

SOME MONOGENETIC TREMATODES FROM THE
GALAPAGOS ISLANDS AND THE NEIGHBORING PACIFIC*

(WITH SEVEN PLATES)

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This paper is an account and description of new species of ectoparasitic trematodes found on marine fishes in the south Pacific in the region of the Galapagos Islands. The animals were collected and preserved by Professor H. W. Manter, who was a member of the G. Allan Hancock Expedition to the Galapagos Islands in 1934. All the specimens were collected in January, February, and early March. In the preliminary report Manter (1934) states:

Over 500 marine fish, representing approximately 100 species, were examined for parasites. Approximately 100 species of trematodes were collected, 80 per cent of the species of fish and 43 per cent of the individuals examined being infected. Approximately 20 per cent of the trematodes collected were Monogenea.

The writer wishes to extend acknowledgment and express sincere thanks to Professor H. W. Manter, under whose direction these studies were made. All descriptions were made from specimens collected by him with the exception of type material of *Protomicrocotyle* which was made available through the courtesy of Doctor E. W. Price. Particularly valuable in this research was the loan of books and reprints from Professor Manter's personal library. The writer is also indebted to Professor T. J. Fitzpatrick of the University of Nebraska for his valuable aid in securing periodicals and reprints from other libraries. Special acknowledgment is given to Doctor E. W. Price of the Bureau of Animal Husbandry, U. S. Department of Agriculture, for the loan of type material of *Protomicrocotyle mirabile* (MacCallum, 1918) from the United States National Museum. He also reviewed this paper and made some corrections before it went to the publisher. Sincere gratitude is also expressed to Professor D. D. Whitney of the University of Nebraska who co-operated in many ways and expressed a keen and kindly interest throughout these studies.

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No new methods of technique were used. The animals were killed in formol-alcohol-acetic acid solution (formalin $6\frac{1}{2}$ parts, 50 per cent alcohol 100 parts, glacial acetic acid $2\frac{1}{2}$ parts) under a cover glass to flatten the specimen. After several hours the killing solution was removed and the specimens were preserved in 70 per cent alcohol. Specimens were stained in Delafield's haematoxylin. Some were counterstained with orange G, eosin, or erythrosin. Serial sections were made except where there were few specimens. Toto mounts were cleared in cedar oil and serial sections in xylol. All were mounted in balsam.

Identification of fish hosts of these trematodes is often incomplete. Unless otherwise indicated the fishes were identified by H. W. Manter and Dr. Waldo Schmitt. Because no specialist on fishes was available at the time of collecting, these identifications cannot be considered as authoritative. However, an identification thus made is used only after reasonable satisfaction that it is correct. Some specimens, especially of the smaller fishes, were sent to the United States National Museum and kindly identified by Dr. G. S. Myers. These identifications are indicated in the text. The names of all fish hosts, as far as identified, are as listed in Jordan, Evermann and Clark's check list (1930).

Types of all new species will be deposited in the United States National Museum at Washington, D. C. Paratypes will be located at The University of Southern California.

The recent comprehensive studies of Price (1937, 1937a) on the Monogenea make extensive history and bibliographies unnecessary. The descriptions in this paper are condensed to serve as specific diagnoses.

FAMILY: CAPSALIDAE BAIRD, 1853

SUBFAMILY: BENEDENIINAE JOHNSTON, 1931

Monticelli (1903) in a revision of the genus *Epibdella* Blainville, 1827* divided it into those with true suckers, subgenus *Benedenia* Odhner, 1905 and those with pseudosuckers, subgenus *Phylline*

* "The date 1828 is usually quoted, but Sherborn (*Index Animalium*, pt. ix., 1926, p. 2169) recorded the genus as having been published by Blainville in *Dict. Sci. Nat.*, vol. xlvii., 1827, p. 269, and in vol. lviii., 1828, p. 567."—[from Johnston (1929)].

Oken, 1815 (*P. hippoglossi*). Phylline was shown by Odhner (1905) to be a synonym of *Tristomum maculatum* Rudolphi, 1819 (which in turn is now considered a synonym of *Capsala*). The type of *Epibdella* is *E. hippoglossi* (Mueller, 1776) which possesses pseudo-suckers. Odhner (1905) elevated the subgenus *Benedenia* to generic rank, resulting in two genera, *Epibdella* with pseudosuckers and *Benedenia* with true suckers. Johnston (1929) points out that *Epibdella* should be submerged as a synonym of *Entobdella*.

Johnston (1929) says:

In 1817 Cuvier, in his "Le Règne Animal," vol. 4, erected the genus *Tristoma*, describing and figuring one species, *T. coccineum*. Next year Lamarck (1818, 295) gave a summary of *Phylline*, mentioned the synonymy of *P. hippoglossi*, and stated his belief that the parasites were related to *Polystoma* instead of Annelids (leeches), where they had been allotted. He also referred to Blainville's manuscript name, *Entobdella*, for the genus, but retained Oken's *Phylline*. The reference was quoted erroneously by Braun (1889) as appearing in Lamarck's vol. 1, p. 444, and subsequently (1890, 518) he indicated the genus with the date 1815 (when vol. 1 appeared) as a synonym of *Epibdella*. Stiles and Hassall (1908, 251) credit *Entobdella* to Audouin 1828, whereas Agassiz (1845) and Scudder (1884), in their respective *Nomenclatores Zoologici*, attribute it to Blainville, but without mentioning a date. Sherborn, in his *Index Animalium*, gives the correct date (1818) for *Entobdella* (Blainville MS.) Lamarck. It was not mentioned by Rudolphi (1819), and has remained practically unrecognized since.

Yamaguti (1937) uses the genus name *Epibdella* with two subgenera, *Epibdella* and *Benedenia*, and classifies it in the family *Capsalidae*. He does not explain his adoption of these names but evidently does not follow either Odhner or Johnston. The subgenus *Epibdella* seems to possess anterior suckers and the subgenus *Benedenia* seems to possess anterior suckers together with the folds of "an anterior adhesive organ," thus corresponding to the genera *Benedenia* and *Pseudobenedenia*, respectively, of Johnston (1931).

Johnston (1931) in a revision of the family *Capsalidae* Baird, 1853 (*Tristomidae* Taschenberg, 1879) names the subfamily *Capsalinae* Johnston, 1931 (*Tristominae* Monticelli, 1903) with *Capsala* (*Tristoma*) as the type genus characterized by numerous radii in the posterior haptor; the subfamily *Nitzschinae* Johnston, 1931 with *Nitzschia* von Baer as the type genus characterized by numerous testes and a median genital pore; *Ancyrocotylinae* Monticelli, 1902; *Benedeniinae* Johnston, 1931. Johnston (1931) gives the following diagnosis of the subfamily *Benedeniinae*:

Capsalidae with large stalked posterior suckers, provided with typically, three pairs of hooks, the second pair largest, the third smallest (or perhaps absent), but without septa dividing it into loculi; either with anterior glandular organs (*Entobdella*) or with anterior suckers (*Benedenia*), or with both (*Pseudobenedenia*); with two testes lying side by side.

I include the following subfamilies under the family *Capsalidae*: *Capsalinae* Johnston, 1931, *Nitzschinae* Johnston, 1931, and *Benedeniinae* Johnston, 1931.

The genera of the subfamily *Benedeniinae* may be distinguished as follows:

- | | |
|--|---------------------------------------|
| 1 (2) Lateral intestinal branches absent..... | |
| | Ancyrocotyle Parona and Perugia, 1903 |
| 2 (1) Lateral intestinal branches present..... | 3 |
| 3 (4) True anterior suckers absent; anterior adhesive organs present | |
| | Entobdella Blainville, 1818* |
| 4 (3) True anterior suckers present..... | 5 |
| 5 (6) Anterior adhesive organs present..... | |
| | Pseudobenedenia Johnston, 1931 |
| 6 (5) Anterior adhesive organs absent..... | |
| | Benedenia Odhner, 1905 |

According to Johnston (1931, p. 95) *Ancyrocotylineae* should be restricted to include *Ancyrocotyle* with a single preovarian testis and the absence of lateral branches to the intestinal crura. Price (1934), however, places *Ancyrocotyle* in the subfamily *Benedeniinae*. It was suggested by him that, due to the fact that the material of *Ancyrocotyle vallei* was in poor condition, there might have been an error in interpreting the preovarian testis. *A. bartschi* Price, 1934 has two testes posterior to the ovary.

In this paper, the genus name *Benedenia* is accepted for those forms with true anterior suckers. The following species of *Benedenia* have been described:

1. *B. derzhavini* (Layman, 1930) n. comb. on *Sebastodes schlegelii*.

*Lamarck (1818) in referring to *Phylline* Oken states: "Ce genre est établi par M. Ochen, sous le nom que nous lui conservons, et néanmoins M. de Blainville, que l'avait déjà reconnu, lui assigna celui de *Entobdella*, dans ses manuscrits."

2. *B. epinepheli* (Yamaguti, 1937) n. comb. on *Epinephelus akaara*.
3. *B. hendorffii* (von Linstow, 1889) on *Sciaena aquilla*.
4. *B. ishikawae* (Goto, 1894) on *Lethrinus sp.*
5. *B. macrocolpa* (Lühe, 1906) on *Rhinoptera javanica*.
6. *B. melleni* (MacCallum, 1927) n. comb. on *Spheroides annulatus*, etc.
7. *B. monticelli* (Parona and Perugia, 1895) on *Mugil auratus*.
8. *B. ovata* (Goto, 1894) on *Anthias schlegeli*.
9. *B. seriolae* (Yamaguti, 1934) n. comb. on *Sebastodes aureovittata*.
10. *B. sciaenae* (van Beneden, 1858) on *Sciaena aquilla*.
11. *B. sebastodis* (Yamaguti, 1934) n. comb. on *Sebastodes inermis*.
12. *B. sekii* (Yamaguti, 1937) n. comb. on *Pagrosomus unicolor*.

***Benedenia isabellae*, new species**

(Plate 4, figs. 1-2)

Host: Unidentified, spotted, grouper-like fish

Location: Gills

Locality: Isabel Island, Mexico

Number: 5 specimens

Body elongated oval, 3.282 to 5.113 mm. in length by 1.820 to 2.5 mm. in greatest width. Posterior haptor circular, not indented, 0.848 to 1.56 mm. in diameter, with irregularly notched, relatively wide marginal membrane. The anterior pair of hooks 0.118 to 0.424 mm. in length, straight, sharply pointed at one end, truncated at the other end. Middle pair of hooks 0.271 to 0.424 mm. in length, fairly stout, straight except for a recurved point. Posterior pair of hooks 0.08 to 0.10 mm. in length, with fine, recurved point. Larval hooks not seen. Anterior suckers elliptical, with slightly elevated margins but without marginal membrane, 0.220 to 0.339 mm. in length by 0.305 to 0.390 mm. in width. Oral sucker broader than long, 0.220 to 0.339 mm. in length by 0.388 to 0.557 mm. in width, indented to form two to five lobes. Esophagus short, intestinal limbs with lateral branches. Testes approximately in mid-body, side by side and close together, with slightly lobed or crenate margin, longer than wide, 0.736 to 0.996 mm. by 0.520 to 0.693 mm., pierced by sixteen to twenty dorso-ventral muscles. Posterior to testes are two

small, smooth, elliptical bodies, broader than long, 0.056 to 0.067 mm. in length by 0.101 to 0.118 mm. in width. Similar structures were first described by Goto (1894) in *Benedenia ovata*. Their function is problematic. The name glands of Goto is proposed for them. The cirrus sac extends less than halfway between oral sucker and ovary. Prostate glands fan-shaped, opposite cirrus sac, extending nearly to lateral edges of body and posteriorly almost to the ovary. The genital pore to the left opposite the middle of the oral sucker. Ovary median, partly pretesticular, partly between the anterior edges of the testes, elliptical, 0.305 to 0.557 mm. in length by 0.237 to 0.339 mm. in width, and pierced by eleven dorso-ventral muscles. Seminal receptacle intraovarian. Vitellaria extending from the oral sucker to the posterior end of the body. Yolk reservoir just anterior to ovary, transversely extended, constricted in middle. Vagina not seen. Egg triangular in surface view, 0.101 by 0.130 mm. with short, curved, stout appendage at one pole and a long, slender filament at the other.

Comparisons. *B. isabellae* differs from *B. ishikawae* in possessing lobed testes and glands of Goto; from *B. ovata* in possessing lobed testes and nonindented haptor; from *B. epinepheli* in possessing lobed testes, perforated testes, more posterior genital pore as well as different hooks. It is most similar to *B. melleni* but has larger, more elongated, more lobed testes with more numerous perforations, with more expanded prostate glands, and glands of Goto.

This species is named after its geographic location, Isabel Island, Mexico.

***Benedenia adenea*, new species**

(Plate 4, figs. 3-4)

Host: *Mycteroperca* sp.

Location: Gills

Locality: Socorro Island, Mexico

Number: 5

Body elongated oval, 1.7 to 2.9 mm. in length by 1.256 to 1.773 mm. in greatest width. Posterior haptor circular, with indentations which form five lobes, 0.678 to 0.953 mm. in diameter, with irregularly notched, relatively wide marginal membrane. The anterior pair of hooks 0.084 to 0.118 mm., strong with relatively long projecting piece slightly oblique and posterior to base of hook, straight with points anterior in floor of haptor. Middle pair of hooks 0.169 to

0.237 mm. in length, relatively long and strong, sharp recurved points projecting anteriorly at the two indentations in posterior border of haptor. Posterior pair of hooks 0.050 to 0.084 mm. in length, straight except at very fine recurved tips. Larval hooks present 0.040 mm. in length. Anterior suckers elliptical, without marginal membrane, broader than long, 0.101 to 0.185 mm. in length by 0.117 to 0.254 mm. in width. Oral sucker broader than long, 0.169 to 0.332 mm. in length by 0.204 to 0.390 mm. in width, deeply five-lobed. Esophagus short, intestinal limbs with lateral branches. Testes approximately in mid-body, side by side and close together, smooth, unlobed, slightly longer than broad, 0.339 to 0.661 mm. in length by 0.288 to 0.491 mm. in width, pierced by twelve to seventeen dorso-ventral muscles. Posterior to testes are two kidney-bean shaped glands of Goto, broader than long, 0.03 mm. in length by 0.118 mm. in width, concave borders anterior and of same contour as posterior border of testes. The cirrus sac extends less than halfway between oral sucker and ovary. Prostate glands fan-shaped, opposite cirrus sac, extending nearly to lateral edges of body and posteriorly over halfway from oral sucker to ovary. The genital pore to left of oral sucker and anterior to anterior border of oral sucker. Ovary median, partly pre-testicular, partly between anterior edges of testes, smooth, globular, unlobed, 0.152 to 0.305 mm. in length by 0.169 to 0.322 in width. Seminal receptacle intraovarian. Vitellaria coarsely acinous extending from anterior suckers to posterior end and lateral to the sides. Yolk reservoir just anterior to ovary, one and one-half times the width of the ovary, over twice as wide as long and receives vitelline ducts from its lateral, anterior, and posterior borders. Vagina not seen. Egg triangular in outline appearing pyramidal from the ventral side, 0.092 mm. in length by 0.125 mm. in width, polar filament and appendage absent, lower border has thick ridge of shell material which also extends up middle of ventral side over halfway to anterior end of egg.

B. adenea is most similar to *B. isabellae* but differs in possessing smooth testes, more elongated glands of Goto, smaller size, more anterior genital pore, and more spherical ovary. It differs from *B. ovata* in possessing elongated glands of Goto and differently shaped hooks. *B. ishikawae* differs in lacking glands of Goto.

The species name (*denea*-gland) is derived from the fact that it possesses glands of Goto posterior to the testes.

Benedenia anadenea, new species
(Plate 4, figs. 5-8)

Host: *Mycteroperca* sp.

Location: Gills

Locality: Socorro Island, Mexico

Number: 12

Body elongated oval, 2.1 to 3.99 mm. in length by 1.56 to 2.16 mm. in greatest width. Posterior haptor circular and strongly five-lobed, 0.076 to 1.12 mm. in diameter, broad unnotched marginal membrane. The anterior pair of hooks 0.067 to 0.118 mm. in length, straight with sharp points directed anteriorly. Middle pair of hooks 0.118 to 0.288 mm. in length, strong, arcuate with strongly recurved points directed anteriorly. Posterior pair of hooks 0.048 mm. in length, relatively slender with recurved points directed anteriorly. Larval hooks 0.028 to 0.080 mm. in length. Anterior suckers elliptical, without marginal membrane, broader than long, 0.16 to 0.20 mm. in length by 0.16 to 0.27 mm. wide. Oral sucker broader than long 0.18 to 0.25 mm. in length by 0.30 to 0.42 mm. in width, five-lobed with slight indentations. Esophagus short, intestinal limbs with lateral branches. Testes approximately in mid-body, side by side and close together, smooth, unlobed, slightly longer than broad, 0.47 to 0.75 mm. in length by 0.50 to 0.54 mm. in width, pierced by eleven to seventeen dorso-ventral muscles. Glands of Goto absent. Cirrus sac bulbous, twice as long as wide, posterior to oral sucker extending halfway between oral sucker and ovary. Prostate glands fan-shaped opposite cirrus sac, extending nearly to lateral edges of body and posteriorly over halfway from oral sucker to ovary. The genital pore to left of oral sucker, anterior to anterior border of oral sucker. Ovary median, partly between anterior edges of testes, smooth, globular, unlobed, slightly broader than long, 0.169 to 0.254 mm. in length by 0.169 to 0.288 mm. in width. Seminal receptacle intraovarian. Vitellaria extend from lateral borders of anterior suckers to posterior end of animal and lateral to sides. Yolk reservoir not visible. Vagina not seen. Egg triangular in surface view, 0.092

mm. in length by 0.112 mm. in width, single polar filament extends posteriorly, 0.20 mm. in length.

Discussion. The following observations on the histology of the posterior haptor may be of some interest. Unicellular high columnar gland cells are present in the posterior haptor. They have an almost spherical nucleus slightly anterior to the center of the cell with chromatin granules aggregated around the nuclear wall. The diameter of the nucleus is over one half the width of the cell. A large area of secretory granules lies just anterior to the nucleus toward the border of the cell which is toward the border of the cell on inside of haptor. Other nonsecretory cells of the haptor are tall, columnar, and slightly wider than the gland cells. They have large elliptical nuclei at their bases. The chromatin is scattered in a network throughout the nucleus. The nucleolus was not visible. The gland cells have a heavily staining nucleolus toward one end of the nucleus.

Comparisons. This species is very similar to *B. melleni*, which has testes which are smaller, lobed, with two to ten dorso-ventral muscles as compared with larger, smooth testes with eleven to seventeen dorso-ventral muscles. A prostate gland is present in both but is more compact and fan-shaped in *B. anadenea*. *B. anadenea* differs from *B. adenea* in not possessing glands of Goto and in having larger hooks.

The name *anadenea* is given to this species since glands of Goto are absent.

GENUS: ENTOBDELLA BLAINVILLE, 1818

As previously stated the genus name Entobdella is used in this paper for *Benedeniinae* with false suckers.

The following species of the genus Entobdella have been previously described:

- E. bumpsii* (Linton, 1900) on *Lasyatis centrura*.
- E. convoluta* (Yamaguti, 1937) n. comb. on *Epinephelus akaara*.
- E. diadema* (Monticelli, 1902) on *Solea vulgaris*.
- E. hippoglossi* (Mueller, 1776), the type species on *Spheroides annulatus*, etc.
- E. producta* (von Linstow, 1904) on *Solea vulgaris*.
- E. solea* (van Ben. and Hesse, 1863) on *Solea vulgaris*.
- E. squamula* (Heath, 1902) on *Paralichthys californicus*.
- E. steingröveri* (Cohn, 1916) on unidentified fish.

Entobdella muelleri, new species

(Plate 4, fig. 9)

Host: *Cratinus agassizii* Steindachner*

Location: Gills

Locality: Tagus Cove, Albemarle Island, Galapagos Islands

Number: 1

Body elongated oval, more than twice as long as wide, 4.116 mm. long by 1.603 mm. in greatest width. Posterior haptor circular and unlobed, 1.083 mm. in diameter with narrow marginal membrane. Anterior pair of hooks 0.176 mm. in length, straight, relatively strong. Middle pair of hooks large and powerful, 0.50 mm. in length, arcuate with recurved points. Posterior pair of hooks 0.100 mm. in length, straight, with short, fine recurved points. Larval hooks 0.020 mm. in length. Anterior pseudosuckers 0.508 mm. in length, elliptical, slightly broader than long with thin, flat crenate margins. Oral sucker weakly five-lobed, slightly broader than long, 0.440 mm. in width. Pharynx present and can be seen in ventral view through mouth opening as two kidney-shaped muscular structures close together with concave sides toward each other. Esophagus probably present but not visible. Intestinal limbs with lateral branches, not united posteriorly. Testes approximately in mid-body, side by side and close together, smooth, unlobed, slightly longer than broad, small, 0.339 mm. in length by 0.235 mm. in width, each pierced by nine dorso-ventral muscles. Glands of Goto 0.080 mm. in length by 0.048 mm. in width, elliptical, longer than broad, tipped obliquely toward each other anteriorly and located a relatively great distance posterior to testes. Cirrus sac bulbous, approximately twice as long as wide, just posterior to left of oral sucker, not quite one third of distance from oral sucker to ovary. Genital pore to left of oral sucker opposite mouth approximately two thirds distance from posterior to anterior border of oral sucker. Ovary elliptical, smooth, broader than long, relatively far anterior to testes, 0.305 mm. in length by 0.339 mm. in width, smaller than testes. Seminal receptacle intra-ovarian. Vitellaria extend from anterior suckers to posterior end of animal. Yolk reservoir anterior to ovary, three times as long as broad, its width approximately equal to width of ovary, slightly

* For the identification of this host the writer is indebted to Dr. G. S. Myers of the United States National Museum.

constricted in middle. Vagina not seen. No mature egg present in type specimen.

Comparisons. *E. muelleri* differs from *E. hippoglossi* in possessing no papillae in posterior haptor. It differs from *E. soleae* in having no papillae on the body. It is more similar to *E. steingröveri* but its posterior hooks are different. The posterior hooks of *E. steingröveri* are split almost their whole length. The posterior hooks of *E. muelleri* are not split. *E. muelleri* has glands of Goto which are absent in *E. steingröveri* and differs from *E. convoluta* which has no glands of Goto, possesses an anterior adhesive hood connecting the pseudo-suckers and an extremely long cirrus pouch.

Since there is only one specimen, the type, the species is provisional.

E. muelleri is named after Mueller, who named the type species of the genus.

ENCOTYLLABE PAGROSOMI MacCallum, 1917

(Plate 5, figs. 10-12)

Host: *Caulolatilus* sp.

Location: Gills

Locality: James Island, Galapagos Islands

Number: 1

The following species of Encotyllabe Diesing, 1850 have been described to date: *E. nordmanni* Dies., 1850, *E. pagelli* van Ben. and Hesse, 1863, *E. pagrosomi* MacCal., 1917, *E. paronae* Mont., 1907, *E. spari* Yamaguti, 1934, *E. vallei* Mont., 1907 and *E. lintoni* Monticelli, 1909.

Only one specimen was collected for which reason it is provisionally identified as *E. pagrosomi*. Price (1937) has redescribed *E. pagrosomi* and the comparisons made in this paper are based on his redescription.

MacCallum's four specimens were from the "mouth and throat" of *Pagrosomus auratus* (Houttuyn). Price (1937) gives the following measurements for MacCallum's material: 5.0 to 5.4 mm. in length; 1.4 mm. in width. The specimen of the author is 2.166 mm. in length by 1.266 mm. at its greatest width. Its large hooks measure 0.254 mm. as compared to 0.360 to 0.380 mm. The width of the large hooks is 0.080 mm. which is one half the length of MacCal-

lum's (0.152 to 0.172 mm.). The small hooks are approximately the same size (0.028 as compared to 0.030 mm.). Other structures are correspondingly smaller.

FAMILY: DICLIDOPHORIDAE CERFONTAINE, 1896

SUBFAMILY: DICLIDOPHORINAE CERFONTAINE, 1896

Price (1936) includes *Diclidophora* in a new superfamily *Diclidophoroidea* and retains it in the order *Polypisthocotylea* Odhner. He removes *D. affinis* Linton, 1901 and *D. cynoscioni* MacCallum, 1907 from the genus *Diclidophora* and places them in *Heterobothrium* Cerfontaine.

The genera of the subfamily *Diclidophorinae* can be separated by the following key.

- | | |
|---|-----------------------------------|
| 1 (2) Cirrus hooks single..... | <i>Diclidophoropsis</i> Gallien |
| 2 (1) Cirrus hooks double..... | 3 |
| 3 (4) Posterior suckers sessile..... | 7 |
| 4 (3) Posterior suckers on pedicels..... | 5 |
| 5 (6) Three pairs of pedicellate suckers and a long median posterior extension of body..... | <i>Pedocotyle</i> MacCallum |
| 6 (5) Four pairs pedicellate suckers, no posterior extension of body..... | <i>Diclidophora</i> Diesing |
| 7 (8) Testes numerous, extending from genital pore to first pair of posterior suckers..... | <i>Cyclobothrium</i> Cerfontaine |
| 8 (7) Testes few, posterior to ovary..... | <i>Heterobothrium</i> Cerfontaine |

The following seven species of *Diclidophora* have been described to date:

- D. chrysophryi* (v. Ben. and Hess., 1863) v. Ben. and Hess., 1895 on *Chysophrys aurata*.
D. elongata Goto, 1894 on *Pagrus tumifrons* and *Cymothoa* sp.
D. labracis Cerfontaine, 1896 on *Labrax lupus*.
D. merlangi (Kuhn, 1828) Kryer, 1838 on *Merlangus vulgaris*.
D. neomaenis MacCallum, 1917 on *Prionotus carolinus*.
D. smarisi (Ijima, 1894) Goto, 1894 on *Smaris vulgaris*.
D. taschenbergii Parona and Perugia, 1889 on *Sargus rondeletii*.

Diclidophora caulolati, new species

(Plate 5, figs. 13-15)

Host: *Caulolatilus princeps* (Jenyns)

Location: Gills

Locality: Tagus Cove, Albemarle and Chatham Islands,
Galapagos Islands

Number: 2

Body lanceolate, somewhat pointed and tapering at the anterior end, 4.506 to 5.970 mm. in length by 0.784 to 1.170 mm. at greatest width. Posterior haptor approximately one third total body length with eight elliptical posterior suckers on tips of relatively long pedicels which are approximately equal in length. Posterior pair of suckers approximately one half diameter of other three pairs. Anterior pair of posterior suckers 0.339 by 0.373 mm. in length by 0.339 to 0.407 mm. in width, chitinous skeleton (fig. 14) complex with eight chitinous pieces and four spines, eight pieces, one ventral, broad, Y-shaped piece, one pair of short pieces lateral to Y-shaped rod, one pair joining these and imbedded in the lateral wall of the sucker, a single upright piece with a pair of curved lateral rods joining it at the distal end; four spines with bulbous bases and fine recurved points at top of sucker with faces imbedded in sucker wall and having exposed sharp points. Anterior suckers relatively large, without membranous septa, elliptical, longer than broad, 0.127 to 0.169 mm. in length by 0.084 to 0.135 mm. in width. Pharynx bulb-shaped, longer than wide, 0.080 to 0.120 mm. in length by 0.044 by 0.076 mm. in width. Esophagus relatively long and slender, bifurcating just in front of genital pore to form intestinal limbs with lateral branches. Testes smooth, almost spherical, extending from ovary to posterior haptor, fifty-six to sixty-five in number. Cirrus armed with thirteen double recurved hooks. Cirrus hooks 0.012 to 0.016 mm. in length. Genital pore just posterior to bifurcation of esophagus well forward in the anterior part of the worm on ventral side in mid-line. The distance from anterior end of worm to genital pore is 0.271 to 0.424 mm. Size of opening of genital pore is 0.02 mm., diameter of outer rim 0.06 mm. Ovary slightly to left side of mid-line in middle part of body proper, vertical arm approximately twice diameter of horizontal arm, posterior arm at right angles to upright vertical arm and bent in form of a C with ends open and directed posteriorly. Seminal receptacle large to right of ovary, C-

shaped and sac-like with open ends of C to left, lower arm of C directed anteriorly (fig. 13), approximately length and diameter of lower horizontal arm of ovary. Genitointestinal canal present. Vitellaria separated anteriorly extending from genital pore to middle of posterior haptor where they unite. Two vitelline ducts unite in midline about one third distance from genital pore to ovary forming common yolk duct which extends straight posteriorly turning to right at lower end before joining oviduct. No mature egg present.

Comparisons. *D. caulolati* is most like *D. neomaenis*. In both species the posterior pair of suckers is smaller than the anterior pairs. *D. neomaenis* is larger (9.0 mm. in length as compared to 4.5 to 4.9 mm.) and has twenty-five testes and twelve cirrus hooks, whereas *D. caulolati* has fifty-six to sixty-five testes and thirteen cirrus hooks.

D. caulolati is named after the genus of the host, *Caulolatilus*.

***Heterobothrium ecuadori*, new species**

(Plate 5, figs. 16-19)

Host: *Cheilichthys annulatus* (Jenyns)

Location: Gills

Locality: Tagus Cove, Albemarle Island, Galapagos Islands, San Francisco, Ecuador

Number: 4

Body lanceolate, thin, flat, and left side with pronounced greater curvature, 2.903 to 3.466 mm. in length by 0.866 to 1.256 mm. in greatest width, three times as long as wide. Posterior haptor not separated from body proper, approximately one fourth total body length, 0.763 to 1.017 mm. in length by 0.915 to 1.213 mm. in greatest width. Four pairs of posterior suckers arranged in the shape of a horseshoe, four on each side with open end of horseshoe pointing anteriorly, elliptical, slightly broader than long, 0.152 to 0.203 mm. in length by 0.186 to 0.271 mm. in width. Chitinous skeleton (fig. 19) consists of two lateral pieces on each side and a central piece with short, T-shaped distal end. Mouth slightly subterminal leading into large mouth cavity. Anterior mouth suckers large, elliptical, longer than wide, 0.169 to 0.220 mm. in length by 0.118 to 0.186 mm. in width. Pharynx large, elliptical, slightly wider than long, 0.084 to 0.118 mm. in length to 0.085 to 0.120 mm. in width. Esophagus very short without lateral branches. Intestinal

limbs with lateral branches, unite at posterior end of worm. Testes in median line posterior to ovary, twenty-seven to forty in number, smooth, unlobed, closely packed and irregular in shape. Cirrus spherical with fourteen to sixteen strong double hooks arranged in a circle with powerful sucker just below hooks. Diameter of cirrus 0.116 to 0.114 mm. Length of cirrus hooks 0.038 to 0.048 mm. Genital pore well forward in mid-line about posterior part of first eighth of animal, width of opening 0.020 mm. surrounded by circular to elliptical rim 0.036 to 0.040 mm. in diameter. Ovary situated in mid-line in posterior part of first third of animal, ovarian region 0.254 to 0.407 mm. in length, diameter of ovary at widest part 0.084 to 0.135 mm., U-shaped with open end to right, lower arm smaller in diameter with pronounced enlargement at lower end. Vagina absent. Genitointestinal canal present. Vitelline ducts unite at upper end of ovary to form large yolk duct. Vitellaria extend from genital pore to haptor, separated in front, united behind. Eggs elongated oval with short polar knob at anterior end and long filament at posterior end, 0.152 to 0.169 mm. in length by 0.052 to 0.076 mm. in width, length of filament 0.200 to 0.203 mm.

Comparisons. *H. ecuadori* is similar to *H. tetradonis* (Goto, 1894) but is much smaller, 2.9 to 3.4 mm. in length as compared to 5.0 to 15.0 mm., has twelve to fourteen cirrus hooks as compared to ten and the vitellaria extend to the posterior haptor as compared to vitellaria being absent in posterior half of *H. tetradonis*.

H. ecuadori is named after its geographic location, Ecuador.

***Heterobothrium galapagensis*, new species**

(Plate 5, figs. 20-21)

Host: *Paranthias furcifer* (Cuv. and Val.)

Location: Gills

Locality: Tagus Cove, Albemarle Island, Galapagos Islands

Number: 1

Body thin and flat, anterior end bluntly pointed, 1.560 mm. in length by 0.457 mm. in greatest width at middle of body, left side of body with pronounced outward curve, tapering anteriorly and posteriorly from the middle. Approximately same width across anterior end in front of haptor. Posterior haptor relatively short and broad, 0.254 mm. in length by 0.542 in width. Four posterior suckers

present, the rest apparently having been torn off, each sucker elliptical, slightly longer than wide, 0.088 to 0.092 mm. in length by 0.072 to 0.076 mm. in width. Anterior suckers large with membranous septa, elliptical, longer than wide, 0.100 mm. in length by 0.096 mm. in width. Pharynx 0.056 mm. in length by 0.036 mm. in width, bulb-shaped, longer than wide. Esophagus relatively short, intestinal limbs with lateral branches. Testes relatively large extending from middle of ovarian region to posterior haptor, elliptical to slightly angular, smooth, unlobed, thirty-seven in number. Vas deferens relatively wide and tortuous. Cirrus bulb-shaped with six small double hooks. Cirrus 0.048 mm. in diameter. Cirrus hooks 0.012 mm. in length. Genital pore well forward in mid-line at level of anterior border of vitellaria. Ovary approximately in middle of body in mid-line, in shape of inverted U tilted obliquely to left with open end of U pointing posteriorly, lower arm broader than upper arm, length of ovarian region 0.220 mm. in length by 0.203 mm. in width. Oviduct arises from lower end of right arm of ovary. Vitelline ducts arise from vitellaria at about level of middle of ovary. Common vitelline duct relatively broad, passing obliquely posterior to right of ovary. Vitelline glands coarsely acinous, from genital pore to haptor, separated in front, slightly confluent at posterior end. Uterus relatively wide, almost straight. No mature egg present.

Discussion. Since there was only one specimen this species is provisional. *Heterobothrium* normally has eight suckers. *H. galapagensis* has only four. It is quite obvious that there is a vacant space on the right side of the haptor where, no doubt, was once a sucker. If this missing sucker were present there would still be only five. Since the other generic characters are typical of the genus it is provisionally placed in *Heterobothrium*.

Comparisons. *H. galapagensis* differs from *H. tetradonis* (Goto) and *H. ecuadori* in the shape of the body which is more or less distinctly divided into three regions, an anterior portion in front of the genital pore separated by a slight constriction, the middle part of the body which tapers toward the haptor, and the posterior haptor which is broad and distinctly marked off from the body. The cirrus of this species has only six hooks, *H. tetradonis* has ten, and *H. ecuadori* has twelve to fourteen.

H. galapagensis gets its name from its geographic location, the Galapagos Islands.

FAMILY: HEXOSTOMATIDAE PRICE, 1936

Hexostoma euthynni, new species

(Plate 6, figs. 22-24)

Host: *Euthynnus alletteratus* (Rafinesque)

Location: Gills

Locality: James Island, Galapagos Islands

Number: 1

Body elongated, tapering anteriorly from ovary, anterior end pointed, constricted at middle of body proper posterior to ovary, 5.853 mm. in length by 0.953 mm. in width. Posterior haptor large, 0.953 mm. in length by 1.30 mm. in width, slightly wider than the widest part of body. Eight large posterior suckers, elliptical, broader than long, 0.203 mm. in length by 0.339 mm. in width, arranged somewhat in form of a horseshoe. Each sucker has three heavy X-shaped, chitinous, skeletal pieces imbedded longitudinally in its walls, middle skeletal piece longer, imbedded in septum which divides sucker into two parts; one X-shaped skeletal piece imbedded in wall in each side of sucker. Two pairs of hooks at posterior end of animal; anterior pair larger with a base which is imbedded and parallel to the rest of the hook which is straight and points posteriorly, 0.068 mm. in length. Smaller pair of hooks approximately one half the size of larger hooks, situated between and posterior to larger anterior pair. Mouth subterminal, ventral. Two anterior mouth suckers elliptical, longer than broad, 0.056 mm. in length by 0.04 mm. in width. Small pharynx just posterior to anterior suckers. Esophagus short, bifurcating anterior to genital pore. Intestinal limbs with lateral branches, not united behind. Cirrus consists of cup-shaped body with two bean-shaped bodies attached to it posteriorly. Diameter of cirrus cup 0.068 mm. Bean-shaped bodies 0.072 mm. in length. Spines of bean-shaped body straight, sharp, pointed toward mid-line and obliquely downward, 0.012 mm. in length. Testes small, slightly lobed, in mid-line in anterior part of posterior half of animal, twenty-six in number, length of testicular region 0.848 mm., width 0.271 mm. Vas deferens leaves base of penis cup passing posteriorly dorsal and to right of uterus. From genital pore to halfway to ovary it is slender without coils. It then broadens to over twice its anterior width and passes posteriorly by tortuous windings. Genital pore in mid-line, ventral, near posterior end just

posterior to bifurcation of esophagus to form intestinal limbs. Ovary in mid-line at posterior part of anterior third of animal, slender in diameter, U-shaped with open end of U pointing posteriorly. Starting on the left side the ovary passes forward and winds back and forth laterally about ten times and then turns to the right and passes horizontally across the mid-line and turns abruptly posteriorly and winds horizontally about six times. Oviduct arises from ovary at posterior end of right arm. Vitelline glands from slightly posterior to genital pore to anterior part of posterior third of testicular region, separated anteriorly and posteriorly but confluent between ovary and anterior part of testicular region. Uterus relatively wide and straight. Eggs with anterior and posterior filaments, 0.168 to 0.203 mm. in length by 0.072 to 0.080 mm. in width. Anterior and posterior polar filaments approximately 0.10 mm. in length.

Comparisons. *H. euthynni* is considerably different from any previously described species. It varies particularly in the chitinous skeleton of the posterior suckers. Each sucker has three X-shaped bars parallel to the anterior-posterior axis of the body. The sucker is divided into two portions with a long bar separating the two sides and a short one imbedded in the lateral wall of the sucker on each side. Since this description was made from only one specimen the species is provisional.

The species name is derived from the genus name of the host, *Euthynnus alletteratus* (Rafinesque).

FAMILY: MAZOCRAEIDAE PRICE, 1936

Mazocraes macracanthum, new species
(Plate 6, figs. 25-29)

Host: Unidentified species of mackerel

Location: Gills

Locality: Tagus Cove, Albemarle Island, Galapagos Islands

Number: 8

Body elongated, lanceolate, tapering anteriorly, slightly broader posteriorly, 1.473 to 2.340 mm. in length by 0.356 to 0.474 mm. in width. Posterior haptor relatively large, separated from rest of body by slight constriction, with eight posterior suckers arranged in two

parallel rows. Posterior suckers elliptical, wider than long, anterior pair smaller, 0.048 to 0.060 mm. in length by 0.060 to 0.068 mm. in width; other three pairs 0.056 to 0.068 mm. in length by 0.068 to 0.080 mm. in width. Chitinous skeleton (fig. 27) of four pieces, central piece heavy, very broad, bifurcated and blunt posteriorly, bifurcated anteriorly with two sharp points which are recurved, sharply pointed, pointing toward base of sucker; two pairs of lateral pieces, heavy, uniting posteriorly; an anterior piece horizontally across top of sucker with ends bent slightly and pointing toward base of sucker. Two pairs of hooks at posterior end of body between posterior pair of suckers. Outer pair extremely large and stout, 0.100 to 0.132 mm. in length, solid with sharp, recurved points, opposite ends (anterior roots) truncate, anterior root one third distance from distal end; proximal half of hook deeply grooved on its surface. Inner pair hooks approximately one sixth length of larger pair, 0.02 mm. in length, filiform, with sharp recurved points, possessing a process about one third the distance from the distal end, posterior end of hook slightly turned up at end. Each sucker with skeletal apparatus of four pieces. Mouth subterminal, ventral. Anterior mouth suckers large, elliptical, broader than long, without membranous septa. Pharynx bulb-shaped, near anterior suckers, slightly longer than wide. Esophagus relatively long, slender, bifurcating approximately one half distance from anterior end of animal to ovary. Intestinal limbs extend posteriorly to anterior end of posterior pair of suckers, not united posteriorly, with lateral branches. Cirrus consists of central bulb-shaped body 0.052 to 0.064 mm. in diameter. Two lateral bean-shaped bodies of cirrus longer than wide, 0.048 mm. in length. Five pairs of cirrus hooks, one pair of stout, long hooks with broad bifurcated bases and sharp slightly curved points, and four pairs of smaller inner hooks which have bulb-shaped bases and taper gradually from the proximal to distal ends and are slightly curved from base to point. Testes large, few in number (ten), smooth, unlobed, broader than long and angular, to right of and posterior to ovary in anterior part of posterior half of animal. Genital pore in mid-line near anterior end, about one half the distance from anterior end of animal to bifurcation of esophagus. Ovary in middle of body to left of mid-line, U-shaped with open end of U pointing anteriorly, both arms approximately the same length and of uniform diameter throughout. Oviduct leaves anterior part of right arm of

ovary and bends obliquely posterior toward mid-line. Vitellaria relatively fine, acinous, from halfway between genital pore and bifurcation of esophagus to level of anterior pair of posterior suckers. Vitelline ducts unite in mid-line anterior to ovary. Common yolk duct very large with diameter as great as diameter of ovary. No eggs present.

Comparisons. *M. macracanthum* is most similar to *Octocotyle minor* Goto, 1894. The length of the posterior suckers in *O. minor* is 0.03 mm. as compared with 0.056 to 0.064 mm.; there are six pairs of cirrus hooks as compared with five; and the large pair of posterior hooks measures 0.037 mm. in length as compared with 0.100 to 0.123 mm.

M. macracanthum gets its name from the fact that the posterior hooks are extremely large.

FAMILY: MICROCOTYLIDAE TACHENBERG, 1879

GENUS: MICROCOTYLE VAN BEN. and HESSE, 1863

The genus *Microcotyle* is a very large one. At least fifty-eight species have been named. For reference purposes these species are listed alphabetically with their hosts.

1. *M. acanthophallus* MacCal. and MacCal., 1913 on *Roccus lineatus*.
2. *M. acanthurum* Par. and Per., 1890 on *Brama rayi*.
3. *M. alcedinis* Par. and Per., 1890 on *Smaris alcedo*, *Maena trachini* and *M. vulgaris*.
4. *M. angelichthys* MacCal., 1913 on *Holocanthus ciliaris*.
5. *M. angelichthys-townsendi* MacCal., 1916 on *Angelichthys townsendi*. (Note: In the description this is written without the hyphen as *M. angelichthys townsendi*. The hyphen is being inserted here so that the name will be binomial and comply with the rules of nomenclature. Without doubt, MacCallum did not mean to create a subspecies.)
6. *M. archosargi* MacCal., 1913 on *Archosargus probatocephalus*.
7. *M. australiensis* MacCal., 1921 on *Pomatomus saltatrix*.
8. *M. australis* Murray, 1931 on *Sparus australis*.
9. *M. bassensis* Murray, 1931 on *Platycephalus bassensis*.
10. *M. branchiostegi* Yamaguti, 1937 on *Branchiostegus japonicus*.

11. *M. canthari* van Ben. and Hesse, 1863 on *Cantharus grisseus*, *C. lineatus*, and *C. brama*.
12. *M. carangis* MacCal., 1913 on *Caranx crysos*.
13. *M. caudata* Goto, 1894 on *Sebastes* sp.
14. *M. centrodoni* Brown, 1929 on *Pagellus centrodonus*.
15. *M. centropristes* MacCal., 1913 on *Centropristes striatus*.
16. *M. cepolae* Yamaguti, 1937 on *Cepola schlegeli*.
17. *M. chiri* Goto, 1894 on *Chirus hexagrammus*.
18. *M. chrysophryi* van Ben. and Hesse on *Chrysophryi vulgaris*.
19. *M. donovani* van Ben. and Hesse, 1863 on *Labrus donovani*.
20. *M. draconis* Briot, 1904 on *Trachinus draco*.
21. *M. elegans* Goto, 1894 on *Scombrops chilodipteroides*.
22. *M. eriensis* Bangham and Hunter, 1936 on *Aplodinotus grunniens*.
23. *M. erythrini* van Ben. and Hesse, 1863 on *Pagellus erythrinus* *P. acarne* and *Box boops*.
24. *M. eueides* MacCal. and MacCal., 1913 on *Roccus lineatus*.
25. *M. fusiformis* Goto, 1894 on *Centronotus rubulosus*.
26. *M. gotoi* Yamaguti, 1934 on *Hexagrammos otakii*.
27. *M. hiatulae* Goto, 1899 on *Hiatula onitis*.
28. *M. incisa* Linton, 1910 on *Neomaenia grisseus*.
29. *M. incomparabilis* MacCal., 1917 on *Caranx ruber*.
30. *M. labracis* van Ben. and Hesse, 1863 on *Labrax lupus*.
31. *M. longicauda* Goto, 1899 on *Cynoscion regale*.
32. *M. lichiae* Ariola, 1899 on *Lichia amia*.
33. *M. macroura* MacCal. and MacCal., 1913 on *Roccus lineatus*.
34. *M. mormyri* Lorenz, 1878 on *Pagellus mormyrus*.
35. *M. mugilis* Vogt, 1878 on *Mugil cephalus*.
36. *M. pagrosomi* Murray, 1931 on *Pagrosomus auratus*.
37. *M. pancerii* Sonsino, 1891 on *Umbrina cirrhosa*.
38. *M. pogoniae* MacCal., 1913 on *Pogonias cromis*.
39. *M. polynemi* MacCal., 1917 on *Polynemus auratus*.
40. *M. pomatomi* Goto, 1899 on *Pomatomus saltatrix*.
41. *M. pomocanthi* MacCal., 1915 on *Pomocanthus arcuatus*, *Chaetodon ocellatus*, *Calamus arctifrons*, *Anisotremus virginicus*, *Ephinephelus flavolimbatus*, and *Harpe rufa*.
42. *M. poronoti* MacCal., 1915 on *Poronotus triacanthus*.
43. *M. pyragraphorus* MacCal. and MacCal., 1913 on *Trachinotus carolinus*.

44. *M. reticulata* Goto, 1894 on *Stromateus argenteus*.
45. *M. salpae* Par. and Per., 1890 on *Box salpa*.
46. *M. sargi* Par. and Per., 1890 on *Sargus rondeletii*, *S. annularis*, *S. salviani*, and *S. vulgaris*.
47. *M. sciaenae* Goto, 1894 on *Sciaena sina*.
48. *M. sciaenicola* Murray, 1932 on *Sciaena antarctica*.
49. *M. sebastis* Goto, 1894 on *Sepastes sp.*, *S. maliger*, *S. caurinus*, *S. melanops*, and *Sebastodes schlegeli*.
50. *M. sillaginae* Woolcock, 1936 on *Sillaginoides punctatus*.
51. *M. sp.* Linton, 1907 on *Calamus calamus*.
52. *M. spari* Yamaguti, 1937 on *Sparus longispinus*.
53. *M. spinicirrus* MacCal., 1918 on *Aplodinotus grunniens*.
54. *M. stenotomi* Goto, 1899 on *Stenotomus chrysops*.
55. *M. trachini* Par. and Per., 1899 on *Trachinus radiatus*.
56. *M. truncata* Goto, 1894 on *Pristipoma japonicum*.
57. *M. victoriae* Woolcock, 1936 on *Helicolenus percoides*.
58. *M. virgatarum* Tubangui, 1931 on *Teuthis virgata*.

***Microcotyle priacanthi*, new species**

(Plate 6, figs. 30-32)

Host: *Priacanthus sp.*

Location: Gills

Locality: Hood Island, Galapagos Islands

Number: 4

Body long, slender, lanceolate, 2.980 to 4.333 mm. in length by 0.237 to 0.339 mm. in greatest width, tapering to a point at posterior end, anterior end attenuated and bluntly pointed. Posterior haptor long, approximately four fifths of total body length. Numerous (approximately 200) small posterior suckers 0.044 to 0.048 mm. in length by 0.060 to 0.064 mm. in width. Chitinous skeleton (fig. 32) of seven pieces, a central inverted U-shaped piece, one arm of U longer than the other and bifurcated at proximal end; two lateral pairs, relatively slender; one pair at distal end of lateral pairs extending obliquely downward and toward center of sucker; one pair across top of sucker, somewhat beaded in appearance and convex on distal borders. Mouth subterminal, ventral. Pharynx almost spherical, 0.032 to 0.036 mm. in length by 0.032 to 0.040 mm. in width. Esophagus relatively short, bifurcating in front of genital pore. Intestinal limbs with lateral branches ending blindly. Anterior

suckers elliptical, broader than long, with membranous septa, 0.032 to 0.036 mm. in length by 0.060 to 0.064 mm. in width. Genital pore near anterior end, halfway from anterior end to vitellaria. Genital atrium (fig. 31) armed with two sets of hooks; sixteen in anterior set forming an incomplete circle, open posteriorly. Anterior genital hooks long, slender, 0.024 to 0.028 mm. in length. Twelve posterior hooks consisting of four strong chitinous spines with slightly recurved points on each side and four other hooks posterior and median pointing anteriorly and associated with a strong, muscular sucker-like structure. The paired posterior spines 0.020 to 0.032 mm. in length. Testes large, smooth, almost spherical, eleven in a single row posterior to ovary and extending almost to haptor. Ovary in middle of body in mid-line, shaped like a question mark from ventral side, right arm broader and about one half as long as left arm. Oviduct arises from lower part of right arm. Seminal receptacle spherical, posterior to lower end of right arm. Vagina single, straight, dorsal, median, opening dorsally posterior to level of anterior end of vitellaria. Vitellaria from just anterior to vaginal opening to short distance into haptor. No eggs present.

Comparisons. *M. priacanthi* has eleven testes as compared to *M. erythrini* (which has ten) but differs in number, size, and arrangement of the genital spines and the posterior suckers. *M. sargi* has an incomplete corona of sixteen hooks in the genital atrium as compared to twenty-eight. *M. momyri* has 120 to 130 posterior suckers as compared with almost 200; its spines in the genital atrium differ greatly in number, size, and arrangement. *M. chiri* has a similar cup-shaped organ in the genital atrium but has only sixty suckers and twenty-five testes as compared to 200 and eleven. *M. sciaenae* differs in number, size, and arrangement of the genital spines and the number and size of the posterior suckers.

M. priacanthi is named after the genus name of the host, *Priacanthus*.

***Gotocotyla acanthocybii*, new species**

(Plate 6, figs. 33-36)

Host: *Acanthocybium solandri* (Cuv. and Val.)

Location: Gills

Locality: Galapagos Islands

Number: 15

Body elongated, leaf-like, tapering at anterior end and rounded at posterior end, 6.283 to 11.093 mm. in length by 0.848 to 0.953 mm. in greatest width just anterior to haptor. Posterior haptor long, over one half total body length, 0.953 to 1.256 mm. in width at widest part, with two hooks at posterior end. These hooks measure 0.024 to 0.056 mm. in length and have sharp recurved points. Posterior suckers 223 to 245 in number arranged along each side of haptor, elliptical, broader than long, 0.072 to 0.076 mm. in length by 0.076 to 0.080 mm. in width. Chitinous skeleton of each sucker (fig. 35) consists of fifteen pieces; one median, large; two elongated, curved, in each side; two short curved pieces in base of sucker; and four pairs straight, slender, chitinous rods imbedded in wall on each side, equidistant from each other and in posterior half of sucker. Mouth ventral, sub-terminal. Pharynx bulb-shaped, slightly longer than broad, 0.056 to 0.064 mm. in length by 0.040 to 0.056 mm. in width. Esophagus relatively large in diameter with several lateral branches on each side, bifurcating just in front of genital pore. Intestinal limbs with lateral branches, uniting near posterior end. Anterior suckers elliptical, longer than broad, without membranous septa, 0.080 to 0.108 mm. in length by 0.044 to 0.048 mm. in width. Genital pore well forward about one third distance from anterior end to vitellaria. Genital atrium a large, globular cavity heavily armed with numerous (several hundred) spines 0.020 to 0.048 mm. in length, elliptical, twice as wide as long (fig. 33). Vas deferens dorsal to the uterus, opening at the flattened tip of an irregular globular-shaped papilla which projects into cavity of genital atrium. This papilla may be the homologue of the cirrus of other forms. It appears to be muscular. Testes fifty-three to eighty-five in number, relatively small, irregular, smooth, posterior to ovary. Ovary situated at about middle of body in mid-line forming an inverted U, right arm shorter and of greater diameter than left arm, left arm with distinct enlargement at posterior end. Oviduct arises from lower end of right arm. Vitellaria relatively fine, acinous, extending from posterior part of anterior fifth of body to posterior end of animal, confluent behind, separated in front. Yolk ducts unite in mid-line at level of posterior third of ovary. Common yolk duct relatively short and slender. Eggs elliptical, over twice as long as wide, 0.140 to 0.208 mm. in length by 0.052 to 0.084 mm. in width, long polar filament at each end. Eggs vary in number from several to forty-seven. Excretory pores open dorsally almost at extreme lateral edge of animal.

Comparisons. *G. acanthocybii* has 223 to 245 posterior suckers as compared to 120 in *G. acanthurum* (Par. and Per., 1890) and thirty-seven in *G. carangis* (MacCal., 1913). It also differs in size, number, and arrangement of genital spines and posterior suckers from *G. acanthurum* and *G. carangis*.

G. acanthocybii is named after the genus of its host, *Acanthocybium*.

The genus *Gotocotyla* was named by Ishii in 1936, but at the present writing his paper is not available to the writer. The genus is apparently like *Microcotyle*, but with a pair of hooks at the posterior end of the body.

***Gotocotyla elagatis*, new species**

(Plate 7, figs. 37-40)

Host: *Elagatis bipinnulatus* (Quoy and Gaimard)

Location: Gills

Locality: Bahia Honda, Panama

Number: 4

Body lanceolate, bluntly pointed at anterior end, pointed at posterior end, 3.263 to 6.200 mm. in length by 0.550 to 0.661 mm. in greatest width. Posterior haptor approximately one fourth entire body length, not distinctly marked off from rest of body proper, with ninety to 100 suckers. Posterior suckers slightly longer than broad, 0.044 to 0.060 mm. in length by 0.036 to 0.044 mm. in width. Chitinous skeleton of each sucker (fig. 39) complex, consisting of twenty-two pieces, two strong curved pieces on one side in lateral wall of sucker and two slender curved pieces on opposite side; one wide short piece on side bearing the two strong pieces, in base and extending obliquely outward almost one half the length of sucker; at base on other side one strong piece bent toward base of sucker at middle; eight to ten slender inverted U-shaped pieces, equidistant apart in outer half of sucker on the side bearing the two slender upright curved rods; six small pieces scattered throughout lower half of sucker. Two hooks at posterior end, 0.40 to 0.48 mm. in length, with strongly recurved points bending to right and left away from each other with their points directed outward. Anterior suckers elliptical, longer than broad, 0.060 to 0.076 mm. in length by 0.032 to 0.044 mm. in width, with membranous septa. Pharynx bulb-shaped, 0.020 to 0.060 mm. in length by 0.018 to

0.032 mm. in width. Esophagus slender, bifurcating in region of genital pore. Intestinal limbs extending to half length of haptor, with lateral branches not uniting posteriorly. Genital pore 0.180 to 0.271 mm. from anterior end. Genital atrium with numerous straight chitinous rods, 0.016 to 0.200 mm. in length, arranged in a circle. Testes small, numerous (several hundred), smooth, elliptical, closely packed in posterior third of body between ovary and haptor. Ovary in middle of body in mid-line, shape of inverted U, long and slender with arms of approximately the same length, left arm slightly longer. Oviduct arises from right arm. Vitellaria fine, acinous, from anterior fifth to middle of testicular region. Vitelline ducts unite at level of posterior third of ovary. Uterus relatively straight and broad in mid-line. No eggs present.

Comparisons. *G. elagatis* has ninety to 100 posterior suckers compared with 120 in *G. acanthurum* and thirty-seven in *G. carangis*, one group of genital spines compared with two groups. *G. acanthocybii* has one group of genital spines but they differ in number, size, and arrangement; fewer testes (fifty-two to eighty-four testes compared with several hundred in *G. elagatis* and sixty in *G. carangis*), and the vitellaria extend only to haptor rather than to middle of haptor region.

G. elagatis is named after the genus name of the host, *Elagatis*.

GENUS: THORACOCOTYLE MACCALLUM, 1913

MacCallum (1913) described *Thoracocotyle* from the Spanish mackerel (*Scomberomorus maculatus*). It is unique among the Monogenea in that most of the body functions as a haptor. Most of the body proper lies flat on the substratum or attached to the host by suckers along each side while the rest and least conspicuous part of the animal arises dorsally and at right angles to the haptor region. The anterior part of the animal is practically free from organs with the exception of the almost straight uterus and the relatively broad tortuous vas deferens which lies dorsal to the uterus. Apparently due to the fact that the anterior part of the animal is free from organs, the vas deferens swings broadly from side to side and occupies about one half the width of this part of the animal.

Price (1936) places this genus in the *Diclidophoridae* instead of the *Microcotylidae* and created a new subfamily, *Thoracocotylinae*.

Thoracocotyle paradoxica, new species

(Plate 7, figs. 41-43)

Host: *Scomberomorus maculatus* (Mitchill)

Location: Gills

Locality: Tangola-Tangola, Mexico

Number: 1

Posterior region of body which functions as a haptor 1.476 mm. in length by 0.508 in greatest width. The anterior part of the body is attached to the anterior part of the haptor region, 0.712 by 0.288 mm. in greatest width. The haptor extends 0.968 mm. to the left and 0.508 mm. to the right of the anterior part of the body. Posterior suckers along margins of haptor, eight pairs on posterior part of haptor and six pairs on anterior part. The three pairs on anterior part considerably smaller, as is the sucker at the extreme tip at anterior end of haptor; each one of large suckers, 0.080 mm. in length by 0.100 in width, slightly broader than long. Chitinous framework (fig. 43) typical of the genus with six to ten slender curved pieces imbedded in walls in each side of sucker, one heavy, central I-shaped piece, two lateral curved pieces and one pair on each side at distal end of sucker, curved downward. Two pairs of hooks at posterior tip of haptor, outer pair longer, slender, relatively straight with short recurved points and process at middle, 0.048 mm. in length; inner pair posterior, arcuate and, in shape, resembling a small hand scythe with short handle, 0.016 mm. in length. Slightly anterior to hooks are six conspicuous nuclei, deeply staining with heavy nuclear membranes and prominent eccentric nucleoli. Mouth ventral, slightly subterminal. Anterior mouth suckers elliptical, without septa, broader than long, 0.024 mm. in length to 0.044 mm. in width. Pharynx muscular, bulb-shaped, 0.052 mm. in length by 0.035 mm. in width. Rest of digestive system not visible. Genital pore just posterior to pharynx in mid-line, unarmed. Testes seven in number, smooth, unlobed, longer than wide, in mid-line posterior to ovary, close together and in one row. Vas deferens a broad tortuous tube in mid-line. Cirrus rudimentary, unarmed. Ovary shaped like inverted U in mid-line between seventh pair of suckers counting from posterior end. Shell gland large, spherical, posterior to ovary. Vitellaria in two groups, one in anterior part of haptor and one in posterior part, confluent anteriorly and posteriorly.

Egg 0.168 mm. in length by 0.064 mm. in width with one polar filament 0.292 mm. in length.

Comparisons. There is some doubt that the species described in this paper differs from MacCallum's. The main point of difference seems to be the number of posterior suckers of the haptor, which number forty in *T. croceus* and only twenty-eight in *T. paradoxica*. However, since only one specimen and the anterior part of another were studied and MacCallum had only a few of his species, the variation is not well known. For this reason *T. paradoxica* is proposed as a provisional species.

T. paradoxica is named for the fact that it appears most peculiar in that most of the body proper functions as a haptor.

GENUS: AXINE ABILDGAARD, 1794

The following species of *Axine* have been described to date:

A. aberrans Goto, 1894 on *Belone schismatorhynchus*.

A. belones Abild., 1794 on *Belone acus*.

A. carangis MacCal., 1918 on *Caranx hippos*.

A. heterocerca Goto, 1894 on *Seriola quinqueradiata*.

A. triangularis Goto, 1894 on *Anthias schlegelii*.

***Axine oligoplitis*, new species**

(Plate 8, figs. 44-47)

Host: *Oligoplites saurus* (Bloch and Schneider)

Location: Gills

Locality: San Francisco, Ecuador

Number: 4

Body small, triangular, 1.820 to 1.950 mm. in length by 0.305 to 0.322 mm. in greatest width just anterior to ovary. Posterior haptor triangular with sixteen to eighteen suckers on short side and forty to forty-two on long side. Posterior suckers 0.024 to 0.036 mm in length by 0.044 mm. in width. Chitinous framework (fig. 45) consists of two pairs of lateral pieces which are slender and widely open behind, a central median piece which is also slender and bifurcated at both ends, and a slender pointed spine distal to lateral paired pieces imbedded in lateral wall. Mouth ventral and sub-terminal. Anterior suckers relatively far apart, elliptical, broader

than long, without membranous septa, 0.024 to 0.036 mm. in length by 0.056 to 0.064 mm. in width. Pharynx bulb-shaped, 0.024 to 0.032 mm. in length by 0.022 to 0.029 mm. in width. Esophagus slender, bifurcating in region of genital pore. Intestinal limbs with lateral branches, not united behind. Genital pore well forward 0.120 to 0.169 mm. from anterior end. Genital hooks in two rows on each side, one row dorsal to the other, dorsal hooks shorter; long ventral hooks 0.016 to 0.020 mm. in length, almost straight, wider at proximal end with recurved points pointing posteriorly into genital pore. Short hooks a little over one half length of long hooks. Twenty-eight to thirty-nine testes in two rows posterior to ovary, smooth, wider than long, unlobed. Ovary in shape of interrogation point, anterior part expanded and posterior part with small lobe which is bent to left, in middle of body in mid-line, greatest diameter 0.056 to 0.076 mm. Seminal receptacle elliptical, to right of ovary. Vitellaria from genital pore to one half distance from testes to posterior end. No eggs present. Brain with two projecting anterior lobes with short lateral projections on each side.

Comparisons. The two main features which distinguish *A. oligoplitis* from others previously described are the hooks of the genital pore which are arranged in two parallel groups on each side of the genital pore and the brain which has two small extra lobes arising anteriorly from the brain proper. These accessory anterior lobes have small lateral extensions which arise lateral and at right angles to them. It is most like *A. aberrans* Goto but is somewhat smaller (1.8 to 1.9 as compared with 5.0 mm.). *A. aberrans* has twenty-five suckers on one side and only one on the other as compared with sixteen to eighteen suckers on one side and forty to forty-two on the other in *A. oligoplitis*.

A. oligoplitis is named after the genus of the host, *Oligoplites*.

***Axine seriolae*, new species**

(Plate 8, figs. 48-52)

Host: *Seriola dorsalis* (Gill)

Location: Gills

Locality: Hood Island, Galapagos Islands

Number: 4

Body elongated triangular, slightly curved to right with greatest width at level of ovary, tapering gradually to anterior end of vitel-

larva in front of which is a slight constriction, 5.113 to 7.540 mm. in length to 1.082 to 1.300 mm. in greatest width, with papilla-like tip at anterior end. Surface of body smooth except ventral side with several hundred close, simple, sharply recurved hooks located around genital pore and extending from brain to ovary and laterally to inner borders of intestinal limbs. Posterior haptor triangular, approximately one third total body length with twenty-seven to twenty-nine suckers on short side and thirty-eight to forty on long side. Posterior suckers 0.080 to 0.092 mm. in length by 0.140 to 0.184 mm. in width. Chitinous framework (fig. 49) consists of five main pieces, two curved, relatively heavy pieces on each side, one central piece Y-shaped at each end, and a short stout piece distal to paired lateral pieces, convex distally and inner end pointing toward mid-line of sucker. Anterior suckers far apart, broader than long, without septa, 0.076 to 0.092 mm. in length by 0.120 to 0.168 mm. in width. Mouth small, subterminal, ventral. Pharynx bulb-shaped, longer than broad. Esophagus slender with few lateral branches bifurcating approximately halfway between brain and genital pore at level of excretory pores. Intestinal limbs extending into haptor region, with lateral branches ununited. Genital pore in mid-line halfway from anterior end to vitellaria, unarmed except for the spines mentioned above. Testes posterior to ovary to anterior end of short side of haptor, ninety-three to 105 in number, close together, oval, unlobed. Ovary in mid-line just in front of testes extending anteriorly from oviduct region on right side winding horizontally six times, then turning abruptly to left at right angles to right arm and after passing horizontally to left, again turning abruptly posteriorly, it then bends and passes obliquely anterior and to right and after reaching uterus passes dorsal to it and again bends obliquely posterior and to right with slight enlargement at lower end of left arm. Vaginal opening in mid-line on dorsal surface, unarmed, halfway from constriction at anterior fourth of body to anterior border of vitellaria, opening into two ducts which extend to right and left in horizontal plane expanding laterally and bending posteriorly about midway to lateral borders of animal. It was not possible to follow them posteriorly. Vitellaria in two distinct groups from constriction at level of anterior fourth of animal to posterior border of testicular region, one third of width of animal in mid-line free from them for entire length. Yolk ducts unite to form common duct at middle of vitellaria

in mid-line. Eggs elongated oval, 0.096 to 0.136 mm. in length to 0.056 to 0.068 mm. in width, with extremely slender filiform polar filament at one end of egg approximately one and one-half times the length of egg.

Comparisons. *A. seriolae* is most similar to *A. heterocerca* Goto, 1894, but is smaller (5.1 mm. to 7.5 mm. in length compared with 10.0 mm.), with twenty-seven to twenty-nine suckers on one side of the haptor and thirty-eight to forty on the other as compared with nine on one side and thirty on the other. The vitellaria are separated along the entire length of the body as compared with the posteriorly confluent vitellaria of *A. heterocerca*.

A. seriolae is named after the genus of its host, *Seriola*.

***Axine elongata*, new species**

(Plate 8, figs. 53-58)

Host: *Xurel malampygus* (Cuv. and Val.)

Location: Gills

Locality: Secas Island, Panama

Number: 5

Body long, slender, tapering slightly from posterior haptor to anterior end which has a pronounced papilla-like structure at tip, body 2.080 to 3.683 mm. in length by 0.288 to 0.531 mm. in greatest width. Posterior haptor asymmetrical, 0.848 to 0.932 mm. in length by 0.508 to 0.593 mm. in width, four to five suckers on short side, twenty-four to twenty-five on long side. Posterior suckers slightly longer than broad, 0.060 to 0.080 mm. in length by 0.048 to 0.080 in width. Chitinous skeleton (fig. 57) consists of a broad central piece split down the center on one side with broadly bifurcating ends, one side shorter than other; two pairs of lateral pieces uniting at bases, one enlarged piece, blunt and slightly bifurcated at distal end, other piece attenuated; a strong spine-like piece at base on each side. Anterior sucker relatively small, wide apart, wider than long, without membranous septa, 0.040 to 0.044 mm. in length by 0.036 to 0.060 mm. in width. Mouth ventral and subterminal. Pharynx elongated, bulb-shaped, 0.040 to 0.044 mm. by 0.026 to 0.040 mm. in width. Intestinal limbs long, slender with lateral branches, extend well into haptor region, left branch shorter than right, ending blindly just in front of loop made by union of lateral

nerve cords. Genital pore located in mid-line, unarmed, well forward, 0.180 to 2.268 mm. from anterior end. Testes irregular, smooth, in posterior fourth of body posterior to ovary, twenty-seven to forty-eight in number. Ovary in anterior part of posterior third of body in shape of question mark, anterior end enlarged, posterior end bent back on itself for a short distance. Oviduct arises from anterior expanded portion of ovary. Uterus greatly expanded to one half body width, from genital pore to ovary, filled with many eggs. Eggs fusiform, pointed at both ends, four times as long as wide, 0.160 to 0.176 mm. in length by 0.040 to 0.044 mm. in width with operculum at anterior end and slender polar filament at each end, not quite as long as egg. Nervous system with typical brain on dorsal side just in front of genital pore, lateral nerve cords very prominent with cross commissure connecting them at anterior part of haptor, connected at posterior end, with attenuated branch on right side anterior to suckers at anterior end of long side of haptor and slender nerves arising from lateral nerve cords going to base of suckers.

Comparisons. *A. elongata* differs from *A. carangis* MacCallum, 1918 in having an unarmed genital pore and in the number, size, and arrangement of the posterior suckers. *A. heterocerca* Goto, 1894 has thirty suckers on one side of the haptor and nine on the other as compared to twenty-four to twenty-five and four to five, and also differs in body size and size of suckers as well as posteriorly confluent vitellaria.

A. elongata is named from the fact that it is relatively long compared with its width.

***Axine aberrans* Goto, 1894**

(Plate 9, fig. 59)

Host: *Tylosurus fodiator* (Jordan and Gilbert), agujón,
or hound fish

Location: Gills

Locality: Port Utria, Colombia

Number: 6

This species was described by Goto in 1894 from the gills of *Belone schismatorhynchus*. Those found in Colombia are smaller, measuring 1.7 to 2.3 mm. Goto's measure 5.0 mm. in length. In other respects, however, these specimens agree with Goto's description.

Pseudaxine mexicana, new species

(Plate 9, figs. 60-63)

Host: *Scomberomorus maculatus* (Mitchill)

Location: Gills

Locality: Tangola-Tangola, Mexico

Number: 2

Body relatively short and narrow curving to left, 1.950 mm. in length by 0.322 to 0.373 mm. in width at widest part at middle of body and tapering slightly anteriorly and posteriorly. Posterior haptor almost as wide as length of body proper, extremely convex at posterior end, bearing thirty-seven suckers. Posterior suckers large, elliptical, broader than long, 0.058 mm. in length by 0.088 mm. in width. Chitinous skeleton (fig. 61) of suckers has broad triangular piece at anterior of central piece which has two lateral hook-like prolongations at distal end; middle part of central piece double with wide elliptical opening between the two sides, joining at posterior to form another triangular piece which is not quite as wide as anterior one; two pairs of relatively slender curved pieces at sides, one pair somewhat longer than the other and after enlarging at distal tips tapering to fine points; one pair imbedded in base of sucker almost touching each other medianly, approximately one third width of sucker, wider at proximal end, extending obliquely anteriorly and laterally; six to seven slender, equidistant pieces imbedded in each side of sucker. Mouth subterminal, ventral. Pharynx bulb-shaped, 0.044 to 0.056 mm. in length by 0.028 mm. in width. Esophagus relatively short and slender, bifurcating in region of genital pore. Intestinal limbs with lateral branches, not united behind. Genital pore well forward one half distance from anterior end to anterior border of vitellaria. Testes from posterior to ovary to haptor, relatively small, wider than long, irregularly arranged in two rows, thirty-six in number. Vas deferens a relatively wide tortuous tube winding horizontally twelve to fourteen times before reaching upper end of ovary where it is more slender and passes almost straight posteriorly in mid-line to testes, enlarged at anterior end to form cirrus. Cirrus armed with ten straight, slender pointed spines pointing anteriorly, arranged around top of cirrus in a circle and slanting inward toward each other at the anterior end; 0.018 mm. in length. Ovary slightly posterior to middle of body on left

side halfway from mid-line to lateral edge of body, inverted U-shaped, left arm somewhat shorter than right and more slender, posterior end of right arm bends on itself and after running anteriorly a short distance it bends back on itself and passes posteriorly for a short distance. Oviduct arises from lower end of right arm. No eggs present.

Comparisons. *P. mexicana* is very similar to *P. trachuri* Par. and Per., 1890. The chief differences seem to be the more anterior position of the genital pore which is near the pharynx in *P. mexicana* but posterior to the intestinal bifurcation in *P. trachuri*; the apparent lack of the anterior crown of genital spines; the more coiled vas deferens and biloculate rather than uniloculate buccal suckers. The vitellaria in *P. trachuri* extend forward to the genital pore and are a considerable distance posterior to it in *P. mexicana*. *P. trachuri* measures 4.0 to 6.0 mm. in length as compared to 1.95 in *P. mexicana* which has, however, larger buccal suckers, larger suckers on the haptor, and larger posterior hooks. The thirty-seven claspers on the haptor are not significantly different from twenty-four to thirty-two found in *P. trachuri*.

P. mexicana is named after its geographic location, Mexico.

Protomicrocotyle pacifica, new species

(Plate 9, figs. 64-74)

Host: *Xurel marginatus* (Hill)

Location: Gills

Locality: Port Culebra, Costa Rica

Number: 11

Body elongate, flat, broadest at anterior third, attenuated anteriorly, and tapering posteriorly to the haptor, 2.8 to 4.33 mm. in length, width at anterior third 0.996 to 1.430 mm. Posterior haptor dumbbell-shaped bearing three pairs of hooks, outer hooks larger and more anteriorly located, with sharp recurved points directed anteriorly and bifurcated enlargement at middle of length, 0.040 mm. in length; second pair short, slightly anterior to inner pair, 0.016 mm. in length; inner hooks similar in shape to outer, 0.024 mm. in length. Four posterior suckers on left side at posterior end, ventral, elliptical, broader than long, 0.076 to 0.092 mm. in length by 0.108 to 0.120 mm. in width. Chitinous skeleton (fig. 65) consists of cen-

tral piece slightly broader at base bifurcating at distal end; one pair of lateral pieces connected posteriorly with blunt tip at distal ends and a pair of projecting pieces, stout and bluntly pointed, pointing halfway to base of sucker and obliquely toward central piece; one pair of lateral pieces separated posteriorly, not as long as other pair. Brain anterior to pharynx. No eyes. Excretory pores paired, dorsal, lateral almost to the edge of worm. Mouth subterminal, ventral. Two anterior suckers elliptical, without membranous septa, broader than long, 0.044 to 0.054 mm. in length, 0.060 to 0.092 mm. in width. Pharynx longer than wide, bulb-shaped, 0.100 to 0.116 mm. in length by 0.080 mm. in width. Esophagus long, branched, in mid-line to right of genital atrium and to left of vaginal opening, bifurcating short distance posterior to genital opening. Intestinal crura extend to haptor, separated posteriorly, numerous lateral branches to outside, few to inside. Genital pore ventral, to left of mid-line. Genital atrium elliptical, large, longer than broad, with ten short hooks and ten long hooks with sharp recurved points, short hooks 0.108 to 0.120 mm. in length, long hooks 0.168 to 0.184 mm. in length. Ovary in posterior part of body. Genitointestinal canal present. Vitellaria, fine, acinous, extend from genital atrium to haptor, separated in front and intermingled behind. Uterus opens into side of genital atrium. Vaginal opening ventral, to right of mid-line, armed with numerous, short, triangular spines, 0.008 to 0.012 mm. in length. Vagina simple. Testes anterior to ovary, small and numerous (150 to 200). Vas deferens opens into base of genital atrium. Cirrus muscular, unarmed, cylindrical, in genital atrium. Eggs 0.046 mm. in width by 0.160 mm. in length with polar filament at each end.

Comparisons. *P. mirabile* (MacCallum) from *Caranx hippos* differs from *P. pacifica* in the length of the genital atrium spines, measuring 0.040 mm. in length and all approximately the same length, compared to spines of *P. pacifica* of two sizes, three to four times the length of spines of *P. mirabile*. The eggs of *P. pacifica* are 0.046 mm. in width by 0.160 mm. in length compared to 0.320 to 0.720 mm. by 0.080 to 0.140 mm.

Discussion. This is another example of related species living on related hosts among the ectoparasitic trematodes. The type species, *Protomicrocotyle mirabile* (MacCallum, 1918), was found on *Caranx hippos* Linnaeus from the New York Aquarium. The above species,

P. pacifica, was found on the gills of *Xurel marginatus* (Gill) [synonym: *Caranx marginatus* (Gill)], from Port Culebra, Costa Rica.

P. pacifica is named after its geographic location, the Pacific Ocean. The only other described species lives in the Atlantic Ocean.

MacCallum (1918) described *Acanthodiscus mirabile* from *Caranx hippos*, and placed it in the *Gyrodactylidae* van Ben. and Hesse. Johnston and Tiegs (1922) gave it the genus name *Protomicrocotyle* since *Acanthodiscus* was preoccupied and created the new subfamily *Protomicrocotylinae*. Poche (1925) placed it in a new family, the *Protomicrocotylidae*.

The writer has examined and measured the type and paratypes which were sent to him by Dr. E. W. Price from the United States National Museum. Not only did MacCallum misinterpret structures but he also made mistakes in his measurements. The evidence from the type material indicates that when MacCallum says fifteen microns he means 150 microns. He misinterprets the spines of the genital atrium and calls them the penis spines. He does not mention the vagina. Price (1936), after re-examining the type material, reduces the family *Protomicrocotylidae* to subfamily rank since it does not differ enough from other microcotylids to warrant a new family.

***Cestracolpa cypseluri*, new genus, new species**
(Plate 10, figs. 75-80)

Host: *Cypselurus collopterus* (Gunther)

Location: Gills

Locality: Charles Island, Galapagos Islands

Number: 2

Body 3.046 to 3.076 mm. in length by 0.678 to 0.695 mm. at greatest width, slender, broadest throughout middle third, tapering slightly anteriorly and posteriorly to middle of posterior third of body where it broadens posteriorly to haptor. Posterior haptor 1.018 to 1.300 mm. in width, broader than greatest body width, posterior border truncate with almost a straight edge bearing forty-one suckers in one row. Posterior suckers elliptical, four times as wide as long, 0.020 mm. in length by 0.080 mm. in width, located at equal distances one behind the other pointing diagonally anteriorly and toward the right with transverse axis at an approximate angle of forty-five degrees with long axis of body. Chitinous skeleton of

suckers (fig. 76) composed of eleven pieces, central piece bifurcated at distal end, relatively short, bluntly bifurcated at proximal end; short piece placed horizontally distal to central piece and between its bifurcation, concave distally; four pairs in lateral walls of suckers, on each side a basal piece extending laterally from middle piece, convex at posterior border, and three curved, attenuated pieces pointing obliquely and distally toward mid-line of sucker, joining basal pair of lateral pieces at distal end; slender bar across top with beaded appearance, bending inward at center toward middle piece and convex at anterior borders on both sides. Anterior suckers elliptical, longer than broad, 0.068 to 0.072 mm. in length by 0.044 to 0.048 mm. in width, without membranous septa. Mouth subterminal, ventral, close to anterior end. Pharynx bulb-shaped, longer than wide, 0.044 to 0.056 mm. in length by 0.036 to 0.040 mm. in width. Esophagus extremely long and slender, passing ventral to brain swinging to left past genital pore and swinging back again to mid-line just posterior to genital pore, bifurcating posterior to genital pore slightly anterior to level of vaginal opening. Intestinal limbs slender with lateral branches, extend to haptor, not united posteriorly. Brain as in *Axine*, a relatively great distance posterior to pharynx almost half distance from anterior end to genital pore. Testes large, smooth, broader than long, unlobed, sixty-two in number, extending from ovary almost to haptor. Vas deferens relatively wide and winding, passing posteriorly to right of uterus. Cirrus at base of genital atrium, strongly muscular, cup-shaped, broader than long with open end of cup pointing anteriorly, upper rim has circle of fourteen strong curved spines, with points directed posteriorly and toward center of cup, 0.014 to 0.020 mm. in length. Genital pore anterior to bifurcation of esophagus. Genital atrium (fig. 78) with four groups of spines, a complete circle near the genital pore, with sharp recurved points directed away from center of circle, 0.016 mm. in length; two pairs of ten spines each on each side of circle around genital pore, 0.020 to 0.024 mm. in length, bending posteriorly from their base and then bending slightly anteriorly with sharp points forming two parallel rows on each side of the genital atrium; a posterior group attached to cirrus described above. Vagina opens dorsally on right side at extreme right edge of worm slightly posterior to level of bifurcation of esophagus. Vaginal spine (fig. 77) imbedded in wall of vagina at distal end extending out of vagi-

nal opening a short distance, 0.048 mm. in length by 0.018 to 0.020 mm. in diameter at base, with broad spherical base and tapering distally to outer distal tip which is bifurcated. Vaginal canal, single, slender, extending from vaginal opening obliquely posterior to the left and joining left vitelline duct. Ovary U-shaped, right arm almost twice as long as left arm, just anterior to middle of body in mid-line. Oviduct arises from right arm of ovary, is joined by common yolk duct near ovary, passes anteriorly to right of mid-line where it receives openings of seminal receptacle and genitointestinal before joining upper end of common yolk duct on right side. Seminal receptacle elliptical, relatively large, twice as long as wide, to right of mid-line anterior to ovary, 0.108 to 1.120 mm. in length by 0.520 to 0.060 mm. in width. Vitellaria from vaginal canal on right side and level of bifurcation of esophagus on left to haptor, separated anteriorly and posteriorly. Common yolk duct elongated, sac-like, to left of mid-line. Genitointestinal canal present. Mature eggs not present. Large cells on each side of genital pore for which the author proposes the name *giant cells* (fig. 75), three pairs extending from brain to bifurcation of esophagus, from one fourth to one third width of animal at level of genital pore.

C. cypseluri is named after the genus of its host, *Cypselurus*.

GENERIC DIAGNOSIS OF CESTRACOLPA

Body elongated, slender anteriorly, truncate posteriorly, asymmetrical due to unusual development of one side of posterior haptor. Long side of diagonal posterior haptor bears numerous (sixty to 100) suckers in a single row. No chitinous hooks at posterior end of body. Vaginal opening single, lateral. Vaginal canal single, bearing conspicuous spine at distal end. Genital spines in four groups, one anterior, one posterior, and two lateral. Testes numerous posterior to ovary. Mouth subterminal, ventral. Mouth cavity with a pair of elliptical suckers. Three pairs of giant cells on each side of genital pore. The giant cells on each side of the genital pore seem to be unique. The common yolk duct is enlarged, sac-like, and extends posteriorly to left of mid-line but instead of joining the oviduct at the posterior end it joins it at the anterior end. The vagina arises from the yolk duct on the right side just before the two yolk ducts unite. The four groups of genital spines, three groups associated

with the atrium and one with the cirrus, are characteristic of the genus.

Discussion. The shape, size, and arrangement of posterior suckers of *Cestracolpa* is similar to *Axine*. The genus differs from *Axine* principally in that it has a lateral vaginal opening with a conspicuous spine imbedded in the wall at distal end of vaginal canal and protruding from the vaginal orifice.

The name *Cestracolpa* is from *cestra*, dart, and *colpa*, vagina, referring to the spine in the vagina.

***Cestracolpa yamagutii*, new species**

(Plate 10, figs. 81-85)

Host: Unidentified flying fish

Location: Gills

Localities: Clarion Island, Mexico, and open sea off coast of Mexico

Number: 2

Body 7.323 to 7.886 mm. in length by 1.732 to 1.733 mm. at greatest width, divided into three portions, a slender, attenuated part anterior to vaginal opening, a broad middle part which tapers slightly from middle of body to level slightly anterior to haptor and the short broad region bearing haptor. Posterior haptor with concave border on right side, 1.168 to 1.169 mm. in width. Posterior suckers small, seventy-five in number, four times as wide as long, 0.020 mm. in length by 0.080 mm. in width. Chitinous skeleton (fig. 84) of suckers consists of a very wide, short piece in center bifurcated at both ends; two pairs of relatively short and slender pieces imbedded in lateral walls of sucker; twenty-four short, almost straight pieces imbedded in base of sucker, twelve on each side; and two pieces across top with convex borders directed distally. Mouth subterminal, ventral, almost at extreme end. Pharynx relatively small, bulb-shaped, 0.044 mm. in length by 0.036 to 0.044 mm. in width. Esophagus long, relatively wide, in mid-line, bifurcating just anterior to level of vaginal opening. Anterior suckers small, elliptical, longer than broad without membranous septa, 0.060 to 0.064 mm. in length by 0.032 mm. in width. Intestinal limbs with lateral branches, not united posteriorly. Testes large, smooth, broader than long, in two rows, fifty-two in number. Vas deferens slender,

slightly winding tube from genital pore to one half distance to ovary after which it broadens to wide tortuous tube to left of ovary. Cirrus armed with circle of ten short spines with broad bases and fine, sharp recurved points directed toward center of cirrus. Cirrus spines 0.006 mm. in length. Genital pore in anterior narrow region of body halfway from anterior end to vaginal opening. Genital atrium with four sets of spines, an incomplete circle of fourteen spines surrounding anterior end of uterus, 0.016 mm. in length, pointing anteriorly, curved, with distal ends pointing away from center of incomplete circle; two groups of thirty spines each arranged in a curve on each side of genital atrium, 0.012 mm. in length, slightly curved with points directed anteriorly and outward away from center of genital atrium; fourth group attached to cirrus. Vaginal opening dorsal, posterior to bifurcation of esophagus. Vaginal spine imbedded in wall at distal end of vagina not extending through vaginal orifice, 0.040 to 0.046 mm. in length by 0.020 mm. in width, slightly bifurcated at tip. Vaginal canal single, slender, passingly obliquely posterior to left from vaginal pore joining middle of left vitelline duct. Ovary U-shaped in anterior third of body in mid-line, right arm broader, anterior end of left arm somewhat lobed. Oviduct arises from right arm of ovary and proceeds anteriorly as in *C. cypseluri*. Seminal receptacle elliptical, longer than broad to right of mid-line anterior to ovary, 0.152 mm. in length by 0.067 mm. in width. Vitellaria from vagina on right side and level of bifurcation of esophagus on left to haptor, separated anteriorly and posteriorly. Common yolk duct slender to left of mid-line. Genitointestinal present. Mature eggs not present.

Comparisons. *C. yamagutii* differs from *C. cypseluri* in size, being over twice as long and wide. The region anterior to the vaginal opening is narrower. The ovary is closer to the anterior end. The vaginal spine is slightly shorter and differs greatly in shape, the basal portion is elongated, elliptical rather than spherical. The genital atrium has the same number of groups of spines but their size, number, and arrangement are different, the central group making an incomplete circle as compared with a complete circle. The posterior suckers are seventy-five in number compared to forty-one and vary greatly in number and arrangement of skeletal pieces.

C. yamagutii is named in honor of Professor Yamaguti of Japan.

SUMMARY AND CONCLUSIONS

A study was made of twenty-two species of Monogenea collected from the gills of marine fish by Dr. H. W. Manter from the Galapagos Islands, the Pacific Coast of South America, Central America, and Mexico, including some adjacent islands.

Twenty new species are described. All are placed in known genera with one exception. Two previously described species, *Encotylabe pagrosomi* MacCallum and *Axine aberrans* Goto, are reported from new localities.

One new genus is proposed: *Cestracolpa*, which has a characteristic lateral vaginal opening and a spine imbedded in the wall of the distal end of the vagina.

New species are described in the following genera: *Benedenia*, *Entobdella*, *Heterobothrium*, *Diclidophora*, *Microcotyle*, *Gotocotyla*, *Thoracocotyle*, *Axine*, *Pseudaxine*, *Protomicrocotyle*, and *Cestracolpa*.

Previously undescribed structures surrounding the genital pore of *Cestracolpa cypseluri* and *C. yamagutii* are described and the name giant cells proposed for them.

The name glands of Goto is proposed for posttesticular glands first described by Goto and called different names by various authors. They are considered of taxonomic significance.

The fact that related species of ectoparasitic trematodes live on related hosts is pointed out. For example, two species of *Cestracolpa* were collected, both from flying fish. The twenty-two species described in this paper were each found on only one specific host although over five hundred fish representing approximately one hundred species were examined.



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EXPLANATION OF PLATES

All figures were drawn with the aid of a camera lucida. The scale is indicated in the drawings. Abbreviations are as follows:

<i>d</i>	vas deferens	<i>p</i>	penis
<i>c</i>	cirrus	<i>pr</i>	prostate gland
<i>e</i>	excretory bladder	<i>pr</i>	prostatic reservoir
<i>ep</i>	excretory pore	<i>sr</i>	seminal receptacle
<i>ga</i>	genital atrium	<i>t</i>	testis
<i>gc</i>	giant cell	<i>ut</i>	uterus
<i>gp</i>	genital pore	<i>v</i>	vagina
<i>gic</i>	genitointestinal canal	<i>vll</i>	vitelline gland
<i>i</i>	intestine	<i>vr</i>	vitelline reservoir
<i>m</i>	mouth	<i>vs</i>	vaginal spine
<i>mg</i>	shell gland	<i>x</i>	structure of problematic nature
<i>od</i>	oviduct	<i>vd</i>	common yolk duct
<i>ot</i>	ootype	<i>g</i>	gland of Goto
<i>ov</i>	ovary		

PLATE 4

- FIG. 1. *Benedenia isabellae*. Ventral view.
FIG. 2. Egg of *B. isabellae*.
FIG. 3. *Benedenia adenca*. Ventral view.
FIG. 4. Egg of *B. adenca*.
FIG. 5. *Benedenia anadenea*. Ventral view.
FIG. 6. Larval hook of *B. anadenea*.
FIG. 7. Gland cell of posterior haptor of *B. anadenea*.
FIG. 8. Nonglandular cells of posterior haptor of *B. anadenea*.
FIG. 9. *Entobdella muelleri*. Ventral view.

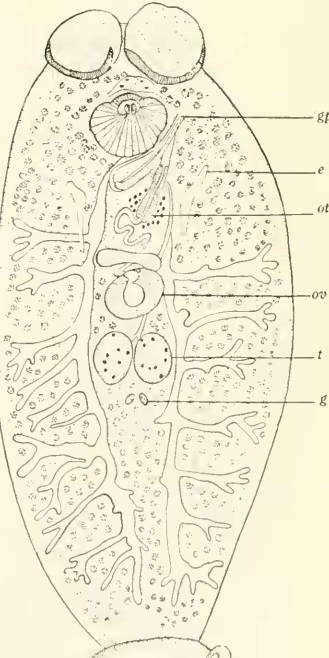
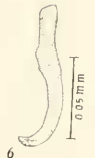
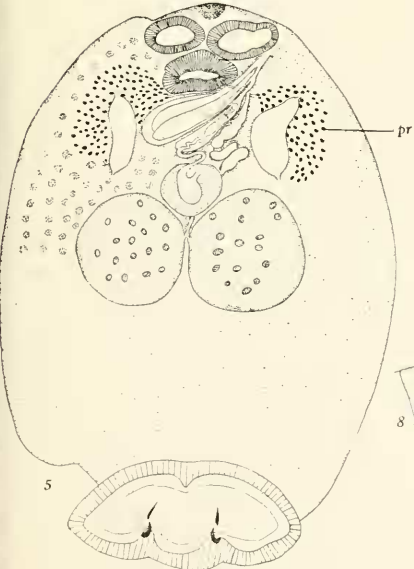
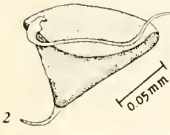
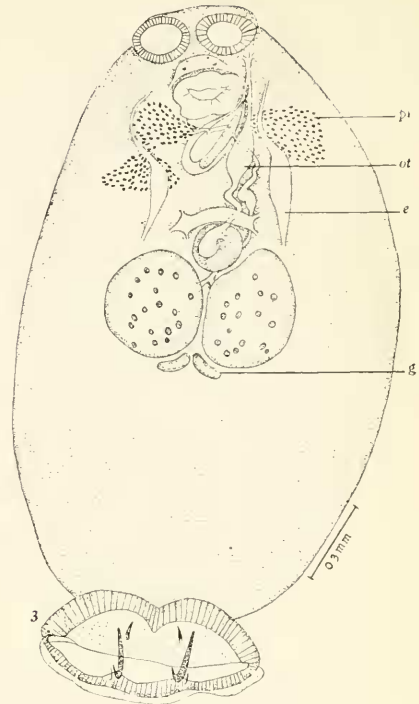
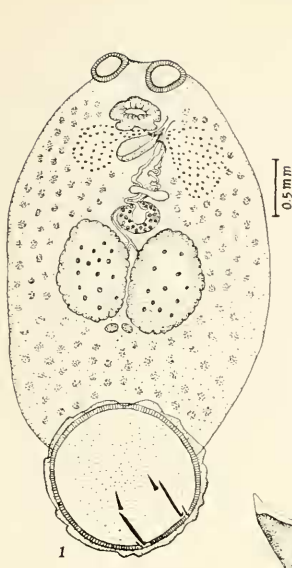
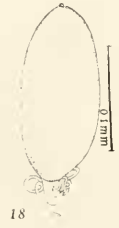
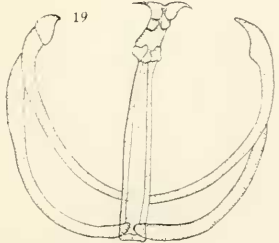
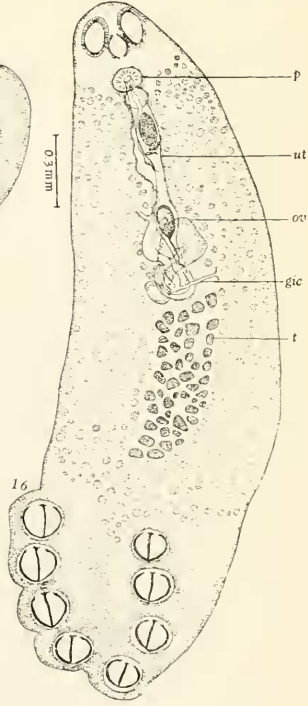
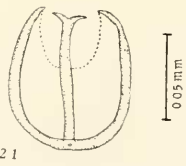
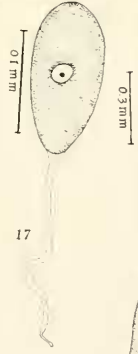
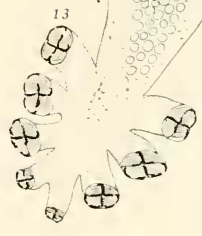
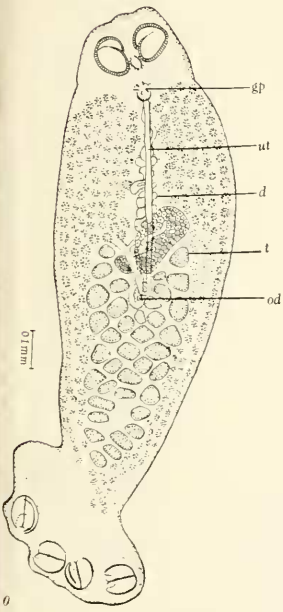
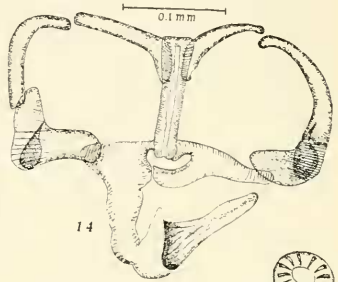
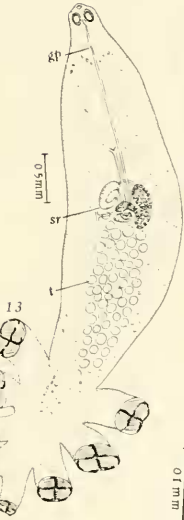
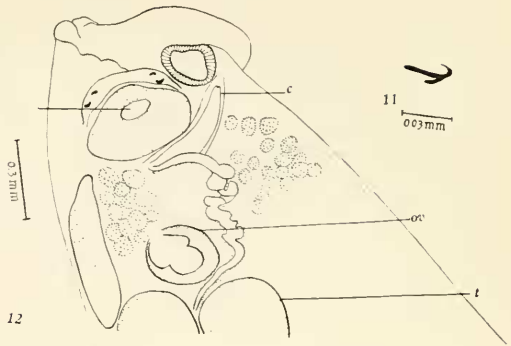
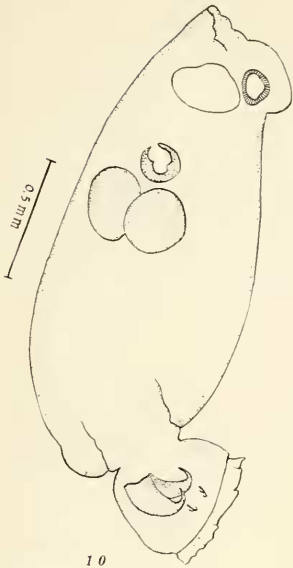


PLATE 5

- FIG. 10. *Encotyllabe pagrosomi* MacCallum. Lateral view.
FIG. 11. Small hook of posterior haptor of *E. pagrosomi*.
FIG. 12. *E. pagrosomi*. Enlarged anterior end.
FIG. 13. *Diclidophora caulolati*. Ventral view.
FIG. 14. Lateral view of chitinous skeleton of *D. caulolati*.
FIG. 15. Ventral view of cirrus and cirrus hooks of *D. caulolati*.
FIG. 16. *Heterobothrium ecuadori*. Ventral view.
FIG. 17. Egg of *H. ecuadori*.
FIG. 18. Egg of *H. ecuadori*.
FIG. 19. Chitinous skeleton of posterior sucker of *H. ecuadori*.
FIG. 20. *Heterobothrium galapagensis*. Ventral view.
FIG. 21. Chitinous skeleton of *H. galapagensis*. The lateral pieces are paired; only one half of each pair is shown.



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PLATE 6

- FIG. 22. *Hexostoma euthynni*. Ventral view.
FIG. 23. Egg of *H. euthynni*.
FIG. 24. Small posterior hook of *H. euthynni*.
FIG. 25. *Mazocraes macracanthum*. Ventral view.
FIG. 26. Posterior end of *M. macracanthum*, showing hooks.
FIG. 27. Chitinous skeleton of posterior sucker of *M. macracanthum*.
FIG. 28. Chitinous skeleton of posterior sucker of *M. macracanthum*.
FIG. 29. Ventral view of cirrus of *M. macracanthum*.
FIG. 30. *Microcotyle priacanthi*. Dorsal view.
FIG. 31. Armature of genital atrium of *M. priacanthi*.
FIG. 32. Chitinous skeleton of posterior sucker of *M. priacanthi*.
FIG. 33. *Gotocotyla acanthocybii*. Dorsal view.
FIG. 34. Dorsal view of *G. acanthocybii*. Vitellaria are diagrammatic.
FIG. 35. Chitinous skeleton of posterior sucker of *G. acanthocybii*.
FIG. 36. Posterior end of *G. acanthocybii* showing hooks.

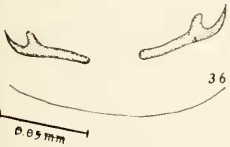
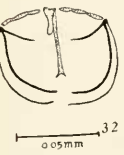
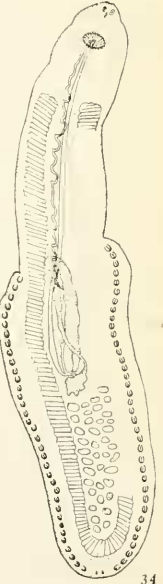
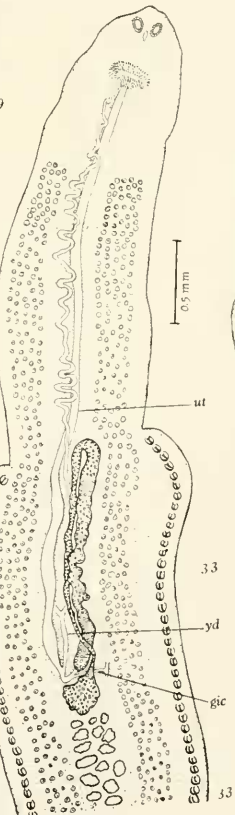
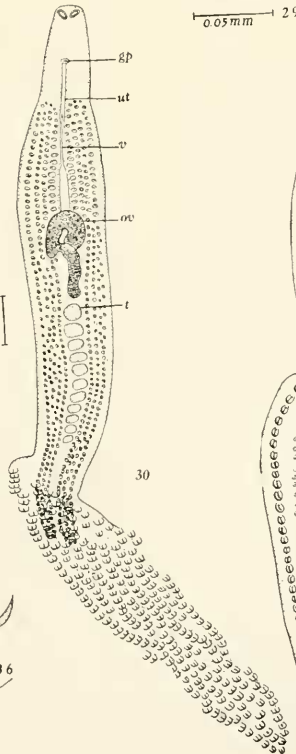
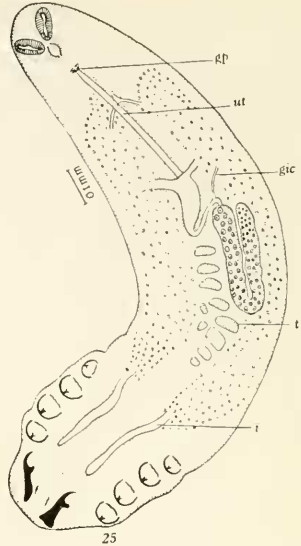
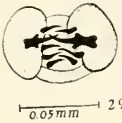
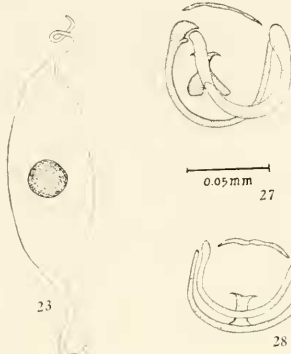
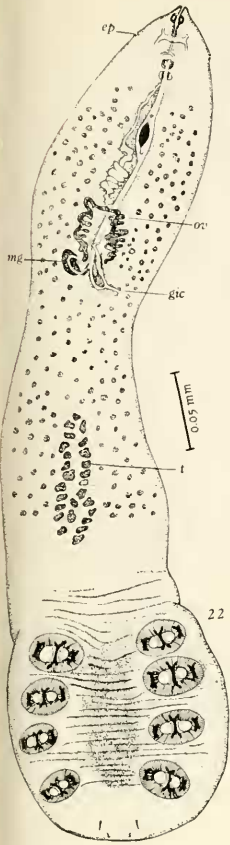


PLATE 7

- FIG. 37. *Gotocotyla elagatis*. Ventral view.
FIG. 38. Posterior end of *G. elagatis* showing hooks, Ventral view.
FIG. 39. Chitinous skeleton of posterior sucker of *G. elagatis*.
FIG. 40. Anterior end of *G. elagatis* showing mouth, anterior suckers, genital pore and pigment granules.
FIG. 41. *Thoracocotyle paradoxica*. Ventral view.
FIG. 42. Posterior end of *T. paradoxica* showing hooks.
FIG. 43. Chitinous skeleton of posterior sucker of *T. paradoxica*.

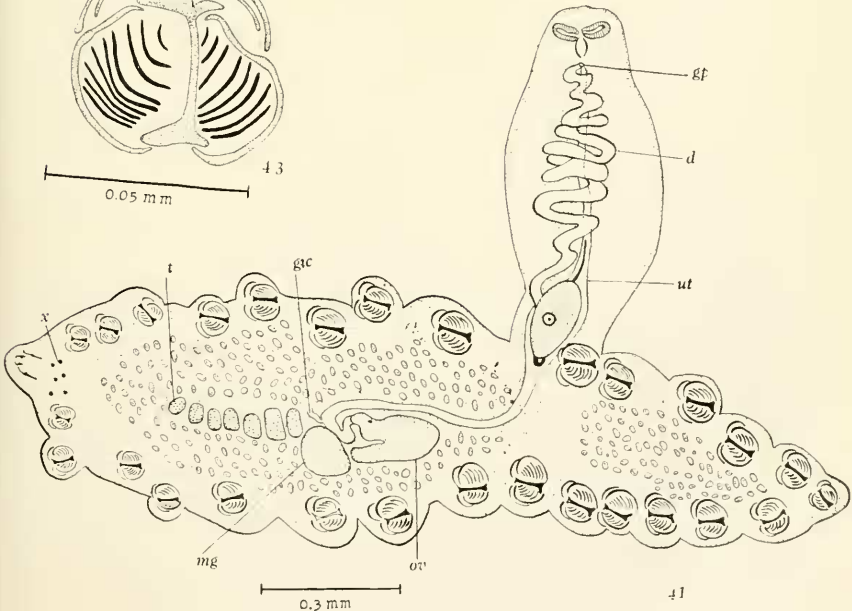
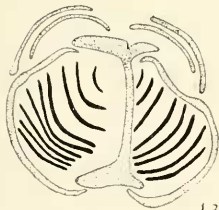
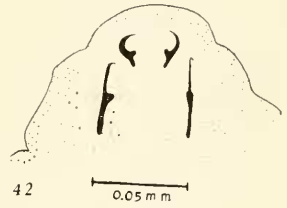
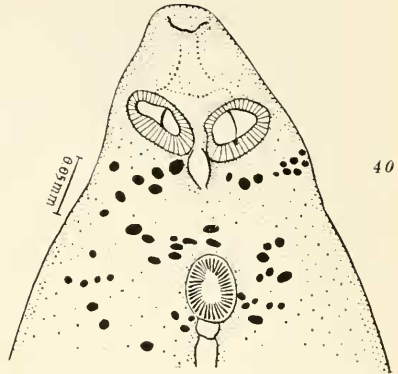
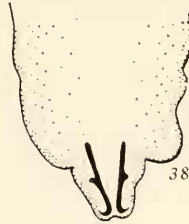
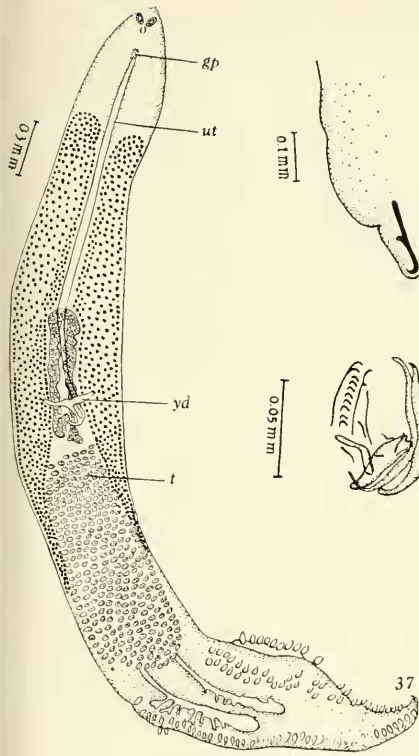


PLATE 8

- FIG. 44. *Axine oligoplitis*. Dorsal view.
- FIG. 45. Chitinous skeleton of posterior sucker of *A. oligoplitis*.
- FIG. 46. Ovary and reproductive ducts of *A. oligoplitis*. Ventral view.
- FIG. 47. Genital atrium of *A. oligoplitis* showing hooks. Ventral view.
- FIG. 48. *Axine seriolae*, ventral view of adult vitellaria and testicular region diagrammatic.
- FIG. 49. Chitinous skeleton of *A. seriolae*. The lateral pieces are paired; one half not shown.
- FIG. 50. Ventral view of ovary and reproductive ducts of *A. seriolae*.
- FIG. 51. Eggs of *A. seriolae*.
- FIG. 52. Anterior end of *A. seriolae*. Ventral view.
- FIG. 53. *Axine elongata*. Dorsal view.
- FIG. 54. Eggs of *A. elongata*, one of which has a detached operculum.
- FIG. 55. Anterior end of *A. elongata* showing anterior suckers and genital pore. Ventral view.
- FIG. 56. Ventral view of genital pore of *A. elongata*.
- FIG. 57. Chitinous skeleton of posterior sucker of *A. elongata*.
- FIG. 58. Dorsal view of ovary and reproductive ducts of *A. elongata*.

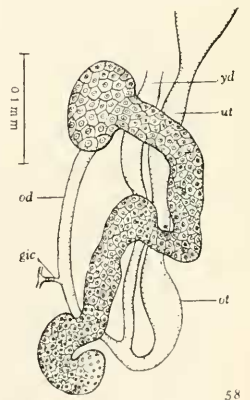
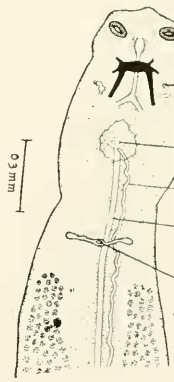
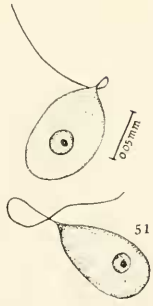
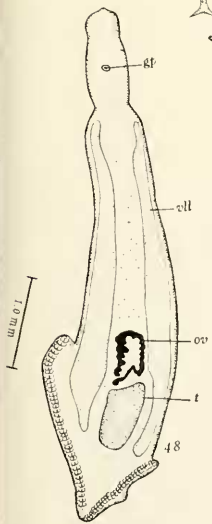
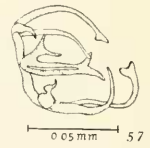
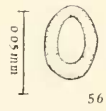
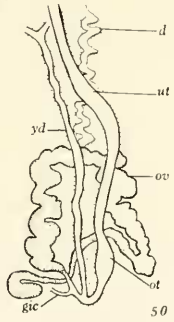
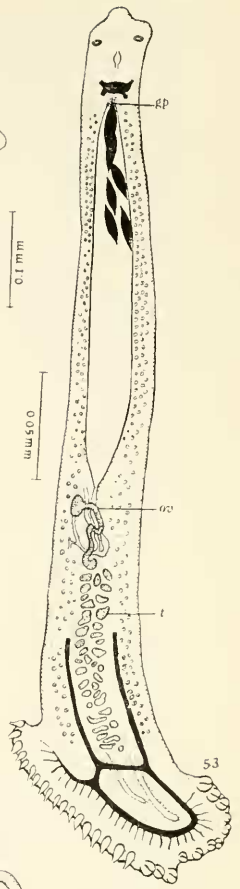
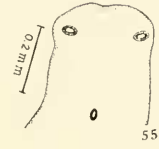
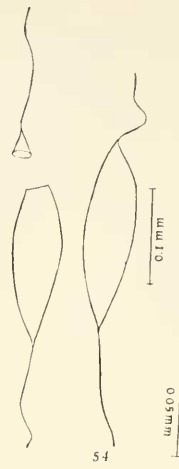
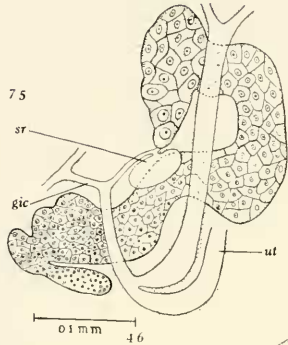
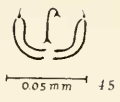


PLATE 9

- FIG. 59. *Axine aberrans* Goto. Dorsal view.
FIG. 60. *Pseudaxine mexicana*. Ventral view.
FIG. 61. Chitinous skeleton of posterior sucker of *P. mexicana*.
FIG. 62. Upper end of vas deferens of *P. mexicana* showing hooks.
FIG. 63. Posterior hooks of *P. mexicana*.
FIG. 64. *Protomicrocotyle pacifica*. Posterior haptor not shown. Ventral view.
FIG. 65. Chitinous skeleton of posterior sucker of *P. pacifica*.
FIG. 66. Posterior haptor and posterior suckers of *P. pacifica*.
FIG. 67. Cross section through genital atrium showing cirrus and atrial spines of *P. pacifica*.
FIG. 68. Large outer hook of posterior haptor of *P. pacifica*.
FIG. 69. Inner hook of posterior haptor of *P. pacifica*.
FIG. 70. Ventral view of anterior end of *P. pacifica*.
FIG. 71. *P. pacifica*. Ventral view.
FIG. 72. Hooks of genital atrium of *P. pacifica*.
FIG. 73. Posterior hooks of *P. pacifica*.
FIG. 74. Vaginal opening and spines in enlarged upper end of vagina of *P. pacifica*. Ventral view.

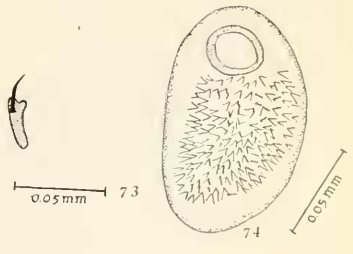
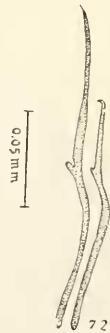
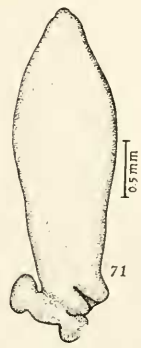
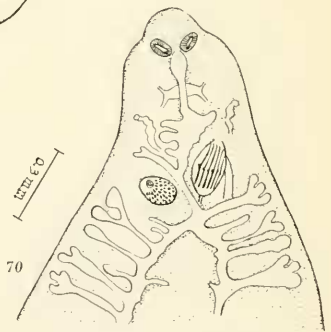
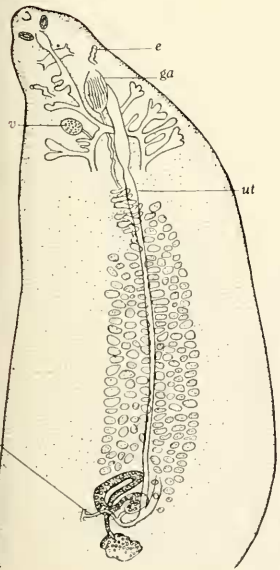
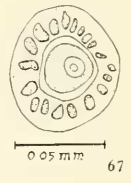
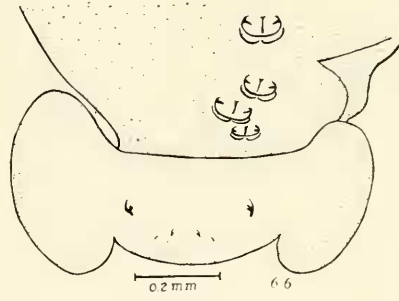
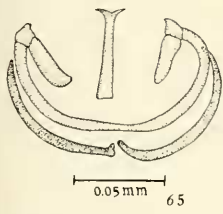
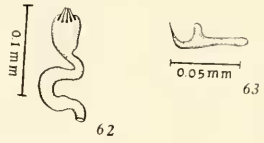
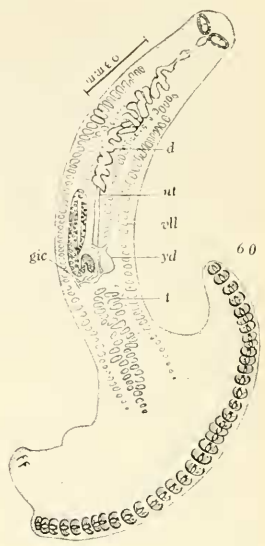
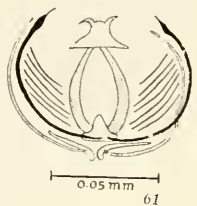
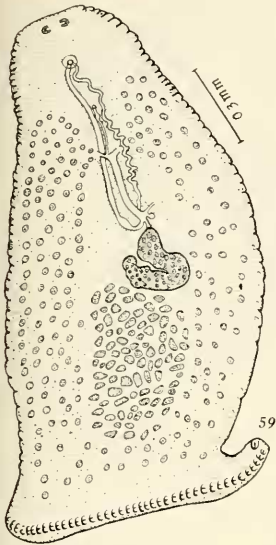


PLATE 10

- FIG. 75. *Cestracolpa cypseluri*, anterior end enlarged. Dorsal view.
FIG. 76. Chitinous skeleton of posterior sucker of *C. cypseluri*.
FIG. 77. Vaginal spine of *C. cypseluri*.
FIG. 78. Armature of genital atrium of *C. cypseluri*.
FIG. 79. Two ova of *C. cypseluri* from anterior end of ovary.
FIG. 80. *C. cypseluri*. Dorsal view.
FIG. 81. *Cestracolpa yamagutii*. Dorsal view.
FIG. 82. Armature of genital atrium of *C. yamagutii*.
FIG. 83. Vaginal spine of *C. yamagutii*.
FIG. 84. Chitinous skeleton of posterior sucker of *C. yamagutii*.
FIG. 85. Ovary and reproductive ducts of *C. yamagutii*. Dorsal view.

