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A survey of the adult trematodes from fishes of the Pacific Marine Station area

William Franklin Johnson
University of the Pacific

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College of the Pacific
Stockton, Calif.

A SURVEY OF THE ADULT TREMATODES FROM FISHES
OF THE PACIFIC MARINE STATION AREA

A Thesis
Presented to
the Faculty of the Department of Zoology
College of the Pacific

28857

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

by
William Franklin Johnson

June 1949

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¹ Some of the fishes requiring an ichthyologist's identification are herein given numbers corresponding to the collector's catalogue number, followed by a capital letter indicating the collector; C indicating Copsey, H indicating Hughes, F indicating Fisk, and J indicating the writer. All fish hosts as well as specimens of trematodes here reported are available for examination at the Pacific Marine Station.

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INTRODUCTION

An effort is here made to assemble all of our knowledge of all adult trematodes which have been found in the fishes of the Pacific Marine Station Area. This includes publications, unpublished material such as graduate theses, and specimens herein described for the first time. It is hoped that this endeavor will facilitate further investigation in trematodology and that this paper will be an aid in identification of trematodes subsequently discovered.

Since 1936, when Park reported two new species of trematodes, Sterrhuras magnatestis and Tubulovesicula californica from littoral fishes of Dillon Beach, California, there have been several subsequent studies of the trematode fauna of this area.

In 1937, Park described a new genus and a new species, Genitocotyle acirrus. Later in 1937, he described eight new species of Podocotyle and revised the genus.

Noble and Park described a new species, Helicometrina elongata and emended the genus Helicometrina, also in 1937.

Two unpublished master's theses have been written on the subject of trematodes from Dillon Beach. Graves, in 1935, wrote a description of a new species of Probolotrema suggesting tomalis as the specific name. This species was named Probolitrema californiese by Stunkard in 1936.

In 1947, Gale wrote a thesis in which he reported finding eight different species, some of which he believed had not been described.

At the present time, there are several theses either just completed or in the latter processes of being completed pertaining to the field of helminthology. Fisk is making a survey of larval trematodes infecting marine invertebrates of Tomales Bay. Copsey is reporting on cystophorous cercaria; and Hughes is reporting on the life cycle of a trematode parasitic in the snail, Cirithidia californica.

There have been specimens taken from time to time at the Pacific Marine Station, some of which have not been fully identified. For the last two years, there has been a more concentrated searching for trematodes of the fishes of this area by Bond, Fisk, Copsey, Hughes, and the writer. The findings of the above investigators have been very encouraging and all their findings concerning adult trematodes are incorporated within this report.

PROCEDURES

FIELD TECHNIQUES

The majority of the fishes examined were caught with a dip-net in tide pools at low tide. Larger fishes from the tide pools were caught with a "poke pole" rod which consists of a long pole with a short wire leader tied to a hook. A few fishes were obtained from the commercial fishermen at Bodega Bay who were very cooperative in this respect. Another source of fishes was the dredging trips taken by the students of the Pacific Marine Station.

LABORATORY TECHNIQUES

Collecting the parasites

The fishes were placed in aquaria in the laboratory and in this way could be kept alive for several days. Imme-

diately before examination, the fish was anesthetized by placing a few drops of dilute chloratone on its gills.

After the gills were removed, the body wall was cut from the anus to the gill chamber. On removal of the viscera, each organ was placed in a separate watch glass. The external surface of the body, gills, coelom, liver, and heart were examined for parasites. The alimentary canal was then segmented into its divisions; oesophagus, stomach, and intestine, and placed in separate watch glasses. The divisions were split lengthwise, flooded with sea water and the inside surface scraped to dislodge any parasites which might be present. Some specimens were apparent without the aid of a microscope but a dissecting microscope was necessary for the examination of most of the material.

On discovery of a trematode, it was removed to a clean watch glass with the aid of a pipette and flooded with sea water. Additional worms from the same division of the alimentary canal were placed with it.

Infected fishes were assigned consecutive numbers and placed in formalin for future identification. The numbers were also placed in a note book together with such information as date, locality of collection, site of infection, number of trematodes found, and other pertinent data.

Fixing and flattening the trematodes

Because of the tendency for a live trematode to contract vigorously when fixative is put on it, attempts were made to relax the worms by various methods. The methods which were fairly satisfactory were those using dilute chloratone or warm water. Even these methods were not completely satisfactory. The worms which had active elastic necks, as some of the hemiurids, pulled their necks back compactly against the ventral sucker.

To flatten and fix the trematodes, they were placed separately on microscope slides, and a cover slip which had been dipped in fixative was put directly on each of the specimens. The excess fixative was drawn off with lens paper, and the specimens were allowed to remain in this position for ten minutes. The slides were then flooded with fixative and the cover slips and worms washed off into a watch glass. The specimens were put into vials numbered correspondingly with the number of the fish from which they had been taken.

The fixative used was Lavdowsky's mixture of formalin, alcohol, and acetic acid commonly called F. A. A.

Staining and mounting the trematodes

Almost all of the trematode whole mounts were stained in Henneguy's acid alum carmine with good results. A few specimens were stained in borax carmine with good results, and a few were stained in Bismark brown with inferior results. Harris' hematoxylin counterstained with eosin gave fairly satisfactory results and has the advantage over the carmine stains in that it takes only a few minutes to stain the specimens.

Drawing the trematodes

All drawings were made with the aid of a camera lucida or by means of a microprojector. The lucida method is superior, because it gives a more definite outline of the specimen. Very small objects, such as eggs, can be seen clearly with the camera lucida but cannot be distinguished when employing the microprojector method.

Identification of the trematodes

A systematic search of the literature and the cross-indexed taxonomic cards at the Pacific Marine Station was followed by collections of reprints and examinations of journals containing relivent materials not available at the Pacific Marine Station. The writer is confident that the identification of specimens, in so far as it is given, is accurately made and that the five species here described as new have not been previously reported.

DESCRIPTION OF TREMATODES

ALLOCREADIIDI

Podocotyle endophrysi Park 1937

Plate 1, fig. 3

Sixty specimens of Podocotyle endophrysi were found by Park in the intestine and stomach of a sculpin, Endophrys bison. The most diagnostic features of this species were said to be: the cirrus sac is elongated and S-shaped, extending to midway between the ovary and the ventral sucker, with its anterior end always protruded(?); the ventral sucker is 1.6 times as large as the oral sucker; the oesophagus is about 1.7 times as long as the pharynx; the subglobular or slightly lobed testes are close together; the four-lobed ovary is about one half as large as either testis.

Podocotyle apodichthysi Park 1937

Plate 3, fig. 16

Ten specimens of Podocotyle apodichthysi were found by Park in the lower part of the intestines of two blennies, Apodichthys flavidus. One specimen was found by Hughes in the intestine of fish 4H collected one mile north of Dillon Beach, June, 1948. The most diagnostic features of this species were said to be: the cirrus sac extends to about the mid-point of the ventral sucker; the seminal vesicle is divided into a large uncoiled posterior part and a slender coiled anterior part; the ventral sucker is only slightly larger than the oral sucker; the oesophagus is about the same length as the pharynx; the lobed testes are separated by vitellaria; the three-lobed ovary is almost as large as either testis.

Podocotyle blennicottusi Park 1937

Plate 1, fig. 4

Four specimens of Podocotyle blennicottusi were found by Park in the lower intestine of a sculpin, Blennicottus globiceps. One specimen was found by Hughes in the intestine

of the fish 10H collected one mile north of Dillon Beach, July, 1948. Two specimens were found by the writer in the intestine of the fish 24J, and one specimen in the intestine of the fish 20J collected one mile north of Dillon Beach, July, 1948. The most diagnostic features of this species were said to be: the cirrus sac extends to about the mid-point of the ventral sucker; the seminal vesicle is divided into a large posterior part and a slender recurving anterior part; the ventral sucker is about 1.7 times as large as the oral sucker; the oesophagus is about the same length as the pharynx; the lobed testes are close together; the four-lobed ovary is about half as large as either testis; there are rudimentary spines present in the region of the ventral sucker.

Podocotyle californica Park 1937

Plate 1, fig. 2

Five specimens of Podocotyle californica were found by Park in the lower intestines of two sculpins, Blennicottus globiceps. One specimen was found by Gale (1947) in the intestine of Crossochir koelzi. Gale stated that this specimen was proportional but smaller than those specimens described by Park. The most diagnostic features of this

species were said to be: the cirrus sac extends to about the mid-point of the ventral sucker; the seminal vesicle is divided into a large posterior part and a small anterior part; the ventral sucker is about twice as large as the oral sucker; the oesophagus is about the same length as the pharynx; the lobed testes are close together; the four-lobed ovary is about half as large as either testis.

Podocotyle kofoidi Park 1937

Plate 3, fig. 14

Thirty specimens of Podocotyle kofoidi were found by Park in the intestines of three sculpins, Blennicottus globiceps. The most diagnostic features of this species were said to be: the cirrus sac extends to about the posterior level of the ventral sucker; the seminal vesicle is straight and fills the cirrus sac; the ventral sucker is about 1.8 times as large as the oral sucker; the oesophagus is about twice as long as the pharynx; the lobed testes are close together; the three-lobed ovary is about one half as large as either testis; there are rudimentary spines present in the region of the ventral sucker.

Podocotyle elongata Park 1937

Plate 1, fig. 6

Two specimens of Podocotyle elongata were found by Park in the lower intestine of a sculpin, Blennicottus globiceps. One specimen was found by Gale (1947) in the intestine of Sebastes paucispinus. Gale stated that this specimen was far below the size of those described by Park. One specimen was found by Hughes in the intestine of the fish 9H, five in the intestine of the fish 10H, and three in the intestine of the fish 12H. Collections were made one mile north of Dillon Beach, July, 1948. Three specimens were found by the writer in the intestine of the fish 28J collected at Duxberry Reef, July, 1948; two specimens in the intestine of the fish 9J and one in the intestine of the fish 5J, collected one mile north of Dillon Beach, June, 1948; five specimens in the intestine of the fish 17J and two in the intestine of the fish 24J, collected at Stemple Creek, July, 1948. The most diagnostic features of this species were said to be: the cirrus sac extends to about the posterior level of the ventral sucker; the seminal vesicle is constricted into a large posterior part and a small anterior part; the ventral sucker is about 1.7 times as large as the oral sucker; the oesophagus is about as long as the pharynx; the lobed testes are separated by

vitellaria; the three-lobed ovary is slightly more than one half as large as either testis. Park states that Podocotyle elongata may be the older stage of Podocotyle kofoidi.

Podocotyle pedunculata Park 1937

Plate 2, fig. 7

Six specimens of Podocotyle pedunculata were found by Park in the intestines of two sculpins, Oligocottus maculosus. The most diagnostic features of this species were said to be: the cirrus sac extends to the posterior level of the ventral sucker; the seminal vesicle is straight and uncontracted; the ventral sucker is pedunculated and about twice as large as the oral sucker; the oesophagus is slightly longer than the pharynx; the unlobed or slightly lobed testes are separated by vitellaria; the three lobed ovary is about two-thirds as large as either testis.

Podocotyle pacifica Park 1937

Plate 1, fig. 5

One specimen of Podocotyle pacifica was found by

Park in the intestine of a sculpin, Blennicottus globiceps. Three specimens were found by Hughes in the intestine of the fish 8H collected one mile north of Dillon Beach, July, 1948. The most diagnostic features of this species were said to be: the cirrus sac extends to the posterior margin of the ventral sucker; the seminal vesicle is divided into a large posterior part and a slender recurving anterior part; the ventral sucker is almost twice as large as the oral sucker; the oesophagus is about the same length as the pharynx; the almost smooth testes are separated by vitellaria; the four-lobed ovary is about two-thirds as large as either testis.

Podocotyle attenuata n. sp.

Plate 4, fig. 19

Three specimens of Podocotyle attenuata were found by the writer in the intestine of the fish 6J collected one mile north of Dillon Beach, July, 1948. A study of its morphology indicates that it belongs to a hitherto undescribed species.

Description.--The body length is about thirteen times the width at the ovary. The ovoid and sometimes slightly pedunculate ventral sucker is about twice as large as the

spherical and terminal oral sucker. The oesophagus is slender and about the same length as the spherical pharynx. There is a very short prepharynx. The intestinal caeca are slender, extending almost to the posterior body margin. The cirrus sac extends to the posterior level of the ventral sucker. The genital pore is slightly anterior to the intestinal bifurcation, mid-way between the oesophagus and the lateral body margin. The seminal vesicle is straight and almost completely fills the cirrus sac. The posterior end of the seminal vesicle is expanded, tapering gradually to a more slender anterior end. The testes are globular, separated by vitellaria, and slightly larger than the three-lobed ovary. There is a large pear-shaped seminal receptacle immediately anterior to the ovary. The well developed vitelline reservoir is located on the ventral side of the seminal receptacle. The uterine coils are intercaecal between the ovary and the ventral sucker. The eggs are few in number and relatively large. The vitellaria are well developed, extending from slightly posterior to the ventral sucker to the posterior margin of the body. Interruptions in the vitellaria occur at the level of the testes. The vitellaria are largely extracaecal except between and posterior to the testes. The excretory pore is terminal, and the excretory bladder is slender, extending to the level of the ovary.

Comparisons.-Podocotyle attenuata is similar to P. pedunculata Park (1937) but may be distinguished by (1) the absence of the pedunculated ventral sucker characteristic of P. pedunculata, (2) having a ratio of body length to body width which is about 13:1 rather than about 5:1 as is the case in P. pedunculata.

Body measurements. - Body length, 1.91 (1.69-2.06)mm.; width, 0.127 (0.103-0.147)mm. Oral sucker length, 0.113 (0.103-0.132)mm.; width 0.10(0.081-0.132)mm. Ventral sucker length, 0.196 (0.177-0.22)mm.; width, 0.216 (0.191-0.25)mm. Prepharynx length, 0.015. Pharynx length, 0.073 (0.066-0.088)mm.; width, 0.073 (0.059-0.088)mm. Oesophagus length, 0.088 mm. Anterior testis length, 0.132 (0.088-0.177)mm.; width, 0.083 (0.074-0.088)mm. Posterior testis length, 0.117(0.103-0.132)mm.; width, 0.088mm. Testes separated by 0.167 (0.147-0.191)mm. Ovary length, 0.074mm.; width, 0.099 (0.081-0.1174)mm. Seminal receptacle length, 0.081mm.; width, 0.059mm. Egg length, 0.063(0.059-0.066)mm.; width, 0.037(0.029-0.044)mm. Where range in size is not indicated, only one measurement was obtained.

Podocotyle bodegensis n. sp.

Plate 5, fig. 22

One specimen of Podocotyle bodegensis was found by Hughes in the lower intestine of the fish 1H, one in the intestine of the fish 13H, and two in the stomach of the fish 14H. The collections were made one mile north of Dillon Beach, June and July, 1948. Five specimens were found by the writer in the intestine of the fish 7J, two in the intestine of the fish 1J, one in the intestine of the fish 3J, two in the intestine of the fish 2J, one in the intestine of the fish 4J, one in the intestine of the fish 10J, two in the intestine of the fish 11J, and three in the intestine of the fish 14J. The collections were made one mile north of Dillon Beach, June, 1948. In addition, one specimen was found in the intestine of the fish 18J collected at Stemple Creed, July, 1948. A study of its morphology indicates that it belongs to a hitherto undescribed species.

Description.—The body length is about five times the width at the level of the ovary. The ovoid ventral sucker is almost twice as large as the spherical oral sucker. The terminal oral sucker is followed by a short prepharynx. The oesophagus is about 1.6 times the length of the globular pharynx. The intestinal caeca are slender, extending nearly

to the posterior body margin. The cirrus sac extends to the mid-point of the ventral sucker. The seminal vesicle is divided into a large posterior part and a small anterior part which leads to the genital pore. The genital pore is at the left and anterior to the intestinal bifurcation. The testes have either lobed or irregular margins and are separated by vitellaria. The irregularly four-lobed ovary is slightly smaller than either testis. The large seminal receptacle is immediately anterior and to the left of the ovary, its anterior end continuing as the slender Laurer's canal toward the left caecum. The vitelline reservoir is anterior to the ovary. The shell gland is diffused laterally from the region anterior to the ovary. The uterine coils are intercaecal between the ovary and the ventral sucker. The vitellaria extend from the posterior level of the ventral sucker to the posterior margin of the body, largely extracaecally except between and posterior to the testes. The excretory pore is terminal, and the excretory bladder extends to the level of the ovary.

Comparisons.-Podocotyle bodegensis is similar to P. kofoidi, P. pedunculata, and P. elongata. P. bodegensis may be distinguished from P. kofoidi by (1) the cirrus sac extending from the mid-level of the ventral sucker rather than the posterior level, (2) the testes having unlobed, crenulated, or slightly lobed margins rather than deeply lobed margins possessed by P. kofoidi. P. bodegensis may

be distinguished from P. pedunculata by not having a pedunculated ventral sucker characteristic of P. pedunculata. P. bodegensis may be distinguished from P. elongata by (1) having unlobed or slightly lobed testes rather than deeply lobed testes characteristic of P. elongata, (2) having a body length not greater than half that of P. elongata (7mm.)

Body measurements.—Body length, 1.6(0.92-2.13)mm.; width, 0.271(0.162-0.353)mm. Oral sucker length, 0.138(0.118-0.147)mm.; width, 0.13(0.11-0.155)mm. Ventral sucker length, 0.227(0.177-0.25)mm.; width, 0.264(0.206-0.31)mm. Prepharynx length, 0.015mm. Pharynx length, 0.084(0.073-0.095)mm.; width, 0.073(0.059-0.088)mm. Oesophagus length, 0.116(0.088-0.147)mm. Anterior testis length, 0.1(0.059-0.147)mm.; width, 0.144(0.103-0.191)mm. Posterior testis length, 0.115(0.088-0.147)mm.; width, 0.147(0.103-0.206)mm. Testes separated by 0.067(0.015-0.088)mm. Ovary length, 0.086(0.044-0.132)mm.; width, 0.145(0.118-0.162)mm. Seminal receptacle length, 0.055(0.044-0.066)mm.; width, 0.058(0.044-0.073)mm. Egg length, 0.058(0.044-0.066)mm.; width, 0.033(0.029-0.037)mm.

Variations occurring in this species are: the testes may be almost entire, circular to ovoid, ranging to slightly lobed, and ranging from slightly larger than the ovary to 1.5 times as large as the ovary; the oesophagus length may range from equal to twice the length of the pharynx. These wide variations could be interpreted as specific differences,

but because of their gradations, no constant differences could be determined.

Podocotyle copsis n. sp.

Plate 4, fig. 18

Two specimens of Podocotyle copsis were found by Copsy in the pyloric caeca of the fish Hexagrammos decagrammus collected in the tide pools of Dillon Beach, May, 1948. A study of its morphology indicates that it belongs to a hitherto undescribed species.

Description.-The body length is about nine times the width at the ovary. The ovoid, pedunculated ventral sucker is about twice as large as the sub-spherical oral sucker. The oesophagus is about 1.5 times the length of the spherical pharynx. The terminal oral sucker is followed by a short prepharynx. The intestinal caeca extend to near the posterior body margin. The cirrus sac extends almost to a point mid-way between the ventral sucker and the ovary. The slender seminal vesicle is convoluted in the posterior region of the cirrus sac, from where it extends anteriorly in an S-shaped manner, straightening as it approaches the genital pore. The genital pore is anterior and to the left of the intestinal bifurcation. The ovoid testes may or may

not be separated by vitellaria. The irregularly three-lobed ovary is between one-half and one-third as large as either testis. The large pear-shaped seminal receptacle is immediately anterior to the ovary, the anterior end recurving. The vitelline reservoir is on the anterior margin of the seminal receptacle. The uterine coils are intercaecal between the ovary and the ventral sucker. The vitellaria extend from the level of the ventral sucker to the posterior margin of the body, being interrupted at the level of the testes. They are largely extracaecal except between and posterior to the testes. The excretory pore is terminal.

Comparisons.-Podocotyle copsis is similar to P. endophrysi, P. pacifica, P. blennicottusi, and P. petalophallus. It may be distinguished from these species, however, by the possession of a pedunculated ventral sucker instead of a non-pedunculated one.

Body measurements.-Body length, 2.13(2.06-2.2)mm.; width, 0.269(0.22-0.309)mm. Oral sucker length, 0.222(0.103-0.140)mm.; width, 0.139(0.117-0.162)mm. Ventral sucker length, 0.235mm.; width, 0.247(0.213-0.28)mm. Pharynx length, 0.088mm.; width, 0.081mm. Oesophagus length, 0.117mm. Anterior testis length, 0.23(0.206-0.235)mm.; width, 0.169(0.147-0.191)mm. Posterior testis length, 0.229(0.177-0.28)mm.; width, 0.176(0.162-0.191)mm. Testes separated by 0.125(0.029-0.22)mm. Ovary length, 0.081

(0.073-0.088)mm.; width, 0.139(0.117-0.162)mm. Seminal receptacle length, 0.191mm.; width, 0.103mm. Egg length, 0.069(0.066-0.073)mm.; width, 0.0339(0.0309-0.0368)mm.

Podocotyle cebidichthysi n. sp.

Plate 4, fig. 21

Seven specimens of Podocotyle cebidichthysi were found by Copsey in the pyloric caeca and intestine of the fish Cebidichthys violaceus collected in the Dillon Beach tidepools, March, 1948. A study of its morphology indicated that it belongs to a hitherto undescribed species.

Description.-The body length is about six times the width at the level of the ovary. The ovoid ventral sucker is almost twice as large as the spherical oral sucker. The spherical pharynx is about the same length as the oesophagus. The intestinal caeca extend almost to the posterior body margin. The cirrus sac extends to a point mid-way between the ventral sucker and the ovary. The seminal vesicle, convoluted in the posterior portion of the cirrus sac, becomes gradually less convoluted toward the anterior end of the seminal vesicle until the portion leading to the genital pore is almost straight. The genital pore is slightly anterior and to the left of the intestinal bifurcation.

The lobed testes are close together. The four-lobed ovary is about half as large as either testis. The uterus coils intercaecally between the ovary and the ventral sucker and then continues anteriorly to the genital pore. The vitellaria are in groups of follicles irregularly spaced (possibly because of advanced age of specimens) posterior to the ventral sucker and largely extracaecal except behind the posterior testis. The excretory pore is terminal. The excretory bladder extends to the level of the ovary. The outer surface of the body is ridged.

Comparisons.-Podocotyle cebidichthysi is similar to P. endophrysi, P. pacifica, P. blennicottusi, and P. petalophallus. P. cebidichthysi may be distinguished from these species because it has sparse and irregularly scattered groups of vitellaria rather than uniformly distributed vitellaria characteristic of the other species.

Body measurements.-Body length, 3.06(2.84-3.27)mm.; width, 0.51(0.47-0.56)mm. Oral sucker length, 0.205(0.191-0.22)mm.; width, 0.25(0.22-0.28)mm. Ventral sucker length, 0.331(0.324-0.338)mm.; width, 0.419(0.412-0.426)mm. Pharynx length, 0.1175mm.; width, 0.132mm. Oesophagus length, 0.1175mm. Anterior testis length, 0.368(0.338-0.398)mm.; width, 0.361(0.324-0.398)mm. Posterior testis length, 0.397(0.309-0.485)mm.; width, 0.361(0.324-0.398)mm. Testes separated by 0.05(0.0294-0.0735)mm. Ovary length, 0.191(0.147-0.235)mm.; width, 0.26(0.162-0.353)mm. Egg length, 0.066mm.; width 0.034 (0.0324-0.368)mm.

Podocotyle hexagrammosi n. sp.

Plate 4, fig. 20

Three specimens of Podocotyle hexagrammosi were found by Copsey in the intestine of the fish Hexagrammos(?) sp. collected in the tidepools of Dillon Beach, March, 1948. A study of its morphology indicates that it belongs to a hitherto undescribed species.

Description.-The body length is about six times the width at the level of the ovary. The ovoid ventral sucker is about 2.5 times as large as the terminal spherical oral sucker. The spherical pharynx is about the same length as the oesophagus. The intestinal caeca extend nearly to the posterior body margin. The cirrus sac extends to a point mid-way between the ventral sucker and the ovary. The slender seminal vesicle is highly convoluted in the expanded posterior region of the cirrus sac to the posterior level of the ventral sucker. It then extends sinuously to the genital pore. The genital pore is to the left of the oesophagus, mid-way between the oesophagus and the lateral body margin. The testes are subglobular and close together. The irregularly lobed ovary is about one-half as large as either testis. The seminal receptacle and the vitelline reservoir are well developed. The uterus coils intercaecally between the ovary and the ventral sucker and then continues to the genital

pore. The vitellaria are well developed, extending from the posterior level of the ventral sucker to the posterior body margin. They are largely extracaecal except between and posterior to the testes. The excretory pore is terminal.

Comparisons.-Podocotyle hexagrammosi is similar to P. endophrysi, P. pacifica, P. blennicottusi, and P. mercapera. It may be distinguished from P. endophrysi because P. hexagrammosi has (1) an uncoiled seminal vesicle, (2) an oesophagus about the same length as the pharynx instead of being about 1.7 times as long as the pharynx, (3) an oral sucker-ventral sucker ratio of 1:2.5 instead of 1:1.6. P. hexagrammosi may be distinguished from P. pacifica because P. hexagrammosi has (1) an oral sucker-ventral sucker ratio of 1:2.5 instead of 1:1.7, (2) closely applied testes instead of having testes separated by a considerable distance. P. hexagrammosi may be distinguished from P. blennicottusi because it has (1) unlobed testes, (2) the oral sucker-ventral sucker ratio is 1:2.5 instead of 1:1.7 as it is in P. blennicottusi. P. hexagrammosi may be distinguished from P. mercapera because P. hexagrammosi has vitellaria extending to the posterior level of the ventral sucker instead of extending to the level of the ovary.

Body measurements.-Body length, 1.98mm.; width, 0.353 mm. Oral sucker length, 0.132mm.; width, 0.147mm. Ventral sucker length, 0.243mm.; width, 0.346mm. Pharynx length, 0.103mm.; width, 0.103mm. Oesophagus length, 0.073mm.

Anterior testis length, 0.235mm.; width, 0.265mm. Posterior testis length, 0.28mm.; width, 0.294mm. Testes separated by 0.029 mm. Ovary length, 0.147mm.; width, 0.206mm. Seminal receptacle length, 0.25mm.; width, 0.088mm. Egg length, 0.066mm.; width, 0.0324mm. The above measurements were obtained from a single specimen.

Cymbephallus(?) sp.

Plate 9, fig. 39

A total of five specimens of Cymbephallus(?) sp. were found by Copey in the intestine of two Leptocottus armatus collected at Nick's Cove, October, 1948. One specimen was found by Hughes in the intestine of the fish 7H collected at Stemple Creek, July, 1948.

Description.-The body is about four times the width at the level of the ovary. The ovoid ventral sucker is about 1.7 times as large as the spherical oral sucker. The spherical pharynx is about the same length as the oesophagus. The intestinal caeca extend nearly to the posterior body margin. The cirrus sac is absent. The slender seminal vesicle, slightly S-shaped posterior to the ventral sucker, extends from below the ventral sucker to the genital pore. The genital pore is slightly anterior and to the left of the

intestinal bifurcation. The margins of the testes are either slightly or deeply lobed. The lobed ovary is between one-half and one-third times as large as either testis. A seminal receptacle is not apparent. The vitelline reservoir is immediately anterior to the ovary. The uterine coils are intracaecal between the ovary and the ventral sucker. The vitellaria extend largely extracaecally, except between and posterior to the testes, from a level slightly posterior to the ventral sucker to the posterior body margin. The excretory pore is terminal. The excretory bladder is slender, reaching to the level of the ovary.

Body measurements.-Body length, 1.92(1.77-2.1)mm.; width, 0.354(0.353-0.412)mm. Oral sucker length, 0.169(0.147-0.191)mm.; width, 0.18(0.162-0.206)mm. Ventral sucker length, 0.222(0.213-0.235)mm.; width, 0.289(0.28-0.294)mm. Prepharynx length, 0.0239(0.0147-0.0294)mm. Pharynx length, 0.112(0.0955-0.1175)mm.; width, 0.11(0.103-0.1175)mm. Oesophagus length, 0.127(0.066-0.177)mm. Anterior testis length, 0.198(0.177-0.22)mm.; width, 0.223(0.206-0.265)mm. Posterior testis length, 0.209(0.191-0.235)mm.; width, 0.235(0.206-0.294)mm. Testes separated by 0.0624(0.0294-0.1175)mm. Ovary length, 0.103(0.088-0.132)mm.; width, 0.1744(0.1175-0.198)mm. Egg length, 0.0699(0.059-0.735)mm.; width, 0.0339(0.051-0.0368)mm.

Genitocotyle acirrus Park 1937

Plate 2, fig. 11

Thirty specimens of Genitocotyle acirrus were found by Park in the stomach and upper intestine of six surf-perch, Holconotus rhodoterus. A total of eighty-one specimens were found by Gale (1947) in eleven Crossochir koelzi, forty-one specimens in one Taeniotoxa lateralis, and one specimen in an unidentified sole. All specimens were found in the stomach and intestine. The most diagnostic features of this species were said to be: the genital sucker is about 0.18mm. in diameter and is situated to the left of the intestinal bifurcation; the ventral sucker is about 1.8 times as large as the oral sucker; the oesophagus is about twice as long as the pharynx; the seminal vesicle consists of about ten coils and extends from a point mid-way between the ventral sucker and the ovary; the obovoidal or slightly lobed testes are close together; the two or three lobed ovary is about one-half as large as either testis; there are relatively few uterine coils.

Helicometrina elongata Noble and Park 1937

Plate 2, fig. 9

Fourteen specimens of Helicometrina elongata were found by Park in the small intestine of two cling fish, Caularchus meandricus, collected at Bodega Bay. The most diagnostic features of this species were said to be: there are nine globular testes arranged in two longitudinal rows; the large, clavate and somewhat S-shaped cirrus sac extends slightly posterior to the anterior level of the ventral sucker; the long coiled ejaculatory duct occupies the anterior portion of the cirrus sac, and the large slightly coiled seminal vesicle occupies the posterior portion of the cirrus sac; the genital pore is median and anterior to the intestinal bifurcation; the ventral sucker is almost twice as large as the oral sucker; the diameter of the four-lobed ovary is about equal to that of any of the testes; the vitellaria are largely extracaecal, in two paired groups, one pair anterior and one pair posterior to the ventral sucker.

Helicometrina nimia Linton 1910

Plate 2, fig. 8

Two specimens of Helicometrina nimia were found by Gale (1947) in the intestine of the cabezone, Scorpaenichthys marmoratus. Copsey has reported finding several specimens of this species from the stomach of Sebastes rastrelliger collected from the tidepools of Dillon Beach, April, 1948, and he found ten specimens from the intestine of another fish of the same species in May, 1949. The specimens thus far collected at Dillon Beach differ from those originally described by Linton, in that they are larger and the oral sucker-ventral sucker ratio is 1:2 instead of 1:1.5. Gale regarded these differences as individual variation rather than specific. The most diagnostic features of this species were said to be: the body length is about two and one-half times the width; the genital pore is median, just behind the intestinal bifurcation; the cirrus sac is clavate, inclosing the tubular and convoluted seminal vesicle in its basal portion and extending from the anterior level of the ventral sucker; the nine testes are usually in two longitudinal rows, one row on each side of the median body line in the posterior part of the body; the lobed ovary is immediately in front of the two anterior testes; the wreathed folds of the uterus, which lie between the ovary and the ventral sucker, contain filamented eggs.

HEMIURIDAE

Sterrhurus magnatestis Park 1936

Plate 2, fig. 12

Fifteen specimens of Sterrhurus magnatestis were found by Park in the stomach of three flat-fish, Citharichthys sordidus. Several specimens were found by Copsey in the stomach of the ling cod, Ophiodon elongatus, obtained from the Bodega fisheries. The most diagnostic features of this species were said to be: the ventral sucker is about twice as large as the oral sucker; there is a caudal appendage present which is retractable into the posterior portion of the body; the genital pore is posterior and ventral to the posterior level of the pharynx, to the left of the median body line; the seminal vesicle is constricted into three parts, the anterior part is spheroidal and distinctly divided, the posterior part is dumbbell-shaped or S-shaped; the spherical testes are laterally placed, posterior to the ovary; they are slightly larger than the spherical ovary; the paired vitelline masses are slightly lobed.

Tubulovesicula californica Park 1936

Plate 2, fig. 10

One specimen of Tubulovesicula californica was found by Park in the alimentary canal, probably in the posterior part of the stomach, of the sculpin, Enophrys bison. Two specimens were found by Copey in the stomach of Leptocottus armatus; three more were found in another fish of the same species, two in the stomach and one in the gall bladder. Both fish were collected at Nick's Cove, October, 1948. The most diagnostic features of this species were said to be: the ventral sucker is 1.7 times as large as the oral sucker; the genital pore is near the mid-body line and near the posterior margin of the intestinal bifurcation; the pars prostatica has prostrate cells on its periphery except in the posterior one-tenth of its length; the vitellaria consists of eight slender lobes emerging from the shell gland the spheriodal testes are slightly smaller than the spheriodal ovary; the testes are very close to the anterior margin of the ovary; a caudal appendage is present. The specimens found by Copey differ from the one described by Park by having prostrate cells on the periphery of the pars prostatica for its entire length.

Opisthodena sp.

Plate 3, fig. 13

Sixty-eight specimens of Opisthodena sp. were found by Gale (1947) in the stomach of the fish, Blennicottus sp. Copey has also reported finding this species from the large blennie, Cebidichthys violaceus. More than one-hundred specimens of this same species were found by the writer in the pyloric stomach of Cebidichthys violaceus collected one mile north of Dillon Beach, July, 1948. Gale gave a preliminary description of this species and stated that it probably was undescribed. The most diagnostic features of this species are: the body length, which is about 5mm., is about eight times the width; the globular ventral sucker is about 2.4 times as large as the oral sucker; the oesophagus is absent; the pear-shaped testes are separated by a distance which is about three times the length of either testis; the unlobed ovary is slightly more than one-half as large as either testis; the spherical seminal receptacle is slightly larger than the ovary; the pars prostatica is well developed and the seminal vesicle extends to the level of the anterior testis; the uterine coils extend from near the posterior body margin to the level of the ventral sucker, continuing to the hermaphroditic duct; the paired vitelline glands are compact, ovoid, or tear-drop shaped, and laterally placed

immediately posterior to the ovary; the paired excretory tubules extend on either side of the body to the region of the oral sucker.

This species is similar to Opisthodena dimidia Linton (1910) except for the placement and separation of the testes. In almost every case, the testes of Opisthodena sp. are widely separated from each other and also from the ovary, while in Opisthodena dimidia, the testes are close together and close to the ovary. This is considered by the writer to be a specific difference between Opisthodena sp. and Opisthodena dimidia.

Unidentified hemiurid number 41

Plate 5, fig. 23

Five specimens of unidentified hemiurid number 41 were found by Hughes in the stomach of the fish 12H collected one mile north of Dillon Beach, July, 1948. A total of six specimens were found by the writer in the stomachs of two sea trout, Hexagrammos sp., collected at Stemple Creek, July, 1948. Other specimens of the same species found by the writer were: two specimens in the stomach of the fish 6J, two in the stomach of the fish 7J, four in the stomach of the fish 8J, two in the stomach of the fish 10J, one in the

stomach of the fish 11J, one in the stomach of the fish 12J, one in the stomach of the fish 13J, two in the stomach of the fish 14J, and one in the stomach of the fish 25J. The fish were collected one mile north of Dillon Beach, June and July, 1948.

Description.-The body length is about 4.5 times the width. The spherical ventral sucker is about 1.8 times as large as the oral sucker. The intestinal caeca divide immediately posterior to the spherical pharynx and continue almost to the posterior body margin where they nearly touch each other. The caeca are wide and have wavy margins. The genital pore is about mid-way between the ventral sucker and the oral sucker and is slightly to the left of the median body line. The cirrus is usually protruding. The cirrus sac is constricted into two parts, the posterior part is almost spherical, and the anterior part is pear-shaped, the pointed anterior end terminating at the genital pore. Immediately posterior to the cirrus sac is a short coiled seminal vesicle. The ovoid vitelline glands are tandem or slightly oblique. The ovoid ovary and the ovoid seminal receptacle are immediately anterior to the anterior vitelline gland, side by side. The ovoid testes are separated from the ovary by about the width of either testis. The testes are close together, either tandem or slightly oblique. The testes, ovary, and seminal receptacle are all about equal in size. The uterine coils extend from below

the ovary to the level of the ventral sucker.

Body measurements.-Body length, 1.8(1.62-1.99)mm.; width, 0.421(0.368-0.455)mm. Oral sucker length, 0.147mm.; width, 0.154(0.147-0.162)mm. Ventral sucker length, 0.242(0.235-0.25)mm.; width, 0.245(0.235-0.25)mm. Pharynx length, 0.088mm.; width, 0.088mm. Anterior testis length, 0.103mm.; width, 0.157(0.147-0.162)mm. Posterior testis length, 0.117(0.088-0.176)mm.; width, 0.142(0.117-0.162)mm. Testes separated by 0.31(0.0294-0.59)mm. Ovary length, 0.117(0.103-0.132)mm.; width, 0.157(0.103-0.206)mm. Egg length, 0.0294mm.; width, 0.0162mm. Anterior vitelline gland length, 0.147(0.132-0.162)mm.; width, 0.167(0.117-0.22)mm. Posterior vitelline gland length, 0.132(0.103-0.147)mm.; width, 0.162mm.

The specimens from the sea trout differ from those found in other kinds of fishes in that they are much larger. The above body measurements were obtained from the large specimens from the sea trout. The smaller specimens have a body length of 0.9(0.705-1.28)mm. The body organs of the small specimens have the same ratio to this length as the body organs of the large specimens have to their length. In some cases, however, the ovary and testes are enlarged so that they touch. The striking size differences may be due either to physiological differences of the hosts or to actual genetic differences which would necessitate the recognition of distinct races.

Unidentified Hemiurid number 33

Plate 8, fig. 37

One specimen of unidentified hemiurid number 33 was found by Copey in the stomach of either Hexagrammos superciliosus or Sebastodes rastrelliger (records uncertain) collected two miles north of Dillon Beach, March, 1948.

Description.--The body length is 3.5 times the width. The spherical ventral sucker is about 2.5 times as large as the ovoid oral sucker. The intestinal caeca branch immediately posterior to the spherical pharynx and extend posterior to a level slightly posterior to the mid-point between the posterior body margin and the vitelline glands. The caeca are wide and have wavy margins. The genital pore is located immediately posterior to the intestinal bifurcation on the median body line. The seminal vesicle is constricted into three parts, a small spherical anterior part, and a large everted L-shaped posterior part. The pars prostatica is well supplied with prostrate cells. The seminal vesicle reaches to the anterior level of the ventral sucker. The paired ovoid or tear-shaped vitelline glands are side by side. The ovoid ovary is immediately anterior to the vitelline glands. The ovoid, oblique testes are each about the same size as the ovary. The uterine coils extend from the posterior level of the intestinal caeca to about the

level of the ventral sucker. Many small eggs fill the uterus. There appears to be a sphincter present on the excretory pore.

Body measurements.--Body length, 2.56mm.; width, 0.735mm. Oral sucker length, 0.176mm.; width, 0.235mm. Ventral sucker length, 0.47mm.; width, 0.485mm. Pharynx length, 0.117mm.; width, 0.103mm. Anterior testis length, 0.176mm.; width, 0.28mm.; Posterior testis length, 0.162mm.; width, 0.324mm. Testes separated by 0.015mm. Ovary length, 0.132mm.; width 0.324mm. Egg length, 0.0147mm.; width, 0.009mm. Anterior vitelline gland length, 0.117mm.; width, 0.191mm. Posterior vitelline gland length, 0.132mm.; width, 0.22mm.

MONORCHIIDAE

Unidentified Monorchid

Plate 1, fig. 1

Forty seven specimens of this unidentified species of monorchid were collected by Gale (1947) from the intestine

of five jack smelt, Atherinopsis californiensis. The most diagnostic features of this species were said to be: the body is about 3.13mm. long which is about four times the width; the subterminal oral sucker is slightly larger than the spherical ventral sucker; the oesophagus is absent; the oblong testis is about two times as large as the oval ovary; the cirrus sac is large and is located at about the level of the ventral sucker; the genital pore opens immediately posterior to the ventral sucker; the uterus is highly coiled from the posterior margin of the body to the level of the ovary and then continues to the genital pore; the oval vitelline follicles are 17-19 in number, and they are grouped between the levels of the ventral sucker and ovary.

GORGODERIDAE

Probolitrema californiense Stunkard 1935

Plate 3, fig. 17

Sixty specimens of Probolitrema californiense were found by Graves (1935) in the coelom of the sting ray,

Dasyatis dipterura. The most diagnostic features of this species were said to be: the body length is between 7-13mm. which is slightly greater than the width; the body is extremely flattened dorso-ventrally; the testes are extracaecal, 16-26 irregularly-shaped lobed follicles gathered into 4-6 groups on each side; the cirrus sac is absent; the genital pore is situated mid-way between the oral sucker and the ventral sucker; the usually tri-lobed, median ovary is smaller than the seminal receptacle; the vitellaria consist of branched, extracaecal follicles anterior to the testes; the coiled uterus almost completely fills the intercaecal space posterior to the ovary.

AZYGIIDAE

Otodistomum cestoides (Van Beneden, 1871) Stafford 1904

Plate 3, fig. 15

Nine specimens of Otodistomum cestoides were found by Gale (1947) in the coelomic cavity of the electric ray, Tetranarce californica. Gale states that all previous

reports give the intestine as the site of infection. The most diagnostic features of this species were said to be: the body length, which may reach 80mm. (Stafford), is about four times the width; the oral sucker is about 0.6 times as large as the ventral sucker; the genital pore is median, between the ventral and oral sucker but closer to the oral sucker; the tandem testes are near the mid-body level; the large ovoid cirrus sac lies between the ventral and oral sucker; the ovary, which is immediately anterior to the anterior testis, is slightly smaller than either testis; the vitellaria extend from a level mid-way between the ventral sucker and the ovary to a level mid-way between the posterior testis and the posterior margin of the body.

BUCEPHALIDAE

Unidentified Bucephalid

Plate 9, fig. 38

One specimen of an apparently immature bucephalid was found by the writer in the alimentary canal of the fish 19J

collected at Stemple Creek, July, 1948.

Description.-The body length is about three times the width. At the anterior end of the body is a sucker-like organ of attachment which has muscular inner walls. The circular muscular mouth is situated on the median body line in the posterior half of the body. The sal-like intestine is anterior to the mouth, reaching to a level about one-third of the body distance from the anterior body margin. The few vitelline follicles are arranged in two irregular lateral rows; one row reaches from the posterior region of the mouth to the anterior level of the intestine, the other row reaches from the anterior level of the ovary to the anterior level of the intestine. The spherical ovary is situated at the mid-body level near the right body margin. The tandem testes, each about twice the size of the ovary, are close together and near the right body margin. The anterior testis is immediately behind and slightly overlaps the posterior margin of the ovary. The cirrus sac is situated mid-way between the mouth and the posterior body margin slightly to the left of the median body line; its length is about as long as either testis, or about 2.5 times its width.

Body measurements.-Body length, 1.35mm.; width, 0.44mm. Anterior organ of attachment length, 0.147mm.; width, 0.162mm. Intestine length, 0.31mm.; width, 0.235mm. Mouth diameter, 0.059mm. Ovary length, 0.1175mm.; width, 0.14mm. Anterior

testis length, 0.191mm.; width, 0.132mm. Posterior testis length, 0.162mm.; width, 0.162mm. Distance between testes, 0.015mm. Seminal vesicle length, 0.324mm.; width, 0.103mm.

ZOOCONIDAE

Steganoderma(?) sp.

Plate 5, fig. 24

Two specimens of Steganoderma(?) sp. were found by Copey in the intestine of the rock-cod, Sebastes rastrelliger, collected in the tidepools of Dillon Beach, April, 1947. In May, 1949, Copey found five more specimens, one in the bile duct and four in the gall bladder, in Sebastes sp.

Description.--The body is flattened dorso-ventrally, with a rounded anterior end and a slightly pointed posterior end. The cuticle is thickly covered with minute spines. The body length is about 2.6 times the width. The spherical ventral sucker is about twice as large as the slightly ovoid oral sucker. The propharynx is very short. The spherical

pharynx is about one-half as large as the oral sucker. The wide intestinal caeca divided from the oesophagus, which is almost as long as the ventral sucker, and continue posteriorly to a level slightly posterior to the testes. The two testes are located extracaecally, one on either side of the body, in the posterior one-third of the body. The ovoid ovary is situated near the mid-body level, slightly to the right of the median body line. Immediately posterior to the ovary and about one-half as large, is an almost spherical to ovoid seminal receptacle. The vitellaria extend from the mid-level of the ventral sucker to a level mid-way between the intestinal bifurcation and the ventral sucker, largely extracaecal, consisting of 11-12 large ovoid follicles on either lateral margin. The egg-filled uterus almost completely fills the body from the posterior body margin to near the intestinal bifurcation, then leads to the genital pore which is at the left body margin slightly below the intestinal bifurcation. The seminal vesicle is slender, straight, and poorly developed. The excretory pore is terminal.

Body measurements.—Body length, 3.72(2.35-5.0)mm.; width, 1.377(0.851-1.81)mm. Oral sucker length, 0.23(0.191-0.294)mm.; width, 0.24(0.162-0.294)mm. Ventral sucker length, 0.401(0.309-0.47)mm.; width, 0.431(0.324-0.515)mm. Pharynx diameter, 0.125(0.103-0.147)mm. Oesophagus length, 0.331(0.294-0.369)mm. Right testis length, 0.338(0.22-0.5)mm.;

width, 0.260(0.162-0.309)mm. Left testis length, 0.304
(0.176-0.368)mm.; width, 0.245(0.176-0.353)mm. Testes
separated by 0.609(0.338-0.88)mm. Ovary length, 0.21(0.176-
0.235)mm.; width, 0.402(0.294-0.545)mm. Seminal receptacle
length, 0.155(0.147-0.162)mm.; width, 0.287(0.25-0.324)mm.
Egg length, 0.049(0.441-0.515)mm.; width, 0.0269(0.0221-
0.0294)mm. Vitelline follicle length, 0.1712(0.1175-0.22)mm.;
width, 0.1028(0.088-0.1175)mm.

RAJONCHOCOTYLIDAE

Rajonchocotyle sp.

Plate 6, figs. 25-26-27-28

Twenty-five to thirty specimens of Rajonchocotyle sp. were found by Noble on the gills of the ray, Aetobatus californicus in 1933.

Description.-The body length, without the posterior haptor, is about four times the width. The body is bluntly rounded anteriorly and connected to a large haptor posteriorly. There are six circular suckers, five stalked and one unstalked(?), present on the posterior haptor. Each circular sucker has one large, curved hook which follows fairly closely the curvature of the sucker rim. Besides the six circular suckers, there is a stalked appendix which terminates in two small suckers. There are two small Y-shaped hooks between the two appendix suckers. The vitellaria extend from just posterior to the anterior haptor, posteriorly to the junction between the body and the posterior haptor. They appear laterally on either side of the body as compact masses. The vitelline ducts unite anterior to the ovary and form a common vitelline duct. The multiple testes are thickly packed, in the center of the

body, between the vitellarian masses, from the posterior level of the vitellaria to the posterior level of the ovary. The wide vas deferens coils anteriorly from the testes, between the vitellaria, to the genital pore. The genital pore is located on the median body line just posterior to the anterior limits of the vitellaria. The large ovary appears to be a highly convoluted, rather slender tube immediately anterior to the testes. Anterior to the ovary, the few uterine coils, containing several narrow, pointed eggs, extend to the genital pore.

Body measurements.-Body length without the posterior haptor, 9.46(6.5-13.5)mm.; width, 2.4(1.7-3.0)mm. Posterior haptor length, 2.35(1.75-3.5)mm. Anterior haptor length, 0.441(0.294-0.455)mm.; width, 0.537(0.425-0.65)mm. Pharynx length, 0.161(0.147-0.176)mm.; width, 0.125(0.117-0.132)mm. Egg length, 0.3mm.; width, 0.1mm. Circular posterior haptor sucker diameter, 0.72(0.47-0.95)mm. Appendix length, 1.16(0.81-1.47)mm.; width, 0.691(0.44-0.81)mm.

CAPSALIDAE

Benedenia sp.

Plate 8, figs. 33-34-35-36

Many specimens of Benedenia sp. were found by Copsey on the gills and pectoral fin of the fish Hexagrammos sp. collected October, 1948.

Description.--The body length, without the posterior haptor, is about twice the width at the level of the testes. The diameter of the almost circular posterior haptor is about equal to one-half of the body width. The posterior haptor has three pairs of unequal hooks. The anterior pair is almost centrally located on the posterior haptor (fig. 34). Each hook of this pair is Y-shaped with the base of the Y sharply pointed and curved ventrally. The middle pair of hooks is located between the Y-shaped pair and the posterior rim of the haptor (fig. 35). Each long and slender hook of this pair has a sharp recurving point on its posterior end. The posterior pair of hooks extends from near the posterior end of the above described elongated hooks to the rim of the haptor (fig. 36). Each hook of this pair has a sharp recurving posterior point. The posterior haptor contraction mechanism consists mainly of two lines

attached to the anterior portion of the haptor, running posterior to the Y-shaped hooks where they each turn laterally, passing between the forks of the Y, and are then attached to the lateral edges of the haptor. Around the rim of the posterior haptor there is a very thin membranous band which appears to have several long slender marginal hooks on its outer margin. The paired, almost spherical testes are lateral to each other and very close together, usually touching. Immediately behind the glanular pharynx is a clavate spermatic reservoir, its anterior end narrows and extends to the genital opening. Near the narrowing point of the spermatic reservoir, a vessel, probably the vas deferens, connects and can be traced posteriorly. The ovary is anterior to, and separated from the testes by a thin band of vitellaria about two follicles thick. The ovary is slightly ovoid and nearly as large as either testis. Within the ovary are the fertilization chamber and the seminal receptacle. Immediately anterior to the ovary is the wide vitelline reservoir. The genital opening is slightly to the left of the anterior haptor and almost to the body margin. The vessels leading to the genital opening are not clearly defined. The anterior portion of the uterus lies parallel to the anterior portion of the spermatic reservoir, and these two vessels probably unite before reaching the genital opening. The area surrounding the uterus, between the posterior margin of the spermatic reservoir and the

ovary, seems to be filled with small gland cells. A solitary egg can be seen in the uterus of some specimens. The egg is large, tetrahedral in form, and has a long filamentous spine extending from either of the two lateral corners. The posterior end of the egg seems to extend into a blunt spine or a coiled mass. The anterior haptor, which is divided into two large glandular portions, is located terminally. The vitellaria fill the entire body except for a narrow space between the ovary and the pharynx. The follicles are very numerous and lie in a plane dorsal to the genital organs.

Body measurements.-Body length without posterior haptor, 4.58(3.08-6.15)mm.; width, 2.34(1.47-2.94)mm. Posterior haptor length, 1.26(0.91-1.62)mm.; width, 1.13(0.84-1.4)mm. Haptoral hook (anterior) length, 0.247(0.154-0.336)mm. Haptoral hook (middle) length, 0.336(0.252-0.42)mm. Haptoral hook (posterior) length, 0.165(0.126-0.182)mm. Left testis length, 0.539(0.42-0.63)mm.; width, 0.42(0.35-0.49)mm. Right testis length, 0.53(0.42-0.63)mm.; width, 0.401(0.308-0.475)mm. Ovary length, 0.368(0.28-0.475)mm.; width, 0.461(0.308-0.615)mm. Vitelline reservoir length, 0.14(0.126-0.154)mm.; width, 0.552(0.49-0.615)mm. Egg length, 0.175(0.154-0.196)mm.; width, 0.126mm. Lateral spine off egg length, 0.063mm. Anterior haptoral sucker individual length, 0.383(0.224-0.56)mm.; width, 0.54(0.42-0.73)mm. Pharynx length, 0.424(0.28-0.6)mm.; width, 0.504

(0.322-0.685)mm. Vitelline follicle diameter, 0.047(0.023-0.063)mm.

MICROCOTYLIDAE

Microcotyle sp. number 22

Plate 7, figs. 29-30

Two specimens of Microcotyle sp. (number 22) were found by Copsey on the gills of the fish, Cebidichthys violaceus collected one mile north of Dillon Beach, March, 1948.

Description.-The body length, including the posterior haptor, is about three to four times the width. The length of the posterior haptor is about equal to one fifth of the total length of the animal. The posterior haptor has about twenty-five pairs of hooks arranged in two rows, one row on each lateral margin of the haptor. The anterior haptor consists of a pair of small subterminal, elliptical suckers which are side by side. Each sucker is divided vertically into two parts by a septum. Immediately posterior to the

suckers is the spherical pharynx. The intestinal caeca are branched extensively laterally, the branches appearing in whole mounts, as clear regions in the vitellaria. There are about thirty testes extending in the center of the body, between the vitellarian masses, from the junction of the body-proper with the posterior haptor to just posterior to the ovary. The testes may be ovoid, elongated, or nearly round in shape. The coiled vas deferens lies dorsal and parallel to the uterus. The large ovary appears to be a tube-like structure lying at right angles to the main body axis. The uterus extends straight from the region of the ovary to the median anteriorly located genital pore. Near the mid-point of the uterus is an enlargement, probably the ootype. Half way between the pharynx and the intestinal bifurcation is a muscular structure in which the uterus and vas deferens seem to terminate. Immediately below this muscular structure there appears to be a pore. One specimen contains a single elongated egg which has both ends continuing as a filament. The vitellaria are largely extracacal, extending from the level of the intestinal bifurcation, meeting below the testes and extending into the posterior haptor for almost one-half of its length. Extending below the posterior limits of the vitellaria in the posterior haptor for two-thirds of its length, are one or two irregularly-shaped tubes which may be part of the excretory system.

Body measurements.-Total length of animal, 3.65(3.5-3.8)mm.; width, 1.12(1.05-1.19)mm. Anterior haptor sucker length, 0.066(0.056-0.077)mm.; width, 0.118(0.112-0.125)mm. Pharynx diameter, 0.084mm. Posterior haptor length, 1.08(0.98-1.19)mm. Posterior haptor hook length, 0.053(0.05-0.056)mm.; width, 0.112(0.105-0.119)mm. Egg length, 0.322mm.; width, 0.093mm. Where range in size is not given, only one measurement was obtained.

Microcotyle sp. number 7

Plate 7, fig. 32

Two specimens of Microcotyle sp. (number 7) were found by Fisk on the gills of the ling cod, Ophiodon elongatus in 1948.

Description.-The body is long and narrow, the anterior end being rounded and the posterior end continuous with the posterior haptor. The entire length of the animal is about equal to six times the width. The posterior haptor length is about equal to one-fourth of the total length of the animal. The posterior haptor has about thirty-five pairs of hooks arranged in two rows, one row on each lateral margin of the haptor. The anterior haptor consists of a pair of small ovoid subterminal suckers at the anterior end of the

body. Each of the suckers is vertically divided into two parts by a septum. The spherical pharynx is immediately posterior to the anterior haptoral suckers. The testes are roughly ovoid, about thirty-two in number, and extending, in the center of the body between the vitellarian masses, from the junction of the posterior haptor and the body to just posterior to the ovary. The vas deferens extends from the testes to the genital pore as a convoluted tube, the anterior portion expanded. The uterus appears to be almost straight. The genital pore is located on the median body line in the anterior region of the body halfway between the pharynx and the intestinal bifurcation. The genital pore appears to be an ovoid, nonmuscular structure. The vitellaria are largely extracaecal, extending from a level slightly posterior to the genital pore, meeting below the testes and continuing into the posterior haptor for about one-third of its length.

Body measurements.-Total length of animal, 6.05 (5.6-6.5)mm.; width, 0.945(0.91-0.98)mm. Anterior haptoral sucker diameter, 0.093mm. Pharynx diameter, 0.084mm. Posterior haptor length, 1.54(0.4-1.68)mm. Posterior haptoral sucker length, 0.077(0.07-0.084)mm.; width, 0.1085 (0.105-0.112)mm.

Microcotyle sp. number 52

Plate 7, fig. 31

Two specimens of Microcotyle sp. (number 52) were found by the writer on the gills of the blennie Cebadichthys violaceus collected at Nick's Cove, January, 1949. One specimen was lost when flattened.

Description.-The body tapers to a rounded point anteriorly and is continuous with the posterior haptor posteriorly. The body length, without the posterior haptor, is about three times the width. The length of the posterior haptor is about equal to one-third of the entire length of the animal. The posterior haptor has twenty-five pairs of hooks arranged in two rows, one row on each lateral margin of the haptor. The anterior haptor consists of two small ovoid subterminal suckers which are side by side. The pharynx appears to be overlapped by the anterior haptoral suckers. The testes are compact masses, in the center of the body between the vitellarian masses, extending from the posterior body margin to just below the ovary. Only the anterior portion of the vas deferens is seen where it is expanded and convoluted. About mid-way between the pharynx and the anterior level of the vitellaria, there is a poorly defined clear structure where the vas deferens seems to terminate.

The vitellaria extend from the level of the genital pore, largely extracaecally, meeting behind the testes, into the posterior haptor for about one-third of its length. The ovary is slightly posterior to the mid-body level.

Body measurements.-Total length of animal, 2.38mm.; width, 0.91mm. Posterior haptor length, 0.77mm. Posterior haptoral hook length, 0.05mm.; width, 0.07mm.

SUMMARY AND CONCLUSIONS

Thirty-two different species of adult trematodes from fishes of the Pacific Marine Station Area are here described. These represent collections made by eight investigators, including the writer, since 1936. Fifteen of the species have already been described in professional journals, twelve await more positive identification, and five are herein described for the first time.

This number of species resulting from such limited activity is indicative of enormously productive work which can and should be done on the trematode fauna of this area. Equally productive work on larval trematodes of marine invertebrates, now in progress, suggests large possibilities in future life cycle studies.

EXPLANATION OF PLATES

PLATE 1

- Fig. 1 Unidentified monorchid, from Gale 1947.
Fig. 2 Podocotyle californica (Park), from Park 1937.
Fig. 3 Podocotyle endophrysi (Park), from Park 1937.
Fig. 4 Podocotyle blennicottusi (Park), from Park 1937.
Fig. 5 Podocotyle pacifica (Park), from Park 1937.
Fig. 6 Podocotyle elongata (Park), from Park 1937.

PLATE 2

- Fig. 7 Podocotyle pedunculata (Park), from Park 1937.
Fig. 8 Helicometrina nimia (Linton), from Manter 1934.
Fig. 9 Helicometrina elongata (Noble and Park), from Noble
and Park 1937.
Fig. 10 Tubulovesicula californica (Park), from Park 1936.
Fig. 11 Genitocotyle acirrus (Park), from Park 1937.
Fig. 12 Sterrhurus magnitestis (Park), from Park 1936.

PLATE 3

- Fig. 13 Opisthodena sp., from Gale 1947.
Fig. 14 Podocotyle kofoidi (Park), from Park 1937.
Fig. 15 Otodistomum cestoides (Stafford), from Gale 1947.
Fig. 16 Podocotyle apedichthysi (Park), from Park 1937.
Fig. 17 Probolitrema californiense (Stunkard), from
Stunkard 1935.

PLATE 4

- Fig. 18 Podocotyle copsii n. sp. dorsal view.
Fig. 19 Podocotyle attenuata n. sp.
Fig. 20 Podocotyle hexagrammosi n. sp.

PLATE 5

- Fig. 21 Podocotyle cebidichthysi n. sp.
Fig. 22 Podocotyle bodegensis n. sp.
Fig. 23 Unidentified hemiurid number 41
Fig. 24 Steganoderma(?) sp.

PLATE 6

- Fig. 25 Rajonchocotyle sp.
Fig. 26 Hook of haptor al sucker of Rajonchocotyle sp.
Fig. 27 Hook of haptor al appendix of Rajonchocotyle sp.
Fig. 28 Hook of haptor al appendix of Rajonchocotyle sp.

PLATE 7

- Fig. 29 Microcotyle sp. number 22
Fig. 30 Haptor al hook of Microcotyle sp. number 22
Fig. 31 Microcotyle sp. number 52
Fig. 32 Microcotyle sp. number 7

PLATE 8

- Fig. 33 Benedenia sp.
Fig. 34 Haptor al hook (anterior) of Benedenia sp.
Fig. 35 Haptor al hook (middle) of Benedenia sp.
Fig. 36 Haptor al hook (posterior) of Benedenia sp.
Fig. 37 Unidentified hemiurid number 33

PLATE 9

Fig. 38 Unidentified bucephalid

Fig. 39 Cymbephallus(?) sp.

The following fishes were identified by Clark Hubbs.

- 1H Clinocottus globiceps
- 2H Oligocottus snyderi
- 3H Oligocottus snyderi
- 4H Oligocottus snyderi
- 5H Oligocottus snyderi
- 6H Clinocottus globiceps
- 7H Apodichthys flavidus
- 8H Clinocottus globiceps
- 9H Clinocottus globiceps
- 10H Clinocottus globiceps
- 11H Clinocottus globiceps
- 12H Clinocottus globiceps
- 13H Oligocottus snyderi
- 20H Cymatogaster aggregata
- 25H Leptocottus armatus
- 1J Oligocottus snyderi
- 2J Oligocottus snyderi
- 3J Oligocottus snyderi
- 5J Clinocottus globiceps
- 6J Oligocottus snyderi
- 7J Oligocottus snyderi
- 8J Scorpoenichthys marmoratus
- 9J Clinocottus analis
- 10J Oligocottus snyderi

- 11J Oligocottus snyderi
12J Oligocottus snyderi
13J Oligocottus snyderi
14J Oligocottus snyderi
15J Clinocottus embryum
16J Gibbensia metzi
17J Clinocottus globiceps
18J Oligocottus snyderi
19J Clinocottus embryum
20J Clinocottus globiceps
21J Scorpaenichthys marmoratus
22J Xiphister mucosus
23J Scorpaenichthys marmoratus
24J Clinocottus globiceps
25J Oligocottus snyderi
28J Cebedichthys atropurpureus

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PLATE 1

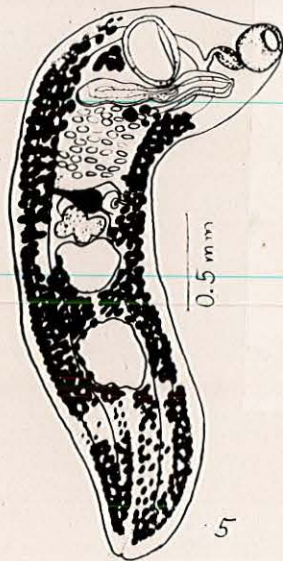
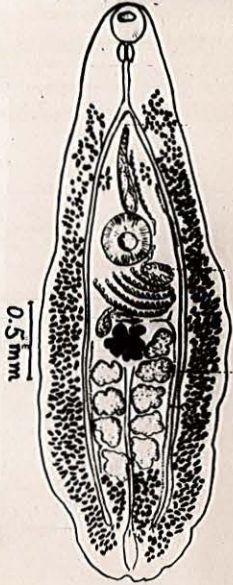


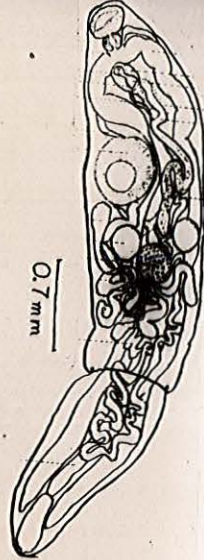
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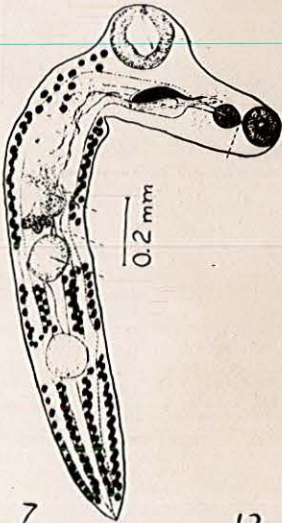
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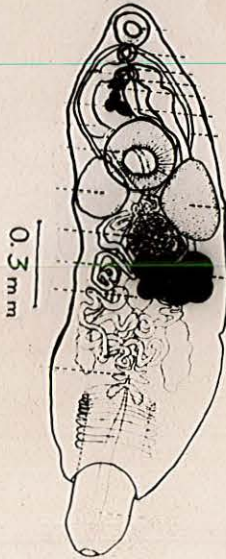
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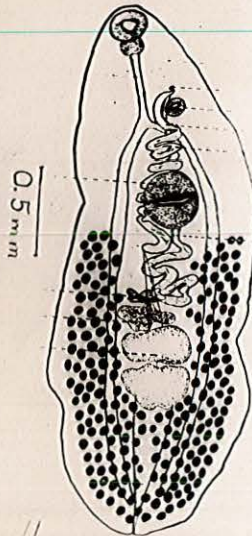
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PLATE 3

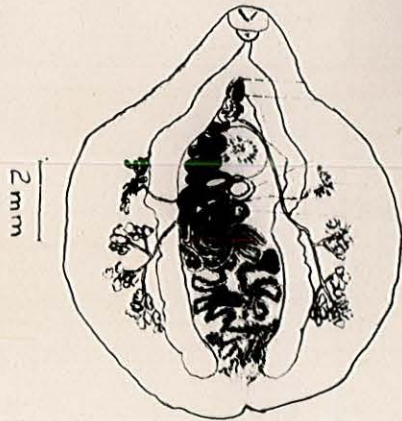
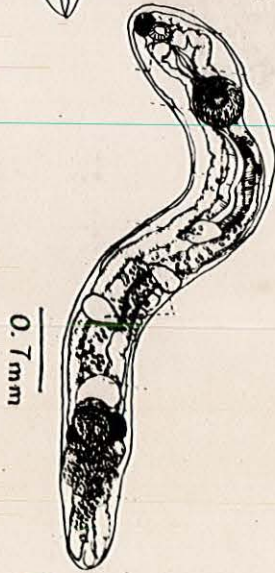
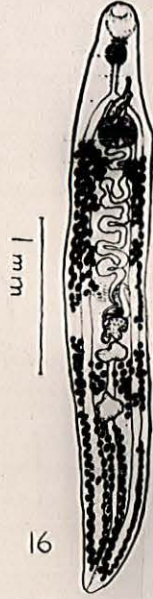
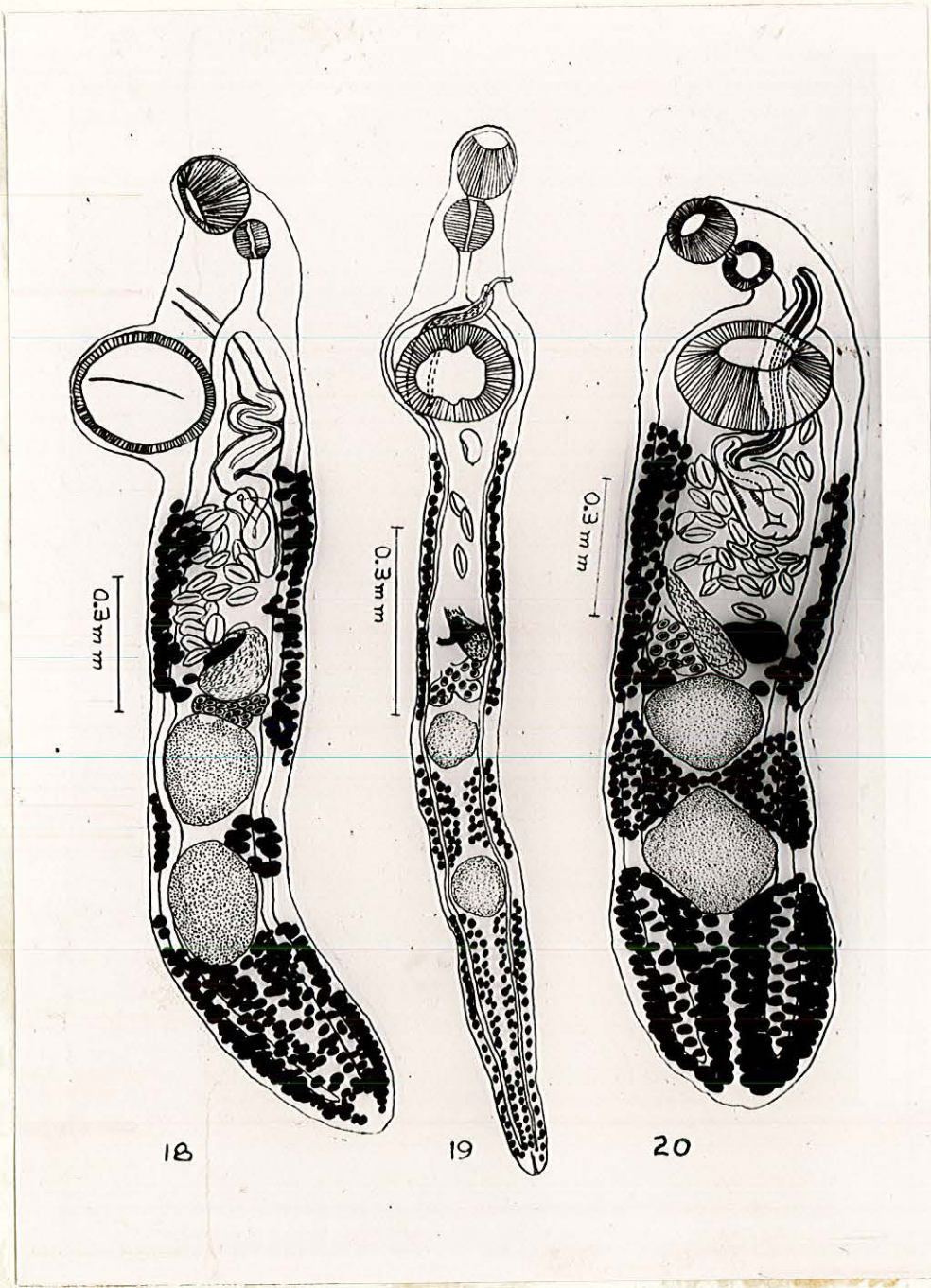


PLATE 4



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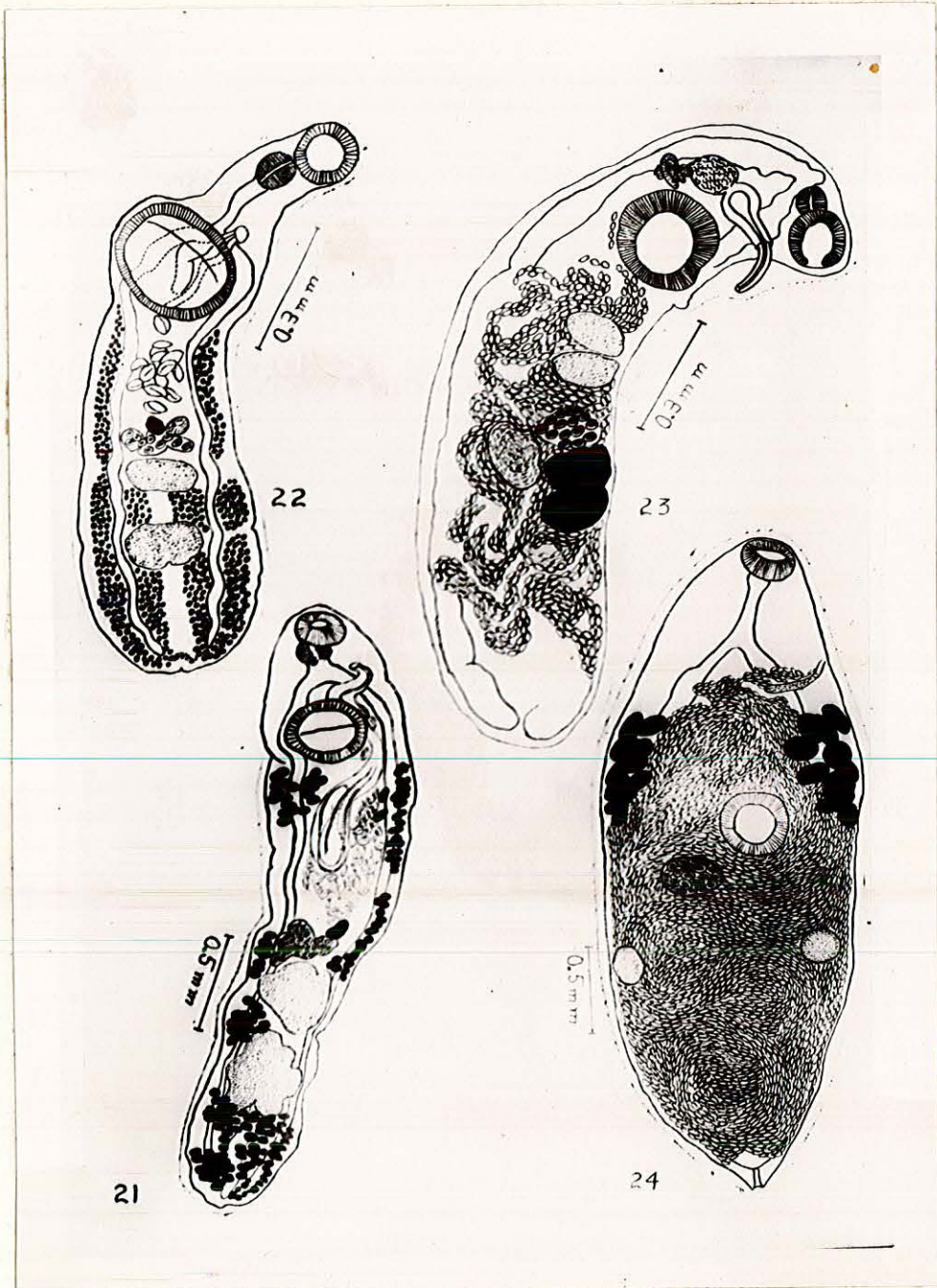
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f. Copei

f. attenuata

f. hexagrammosa

PLATE 5



21. *Podostyle celidichthys*
22. *P. hodegensis*

PLATE 6

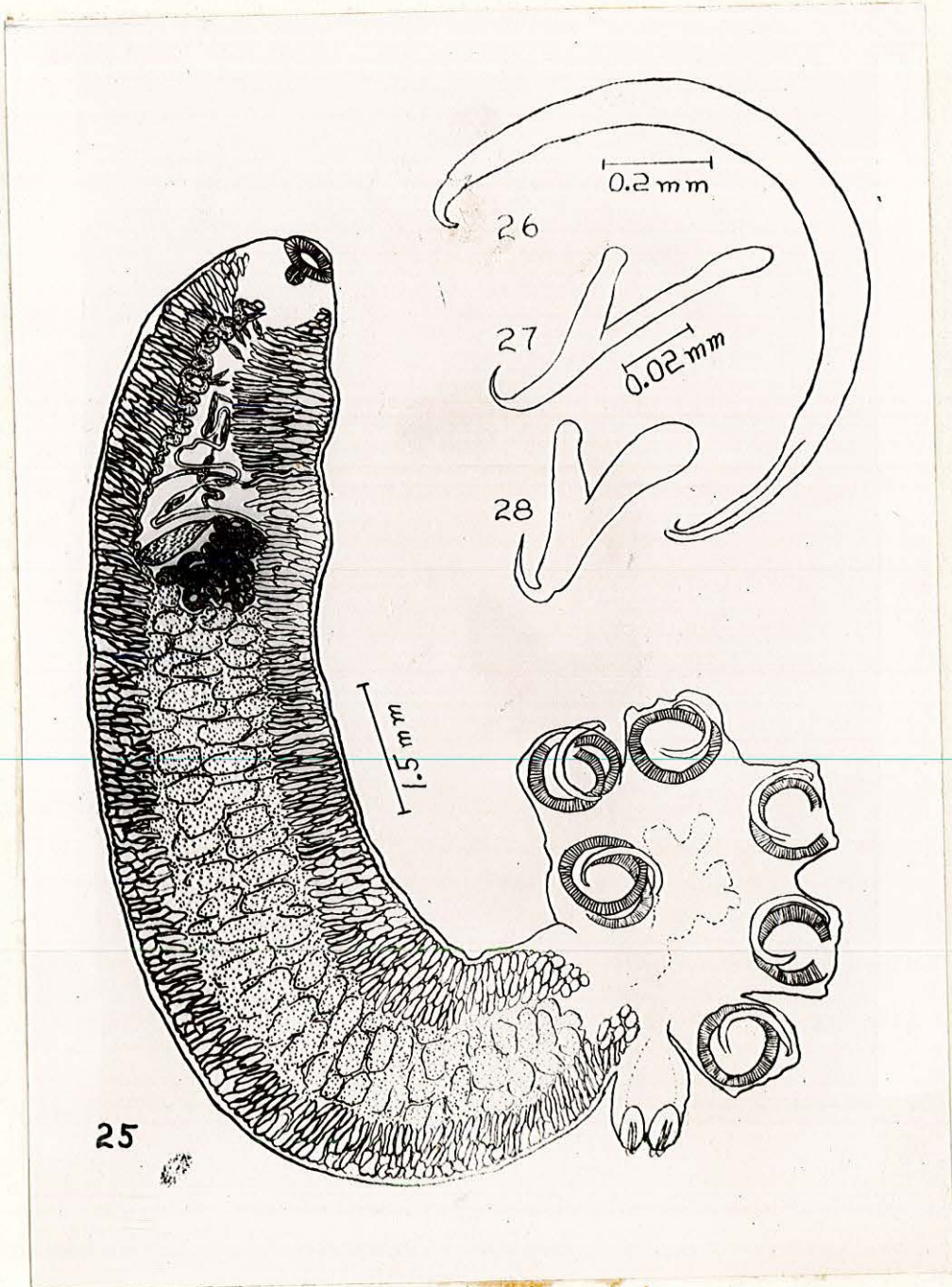
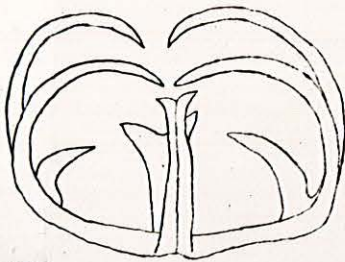


PLATE 7



0.2 mm

30



0.5 mm

29



0.5 mm

32



0.5 mm

31

PLATE 8

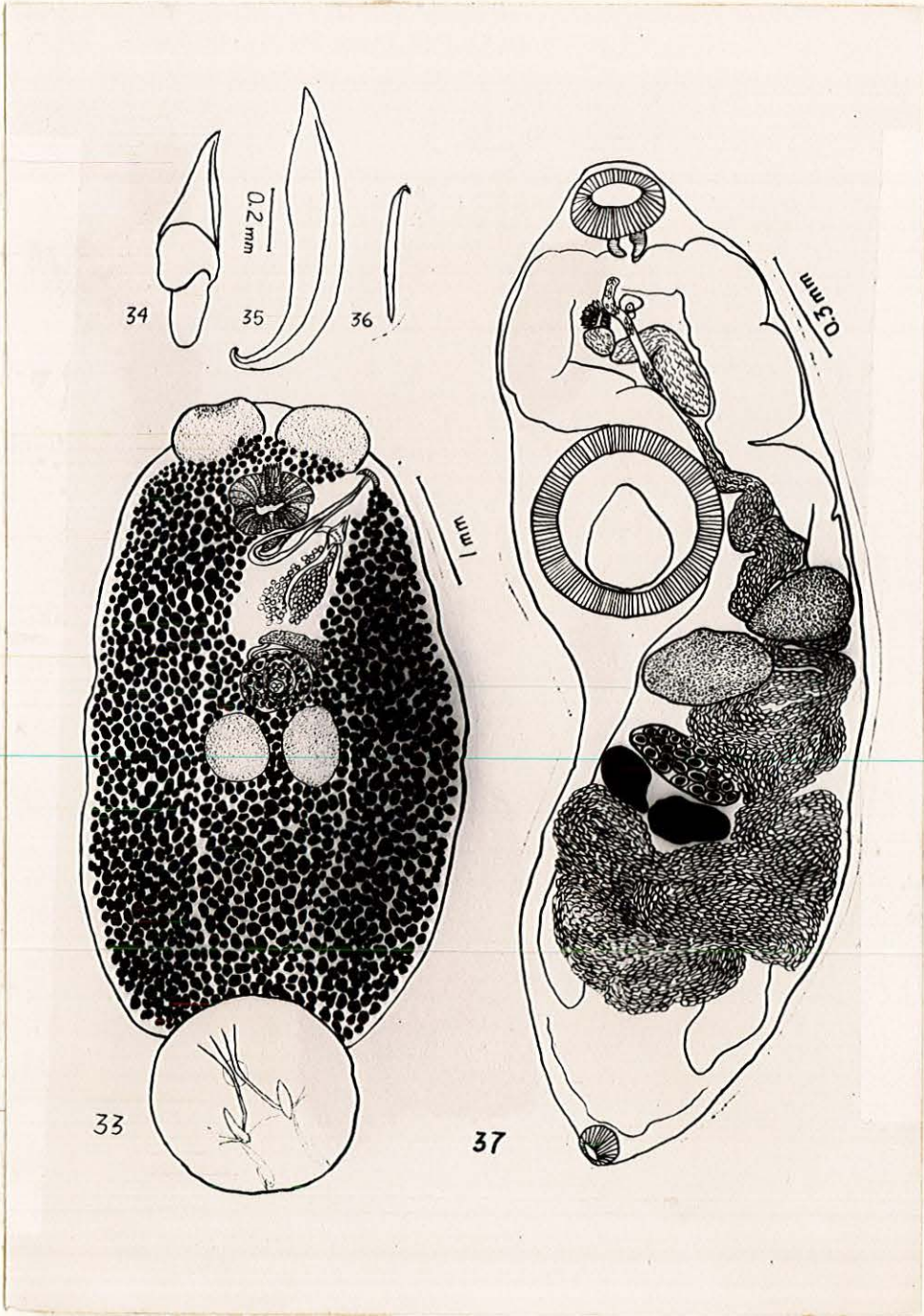
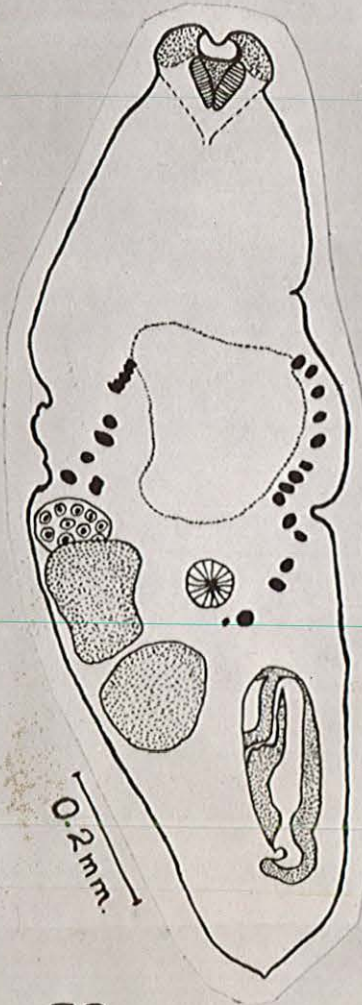
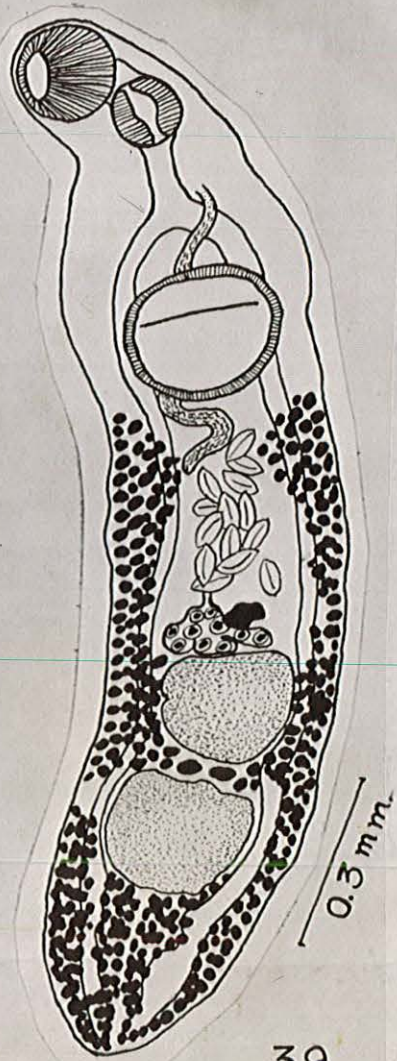


PLATE 9



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