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Survey of marine cercariae from the coasts of Marin and Sonoma Counties, California

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University of the Pacific

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SURVEY OF MARINE CERCARIAE
FROM THE COASTS OF MARIN AND
SONOMA COUNTIES, CALIFORNIA

A Thesis
Presented to
the Faculty of the Department of Biological Sciences
University of Pacific

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Carl Erik Olson
August 1969

This thesis, written and submitted by

Carl Erik Olson,

is approved for recommendation to the
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Dated Aug. 21, 1969

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Bodega jetty

Bodega Bay

Second Sled Road

Dillon Beach

Sand Point

Lawson's flat

Walker Creek

Jensen Oyster Co.

Nick's Cove

Heart's
Desire
Beach

T O R R
B E S

Upper
marsh

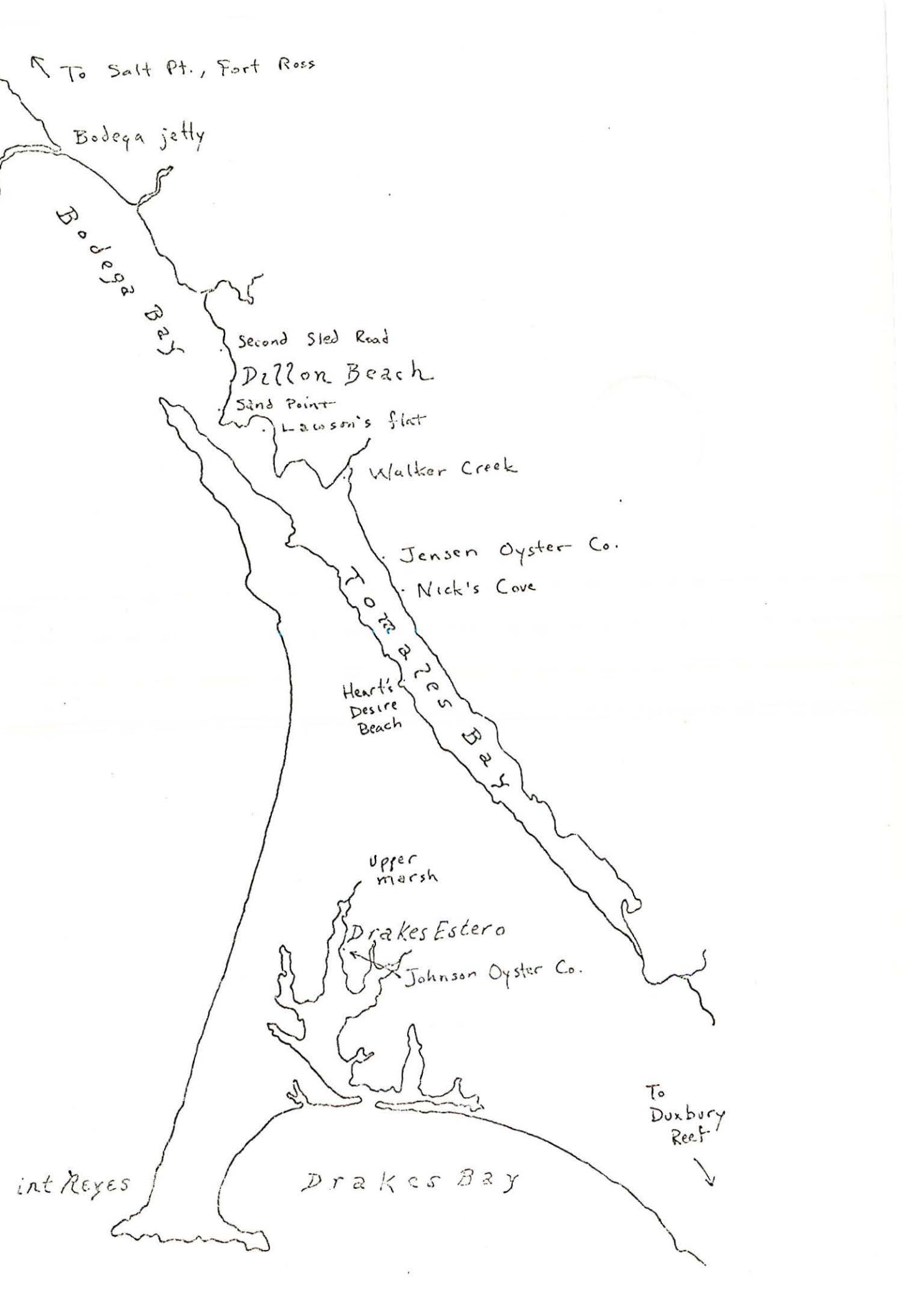
Drakes Estero

Johnson Oyster Co.

To
Duxbury
Reef

int Reyes

Drakes Bay



INTRODUCTION

Historical Review

This study deals with the cercarial fauna of marine mollusks in the littoral zone and estuaries of the California coast between Duxbury Reef and Fort Ross. The investigation began in June, 1968 at the Pacific Marine Station, Dillon Beach, California and continued through July, 1969, with monthly collections at various localities (see map). Two major objectives were aimed at: first, to continue a survey of the cercariae of the area begun by Fisk (1949) and second, to establish a basis for future life history studies.

Fisk (1949) described several larval stages which included three cercariae and several metacercariae from both vertebrate and invertebrate hosts. The life cycle of one of the cercariae (Stephanostomum pacificum) was later determined by Hughes (1952). Additional work was done by Copsey (1950) on a cystophorous cercaria, and by Giles (1962) on a bucephalid form. Grodhaus and Keh (1958) published observations on the cercaria of Austrobilharzia variglandis in Nassarius obsoletus (Say) from San Francisco Bay, and Barber (1954) surveyed cercariae of the bay and costal region

between Drake's and Monterey Bays.

From the southern California coast, Young (1938, 1949, 1953) reported on the life cycles of two cercariae from the vicinity of San Diego. Cercariae from Cerithidea californica at Newport Bay and neighboring areas have been well studied by Hunter (1943, unpublished), Maxon and Pequegnat (1949), Martin (1950a, 1950b, 1950c, 1955, 1956, 1964), Martin and Adams (1961), Martin and Gregory (1951), Adams and Martin (1960, 1963), Robinson (1952) and Sarkisian (1957).

In the northern Pacific, DiMartini and Pratt (1964) described the life cycle of a monorchid cercaria from the Oregon coast. Miller (1925) gave the earliest descriptions of cercariae from the American west coast, in the waters of Puget Sound, Washington. Ching (1959, 1962a, 1962b, 1962c, 1965) described and established the life cycles of several cercariae from the coasts of Washington and British Columbia; Stunkard (1964) reported the presence of a cercaria from Searlesia and Thais spp. in these waters similar or identical to that of Renicola thaidus Stunkard, 1964, for which he demonstrated the first renicolid life cycle. Young (1936) described a furcocercous cercaria from the Bering Sea. Table I lists all the cercariae and their hosts reported to date from the Pacific Coast of North America. Table II

is a Host-Parasite list with geographic distribution on
the Pacific Coast.

DEFINITIONS AND PATTERN
OF THE DIGENETIC TREMATODE LIFE-CYCLE

Adult digenetic trematodes are parasites of vertebrates, usually inhabiting the digestive tract but also known from other organs, depending on the parasite and host species. The mature worm produces eggs which escape from the host. The egg contains a larva, the miracidium, which is eaten by, or hatches in water and penetrates an intermediate host, nearly always a mollusk. Multiplication of the larva occurs by polyembryony, and involves intermediate generations of germinal sacs (sporocysts or rediae) which finally produce cercariae. Cercariae have much of the adult morphology in rudimentary form, but usually possess also a tail as a means of transport in the free-living stage. Some species of cercariae remain in the mollusk to be eaten by the final host, but most emerge from the mollusk to reach a second intermediate host, where an encysted stage precedes entry into the definitive host. In a few trematode families a second intermediate host is not present and the cercaria penetrates the definitive host directly (schistosomes) or is eaten by the final host (bivesiculids).

Digenetic: Trematodes having an "alternation of generations"--i.e., both an asexual and a sexual reproductive stage. The subclass Digenea of the class Trematoda is thereby distinguished from the subclass Monogenea, which has a direct development. Digenetic development also implies more than one host in the life cycle.

Definitive (final) host: organism in which the sexual or adult stage of the trematode lives. These are almost exclusively vertebrates.

Intermediate host: vertebrate or invertebrate organism in or on which an asexual or larval stage of the trematode lives. First intermediate host is usually a mollusk, rarely an annelid. Second intermediate hosts vary, including crustaceans, coelenterates, echinoderms, and insects as well as mollusks and vertebrates. In certain groups, a third intermediate host is also present.

Ovum: egg produced by the adult trematode, which passes from the definitive host into water in embryonated or unembryonated form; with or without an operculum.

Miracidium: ciliated or non-ciliated first larva, developing within the egg and hatching in water or within the first intermediate host.

Sporocyst: first phase of development within the first intermediate host. A simple sac whose germinal epithelium proliferates cell balls. Germinative cells from the miracidium form the "mother sporocyst" within which are produced daughter sporocysts or rediae, depending on the species of trematode.

Redia: first or second phase of development in the first intermediate host. A germinal sac with a mouth, muscular pharynx, and usually a blind, unforked gut. Daughter rediae or cercariae may be formed by its interior germinal epithelium.

Cercaria: larval trematodes, usually tailed, developing in germinal sac within the first intermediate host.

Metacercaria: post-cercarial larval form in second intermediate host. Characterized by loss of tail, usually formation of a cyst, and relatively little maturation.

MATERIALS AND METHODS

Gastropods and lamellibranchs were collected by hand from the littoral zone and salt marshes, or recovered with quantities of algae from subtidal regions by SCUBA diving. Identification of mollusks was based primarily on Light (1967), Intertidal Invertebrates of the Central California Coast, and confirmed by Dr. E.H. Smith, Director, Pacific Marine Station, Dillon Beach, California.

At the Stockton campus, mollusks were separated into small groups of a single species in bowls of sea water for 48 hours at room temperature. Bowls were then examined with a stereomicroscope after 24 and 48 hours and if no cercariae were observed, the mollusks were assumed negative for cercariae and observation was terminated. Large populations of a single species which appeared negative were sampled by crushing some individuals.

Cercariae were studied in the bowls for behavioral response, and for morphology by transferring them with micropipette to a slide in a drop of sea water and covering with a No. 1 coverslip. Coverslip pressure was controlled by the addition or absorption of sea water from the edge of the coverslip. Cercariae were studied both with and without neutral red intra-vitam

staining; Caveny's (1968) stain for esterase was also used in an attempt to trace the excretory ducts. Hosts were crushed to obtain and study the developmental stages. All descriptions are based on cercariae which emerged naturally from the host.

Most measurements were made on heat-killed cercariae according to the method of Cable (1956): living cercariae were placed in a few drops of water in Stender dishes and flooded with boiling sea water. Some measurements were also made on heat-killed material fixed in A-F-A, stained with aceto-carmin, dehydrated in alcohols, cleared in xylene and mounted in Kleer-mount. Measurements of stained specimens varied little and were within the range obtained from heat-killed material. Measurements, in millimeters, were made on 10 cercariae and five of the largest germinal sacs for each species. A minimum, maximum and average figure is given for each cercarial feature; maxima for the developmental sacs. Drawings of killed cercariae and germinal sacs were made by microprojection; freehand drawing of live ones.

"Cercaria" is a super-generic term for the larva of digenetic trematodes and is so construed when used in naming the kinds of larvae encountered. Cercariae

in this study are numbered in the manner of Cable (1956): a temporary term of locality is appended and a distinguishing Roman numeral is given to indicate the cercaria until its life cycle is established, at which time it takes the name of its adult form (viz., "cercaria of..."). The cercariae are here arranged according to the classification of LaRue (1957).

DESCRIPTION AND DISCUSSION OF SPECIES

Superorder ANEPITHELIOCYSTIDIA LaRue, 1957

Order ECHINOSTOMIDA LaRue, 1957

Suborder ECHINOSTOMATA Szidat, 1939

Superfamily ECHINOSTOMCIDEA Faust, 1929

Family Echinostomidae Looss, 1902

Cercaria californica I

Cercaria californica II

Cercaria californica III

Cercaria californica I

(Plate I, Figures 1-4)

Hosts: Cerithidea californica MaldemanLittorina scutulata Gould

Date, incidence, and localities of infection: 11-2-68

4/147 (2.8%) L. scutulata, Johnson's Oyster Co.1/132 (0.8%) C. californica, upper marsh of Drake's

Estero

Description: body 0.340-0.431 (0.377) long, 0.090-0.134 (0.118) in maximum width. Tail 0.331-0.347 (0.336) long, 0.025 wide at base. Oral sucker 0.035-0.044 (0.039) long, 0.037-0.046 (0.043) wide; prepharynx 0.025 long, 0.018 wide; esophagus long, bifurcating just before acetabulum; ceca narrow, extending to level of excretory bladder. Acetabulum 0.053-0.063 (0.060) long, 0.053-0.078 (0.063) wide, located just posterior to midbody. Excretory bladder thin-walled, sac-shaped, receiving merged descending tubules at center of anterior border; caudal excretory tubule extending posteriorly and bifurcating about 0.040 from body-tail junction; descending tubules originating from ascending tubules just posterior to oral sucker remain narrow although receiving many lateral branches with concretions in pre-acetabular region. Ascending tubules ciliated, originating

from joined anterior and posterior collecting ducts at anterior border of acetabulum. Flame cells in pairs; formula may be $2 [(2+2+2+2+2+2+2+2) + (2+2+2+2+2+2+2+2)] = 64$, as determined for Acanthoparyphium. Genital primordia consisting of two masses connected by strands passing dorsal to acetabulum. Two groups of penetration glands on either side of body form common ducts which pass behind oral sucker and open at the dorsal lip. Lobed mucus glands, clear and granular, along the esophagus and laterally along entire length of body. The anterior-most of these send ducts forward to open at the dorso-anterior margin of the oral sucker. Cuticle aspinose, with six anterior papillae with one bristle each. Collar of 23 spines, 0.005 long, in a single row interrupted ventrally. Tail, with numerous globular bodies, presumably glycogen, lashes in S-motion during swimming, while body is doubled ventrally over acetabulum. At fixation anterior body is often straight, with pronounced collar, while post-acetabular portion is curved ventrally. Cercariae develop in collared rediae up to 0.900 long, each containing about 15 maturing individuals.

Discussion: Cercaria californica I is very similar to, if not identical with the cercaria of Acanthoparyphium spinulosum, whose life cycle was determined by Martin

and Adams (1961). According to these authors, the first intermediate host, Cerithidea californica Haldeman, also serves as second intermediate host by eating the free cercaria, which then encysts in radular muscle or surrounding tissue. The observation was not confirmed by this study. The definitive hosts discovered were the black-bellied plover (Squatarola squatarola) and the avocet (Recurvirostra americana). The cercaria of Martin and Adams (1961), however, was not common in the snail host, occurring in only six of 12,995 individuals. Ito (1957) found a similar cercaria of 23 spines, which he named Cercaria yamagutii, in Cerithidea cingulata, C. largillierti, and in Tympanotonus microptera, but its flame cell formula proved to be $2 \left[(3+3+3+3) + (3+3+3+3) \right] = 48$. Ito assigns such formulae to the groups Echinostoma and Acanthoparyphium, while those of $2 \left[(2+2) + (2+2) \right]$ or its expanded formula are assigned to Echinochasmus and Microparyphium. We here choose the geographically closer nomenclature. The appearance of the cercaria in Littorina scutulata establishes a new host record.

Cercaria californica II

(Plate II, Figures 1-4)

Host: Littorina scutulata Gould

Dates, incidence, and localities of infection:

- 9-14-68: 1 of 150 (0.7%), Jensen Oyster Co.
 9-23-68: 1 of 200 (0.5%), Jensen Oyster Co.
 9-28-68: 1 of 360 (0.3%), Jensen Oyster Co.
 10-5-68: 1 of 240 (0.4%), Johnson Oyster Co.
 11-2-68: 4 of 350 (1.1%), Johnson Oyster Co.
 11-30-68: 4 of 280 (1.4%), Johnson Oyster Co.

Description: body 0.667-0.874 (0.782) long, 0.221-0.261 (0.244) in maximum width. Tail 0.736-0.805 (0.763) long, 0.071-0.079 (0.074) wide at base. Oral sucker 0.052-0.063 (0.056) long, 0.060-0.071 (0.066) wide; prepharynx 0.017-0.026 (0.022) long, pharynx 0.033-0.040 (0.035) long, 0.021-0.032 (0.028) wide; esophagus long, bifurcating just before acetabulum; ceca narrow, extending nearly to end of body. Acetabulum 0.110-0.126 (0.118) long, 0.110-0.134 (0.132) wide, located at midbody. Excretory bladder thin-walled, Y-shaped, with short arms receiving broad but sinuous descending ducts originating at level of pharynx, each receiving some 25 lateral branches filled with

concretions; main ducts with convolutions antero-dorsal to acetabulum. A narrow stem continues posteriorly from the bladder and passes into the tail, divides at about 0.1 from its base, and opens by ducts to each side. Ascending tubules ciliated, arising from each side of collar region; flame cell formula 2 $[(5+5+5+5+5+5)+(5+5+5+5)] = 100$. Two cell masses, one preacetabular, the other post-acetabular, are connected by strands, with the posterior mass attaching to vitelline ducts extending laterally to each side. Two other cell masses, probably the future testes, present posterior to the post-acetabular primordium. Indistinct penetration glands paralleling esophagus have ducts passing behind oral sucker to open at dorsal lip. Rod-containing cystogenous glands cover the body. Cuticle spinose anterior to acetabulum, smooth posteriorly. Six or more papillae with one bristle each present in the collar region. A total of 29 collar spines present as a single row of 25 and two angle spines on each side. Spines about 0.0100, slightly curved and flattened in side view. Tail with prominent serial lobes. Body rolled ventrally and tail lashes strongly in swimming. Development in collared rediae up to 1.700 long with each redia containing ten or more mature cercariae.

Discussion: Ching (1962a) reported a cercaria with 29 spines which she called Echinostome cercaria I from the same host in Garrison Bay, Washington. Her brief description suggests that Cercaria californica II may be the same species. Cercaria californica II is very similar to, if not identical with, the cercaria of Himasthia littorinae described by Stunkard (1966) from Woods Hole, Massachusetts. According to Stunkard, the first intermediate hosts are Littorina saxatilis and L. obtusata, with Mytilis edulis, Mya arenaria, or Littorina spp. as second intermediate hosts and the herring gull (Larus argentatus) as definitive host.

Cercaria californica III

(Plate III, Figure 1)

Host: Littorina scutulata Gould

Dates, incidence, and localities of infection:

9-28-68: 3 of 360 (0.9%), Jensen Oyster Co., Tomales Bay

10-5-68: 2 of 400 (0.5%), Johnson Oyster Co., Drake's Estero

Description: body 0.529-0.621 (0.567) long, 0.197-0.221 (0.218) in maximum width, just below pharynx. Tail 0.506-0.552 (0.526) long, 0.039-0.063 (0.057) wide at base with dorsal and ventral plicated finfold along entire length, uniformly 0.015 wide. Oral sucker 0.086-0.102 (0.097) long, 0.079-0.118 (0.094) wide; prepharynx less than 0.011, pharynx 0.055-0.071 (0.062) long, 0.047-0.055 (0.050) wide; esophagus rather short but bifurcating slightly anterior to acetabulum; ceca wide, extending nearly to end of body. Acetabulum 0.087-0.118 (0.104) long, 0.118-0.142 (0.125) wide, located at midbody. Excretory bladder U-shaped, thin-walled, with broad arms containing concretions originating from ascending tubules at level of pharynx, and becoming convoluted and compacted as they pass dorsal to acetabulum. Ascending tubules long, apparently originating at extreme

posterior of body. A short narrow stem connects the merged posterior arms to the body-tail connection. Flame cell formula undetermined. Genital primordia observed as three post-acetabular and one pre-acetabular darkly staining cell groups connected by strands passing dorsal to acetabulum and with beginnings of vitelline duct passing laterally across ceca. Eight pairs or groups of penetration glands are present, four on each side of body lateral to excretory arms with ducts leading to dorsal lip of oral sucker. Body packed laterally with many clear but granular cystogenous or mucus glands. Body and tail smooth, body cell nuclei staining prominently with carmine, and with inconspicuous dorsal rod-filled cystogenous glands. Sensory papillae appear on anterior of oral sucker and on body anterior to acetabulum. Tail flexible and strong, with many glandular bodies and prominent core. In swimming, the cercaria rolls ventrally into a compact form and the tail lashes violently, sending it in straight line dashes with ricochets like a billiard ball. This activity may be interrupted by creeping, using the suckers, but renewed swimming soon begins, with the tail beat seeming to trigger the body roll. L. scutulata may also serve as second intermediate host: some individuals

encysted in the mantle of the snails, leaving the tail alone beating for hours.

Discussion: Ching (1962a) reported a cercaria which she called Echinostome cercaria II from Garrison Bay, Washington. Like Cercaria californica III, it is characterized by a tail finfold and is without collar or spines, but Ching's description is too brief and limited to allow further comparison or suggest synonymy.

Family Philophtalimidae Travassos, 1918

Cercaria californica IV

Cercaria californica V

Cercaria californica IV

(Plate III, Figures 2-3)

Host: Acanthina spirata

Dates, incidence, and localities of infection:

7-30-69: 1 of 8 (12.5%), Duxbury reef, Bolinas

Description: body 0.360-0.440 (0.401) long, 0.150 in maximum width. Tail 0.240-0.290 (0.262) long, 0.060 wide at base. Oral sucker 0.035-0.044 (0.043) long, 0.039-0.046 (0.044) wide; prepharynx 0.011-0.013 (0.012) long; pharynx 0.019-0.026 (0.022) long, 0.019-0.022 (0.021) wide; esophagus long, bifurcating shortly before acetabulum. Acetabulum 0.057-0.063 (0.059) long, 0.052-0.061 (0.055) wide, located just posterior to midbody. Excretory bladder thin-walled, oval, with short anterior stem receiving main excretory ducts, which have granules in anterior portions. Ascending tubules without obvious origin, present at extreme posterior of the body. Caudal excretory tubule short, bifurcating about 0.034 from body-tail junction to open at pores on each side. Flame cell formula undetermined. Genital primordium about 0.024 long, located just anterior to excretory bladder. Indistinct penetration glands opening by ducts at the dorsal lip. Body covered with rod-filled cystogenous

glands. Cuticle thickly spinose up to oral collar. Papillae with bristles scattered over entire body, with six or more located at cephalic end. Collar of about 60 oral spines (not shown in figure) in a single row, obscured from view dorsally but with 11 spines on each side of ventral interruption. Tail of vacuolated parenchyma, with tip invagination of about 0.063, retracted when crawling. Cercaria swims with abrupt head snap after ventral curl and encysts easily in the open; cyst oval, 0.036 long, 0.029 wide, with anterior plug. Develops in yellow rediae up to 1.29 long, with short gut, antero-lateral birth pore, and eight to ten maturing cercariae.

Discussion: This cercaria strongly resembles the larva of Parorchis acanthus, a common parasite of gulls (Larus spp.).

Cercaria californica V
(Plate IV, Figures 1-3)

Host: Cerithidea californica Haldeman

Date, incidence, and locality of infection:

2-22-69: 1 of 100 (1%), upper marsh, Drake's Estero

Description: body 0.644-0.759 (0.701) long, 0.181-0.229 (0.199) in maximum width. Tail 0.437-0.529 (0.485) long, 0.055-0.071 (0.063) wide at base. Oral sucker 0.058-0.074 (0.068) long, 0.060-0.079 (0.070) wide; Prepharynx 0.037-0.053 (0.050) long; pharynx 0.035-0.044 (0.041) long, 0.033-0.035 (0.035) wide; esophagus short; ceca narrow, extending to anterior level of excretory bladder. Acetabulum 0.087-0.110 (0.096) long, 0.094-0.118 (0.102) wide, almost equatorial. Excretory bladder thin-walled, sac-shaped, with short anterior stem receiving descending limbs originating from narrow ascending tubules just posterior to oral sucker. Excretory concretions absent. Flame cell formula undetermined. Genital primordia at a distance anterior and posterior to acetabulum, connected by thin cord. Body with dorsal and ventral layers of dense rod-filled cystogenous cells. Cystogenous cells and genital primordia stain with neutral red. Cavity

esterase stain reacts with stomate and pharyngeal regions and with descending excretory tubules only. Cuticle thick, without spines or collar. Oral sucker with eight or more sensory papillae. Tail of vacuolated parenchyma with invaginated tip. In swimming, body and tail lash together in largely ineffectual motions which, however, maintain the position of the cercaria for a while. Encystment in the open (eg., in bowl or pipette) especially in response to currents. Cercariae encysted on Hemigrapsus oregonensis when placed in bowl together with that crab. Development in slender rediae up to 2.250 long with only one visible lappet. Cercariae appear to escape from the host at 48 hour intervals.

Discussion: The cercarial form is that of a philophthalmid; the oval cyst and lack of collar spines indicate that it may be a species of Cloacitrema rather than of Philophthalmus or Parorchis. Possibly it is the larva of Cloacitrema michiganensis McIntosh, 1938 from Cerithidea californica at Upper Newport Bay, California, reported but not described by Robinson (1952). The cercaria encysts largely on crabs (Hemigrapsus oregonensis); natural adult infections, according to Robinson (1952), are found in the spotted sandpiper (Actitis macularia) and the gull (Larus californicus).

Superorder EPITHELIOCYSTIDIA LaRue, 1957

Order PLAGIORCHIIDA LaRue, 1957

Suborder PLAGIORCHIATA LaRue, 1957

Superfamily PLAGIORCHIOIDEA Dollfus, 1930

Family Microphallidae Travassos, 1921

Cercaria californica VI

Cercaria californica VII

Cercaria californica VIII

Cercaria californica VI

(Plate V, Figures 1-3)

Host: Littorina scutulata Gould

Dates, incidence, and localities of infection:

Monthly in lots of 200 (2-5%), Jensen Oyster Co., Tomales Bay

Nick's Cove, Tomales Bay

Johnson Oyster Co., Drakes Estero

Description: body 0.158-0.189 (0.170) long, 0.046-0.062 (0.051) in maximum width. Tail 0.150-0.173 (0.161) long, 0.047-0.055 (0.049) wide at base. Oral sucker 0.033-0.037 (0.034) long, 0.031-0.037 (0.033) wide; other features of digestive system not evident. Stylet 0.027 long, 0.003 wide, tapering to a point in ventral view but blunt in side view. Acetabular rudiment present in posterior third of body. Excretory bladder heart-shaped, thin-walled; protonephridia mesostomate, flame cell formula $2 \left[\begin{array}{l} (1+1) \\ (1+1) \end{array} \right] = 8$. Four pairs of penetration glands present; two pairs stain with neutral red, and have distended ducts on each side of oral sucker. Cuticle of body smooth, that of tail finely wrinkled. Tail with prominent muscle bands and central core. In swimming, the body is curled ventrally and the tail lashes in figure 8 movements.

Early metacercaria has squared posterior, rounded anterior and closely adhering cyst wall. Cercaria develops in oval sporocysts up to 0.200 in length and with a projecting knob.

Discussion: This cercaria closely resembles that of Levinseniella charadriiformis Young, 1949. Ching (1962c) described this cercaria and worked out the life cycle, in which Hemigrapsus oregonensis and H. nudus were the natural and experimental second intermediate hosts, and Larus glaucescens the natural and experimental final host.

Cercaria californica VII

(Plate V, Figures 4-6)

Host: Littorina scutulata Gould

Dates, incidence, and localities of infection:

Monthly in lots of 200 (1-3%), Jensen Oyster Co.,
Tomales Bay

Description: body 0.110-0.126 (0.120) long, 0.035-0.038 (0.036) in maximum width. Tail 0.094-0.110 (0.109) long, 0.008 wide at base. Oral sucker 0.021-0.026 (0.024) in diameter; other features of digestive system not evident. Stylet 0.017 long, 0.003 wide, slightly ventral curvature. Acetabulum undeveloped. Excretory bladder thin-walled, heart-shaped; two flame cells observed on each side of body. Genital primordia appear double, medio-dorsal and posterior to penetration glands. Four pairs of penetration glands present, two ventral-most stain with neutral red. Body and tail smooth, with white tubular mucus glands over much of body beneath integument and muscle layers. In swimming, the body is curled ventrally and the tail lashes laterally. When slowed, the movement changes to a reach-and-contract, perhaps to use the stylet as an anchor. Development in white oval sporocysts up to 0.395, with attenuated ends, probably due to budding.

Discussion: Cercaria californica VII apparently is that of Maritrema laricola Ching, 1962. Ching (1962b) described the cercaria as well as the entire life cycle of this species in which Hemigrapsus oregonensis and H. nudus serve as second intermediate hosts, and the glaucous-winged gull (Larus glaucescens) as the final host.

Cercaria californica VIII

(Plate V, Figures 7-8)

Host: Olivella biplicata (Sowerby)

Dates, incidence, and localities of infection:

6-4-69: 2 of 50 (4%), Sand Point, Dillon Beach

7-12-69: 1 of 1 (100%), Second Sled Road, Dillon Beach

Description: body 0.115-0.125 (0.118) long, 0.021-0.024 (0.023) maximum width. Tail 0.013-0.016 (0.015) long, 0.005 wide at base, appears glandular. Oral sucker 0.024 in diameter; remainder of digestive system not evident. Stylet 0.018 long, 0.003 wide at base, tapering to a fine point, and barely projecting from an anterior "hood." Acetabulum not evident. Excretory bladder thin-walled, U-shaped. Main excretory tubules emerge in the area of penetration glands and are received at the ends of excretory bladder arms. Four penetration glands, staining with neutral red, occupy three fourths of body with two distended ducts opening on each side of stylet. Fine and widely spaced spines present over entire body cuticle. In swimming, the anterior portion of the body is lifted backwards and up, then snapped forward as if climbing by means of its stylet. The body elongates and contracts, with the short tail

playing little more than a stabilizing role. Development in sporocysts up to 0.180 in diameter containing more than 15 cercariae each.

Discussion: Morphological similarity of Cercaria californica VIII to species described in the literature has not been found, but it appears related to the other monostome xiphidiocercariae of the Family Microphallidae. The location of the snail host in shallow sand flats indicates that the adult trematode may be found in shore birds. The only crustacean in the immediate vicinity at Sand Point was the sand crab (Emerita analoga), which is fed upon by shore birds and may be the second intermediate host. A single Olivella from a tidepool at Second Sled Road was also heavily infected, possibly from eggs passed by gulls (Larus spp.) which frequent these rocks.

Superfamily ALLOCREADIOIDEA Nicoll, 1934

Family Acanthocolpidae Lühe, 1909

Cercaria californica IX

Cercaria californica IX

(Plate VI, Figures 1-2)

Host: Thais emarginata (Deshayes)

Dates, incidence, and localities of infection:

12-14-68: 1 of 8 (12.5%), Hearts Desire Beach,
Tomales Bay3-22-69: 1 of 50 (2%), Hearts Desire Beach,
Tomales Bay

7-30-69: 1 of 8 (12.5%), Nick's Cove, Tomales Bay

Description: body 0.258-0.285 (0.271) long, 0.070 in maximum width. Tail 0.313-0.328 (0.320) long, 0.025-0.030 (0.027) wide at base. Oral sucker 0.035-0.045 (0.041) in diameter; prepharynx 0.044; pharynx 0.012 long, 0.011 wide, located nearer to acetabulum than to oral sucker; esophagus very short, with bifurcation at acetabulum; ceca wide but rudimentary beyond acetabulum, extending to level of excretory bladder. Acetabulum 0.028-0.035 (0.032) in diameter, located just posterior to midbody, protruding from body in side view. Excretory bladder transversely oval to V-shaped, thick-walled. Main excretory tubules joining anterolateral margins of bladder extending to oral sucker before receiving secondary collecting tubules. Flame cell formula undetermined but probably $2(3+3+3+3+3+1) = 38$.

Genital primordium consists of distinct lobes immediately posterior to acetabulum. Four pairs of penetration glands in anterior body, with ducts opening in two pairs dorsally on each side of mouth. Body filled with cystogenous glands. Cuticle with small spines anterior to acetabulum; posterior body smooth but with transverse cuticular ridges or wrinkles. Prominent papillae on oral sucker. Eyespots well separated and prominent, located between oral sucker and pharynx. Tail smooth, of uniform width throughout most of its length, with prominent medial core. In swimming, the body is slightly flexed ventrally while the tail lashes, but motion is not sustained or vigorous. The cercaria may also sink to the bottom and crawl by use of suckers and contraction, with the tail retracted. The cercaria is capable of great extension (up to 0.4) into a filamentous condition, although usually the body is roughly rectangular. Development in elongate orange-walled rediae up to 1.0 long, with numerous penetration glands and with a birth canal and pore opposite the pharynx.

Discussion: The cercaria appears to be the larva of Stephanostomum pacificum, described by Hughes (1952). Hughes also worked out the life cycle of the species, in which the second intermediate host is the sculpin

(Leptocottus armatus armatus Girard), and the final host the sand dab, (Citharichtys stigmaeus Jordan and Gilbert). Fisk (1949) had originally found and described the cercaria from Acanthina spirata and Thais emarginata, but Hughes discovered it in Nassarius mendicus Gould. The cercaria bears strong resemblance to Cercaria foliatae Miller, 1925, from Purpura foliata in Puget Sound, Washington.

Family Opecoelidae Ozaki, 1925

Cercaria californica X

Cercaria californica X

(Plate VI, Figures 3-6)

Host: Lacuna sp.

Dates, incidence, and localities of infection:

6-3-69: 2 of 50 (4%), Second Sled Road, Dillon Beach

6-5-69: 1 of 200 (0.5%), Second Sled Road, Dillon Beach

7-29-69: 8 of 400 (2%), Second Sled Road, Dillon Beach

Description: body 0.150-0.185 (0.170) long, 0.040-0.045 (0.042) in maximum width. Tail 0.025 long, 0.020 wide at base. Oral sucker 0.025 long, 0.020 wide; rudiment of pharynx observed; remainder of digestive system not evident. Stylet 0.011 long, 0.005 in maximum width, double pointed with a rim at base of points and tapering posteriorly. Acetabulum 0.030 long, 0.035 wide, located in posterior third of body and protruding in side view. Excretory bladder elongate, thick-walled with gland-like epithelial cells, nearly filling body posterior to acetabulum. Ciliated main excretory tubules join bladder anterolaterally. Flame cell formula undetermined but probably $2 [(2+2) + (2+2)] = 16$. Four apparent penetration glands which take neutral red, two duct openings on each side of stylet.

Cuticle of body and tail smooth but with small bristled papillae on oral sucker circling the mouth. The cercaria does not swim but anchors itself to the substrate by its invaginated glandular tail, then stretches and waves its body forward, particularly when stimulated by water currents or passing amphipods. Development in elongated oval sporocysts up to 0.748 long and containing 30-40 cercariae in roughly the same stages of development. However, cercariae seemed to escape from the host only a few at a time, and never before 24 hours after collection.

Discussion: This cercaria is probably the larva of an opecoelid, possibly Podocotyle species, which are common in tidepool fishes of Second Sled Road. Dissections of amphipods and the isopod Idothea wosnesenskii, which are in close association with the snail host on Phyllospadix and tidepool algae, did not reveal any metacercariae, although the tiny cysts may have been overlooked. Cercariae appeared to be taken up when amphipods were present in bowls of infected snails. Shells of Lacuna sp. were found in one instance in the gills of the cabezon (Scorpaenichthys marmoratus), but fishes are known to become infected with opecoelids following ingestion of crustaceans in which the metacercariae are

encysted. Hemigraus nudus as well as the above crustacea were often found in dissections of this and other tidepool fishes from Second Sled Road. The cercaria bears a strong resemblance to Cercaria caribbea LX Cable, 1963, except for the organization and staining of cephalic and tail glands. Cable (1963) suggested that this larva may be that of Pseudopecoelus, a parasite in the intestine of the pygmy wrasse (Doratonotus megalepis Günther).

TABLE I

Parasite-Host Index

(Cercariae of the Pacific Coast of North America)

Classification	Reported by	Host
Superorder Anepithetiocystidia LaRue, 1957		
Order Strigeatoidea LaRue, 1957		
Suborder Strigeata LaRue, 1957		
Superfamily Strigeoidea Railliet, 1919		
Family Cyathocotyliidae Poche, 1926		
<u>Cercaria cerithidea</u> 17		<u>Cerithidea californica</u>
Hunter, 1943		Haldeman
<u>Cercaria cerithidea</u> 22		<u>Cerithidea californica</u>
Hunter, 1943		Haldeman
<u>Cercaria</u> sp. Maxon and Pequegnat, 1949; syn: <u>Cercaria cerithidea</u> 28,		<u>Cerithidea californica</u>
Hunter, 1943		Haldeman
Superfamily Schistosomatoidea Stiles and Hassal, 1926		
Family Schistosomatidae Looss, 1899		
<u>Cercaria</u> of <u>Austrobilharzia</u> <u>variglandis</u> Penner,	Grodhaus and Keh, 1958	<u>Nassarius obsoletus</u> (Say)
1953		

Suborder Brachylaimata LaRue, 1957
Superfamily Fellodistomatoidea LaRue, 1957
Family Fellodistomatidae Nicoll, 1913

Cercaria sp. Young,
1936

Plankton haul

Family Gymnophallidae

Cercaria of
Lacunovermis
conspicuus Ching,
1965

Macoma inconspicua
(Broderip and Sowerby)

Cercaria of
Meiogymnophallus
multigenimulus Ching,
1965

Macoma inconspicua
(Broderip and Sowerby)

Superfamily Bucephaloidea LaRue, 1957
Family Bucephalidae Poche, 1907

Cercaria sp. Giles,
1961

Mytilis californianus
Conrad

Order Echinostomida LaRue, 1957
Suborder Echinostomata Szidat, 1939
Superfamily Echinostomoidea Faust, 1929
Family Echinostomidae Looss, 1902

Cercaria cerithidea 10
Hunter, 1943

Cerithidea californica
Haldeman

Cercaria cerithidea 14
Hunter, 1943

Cerithidea californica
Haldeman

Cercaria cerithidea 18
Hunter, 1943

Cercaria of
Himasthia sp. Hunter,
1943

Cercaria of
Acanthoparyphium
spinulosum Johnston
1917, Martin and Adams
1961; syn: Cercaria
III Maxon and
Pequegnat, 1949

Cercaria of
Himasthia rhigedana
Dietz, 1909, Adams
and Martin, 1963;
syn: Cercaria I
Maxon and Pequegnat,
1949

Cercaria I Ching,
1962

Cercaria II Ching,
1962

Cercaria californica I This paper

Cercaria californica II This paper

Cerithidea californica
Haldeman

Cerithidea californica
Haldeman

Cerithidea californica
Haldeman

Cerithidea californica
Haldeman

Littorina scutulata
Gould

Littorina scutulata
Gould

Littorina scutulata
Gould

Littorina scutulata
Gould

Cercaria californica III This paper

Littorina scutulata
Gould

Family Philophthalmidae Travassos, 1918

Cercaria of Parorchis
acanthus (Nicoll, 1906);
syn: Cercaria II Maxon
and Pequegnat, 1949

Cerithidea californica
Haldeman

Acanthina lapilloides
(Conrad)

Acanthina spirata
(Blaineville)

Thais emarginata
(Deshayes)

Cercaria of Cloacitrema
michiganensis McIntosh,
1938, Robinson, 1952

Cerithidea californica
Haldeman

Cercaria californica IV This paper

Acanthina spirata
(Blaineville)

Cercaria californica V This paper

Cerithidea californica
Haldeman

Suborder Paramphistomata Szidat, 1936
Superfamily Notocotyloidea LaRue, 1957
Family Notocotylidae Lühe, 1909

Cercaria sp. Maxon and
Pequegnat, 1949

Cerithidea californica
Haldeman

Cercaria of Catatropis
johnstoni Martin, 1956

Cerithidea californica
Haldeman

Order Rencolida LaRue, 1957
Suborder Rencolata LaRue, 1957
Superfamily Rencoloidea LaRue, 1957
Family Rencolidae Dollfus, 1939

Cercaria of Rencola
thaidus Stunkard, 1964

Thais emarginata
(Deshayes)

Thais lamellosa
(Gmelin)

Searlesia dira
(Reeve)

Superorder Epitheliocystidia LaRue, 1957
Order Plagiorchiida LaRue, 1957
Suborder Plagiorchiata LaRue, 1957
Superfamily Plagiorchioidea Dollfus, 1930
Family Microphallidae Travassos, 1918

Cercaria of Spelotrema
nicolli Cable and Hun-
inen, 1940

Young, 1949

Olivella biplicata
(Sowerby)

Cercaria of Maritrema
uca Sarkisian, 1957;
syn: Cercaria sp.
Maxon and Pequegnat,
1949

Cerithidea californica
Haldeman

Cercaria of Spelotrema
pygmaeum Levinsen, 1881

Ching, 1962a

Littorina scutulata
Gould

Cercaria of Levinseniella
charadriiformis Young, 1949

Littorina scutulata
Gould

Cercaria of Maritrema
laricola Ching, 1962

Littorina scutulata
Gould

Cercaria californica VI This paper

Littorina scutulata
Gould

Cercaria californica VII This paper

Littorina scutulata
Gould

Cercaria californica VIII This paper

Olivella buplicata
(Sowerby)

Plagiorchioid cercariae of
unknown affinity:

Cercaria cerithidea 19
Hunter, 1943

Cerithidea californica
Haldeman

Cercaria cerithidea 23
Hunter, 1943

Cerithidea californica
Haldeman

Superfamily Allocreadioidea Nicoll, 1934
Family Acanthocolpidae Luhe, 1909

Cercaria of
Stephanostomum
pacificum Hughes,
1952; syn: Cercaria sp.
Fisk 1949

Thais emarginata
(Deshayes)
Acanthina spirata
(Blainville)
Nassarius mendicus
(Gould)

Cercaria of
Stephanostomum
tenue(Linton, 1898)
Martin, 1939

Barber, 1954

Nassarius obsoletus (Say)

<u>Cercaria californica</u> IX	This paper	<u>Thais emarginata</u> (Deshayes)
Family Lepocreadiidae		
Cercaria of <u>Lepocreadium</u> <u>setiferoides</u> Miller and Northrup 1926, Martin, 1938	Barber, 1954	<u>Nassarius obsoletus</u> (Say)
Family Monorchidae Odhner, 1911		
Cercaria of <u>Postmonorchis donacis</u> Young, 1953		<u>Donax gouldii</u> Dall
Cercaria of <u>Telolecithus</u> <u>pugetensis</u> Lloyd and Guberlet, 1932, DeMartini and Pratt, 1963		<u>Transenella tantilla</u> (Gould)
Family Opecoelidae Ozaki, 1925		
<u>Cercaria searlesiae</u> Miller, 1925		<u>Searlesia dira</u> (Reeve)
<u>Cercaria californica</u> X	This paper	<u>Lacuna</u> sp.
Family Zoogonidae Odhner, 1911		
Cercaria of <u>Zoogonius lasius</u> Stunkard, 1941	Barber, 1954	<u>Nassarius obsoletus</u> (Say)

Order Opisthorchiida LaRue, 1957
Suborder Opisthorchiata LaRue, 1957
Superfamily Opisthorchioidea Faust, 1929
Family Heterophyidae Odhner, 1914

Cercaria purpuracauda
Miller, 1925

Cercaria of
Euhaplorchis
californiensis Martin,
1950

Cercaria of
Parastictodora
hancocki Martin
1950; syn: Cercaria
pleurolophocercous I
Maxon and Pequegnat,
1949

Cercaria
pleurolophocercous
sp Ching, 1962

Cercaria of
Pvgidiopsoides
spindalis Martin,
1964

Magnacercous opisthorchioid
cercariae of unknown affinity:

Cercaria buchanani
Martin and Gregory,
1951

Bittium eschrichtii
(Middendorf)

Cerithidea californica
Haldeman

Cerithidea californica
Haldeman

Littorina scutulata
Gould

Cerithidea californica
Haldeman

Cerithidea californica
Haldeman

Family Opisthorchiidae Braun, 1901

Cercaria of
Phocitremoides ovale
Martin, 1950; syn:
Cercaria
pleurolophocereous
II Maxon and
Pequegnat, 1949

Cerithidea californica
Haldeman

Gymnocephalous cercaria
Whose family relationship
is not known:

Cercaria foliatae
Miller, 1925

Purpura foliata Martyn

Suborder Hemiurata Skrjabin and Guschanskaja, 1954
Superfamily Hemiuroidea Faust, 1929
Family Hemiuridae Luhe, 1901

Cercaria prenanti
Arvy, 1949

Ching, 1959

Dentallium dalli
Pilsby and Sharp

Cercaria of
Lecithaster salmonis
Yamaguti, 1934, Ching
1959(?); syn: Cercaria
cystophorous A Miller,
1925; Cercaria
cystophorous sp.
Copsey, 1950

Thais emarginata
(Deshayes)

Thais canaliculata
(Duclos)

Cercaria
cystophorous B
(Miller, 1925) Ching,
1959

Thais lamellosa
(Gmelin)

TABLE II

Host-Parasite Index

(Mollusks infected with Cercariae from the Pacific Coast of North America)

Host	Cercaria	Locality
<u>Acanthina lapilloides</u> (Conrad)	Cercaria of <u>Parorchis acanthus</u> (Nicoll, 1906); syn: <u>Cercaria II</u> Maxon and Pequegnat, 1949	Monterey Bay, California
<u>Acanthina spirata</u>	Cercaria of <u>Parorchis acanthus</u> (Nicoll, 1906); syn: <u>Cercaria II</u> Maxon and Pequegnat, 1949	Tomales Bay, California
	<u>Cercaria californica</u> IV	Duxbury Reef, Bolinas California
	Cercaria of <u>Stephanostomum pacificum</u> Hughes, 1952; syn: <u>Cercaria</u> sp. Fisk, 1949	Tomales Bay, California
<u>Bittium escherichtii</u> (Middendorf)	<u>Cercaria purpuracauda</u> Miller, 1925	Puget Sound, Washington
<u>Cerithidea californica</u> Haldeman	<u>Cercaria cerithidea</u> 17 Hunter, 1943	Anaheim Slough (Seal Beach) Orange County, California
	<u>Cercaria cerithidea</u> 22 Hunter, 1943	Anaheim Slough (Seal Beach) Orange County, California

- Cercaria sp. Maxon and Pequegnat, 1949; syn: Cercaria cerithidea 28 Hunter, 1943
Upper Newport Bay and Anaheim Slough (Seal Beach), Orange County, California
- Cercaria cerithidea 10 Hunter, 1943
Anaheim Slough (Seal Beach) Orange County, California
- Cercaria cerithidea 14 Hunter, 1943
Anaheim Slough (Seal Beach) Orange County, California
- Cercaria cerithidea 18
Anaheim Slough (Seal Beach) Orange County, California
- Himasthla sp. Hunter, 1943
Anaheim Slough (Seal Beach) Orange County, California
- Cercaria of Acanthoparyphium spinulosum Johnston, 1917, Martin and Adams, 1961; syn: Cercaria III Maxon and Pequegnat, 1949
Upper Newport Bay, California
- Cercaria of Himasthla rhigedana Dietz, 1909, Adams and Martin, 1963; syn: Cercaria I Maxon and Pequegnat, 1949
Upper Newport Bay, California
- Cercaria of Parorchis acanthus (Nicoll, 1906) syn: Cercaria II Maxon and Pequegnat, 1949
Upper Newport Bay, California

<u>Cercaria of Cloacitrema michiganensis</u> McIntosh, 1938, Robinson, 1952	Upper Newport Bay, California
<u>Cercaria californica</u> V	Drake's Estero, California
<u>Cercaria</u> sp. Maxon and Pequegnat, 1949	Upper Newport Bay, California
<u>Cercaria of Catatropis johnstoni</u> Martin, 1956	Newport Beach, California
<u>Cercaria of Maritrema uca</u> Sarkisian, 1957; syn: <u>Cercaria</u> sp. Maxon and Pequegnat, 1949	
<u>Cercaria cerithidea</u> 19 Hunter, 1943	Mission Bay, California
<u>Cercaria cerithidea</u> 23 Hunter, 1943	Mission Bay, California
<u>Cercaria of Euhaplorchis californiensis</u> Martin, 1950	Playa del Rey, California
<u>Cercaria of Parastictodora hancocki</u> Martin, 1950; syn: <u>Cercaria pleurolophocercous</u> I Maxon and Pequegnat, 1949	Upper Newport Bay, California
<u>Cercaria of Pygidiopsis spindalis</u> Martin, 1964	Upper Newport Bay, California

	<u>Cercaria buchmanani</u> Martin and Gregory, 1951	Playa del Rey, California
	<u>Cercaria of Phocitre- moides ovale</u> Martin, 1950; syn: <u>Cercaria pleurolophocercous</u> II Maxon and Pequegnat, 1949	Upper Newport Bay, California
<u>Dentallium dalli</u> Pilsby and Sharp	<u>Cercaria prenanti</u> Arvy, 1949	Friday Harbor, Washington
<u>Donax gouldii</u> Dall	<u>Cercaria of Post- monorchis donacis</u> Young, 1953	San Diego, California
<u>Lacuna</u> sp.	<u>Cercaria californica</u> X	Dillon Beach, California
<u>Littorina scutulata</u> Gould	<u>Cercaria</u> I Ching, 1962	Garrison Bay, Washington
	<u>Cercaria</u> II Ching, 1962	Garrison Bay, Washington
	<u>Cercaria californica</u> I	Drake's Estero, California
	<u>Cercaria californica</u> II	Drake's Estero and Tomales Bay, California
	<u>Cercaria californica</u> III	Drake's Estero and Tomales Bay, California
	<u>Cercaria of Spelotrema pygmaeum</u> Levinsen, 1881	Coal Harbor, B.C., Canada Friday Harbor, Washington

	<u>Cercaria of <i>Levinseniella</i> <i>charadriiformis</i> Young, 1949</u>	Friday Harbor, Washington Vancouver, Canada Newport, Oregon
	<u>Cercaria of <i>Maritrema</i> <i>laricola</i> Ching, 1962</u>	Friday Harbor, Washington Vancouver, Canada
	<u><i>Cercaria californica</i> VI</u>	Drake's Estero and Tomales Bay, California
	<u><i>Cercaria californica</i> VII</u>	Tomales Bay, California
	<u><i>Cercaria pleurolophocercus</i> sp. Ching, 1962</u>	Friday Harbor, Wescott Bay, and Garrison Bay, Washington Coal Harbor, B.C., Canada
<u><i>Macoma inconspicua</i></u> (Broderip and Sowerby)	<u>Cercaria of <i>Lacunovermis</i> <i>conspicuus</i> Ching, 1965</u>	Vancouver, Canada
	<u>Cercaria of <i>Meiogymnophalus</i> <i>multigemmulus</i> Ching, 1965</u>	Vancouver, Canada
<u><i>Mytilis californianus</i></u> Conrad	<u><i>Cercaria</i> sp. Giles, 1961</u>	Dillon Beach, California
<u><i>Nassarius mendicus</i></u> Gould	<u>Cercaria of <i>Stephanostomum</i> <i>pacificum</i> Hughes, 1952; syn: <i>Cercaria</i> sp. Fisk, 1949</u>	Tomales Bay, California
<u><i>Nassarius obsoletus</i></u> (Say)	<u>Cercaria of <i>Austrobilharzia</i> <i>variqlandis</i> Penner, 1953</u>	San Francisco Bay, Alameda, California
	<u>Cercaria of <i>Stephanostomum</i> <i>tenue</i> (Linton, 1898) Martin, 1939</u>	San Francisco Bay, Alameda, California

	<u>Cercaria of Lepocreadium setiferoides</u> (Miller and Northrup, 1926) Martin 1938	San Francisco Bay, Alameda, California
	<u>Cercaria of Zoogonius lasius</u> Stunkard, 1941	San Francisco Bay, Alameda, California
<u>Olivella biplicata</u> (Sowerby)	<u>Cercaria of Spelotrema nicolli</u> Cable and Hunninen, 1940	San Diego, California
	<u>Cercaria californica</u> VIII	Tomales Bay and Dillon Beach, California
<u>Purpura foliata</u> Martyn	<u>Cercaria foliatae</u> Miller, 1925	Puget Sound, Washington
<u>Searlesia dira</u> (Reeve)	<u>Cercaria of Renicola thaidus</u> Stunkard, 1964	Vancouver, Canada
	<u>Cercaria searlesiae</u> Miller, 1925	Puget Sound, Washington
<u>Thais canaliculata</u> (Duclos)	<u>Cercaria of Lecithaster salmonis</u> Yamaguti, 1934, Ching, 1959(?); syn: <u>Cercaria cystophorous</u> A Miller, 1925; <u>Cercaria cystophorous</u> sp. Copsey, 1950	Friday Harbor, Washington Puget Sound, Washington Tomales Bay, California
<u>Thais emarginata</u> (Deshayes)	<u>Cercaria of Parorchis acanthus</u> (Nicoll, 1906); syn: <u>Cercaria II</u> Maxon and Pequegnat, 1949	Anaheim Slough (Seal Beach) Orange County, California Upper Newport Bay, California

	<u>Cercaria of <i>Renicola thaidus</i> Stunkard, 1964</u>	Vancouver, Canada
	<u>Cercaria of <i>Stephanostomum pacificum</i> Hughes, 1952; syn: <i>Cercaria</i> sp. Fisk, 1949</u>	Tomales Bay, California
	<u><i>Cercaria californica</i> IX</u>	Tomales Bay, California
	<u>Cercaria of <i>Lecithaster salmonis</i> Yamaguti, 1934, Ching, 1959(?); syn: <i>Cercaria cystophorous</i> A Miller, 1925; <i>Cercaria cystophorous</i> sp. Copsey, 1950</u>	Friday Harbor, Washington Puget Sound, Washington Tomales Bay, California
<u><i>Thais lamellosa</i> (Gmelin)</u>	<u>Cercaria of <i>Renicola thaidus</i> Stunkard, 1964</u>	Vancouver, Canada
	<u><i>Cercaria cystophorous</i> B (Miller, 1925) Ching, 1959</u>	Puget Sound, Washington Friday Harbor, Washington
<u><i>Transenella tantilla</i> (Gould)</u>	<u>Cercaria of <i>Telolecithus pugetensis</i> Lloyd and Guberlet, 1932, DeMartini and Pratt, 1963</u>	Yanquina Bay, Oregon Friday Harbor, Washington Humboldt Bay and Tomales Bay, California
(Plankton haul)	<u><i>Cercaria</i> sp. Young, 1936</u>	Bering Sea

SUMMARY

Ten cercariae named Cercaria californica I-X are described from marine and brackish water snails of the California coast between Duxbury Reef and Fort Ross. These are Cercaria californica I from Cerithidea and Littorina scutulata, C. californica II and III from Littorina scutulata, C. californica IV from Acanthina spirata and Thais emarginata, C. californica V from Cerithidea californica, C. californica VI and VII from Littorina scutulata, C. californica VIII from Olivella biplicata, C. californica IX from Thais emarginata, and C. californica X from Lacuna sp. Some behavioral observations are included; host-parasite and parasite-host lists of all marine cercariae reported from the West Coast are also given.

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PLATE I

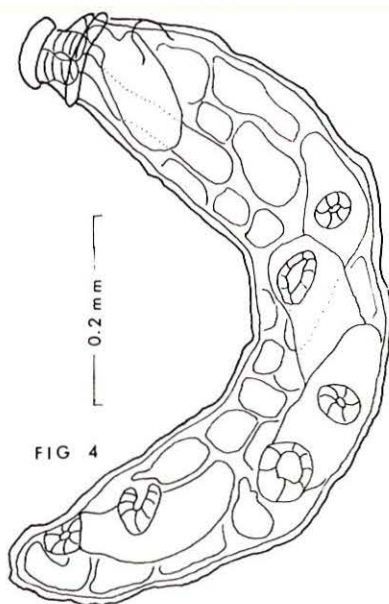
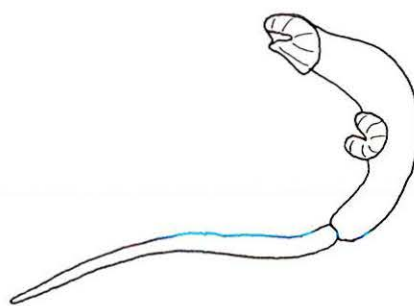
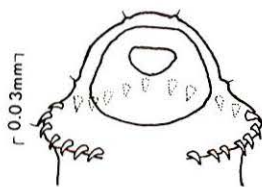
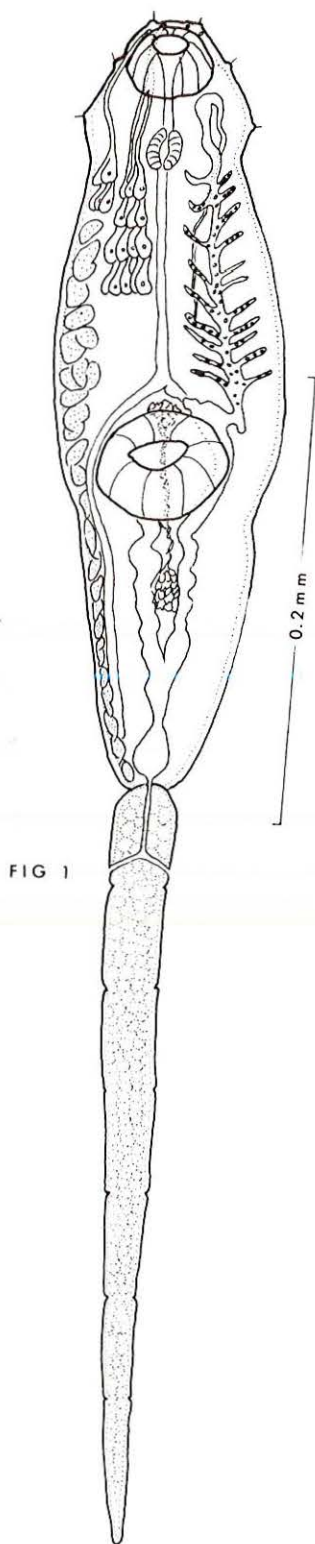


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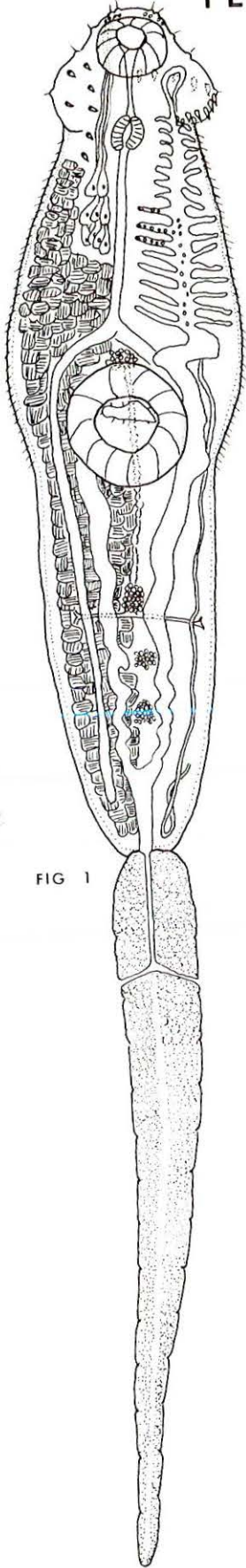


FIG 1

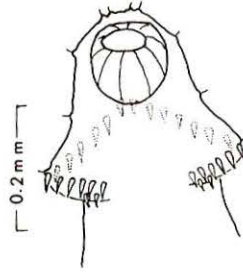


FIG 2

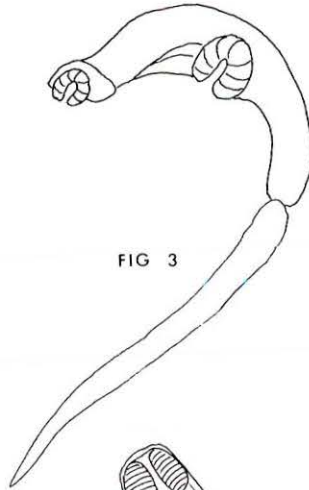


FIG 3

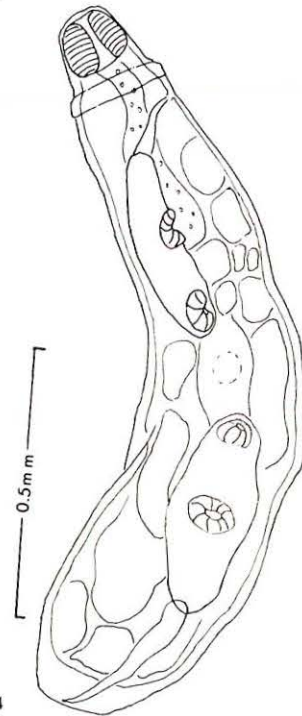


FIG 4

PLATE III

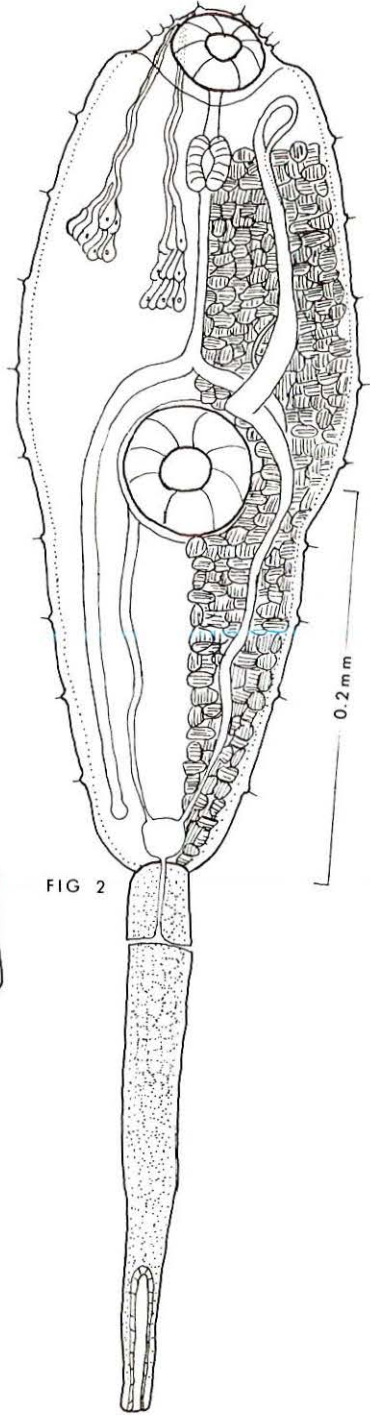
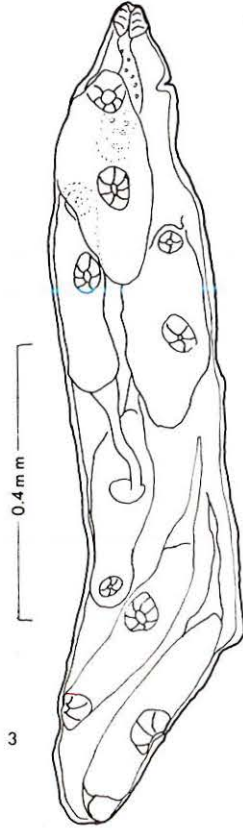
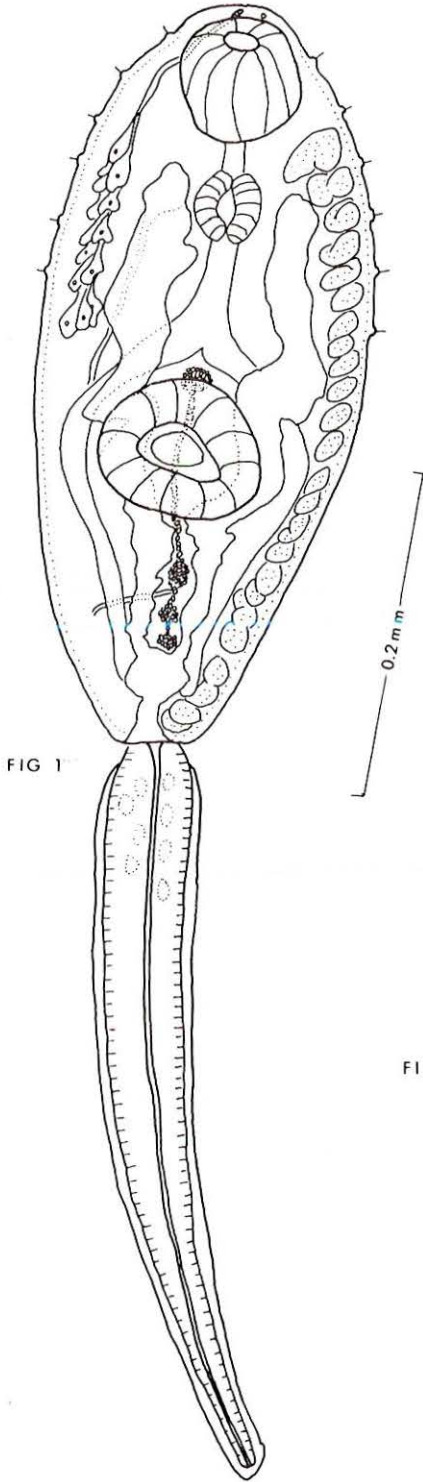


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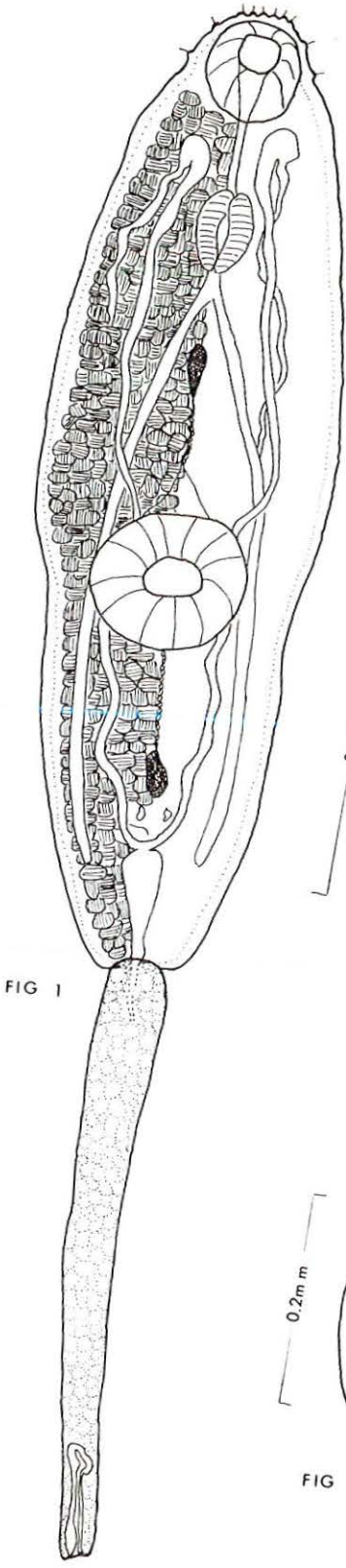


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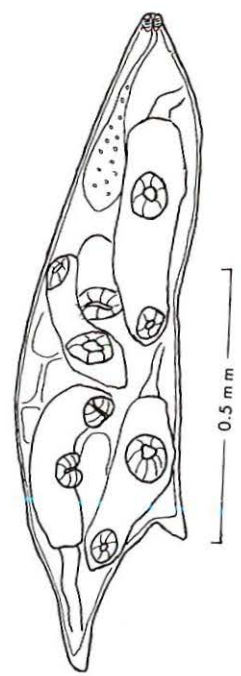


FIG 3

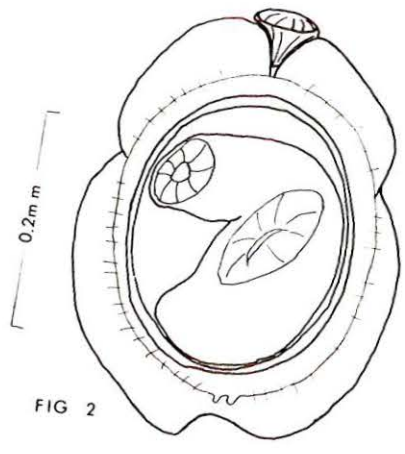


FIG 2

PLATE V

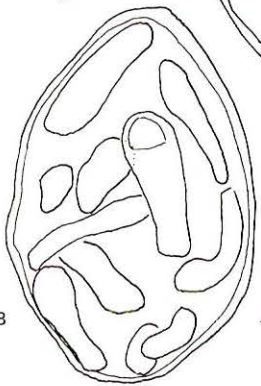
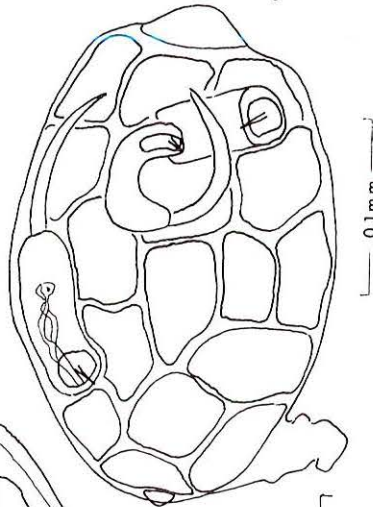
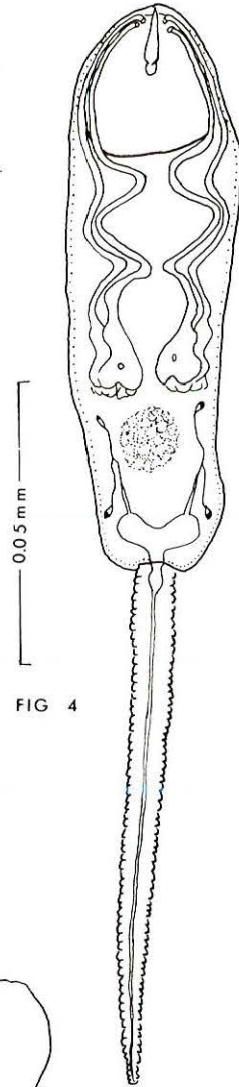
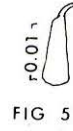
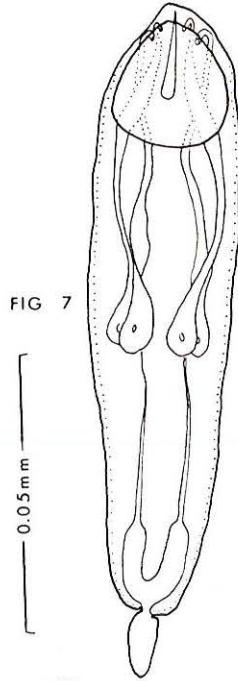
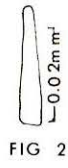
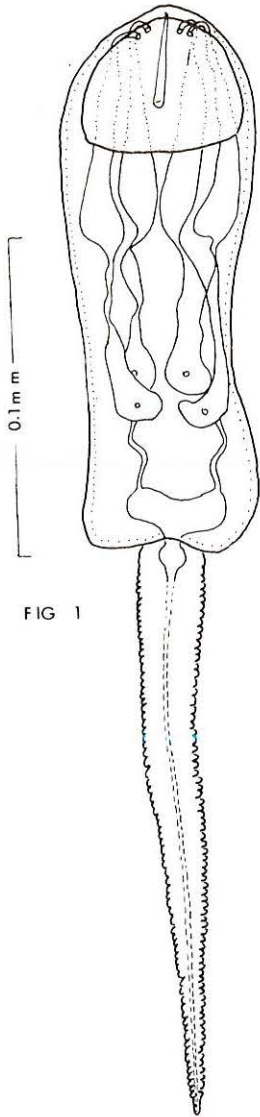


FIG 3

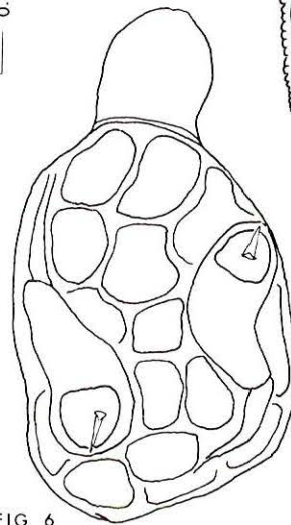


FIG 6

FIG 8

PLATE VI



FIG 4

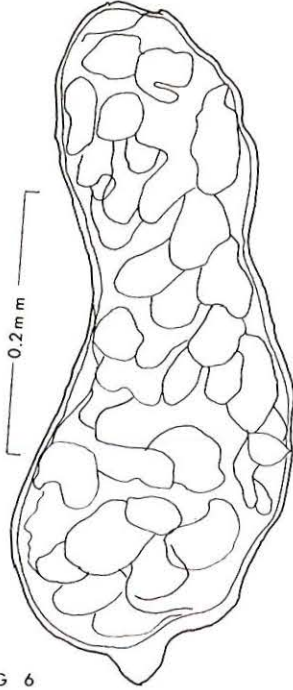


FIG 6

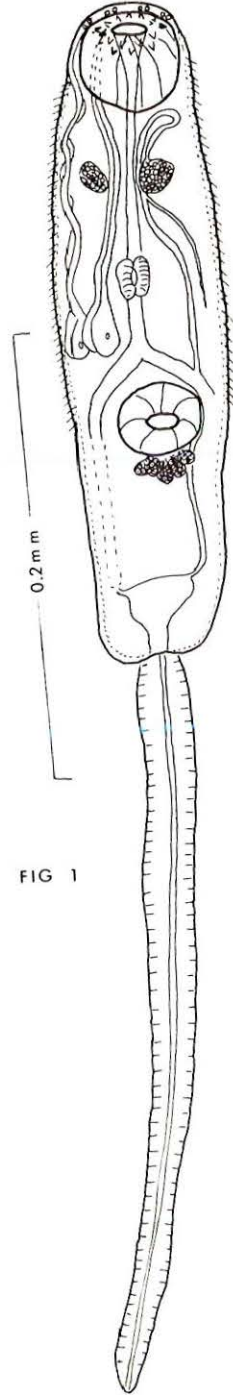


FIG 1

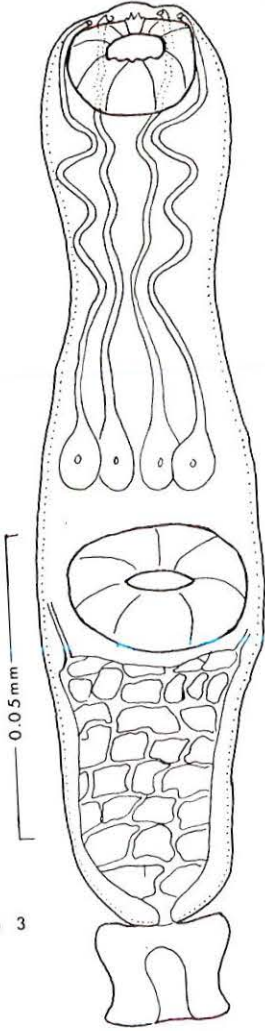


FIG 3

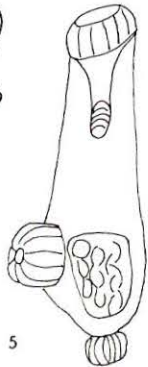


FIG 5

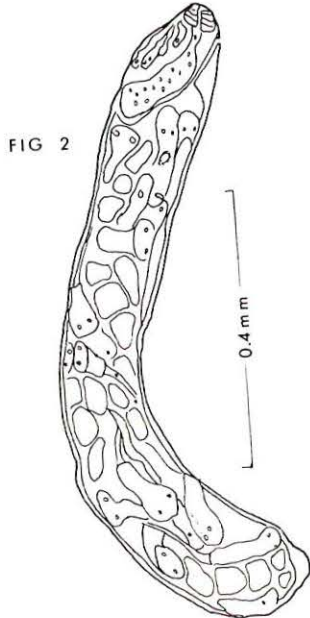


FIG 2