of the ovary and vitellaria and in egg width. In *D. superpalati* the ovary consists of two branched tubules, and the vitellaria are divided into a smaller anterior group and a posterior group consisting of two main trunks bifurcating two to four times. The specific name refers to the local name of the host.

239

138. *Didymocystis reniformis* Ariola, 1902

A number of this species were found encysted on the esophagus and stomach of *Euthynnus pelamys* (Linn.) from the Pacific coast of Mie Prefecture. Larger cysts were attached to the upper portion of the esophagus and smaller ones to the stomach. The cysts are globular to oval and consist of a lamellar layer of connective tissue fibers. According to Ariola the worms enclosed in each cyst are perfectly similar to each other, but in all the cases that have come under my observation, one of them is constantly a little larger than the other. Ariola states that "l'apertura genitale" (undoubtedly male genital pore) lies immediately below the intestinal bifurcation, but there is no doubt that it passes farther forwards along with the uterus and joins the latter to form a common aperture. The pharynx described by Ariola as bipartite should be regarded as the oral sucker plus pharynx, as pointed out by Odhner.

Didymocystis scomberomori (MacCallum & MacCallum, 1916) Yamaguti, 1954

from Overstreet, 1969

FAMILY DIDYMOZOIDAE Poche, 1907

Didymocystis scomberomori (MacCallum and MacCallum, 1916) Yamaguti, 1954
Figures 36 and 37

Distomum (*Koellikeria*) sp. Linton, 1901.
Koellikeria scomberomori MacCallum and MacCallum, 1916.

Hosts: *Scomberomorus maculatus* (2 of 2); *Scomberomorus regalis* (1 of 2)*.
Site: Encysted in pairs in wall of stomach, intestine, and pyloric caeca.
Specimen deposited: U. S. N. M. Helm. Coll. No. 71319.
Description (based on 24 wholemounts and 1 sectioned cyst): Hermaphroditic, enclosed as pair in globular to subglobular cyst. Hindbody hemispherical to reniform, 0.43 to 1.32 long at median axis by 0.86 to 2.17 wide in wholemounts. Forebody attaching near anterior margin of hindbody, 0.23 to 0.92 long by 0.07 to 0.16 wide; widest at anterior level. Oral sucker replaced by a spherical glandular organ, sometimes overlapping pharynx. Pharynx muscular, 0.021 to 0.035 long by 0.017 to 0.026 wide. Esophagus longer or shorter than ½ width of forebody. Caeca usually narrow in forebody, and vesicular in hindbody.

Testes tubular, paired, near midlevel at side of hindbody; straight, arcuate, or sinuous. Genital pore subterminal or terminal, near pharynx. Vas deferens sinuous or not.

Ovary tubular, either undivided or dividing near seminal receptacle into 2 stems, usually of unequal length, each extending in opposite directions, winding sinuously along lateral and posterior margins of hindbody, without secondary branching. Seminal receptacle saccate, site variable from almost median to midway to lateral margin, near base of hindbody or well interior. Mehlis's gland lateral to receptacle. Vitellaria tubular, slender, sinuous, extending along posterior or dorsolateral margins of hindbody; branching more in some specimens than in others; number of free ends variable; occasionally vitellaria occupying a little more than ½ of posterior margin of hindbody and a branch of ovary occupying the remainder of the margin. Uterus extensive, occupying almost all available space in hindbody. Reservoir apparently present. Eggs slightly reniform, 12 to 15 by 8 to 11 microns, usually 14 by 10 microns.

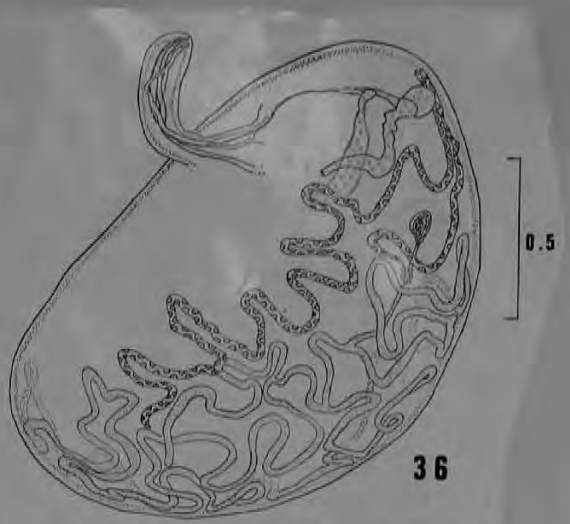
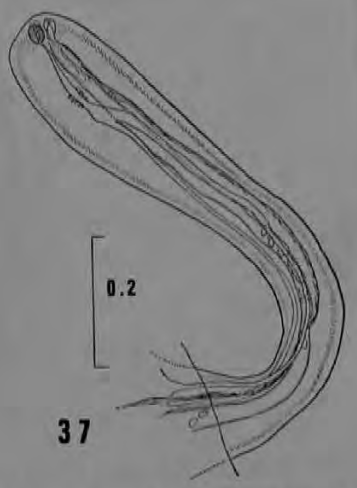


Figure 36. *Didymocystis scomberomori*. Figure 37.



Didymocystis scomberomori, anterior end.

Discussion: My specimens are apparently of the same species as that reported and illustrated by Linton (1901:447) as *Distomum* (*Koellikeria*) sp. from the same host. Linton gave measurements on length, width, diameter of neck, and eggs from a single specimen. MacCallum and MacCallum (1916:153), not citing Linton's report, gave almost identical measurements for *K. scomberomori* but did not provide a detailed description.

The anterior glandular organ might be the same as the "feebly muscular" oral sucker in *D. submentalis* Yamaguti, 1938. There is a thin membrane around the structure, but the membrane is not muscular.

Didymocystis singularis ~~n. sp.~~ S.V. JOB, 1966

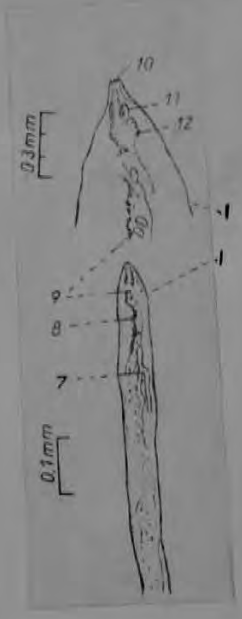
These parasites were located deep in the host tissue surrounding the heart he gular or sublingual region. They appeared bright yellow in colour and asured from 0.5 to 5.0 mm in their longest axis. They appeared to change ir shape and anything from a comma to a sphere or a dumbel was possible one and the same parasite. Thus they appeared to be more mobile than the author has so far come across (JOB 1961 a, b, c and 1964). This change the shape refers only to the hind body which is disproportionately large pared to the fore part. These parasites apart from being single did not have yst enveloping them.

At first it was difficult to identify the parasite, but measurement of the e embryo gave the clue. (The use of ovic embryo dimensions in systematics he group is discussed elsewhere by the author.) It is now definite that these ong to the Genus *Didymocystis*. The ovic embryos of this species is closest hat of *D. pseudobranchialis* (JOB 1964). It also resembles the latter in the owing details: The body is divided into a slender forepart and a plump hind t. At the end of the forepart both an oral sucker and a pharynx are present. e genital opening is also located close to the mouth subterminally. The epart stems from a point at about the middle of the hind part and is a little er $^1/_3$rd the length of the hind part. The ovary appears to be single and invade the testicular region. The testes are paired, long and club-shaped. e ootype is spherical and located almost in the centre of the hind body. The ellarium is also coiled and extends throughout the hindbody. The bulk of space in the latter is occupied by the uterus. The intestinal diverticulum mmences at about $^1/_5$th the distance from the free end of the fore part.

The present form differs from the other species in the following: It does t occur in pairs, is free and not encysted. It appears to be capable of nited movement. The fore part is slender measuring only about $^1/_{12}$th as ick as the average thickness of the hindbody. The pointed end is armed with ree short spines. The fore part is adapted for piercing. The ovic embryos pear to be more angular and each measures about 1 μm in length and 0.5 μm thickness.

On the basis of the above description, the present form is assigned the atus of a new species. It is internal, has no definite shape, occurs singly and e fore part is very slender and adapted for piercing. Hence, it is named *idymocystis singularis*. The types of the species are deposited in the collec- ons of this center of the University of Madurai.

Fore-part; 2. Testis; 3. Vitellarium; 4. Ovary; 5. Ootype; 6. Uterus; 7. Intestinal diverticulum; 8. Vas deferens; 9. Uterine opening; 10. Oral armature; 11. Oral sucker, 12. Pharynx



Host: SPHYRAENA JELLO 20 WORMS FROM 2 HOSTS

Loc.: OFF PAMBAN IN GULF OF MANNAR. (INDIA)

240. *Didymocystis spirocauda* n. sp.

(Fig. 240)

Yamaguti, 1970

HABITAT: Encysted in pairs in retrorbital connective tissue of *Neothunnus macropterus* (local name "ahi" or "sibi"); Hawaii.

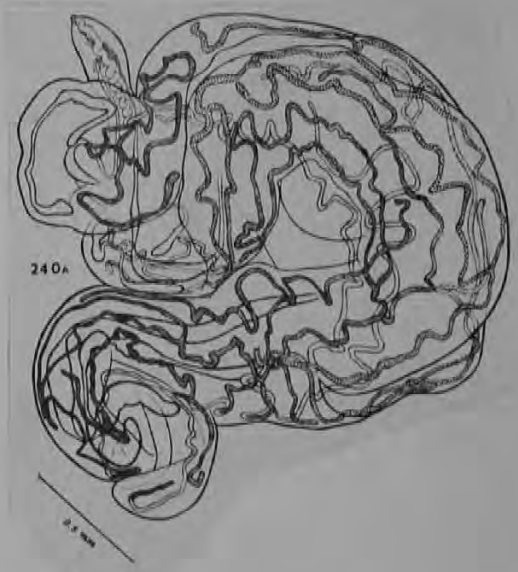
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63813.

DESCRIPTION (basde on two fellow occupants, one of which was selected as holotype): Forebody flattened subcylindrical, pointed anteriorly, 0.8 mm long, 0.26 mm wide at level of esophagus, arising from bottom of groove between two anterior lobes of hindbody. Hindbody C-shaped, 0.7 mm long by 0.8 mm wide under strong cover glass pressure, divided anteriorly into two rounded lobes 0.8 mm wide, with its tapering posterior extremity twisted spirally. Oral sucker terminal, rather weakly muscular, 37 μ long by 23 μ wide; pharynx absent; esophagus simple, slender, bifurcating at a distance of 0.33 mm from head end into stomach portion densely surrounded by gland cells. Ceca narrow and parallel to each other in forebody, at the base of which they turn abruptly backwards to terminate blindly near the posterior extremity of the hindbody. No acetabulum.

Testes tubular, unequal, swollen at some places, each extending along convex margin of anterior lobe of hindbody in form of an irregular loop. No seminal vesicle. Vas deferens running alongside metraterm. Genital pore anteroventral to oral sucker, projecting prominently in form of a prolapsus in the type.

Ovary divided near its distal end into two forwardly directed stems, one of which, after giving off a side branch near its origin, divides again into two terminal branches running close to convex side as far as beyond middle of hindbody, whereas the other stem, after giving off a side branch far away from its origin, divides into two rather short terminal branches at base of anterior lobes of hindbody, so that there are three blind ends for each stem, making a total of six. There is no ovarian tubule extending into the hindbody posterior to the genital junction. Genital junction formed by union of distal end of ovary and common vitelline duct, situated close to convex surface about mideay between two extremities of hindbody. No seminal receptacle. Uterus winding largely longitudinally among ovarian and vitellarian tubules, finally forming a very conspicuous longitudinal egg reservoir occupying entire concave side of hindbody except for two extremities. Eggs small, bean-shaped, embryonated, 16-18 X 10-12 μ in life. Vitelline gland consisting of three anterior and three posterior, narrow tubules, each of which divides sooner or later into one to four terminal branches, so that 12 blind ends have been counted for the type; vitelline tubules extending largely on convex side of hindbody from its anterior lobes to posterior extremity; anterior stems and their branches are largely distributed anterior to genital junction, whereas posterior stems and their branches are mostly confined to hindbody posterior to genital junction. Excretory system not made out except for a pair of nearly parallel arms extending in esophageal region up to head end and uniting dorsal to intestinal bifurcation.

DISCUSSION: This species is characterized by the long spiral tail of the hindbody, to which the specific name refers, the regional distribution of the ovarian and vitellarian tubules, and the long, slender, looped testes. From the presence of a stomach portion it seems certain that this species develops from the *Monilicaecum* form. The absence of the pharynx in this species is worth noting.



241. ***Didymocystis superpalati*** n. sp.

(Figs. 241 and 340)

Yamaguti, 1970

HABITAT: Encysted in pairs in teeth of palate of *Neothunnus macropterus*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63814.

DESCRIPTION (based on ten whole mounts): Cyst round, with hard, sclerotized walls irregular in shape when fully developed. Forebody rather slender when extended, attenuated anteriorly, with blunt-pointed end, 0.7-1.25 × 0.1-0.4 mm, attached to hindbody ventrosubterminally. Oral sucker cellular, pyriform to oval, 25-51 × 23-46 μ, directly followed by weakly muscular pharynx 25-40 × 23-37 μ. Esophagus slender, 0.28-0.45 mm long, bifurcating in posterior part of forebody. Ceca narrow in forebody, but swollen and strongly winding in hindbody and terminating close to posterior extremity. Hindbody comma-shaped, 2.0-5.4 × 1-2 mm, with ventral furrow, two-lobed anteriorly, with blunt tail end curved ventrad.

Testes elongate, rather massive, 0.3-0.5 × 0.06-0.2 mm, paired in anterior part of hindbody. Vas deferens running along metraterm, up to 20 μ wide. Genital pore midventral to oral sucker

Ovary consisting of subsymmetrical tubules, each of which gives off three, long or short, side branches before ending in postequatorial region. There are 7-9 terminal ovarian branches. Shell gland about 0.45 mm behind anterior end of hindbody in the type. Seminal receptacle elliptical. Vitellaria divided into two (right and left) main trunks, each of which bifurcates two to four times, thus making a total of 15-20 terminal branches. Uterus occupying all available space of hindbody internal to ovary and vitellaria, finally forming egg reservoir near ventral side; this egg reservoir is characterized by its U-shape. Metraterm muscular, usually winding in forebody. Eggs bean-shaped, embryonated, 16-19 × 8-10 μ.

DEVELOPMENT (Fig. 340): Larval specimens were found in the same location among the adult forms. They represented a series of various developmental stages apparently showing transition from the *Monilicaecum* stage to the adult. The youngest *Postmonilicaecum* forms are elongate, lanceolate, 3.2-3.8 mm long by 0.6-0.7 mm wide, resembling *Monilicaecum*. They differ, however, from the latter in lacking acetabulum; stomach portion seen at the intestinal bifurcation is transversely elongate and bears a certain resemblance to that of *Monilicaecum*. Ceca, twisted and constricted at many places, terminate at different levels close to posterior extremity. In the next stage, shown in Fig. 340 B, the body is 4.5 mm long, rolled back on itself spirally, and divided into two portions of different width; forebody tapering anteriorly, about 1.3 mm long, and contains a slender esophagus, a much reduced "stomach" portion, and anterior part of intestine. Immediately following the terminal oral sucker which is about 45 μ wide, a small pharynx has begun to develop. Hindbody about 1.0 mm wide, is usually rolled up against forebody, but flattened fusiform when straightened out. The previously twisted intestinal limbs became more loosely winding. Anlagen of testes seen at anterior end of hindbody in form of a very narrow arcuate cord of cells crossing intestinal limbs transversely and continued in median line to anlage of male duct, the anterior part of which is not clearly seen. Rudiments of female organs are hardly recognizable, although canalicules with walls well stainable with hematoxylin are seen in interintestinal field posterior to the arcuate testicular anlage.

The more advanced juvenile stage (Fig. 340 C) has taken the form of a youngest adult of *Didymocystis*; forebody widened posteriorly, 0.7 mm long by 0.5 mm wide, slightly telescoped into anterior end of hindbody which is 1.9 mm long by 1.2 mm wide. In the forebody the oral sucker is 60 μ in diameter and directly followed posterodorsally by a round rudimentary pharynx only 23 μ in diameter. Esophagus straight, 0.5 mm long, bifurcating at base of forebody; "stomach" portion, now similar in structure to that of intestine proper, directly following it. Genital pore is seen anteroventral to oral sucker. In the hindbody, which shows a distinct furrow centrally, the two winding intestinal limbs, apparently not functional, terminate at different levels close to the posterior extremity. The previously arcuate filiform testes have turned into paired, subcylindrical, twisted organs, each lying at the anterolateral corner, and the filiform female reproductive organs, except the uterus, show their definitive pattern of arrangement; median shell gland enclosing the genital junction lies shortly behind the level of the posterior ends of testes. Although the course of the right ovarian stem is obscured by the folding of the right edge of the body, the left stem is seen clearly to bifurcate three times before terminating in the left half of the hindbody near the posterior extremity. Each of the paired stems of the vitelline gland bifurcates two times near its origin and eventually some branches reach to the posterior extremity; the others to the testicular zone just in the adult *D. superpalati*. Winding course of the uterine anlage recognizable, though not well traceable.

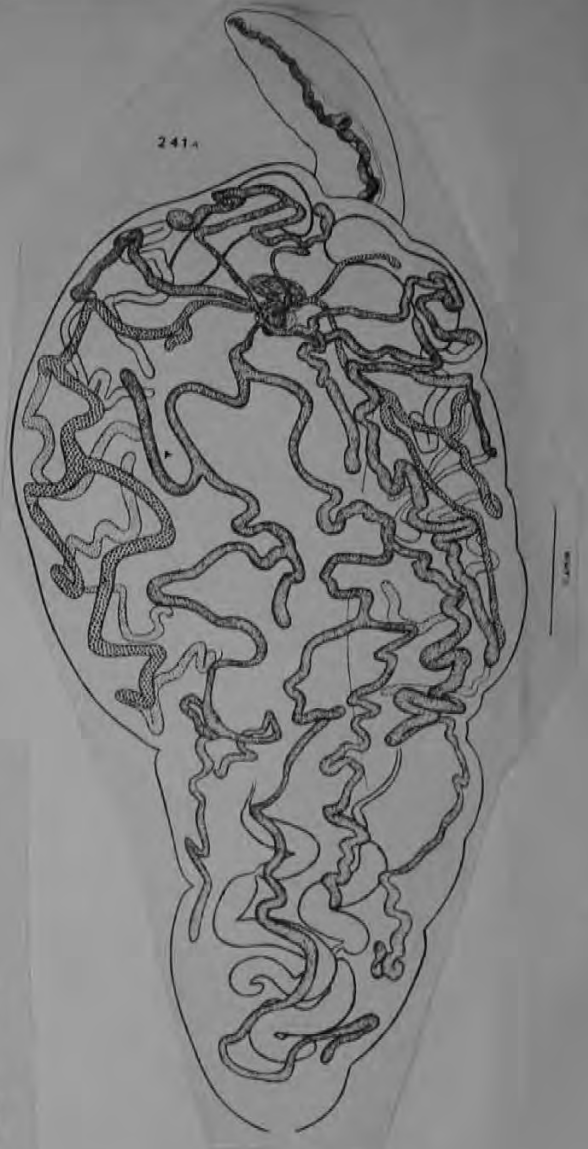
This stage, characterized by the complex branching of ovary and vitelline gland, seems to be a juvenile form of *Didymocystis superpalati* mentioned above. From the

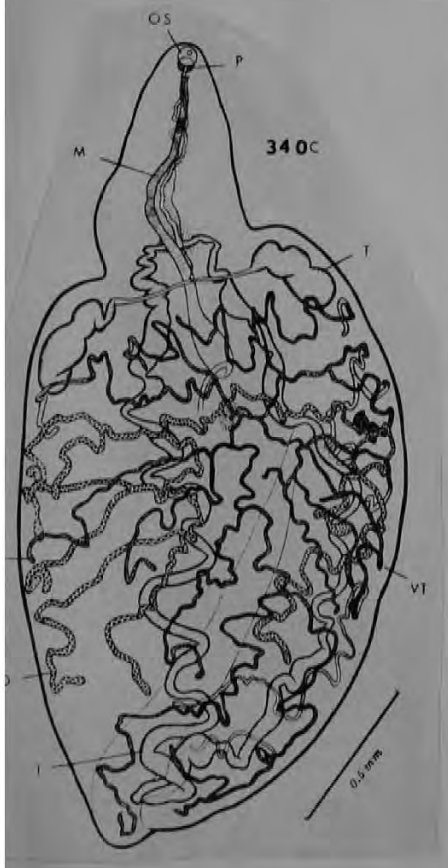
over

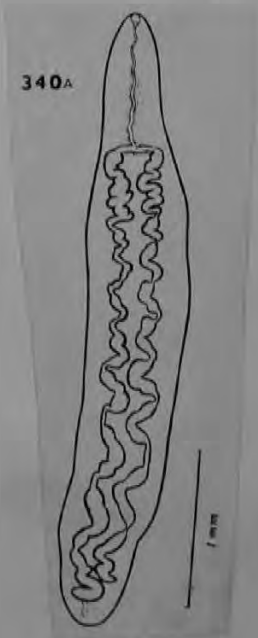
above observation it is almost certain that a form of *Monilicaecum* develops into a *Didymocystis* species by early distintegration of the acetabulum. In this connection it should be reminded that the "stomach" portion is retained in the adult of *Didymocystis spirocauda* n. sp. On the other hand it seems likely that *Opisthorchinematobothrium* and *Epithelionematobothrium*, both characterized by the "stomach" poriton at the beginning of the intestine, develop from the larval stage of *Monilicaecum*. This is the reason why I propose (p. 234) to use the terms *Monilicaecum* and *Torticaecum*, like *Postmonilicaecum* and *Posttorticaecum*, as collective larval group names.

DISCUSSION: This species is characterized by the main branches of the ovary bifurcating three times and the vitelline gland dividing two or more times. In the related species, *D. palati*, which is found associated with the present species, the branching of the ovary and vitelline gland is much simpler. This is an example of double parasitism by two different species in the same location. The specific name refers to the superinfection over *D. palati*.

From Yamaguti, 1970







139. *Didymocystis wedli* Ariola, 1902

Syn. *Didymozoon* sp. Kobayashi, 1921
Didymocystis kobayashii Dollfus, 1926
Wedlia katsuwonicola Okada, 1926

Large numbers of this trematode were obtained from the gills of *Euthynnus pelamys* from the Pacific and of *Thynnus thynnus* from Toyama Bay. Some of them were sectioned and others were flattened under cover

My (Yamaguti, 1934) observations on the two Didymocystis species described above confirm largely Ariola's description except for the postition of the male genital opening. The Laurer's canal which Kobayashi states to end blindly and be surrounded by a group of peculiar cells in Didymozoon sp. from the gill of Scomber japonicus, probably corresponds to the receptaculum seminis dexcribed above. Although Kobayashi's description leaves much to be desired, yet it is sufficient to show that he had before him the present species, so that Dollfus' Didymocystis kobayashii becomes a synonym of D. wedli. Wedlia katsuwonicola Okada, 1926, is also identical with the present species, as recently confirmed by the author.

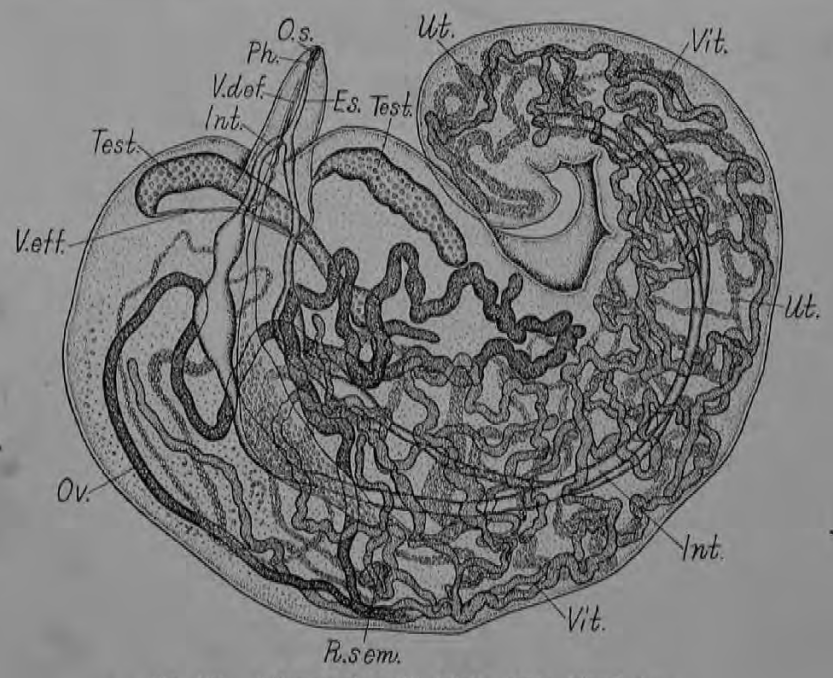


Fig. 134. *Didymocystis wedli* Ariola, 1902; lateral view.

DIDYMOCYSTIS

Didymocystoides n. g.

GENERIC DIAGNOSIS: Didymozoidae, Didymozoinae. Complete hermaphrodite, enclosed in pairs in round cysts. Forebody flattened subcylindrical or scoop-shaped, attached to hindbody at or near anterior end of its flat surface; hindbody half-oval, hemispherical or subglobular, flattened on ventral side, without being furrowed longitudinally, never two-lobed anteriorly. Oral sucker and pharynx present, latter usually better developed than former. Ceca winding or swollen in hindbody, terminating near posterior extremity. Genital pore near oral sucker. Testes tubular, paired, in anterior part of hindbody. Ovary tubular, slender, single or more often divided into two simple or branched main branches extending back of testes. Genital junction near dorsal side of hindbody at varying distances from anterior end of hindbody. Receptaculum seminis present. Vitellaria with a few or several, long, slender branches. Uterus irregularly coiled in hindbody; egg reservoir sometimes conspicuous; metraterm well developed; eggs numerous, bean-shaped, embryonated. Parasitic on gill or operculum, or more frequently in tissue of various parts of body of marine teleosts.

TYPE SPECIES: *D. bifasciatus* n. sp.

OTHER SPECIES: *D. alalongae* (Yamaguti, 1938); *D. buccalis* n. sp.; *D. exiguus* n. sp.; *D. intestinomuscularis* n. sp.; *D. oesophagicola* n. sp.; *D. opercularis* (Yamaguti, 1938); *D. pectoralis* n. sp.; *D. pinnicola* n. sp.; *D. semiglobularis* (Ishii, 1935), *D. submentalis* (Yamaguti, 1938).

From Yamaguti, 1970

Key to species of *Didymocystoides* from Hawaiian fishes

Yamaguti, 1970

Parasitic in inner wall of intestine; hindbody 0.5-1.0 mm long; ovary bifurcate; vitellaria with 3-4 branches . . . . . *D. exiguus*

Parasitic in pectoral fin; hindbody 0.5-1.0 mm long; ovary single, not bifurcate; vitellaria bifurcate posteriorly . . . . . *D. pectoralis*

Parasitic in pre-opercular or submental region; hindbody 1.45-6.5 mm long; ovary bifurcate; vitellaria with four long terminal branches . . . . . *D. bifasciatus*

Parasitic in outer wall of esophagus; hindbody 2.0-3.4 mm long; ovary bifurcate, one branch bifurcating again; vitellaira with 6-8 terminal branches . . . . . *D. oesophagicola*

Parasitic in dorsal fin membrane; hindbody 1.3-3.5 mm long; ovary bifurcating two times; vitellaria with 9-10 terminal branches . . . . . *D. pinnicola*

Parasitic in oral cavity; hindbody 1.8-6.0 mm long; ovary bifurcate, one branch bifurcating again; vitellaria with three main branches, each of the two longest of which may give off a side branch . . . . . *D. buccalis*

Parasitic exclusively in muscle layer of intestine; hindbody 1.5-3.2 mm long; ovary bifurcating into two long simple branches; vitellaira with five terminal branches . . . . . *D. intestinomuscularis*

242. *Didymocystoides bifasciatus* n. g., n. sp.

(Fig. 242)

Yamaguti, 1970

HABITAT: Encysted in pairs in round cysts under membrane medial to hypohyal (type location), beneath free edge of pre-operculum and connective tissue covering gill arch at base of gill filaments of *Neothunnus macropterus* (type host), under branchiostegal membrane along ventral margin of ceratohyal and epihyal bones, and under membrane bordering gill filaments in area extending anteriorly from ventral end of posterior gill slit of *Parathunnus sibi*; Hawaii.

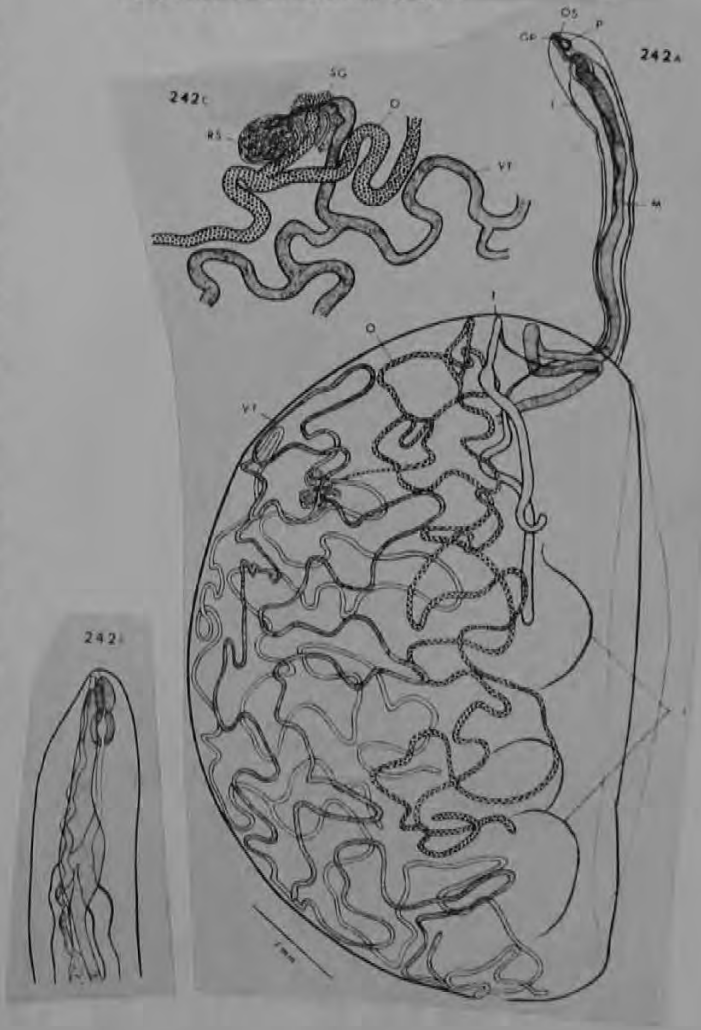
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63815.

DESCRIPTION (based on 26 flattened whole mounts): Forebody attached to hindbody near its anterior end on ventral side, 0.7-3.5 mm long, with maximum width of 0.15-0.5 mm in region of intestinal bifurcation, whence it tapers abruptly toward the conical head end. Hindbody hemispherical or half-oval, flattened on ventral side and convex dorsally, 1.45-6.5 mm long, 0.09-4.5 mm dorsoventrally, rounded at both extremities. Oral sucker acorn-shaped, weakly muscular, 42-70 × 25-44 μ; pharynx muscular, 39-70 × 32-58 μ; esophagus 0.1-0.25 mm long. Intestinal limbs swollen and twisted in hindbody, terminating at different levels near posterior extremity, with saccular ends directed ventrad.

Testes paired, long, tubular, 30-140 μ wide, more or less winding, one on each side, in anterior part of hindbody; vas deferens winding along metraterm, up to 30-50 μ wide. Genital pore ventral to oral sucker, slightly to right of median line.

Ovary consisting of a comparatively long slender stem and two similar, extremely long, usually simple branches; stem dividing at a point 1.7mm anterior to genital junction in the type. In this specimen the two ovarian branches originate at about the level 1.6 mm anterior to posterior extremity of hindbody, 2 mm back of posterior end of testes, and, after winding coarsely forward largely in testicular fields, unite at a point 1.3 mm posterior to anterior extremity of hindbody, 0.5 mm from dorsal surface; the resulting stem describes an S-shaped curve, the distal portion of which is very fine (only 2 μ wide), but which widens again (to 30 μ) before leading into short germiduct; initial uterine duct provided with dense coat of shell gland cells for a short distance; receptaculum seminis rounded, 0.09-0.17 mm in diameter, situated near dorsal surface, 0.6 mm away from it in the type. Vitelline gland consisting, in the type, of a short curved stem, which divides three times near the genital junction into four very long slender branches. These branches, coarsely winding and occupying the peripheral area in the dorsolateral and dorsal intertesticular field, mostly external, partly internal, to the uterus, terminate at the posterior extremity of the hindbody at certain intervals; there is no vitelline reservoir. In two of the paratypes the stem of the vitelline gland divides only once, so that there are two vitelline branches instead of four. The manner of division of the gland does not seem to be constant in this species. Uterus coiled irregularly and occupying most of central area of hindbody; egg reservoir up to 2.0 mm in diameter; initial portion of metraterm forming N- or W-shaped curve in anterior part of hindbody before entering forebody. In the forebody of the type the muscular metraterm is very conspicuous, and runs forward along with the vas deferens in the median field. Eggs bean-shaped, embryonated, 15-19 × 7-13 μ. Excretory system not made out.

DISCUSSION: This new genus bears a superficial resemblance to *Didymocystis* Ariola, but differs in the hindbody being flattened on the ventral surface without being furrowed longitudinally. *Didymocystis alalongae* Yamaguti, 1938, *D. opercularis* Yamaguti, 1938 and *D. submentalis* Yamaguti, 1938 are transferred to *Didymocystoides*. *Didymocystis semiglobulairs* Ishii, 1935, probably belongs to this new genus. The specific name refers to the bifurcate ovary.



243. *Didymocystoides buccalis* n. sp.

(Fig. 243) Yamaguti, 1970

HABITAT: Encysted in pairs at bottom of oral cavity of *Thunnus alalonga*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63816.

DESCRIPTION (based on four whole mounts): Cyst round, with two completely hermaphroditic individuals identical in size and shape. Forebody slender, 0.7-1.7 mm long, up to 0.15-0.27 mm wide at level of esophagus, arising from anterior end of hindbody. Hindbody globular to oval, 1.8-6.0 × 1.5-5.0 mm when flattened. Mouth terminal; oral sucker pyriform, 37-58 × 30-42 μ; esophagus 0.05-0.15 mm long; ceca narrow, simple in forebody, their termination in hindbody not made out.

Testes elongate, subcylindrical, 0.37-1.9 × 0.05-0.1 mm, situated almost symmetrically at anterior end of hindbody. Vas deferens winding in forebody along with metraterm, opening with latter ventral to oral sucker.

Ovary divided into three winding filiform branches close to shell gland complex which lies posterior to the distal ends of the two testes; one branch on the left and two on the right, each reaching to equatorial level in the type, though the medial branch may well reach posterior end of hindbody in the largest specimen. Receptaculum seminis ovoid, 90-170 × 80-90 μ. Vitellarium divided near its reservoir into three very slender main branches which are convoluted mainly in the peripheral area of the hindbody; each of two main branches with a side branch in the type; vitelline reservoir claviform, 60 × 40 μ in the type. Uterus occupying most of central area of hindbody, forming large elongate egg reservoir before entering forebody. Eggs bean-shaped, 18-20 × 8-12 μ. Excretory vesicle voluminous, close to ventral surface of hindbody.

DISCUSSION: This species differs from *Didymocystoides esophagicola* n. sp. chiefly in the smaller number of vitellarian branches and in their limited extent.

244. *Didymocystoides exiguus* n. sp.

(Fig. 244) Yamaguti, 1970

HABITAT: Encysted in pairs on inner wall of intestine of *Euthynnus yaito* (local name "kawakawa"); Hawaii.

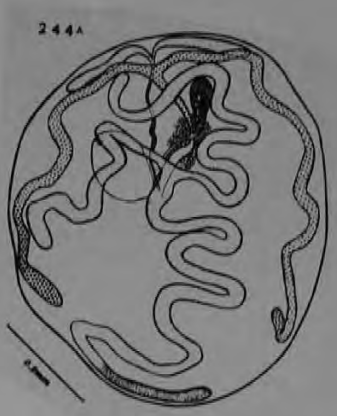
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63817.

DESCRIPTION (based on ten whole mounts): Cyst round to oval, without distinct capillary network of host. Forebody subcylindrical when extended, but fusiform or elliptical when contracted, 0.16-0.4 mm long, blunt-pointed, may be more or less enlarged in bifurcal region, attached to ventral side of hindbody near its middle or near its anterior end. Hindbdoy rounded, 0.5-1.0 × 0.4-0.8 mm, flattened on ventral side, by which the two partners are in direct contact with each other. Oral sucker terminal, poorly developed, musculocellular; pharynx oval, well muscular, 18-25 μ in diameter. Esophagus slender, only 23-46 μ long, bifurcating at widest part of forebody; ceca narrow in forebody, not traceable in hindbody.

Testes tubular, situated symmetrically along anterior border of hindbody, 130-280 × 16-28 μ. Vas deferens running alongside metraterm. Common genital pore midventral to oral sucker.

Ovary consisting of a common stem and two long narrow (15-30 μ wide) branches, each of which runs undulatingly along each side of hindbody to near its posterior end; common stem comparatively narrow, uniting with common vitelline duct at a short distance (0.16 mm in the type) from anterior end of hindbody. Seminal receptacle retort-shaped. Vitelline gland dividing at base of common stem into three or four (one median and two lateral in the type) winding branches a little wider (20-50 μ) than ovarian branches. In the type the right vitelline branch winds its way forward around the shell gland and terminates near the base of the common stem of the ovary, the shortest left one, however, is directed backward and ends short of the distal end of the left branch of the ovary; the longest median branch reaches to the extreme posterior end of the hindbody after describing several U-turns in the dorsal median field. Uterus filling all available space of hindbody; metraterm not well differentiated, may be distended with eggs. No egg reservoir. Eggs bean-shaped, embryonated, 14-17 × 7-10 μ in balsam mounts. Excretory system not made out.

DISCUSSION: This species differs markedly from the most closely related *Didymocystoides bifasciatus*, from the pre-opercular or submental region of *Neothunnus macropterus* of Hawaii, in habitat, in the body being much smaller, in the oral sucker being more poorly developed, and in the distriubtion of the ovary and vitelline gland, though the two species agree in the number of the branches of these organs. The specific name refers to the smallest form ever known for this genus.



245. *Didymocystoides intestinomuscularis* n. sp.

(Fig. 245) Yamaguti, 1970

HABITAT: Encysted in pairs in muscle layer of intestine of *Katsuwonus pelamys*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm Coll., No. 63818.

DESCRIPTION (based on seven whole mounts): Cyst oval to elliptical, supplied with capillary network of host. Forebody subcylindrical, only slightly swollen at esophagobifurcal level, 0.4-1.5 mm long by 0.06-0.12 mm wide. Hindbody elliptical, 1.5-3.2 × 0.08-3.0 mm, somewhat flattened on ventral side, to which the forebody is attached, dividing the hindbody in ratio of 1:1.5-2.4. Oral sucker terminal, elliptical, weakly muscular, 23-35 × 18-23 μ, followed by globular pharynx 18-26 μ long by 16-21 μ wide. Esophagus short; ceca narrow in forebody, swollen (up to 0.2 mm) and winding along each side of hindbody.

Testes tubular, almost symmetrical, nearly equal in length, 0.15-1.3 × 0.02-0.12 mm, lying along anterior end of hindbody. Vas efferens arising from recurved end of one testis, joining near its origin its partner from other testis; vas deferens comparatively long in hindbody, up to 20 μ wide, running alongside metraterm in forebody. Common genital pore ventral to oral sucker.

Ovary consisting of a comparatively long stem and two long branches, of which in the type one lies on the right of the median line close to the convex dorsal side posterior to the right testis, whereas the much longer one describes four U-turns close to the left convex dorsal side posterior to the left testis. Seminal receptacle oval, 0.1-0.25 × 0.05-0.15 mm, situated close to dorsal cuticle at about level of base of forebody, with shell gland complex immediately behind. Vitelline gland consisting of a stem shorter than that of ovary and five (one short and four longer), loosely winding, terminal branches, of which the two right ones terminate one behind the other close to the right margin of the hindbody; the left one also terminates near the left margin of the hindbody, whereas one of the two remaining posterior branches reaches to near the posterior extremity of the hindbody after describing two large U-turns on the posterior convex dorsal side, but the other is much shorter and, after turning back on itself posterior to the left branch, proceeds straight backward to end short of the posterior extremity of the hindbody. Uterus first winding irregularly in peripheral area, then forming a very conspicuous egg reservoir running in median axis of hindbody from end to end; metraterm in forebody somewhat muscular, median. Eggs small, bean-shaped, embryonated, 13-18 × 10-12 μ in balsam mounts. Excretory system not made out.

DISCUSSION: This species resembles *Didymocystoides buccalis* n. sp. in the branching of the vitellaria, but differs from the latter in the ovary consisting of two long simple branches, and what is more important, the present parasite lodges exclusively in the muscle layer of the host intestine. The specific name refers to this peculiar habitat.

246. *Didymocystoides oesophagicola* n. sp.

(Fig. 246) Yamaguti, 1970

HABITAT: Encysted in pairs in outer wall of esophagus of *Neothunnus macropterus* (local name "ahi" or "sibi"): Hawaii.

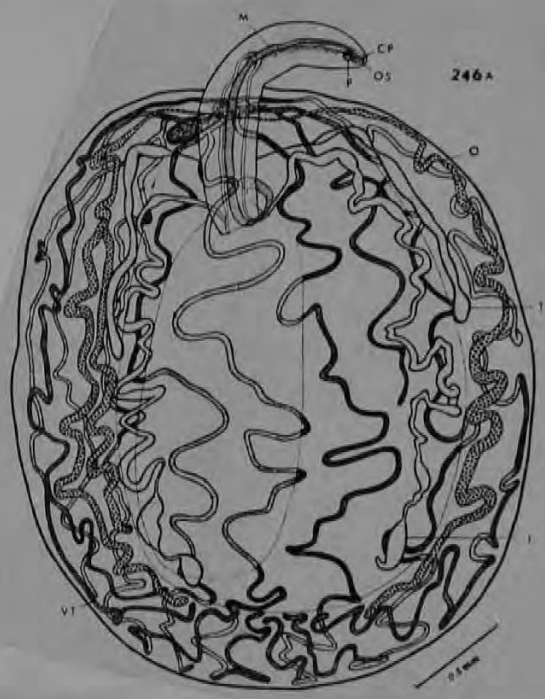
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63819.

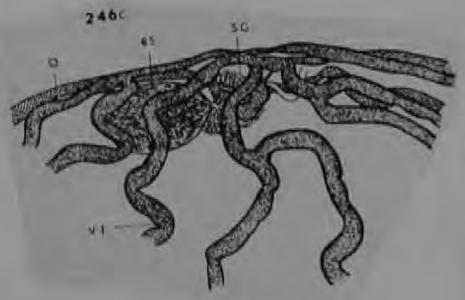
DESCRIPTION (based on 11 whole mounts): Forebody flattened subcylindrical, 1.3-2.5 mm long, 0.2-0.3 mm wide at base, very finely ciliated throughout its length, head end approximately blunt-conical. Hindbody oval, flattened on the side on which the two partners of the pair are pressed against each other, 2.0-3.4 X 1.5-2.5 mm, giving off forebody on ventral side near its anterior end. Oral sucker pyriform, 37-56 X 30-37 μ, opening ventroterminally, directly followed by subcylindrical or globular pharynx 32-51 μ long by 28-35 μ wide. Esophagus straight or winding, 0.3-0.6 mm long, surrounded by glandular cells, as is the beginning of the two ceca representing "stomach" portion. In the forebody the ceca are narrow, with sinuous walls, but in the hindbody they are invariably tortuous, with membranous walls, and terminate near the posterior extremity in straight or curved, fusiform or sausage-shaped swellings. This is the first time that I have been able to trace the whole course of the intestine of an adult didymozoid. No acetabulum.

Testes tubular, curved, 0.4-1.0 mm long by 50-130 μ wide, situated symmetrically near anterior end of hindbody, with their attenuated anterior ends directed toward median line; vasa efferentia joining at base of forebody; vas deferens may be distended with sperm at the very beginning, running forward along with metraterm. Common genital pore ventral to oral sucker.

Ovary tubular, slender, winding, divided into three tubules, of which two extend close to each other on the right side of the hindbody as far as the posterior end of the right cecum, whereas the third extends on the left side to behind the left cecum. Seminal receptacle claviform, large, about 0.3 X 0.2 mm in the type, close to anterior extremity. Vitellaria divided at anterior end of hindbody into six or eight tubules, which extend along the convex lateral and dorsal sides from the anterior extremity to the posterior; the most lateral tubules terminate posterolaterally, while the middorsal ones reach the posterior extremity, with the intermediate ones ending between the lateral and middorsal ones, so that all the vitellarian tubules are seen to end blindly at nearly regular intervals along the greater posterior marginal area of the hindbody; the number of the blind ends of vitellarian tubules, however, may be variable (ten in the type). No vitelline reservoir visible. Uterine coils occupying all available space of hindbody, finally forming elliptical median egg reservoir 1.3-1.6 mm long by 0.7-1.0 mm wide before entering forebody. Metraterm well differentiated, muscular. Eggs elliptical to slightly bean-shaped, 16-18 X 9-10 μ. Excretory vesicle not traceable.

DISCUSSION: Although this species resembles *Didymocystoides buccalis* n. sp. in the branching of the ovary, it differs from the latter in the more profuse development of the vitellaria, the longer esophagus surrounded by gland cells, and the beginning of the intestine forming a typical "stomach" portion. From the two last mentioned characteristics it seems likely that this species develops from *Monilicaecum*.





247. *Didymocystoides pectoralis* n. sp.

(Fig. 247) Yamaguti, 1970

HABITAT: Encysted in pairs in round cysts at base of inner surface of pectoral fin of *Parathunnus sibi* (local name "poonui"); Hawaii.

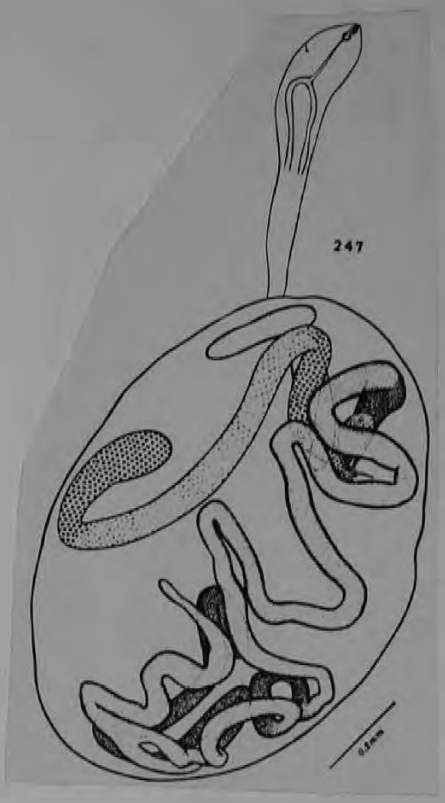
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63820.

DESCRIPTION (based on ten whole mounts): Forebody 0.4-0.65 mm long, 60-110 μ wide at level of intestinal bifurcation, whence it gradually tapers posteriorly, attached to anterior end of flat ventral side of body. Hindbody semioval, flattened on ventral side, by which the two partners lie in direct contact with each other, 0.5-1.05 X 0.4-0.7 mm. Oral sucker terminal, cellular, acorn-shaped, 23-54 X 31-35 μ; pharynx subglobular, 16-35 X 18-28 μ; esophagus 60-110 μ long; ceca not traceable in hindbody.

Testes close to each other at anteroventral part of hindbody, 0.11-0.3 X 0.04-0.07 mm. Vas deferens up to 20 μ wide. Genital pore ventrolateral to oral sucker.

Ovary tubular, sigmoid, 0.35-0.6 mm long lineally, 40-70 μ wide, extending in hindbody from behind testes to beyond equatorial level. Seminal receptacle saccular. Vitellarium long, winding, giving off an anteriorly directed simple branch at posterior extremity. Uterus occupying all available space of hindbody; metraterm not particularly muscular. Eggs bean-shaped, embryonated, 13-18 X 9-14 μ. Excretory system not made out.

DISCUSSION: This species is characterized by the ovary being simple, the vitellarium consisting of only two terminal branches, and the peculiar habitat, too. The specific name refers to the habitat.



248. *Didymocystoides pinnicola* n. sp.

(Fig. 248) Yamaguti, 1970

HABITAT: Encysted in pairs in dorsal fin membrane of *Katswwonus pelamys* (local name "aku"); Hawaii.

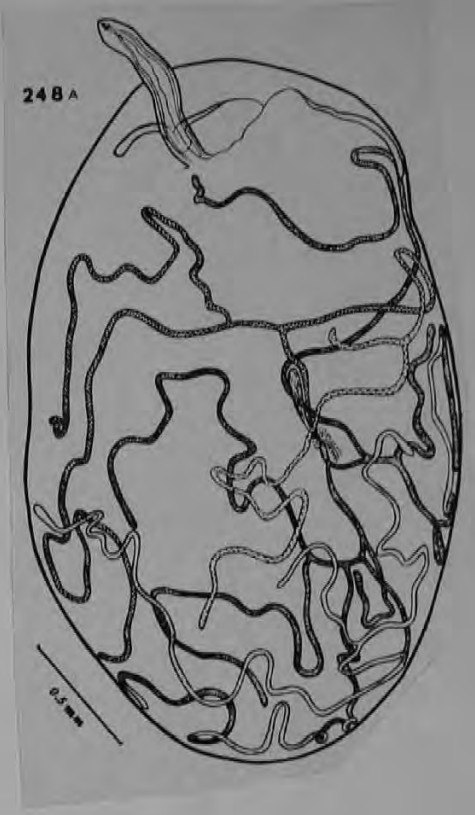
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., No. 63821.

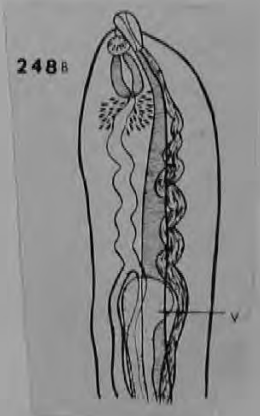
DESCRIPTION (based on 20 whole mounts): Cyst oval, containing two unequal worms. Forebody subcylindrical, 0.4-1.5 mm long, 70-110 μ wide in esophageal region, whence it tapers abruptly forward. Hindbody unlobed anteriorly, strongly convex dorsally, 1.3-3.5 mm long, 0.09-2.5 mm dorsoventrally, obliquely truncate and flat on ventral side to which the forebody is attached subterminally. Oral sucker subterminal, rather cellular, 16-35 μ in diameter; pharynx muscular, barrel-shaped, 23-46 X 16-30 μ. Esophagus narrow, often winding, 35-105 μ long lineally. Ceca winding in lateral fields of forebody, inflated and winding in hindbody, at the posterior end of which they terminate blindly.

Testes tubular, more or less winding, 0.3-0.9 mm long by 15-45 μ wide, situated subsymmetrically near anterior end of hindbody, with their attenuated anterior ends directed toward base of forebody. Vas deferens running forward windingly along metraterm in median field of forebody. Common genital pore midventral to oral sucker.

Ovary tubular, slender, winding; its stem running forward from genital junction, divided into right and left branches; right branch soon divided again into two long terminal branches; left one proceeding transversely to left margin of body, where it turns back on itself and divides into a short and a long terminal branch. Seminal receptacle claviform, 30-40 μ wide at base. Genital junction just postequatorial, near dorsodextral surface of hindbody in the type, but pre-equatorial in one paratype. Vitelline gland divided dichotomously near genital junction into 9-10 terminal branches. These branches terminate in the type largely in the posterior half of the hindbody, except for one which reaches to the base of the forebody. Uterus winding in lateral and dorsal areas of hindbody, but finally leading into cylindrical egg reservoir which extends near ventral side from posterior end of the hindbody to its anterior end, where the uterus abruptly tapers to the metraterm entering the base of the forebody. In the forebody the metraterm is strongly muscular, 15-40 μ wide, and runs straight in the median field. Eggs oval, small, 11-14 X 7-9 μ. Excretory system not made out.

DISCUSSION: This species is characterized by the location in which it is found. It occurs constantly in the fin, especially the dorsal one, of the host; hence the specific name. It is also worth noting that the genital junction is wide apart from the base of the forebody.





Didymocystoides

Didymoproblema Ishii, 1935

Generic diagnosis. — Didymozoidae, Didymozoinae: Complete hermaphrodite, enclosed in a fusiform cyst attached to base of gill filament by a filiform process. Body divided into a slender forebody and a fusiform hindbody; forebody projecting from hindbody at about its middle. Pharynx present. No acetabulum. Ceca extending to near posterior end opposite attachment process. Testes situated in hindbody in a linear series near inner side, with distal ends joining together some distance posterior to base of forebody. Genital pore near oral sucker. Ovary tubular, winding, extending further back of posterior testis. Shell gland complex near anterior extremity of hindbody. Vitellaria tubular, winding, divided two to four times, confined for most part to area anterior to shell gland complex. Uterus occupying all available space of hindbody. Parasitic in marine fishes.

Genotype: *D. fusiforme*, Ishii, 1935 (Pl. 28, Fig. 373), on *Thynnus orientalis* and *Euthynnus pelamys*; Pacific, Japan.

249. *Didymoproblema fusiforme* Ishii, 1935

(Fig. 249) Yamaguti, 1970

HABITAT: Encysted in pairs along gill filaments of *Katsuwonus pelamys*; Hawaii.

DESCRIPTION (based on eight whole mounts): Forebody slender, 1 3-3.2 mm long by 48-100 μ wide. Oral sucker rather pyriform, 37-46 X 23-30 μ; pharynx 18-28 μ in diameter; esophagus short (0.611 mm after Ishii). Ceca narrow and straight in forebody; as they enter the hindbody they proceed toward the anterior end of the hindbody and, turning back on themselves at same level or different levels a short distance from the anterior extremity, run as far back as the posterior end of hindbody proper, where the body abruptly tapers into the attachment process of Ishii. Ishii has evidently overlooked the posterior extension of the ceca, so that he seems to regard the end opposite the "attachment process" as the posterior end of the hindbody. The posterior or caudal process, termed by Ishii "attachment process", is 0.5-1.0 mm long, slightly enlarged at its smooth blunt end, and devoid of any special structure. It is nothing but the caudal extension of the hindbody enclosed in connective capsule of host origin, through which the host supplies its blood for feeding the parasite. According to Ishii's description and figures, the elongate cyst "hangs on" by a filiform process to the base of the free portion of the gill lamellae (Fig. 29 & 30), but in our observation the two parasites lie alongside each other in the fusiform capsule of the host origin which is attached to the gill longitudinally along the gill filament. Even if the worm hangs on by a filiform process, the attachment is effected by the capsule itself produced from the host. Hindbody fusiform, 3.8-7.5 X 0.5-0.9 mm, tapered anteriorly to a blunt-pointed tip, but produced backward to an apparently non-functional caudal process mentioned above.

Testes two, cylindrical, 0.56-0.58 X 0.03 mm in a specimen whose hindbody proper is 4 mm long, situated longitudinally, end to end, largely in pre-equatorial region of hindbody, with anterior end of fore testis reaching to a point 0.85 mm from anterior extremity of hindbody in the said specimen. Vas deferens straight and narrow in forebody. Common genital pore ventral to oral sucker. Genital junction dividing hindbody proper in ratio of 4.8-5.2:1 in two full-grown specimens.

Ovary tubular, winding, up to 50 μ wide, consisting of a short stem and two long terminal branches, one of which terminates some distance short of the anterior extremity of the hindbody, whereas the other reaches to near this extremity. From Ishii's description and figure (Fig. 32), it seems certain that Ishii found only one ovarian tubule. Seminal receptacle retort-shaped, 50-60 μ wide. Vitelline gland tubular and winding like ovary, 30-70 μ wide, bifurcating two times into three terminal branches, one of which reaches to base of caudal process. Ishii does not mention the dichotomous division of the vitelline gland and illustrates a single vitelline tubule in his Figure 32. Uterine coils extending largely in anteroposterior direction and occupying all available space of hindbody; metraterm well differentiated in forebody, often winding; eggs bean-shaped, 13-18 X 8-11 μ (17-19 X 10-12 μ after Ishii).

DIDYMOPROBLEMA

Genus Didymozoon S.V. JOB 1961

The following description is summarised from Yamaguti 1957, order to bring out the salient features shared by the present rm. Parasites on fish encysted in pairs; completely hermaphro-te; body divided into a slender forepart (fore body) and a thic-r hind body, straight and cylindrical; fore body attached to hind dy sub-terminally oral sucker Present; no acetabulum; testis ired, elongate, at anterior part of hind body; vas deferens not rming dennite seminal vesicle; no pars prostatica; genital pore side oral sucker; vitellarium branched narrow and winding more tensively; uterus occupying almost entire available space of hind dy; ovary occasionally branched.

Several parasites of the family *Didymozoidae* parasitizing ree species of fish of the genus *Sphyraena* (Barracuda) were tained from the sea off Rameshwaram island, Tuticorin, Porto-vo, Madras and Andaman islands. This record thus extends the stribution of the Parasites to the Indian region from the Mediter-nean on the one hand and the Japanese (Pacific) region on the ner. Two new species *Didymozoon apharyngi* (Job, 1961a) and *atocystis polyastra* (Job, 1961b) have been described from this lection covering two distinct genera *Didymozoon* and *Platocy-* respectively. The present form undoubtedly belongs to the

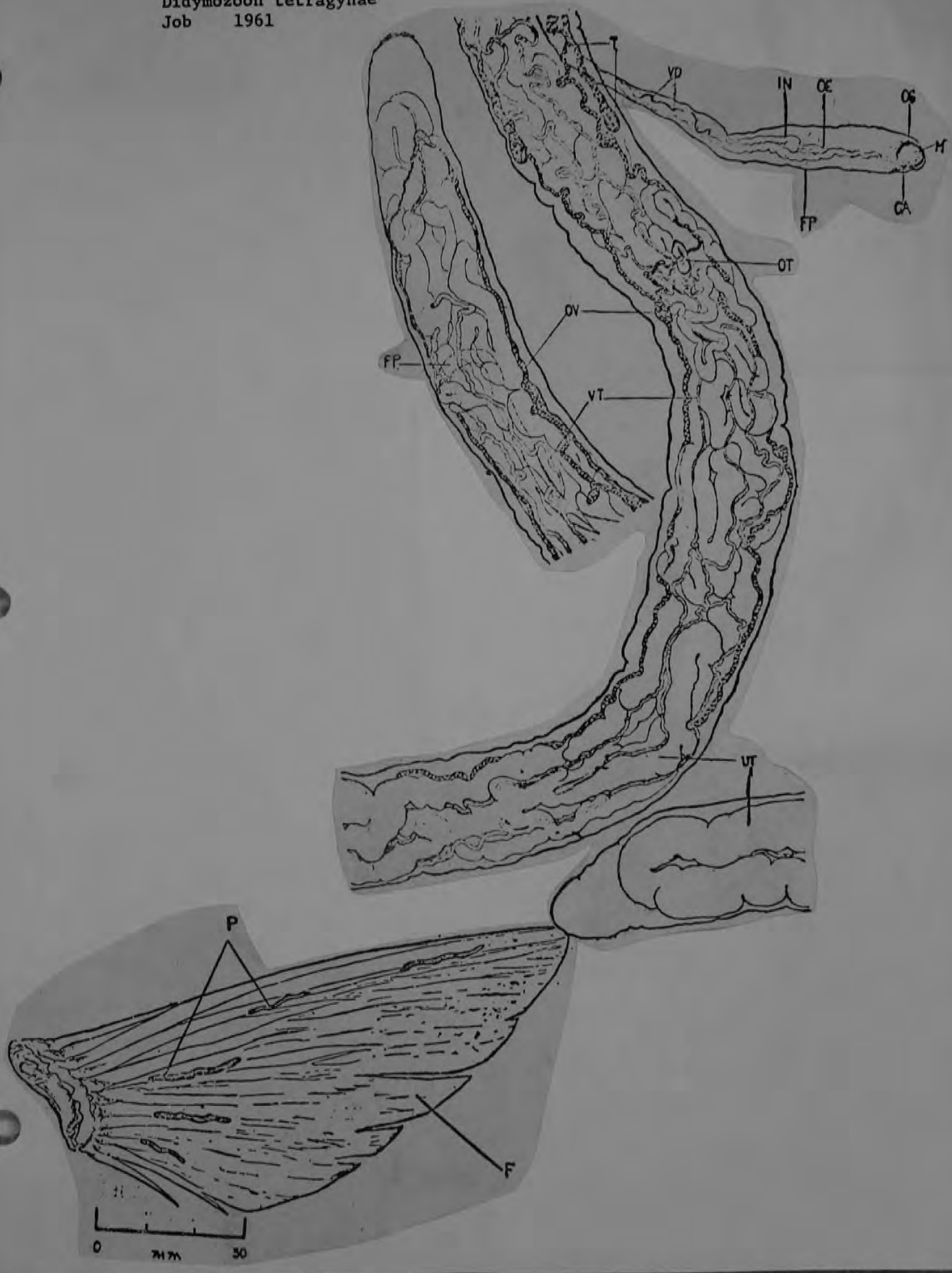
Didymozoon exocoeti Parona and Perugia, 1893

Syn. Monostoma filum Wagener nec Dujardin.

see MHP report - no fig.

Didymozoidae

Didymozoon tetragynae
Job 1961



DIDYMOZOON