

# New Monogenetic Trematodes from Hawaiian Fishes, I<sup>1</sup>

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THE PRESENT REPORT is based on the collections made by my technical assistant, Mr. Shunya Kamegai, in 1963. The source of material was chiefly from the Honolulu Fish Market, and partly from the University Aquarium at Waikiki Beach. I am particularly indebted to the director of the Aquarium, Prof. S. W. Tinker, for his supply of frozen fish material from which my first collections of monogenetic forms were made. I wish to express my appreciation also to Prof. W. A. Gosline, Department of Zoology, University of Hawaii, who identified the fish; Prof. G. W. Chu, Department of Microbiology, for his official sponsorship on behalf of the University of Hawaii; Mr. S. Kamegai for collecting parasites and drafting the figures of the parasites; and Mrs. S. Yamaguti for finishing the figures, preparing the plates, and typing the manuscript.

The monogenetic trematodes of the Hawaiian fishes have so far remained unexplored, so that special attention was directed to this group of trematodes. It is surprising that Hawaiian fishes are very commonly infested with monogenetic trematodes and that the parasites so far examined are all, with some exceptions, new to science. It will take, therefore, a long series of years to report all the findings. For this reason I have decided to report here only those new species representing new genera, before describing the large numbers of species which remain to be published in a later monograph. Some of the new genera represent new subfamilies, or even new families, as indicated in the list given below. The holotype specimens and some of the paratypes mounted on the same slides as the holotype will be deposited in the Helminthological Collection of the United States National Museum at Beltsville, Maryland, and the paratypes will be deposited along with described species in the Meguro Parasitological Museum in

Meguro, Tokyo, where I shall be in active research service after completing my research project in the United States.

The new genera described below are assigned to different families as follows:

## I. CAPSALIDAE Baird, 1853

Benedeniinae Johnston, 1931

1. *Dioncoseudobenedenia kala* n. g., n. sp.

2. *Oligoncobenedenia nasonis* n. g., n. sp.  
Pseudonitzschiinae n. subf.

3. *Pseudonitzschia uku* n. g., n. sp.

## II. MONOCOTYLIDAE Taschenberg, 1879

Monocotylineae Gamble, 1896

4. *Diplobheterocotyla dasyatis* n. g., n. sp.

## III. DACTYLOGYRIDAE Bychowsky, 1933

Ancyrocephalinae Bychowsky, 1937

5. *Neohaliotrema maomao* n. g., n. sp.

6. *Pseudempleurosoma carangis* n. g., n. sp.

## IV. DIPLECTANIDAE Bychowsky, 1957

7. *Nasobranchitrema pacificum* n. g., n. sp.

## V. PSEUDODICLIDOPHORIDAE n. fam.

Pseudodiclidophorinae n. subf.

8. *Pseudodiclidophora decapteri* n. g., n. sp.

Allopseudodiclidophorinae n. subf.

9. *Allopseudodiclidophora opelu* n. g., n. sp.

## VI. DISCOCOTYLIDAE Price, 1936

Opisthogyninae Unnithan, 1962

10. *Pseudopisthogyne lepidocybii* n. g., n. sp.

11. *Allopseudopisthogyne constricta* n. g., n. sp.

12. *Pseudopisthogynopsis lepidocybii* n. g., n. sp.

Pseudodiscocotylineae n. subf.

13. *Pseudodiscocotyla opakapaka* n. g., n. sp.

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## VII. AXINIDAE Unnithan, 1957

Alloposeudaxininae Yamaguti, 1963

14. *Alloposeudaxinoides euthynni* n. g.,  
n. sp.

Monaxininae Unnithan, 1957

15. *Allomonaxine carangoides* n. g., n.  
sp.

## VIII. GASTROCOTYLIDAE Price, 1943

Gastrocotylinae Sproston, 1946

16. *Pseudochaubanea sphyraenae* n. g.,  
n. sp.

Areotestiinae n. subf.

17. *Areotestis sibi* n. g., n. sp.

## IX. ALLOMICROCOTYLIDAE n. fam.

18. *Allomicrocotyla onaga* n. g., n. sp.

1. *Dioncopsudobenedenia kala* n. g., n. sp.

Fig. 1

HABITAT: Gill of *Naso unicornis*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 1.

DESCRIPTION (based on 18 whole mounts): Body flattened, oval or more elongate, 2.1–4.2 mm in length, with maximum width of 0.6–2.0 mm in middle third; cuticle beset with conical papillae. Opisthohaptor circular 0.5–1.0 mm in diameter, aseptate, fringed with scalloped membrane up to 25 $\mu$  wide, provided with only one pair of slender, rather acicular spines 50–75 $\mu$  long behind the center, where the haptor is attached dorsally to the body proper by a short muscular stalk; spines usually straight, apparently no more functional. Prohaptor suctorial, 0.16–0.3 mm in longer diameter, with strongly muscular wall, the anterolateral part of which contains granular, apparently glandular tissue; the two suckers are connected by a flat apical border of the body proper. Two pairs of compact eye-spots anterodorsal to pharynx. Mouth followed by a distinct prepharynx which consists of circular muscle lamellae and provided inside with more or less prominent cuticular papillae, measuring 0.1–0.24  $\times$  0.14–0.3 mm. Pharynx subglobular, 0.14–0.34  $\times$  0.16–0.38 mm, consisting mainly of radial muscle fibers enclosed in smooth capsule of circular muscle fibers. Intestinal limbs with numerous subdivided outer branches and fewer short inner branches, not confluent posteriorly; outer branches with longi-

tudinal anastomosis parallel to principal limb.

Testes oval, 0.2–0.5  $\times$  0.15–0.38 mm, directly juxtaposed, just pre-equatorial. Paired Goto's gland irregular in shape and size, containing a variable number of rounded nuclei and fine granules; the nuclei are massed together and pressed to one side of the gland or to the posterior end, sometimes showing signs of degeneration; the granules, when liquefied, occupy some or greater part of the cell. In the type the vas deferens contains a small oval degenerating nucleus in addition to spermatozoa at its very beginning among the ovary and testes; this obviously originated from the Goto's gland. After convolutions in front of the vitelline reservoir the vas deferens crosses over the uterus dorsally and penetrates the cirrus pouch near its posterior end; ejaculatory duct well provided with circular muscles, joining with prostatic duct at base of cirrus. Cirrus pouch claviform, 0.36–0.95  $\times$  0.08–0.22 mm, with thick wall of circular muscle fibers, containing prostatic reservoir 0.13–0.33 mm long by 0.05–0.28 mm wide at base, occupied for greater part by muscular ejac-

## ABBREVIATIONS USED IN FIGURES

Ac	Accompanying cell	GT	Gonotyl
ACO	Accessory copulatory organ	HG	Head gland
ACS	Accessory copulatory sclerite	HO	Head organ
AG	Apical gland	M	Mouth
AO	Apical organ	O	Ovary
AR	Atrial ring	OC	Eye spot
AS	Atrial spine	OS	Oral sucker
AVD	Anterior vitelline duct	P	Pharynx
AVGD	Accessory vaginal duct	PC	Prostatic cell
BC	Bulbus cirri	PD	Prostatic duct
BE	Bulbus ejaculatorius	PL	Preoral lobe
C	Cirrus	PM	Pars muscosa
CP	Cirrus pouch	PP	Pars prostatica
DE	Ductus ejaculatorius	PR	Prostatic reservoir
E	Egg	RS	Receptaculum seminis
ES	Esophagus	S	Sucker
EV	Excretory vesicle	SP	Sphincter
GA	Genital atrium	SV	Seminal vesicle
GI	Genito-intestinal canal	T	Testis
GO	Goto's organ or gland	V	Vagina
GP	Genital pore	VC	Vitelline commissure
		VD	Vas deferens
		VP	Vaginal pore
		VR	Vitelline reservoir
		VT	Vitelline gland
		VTD	Vitelline duct
		*	Seminoprostatic reservoir

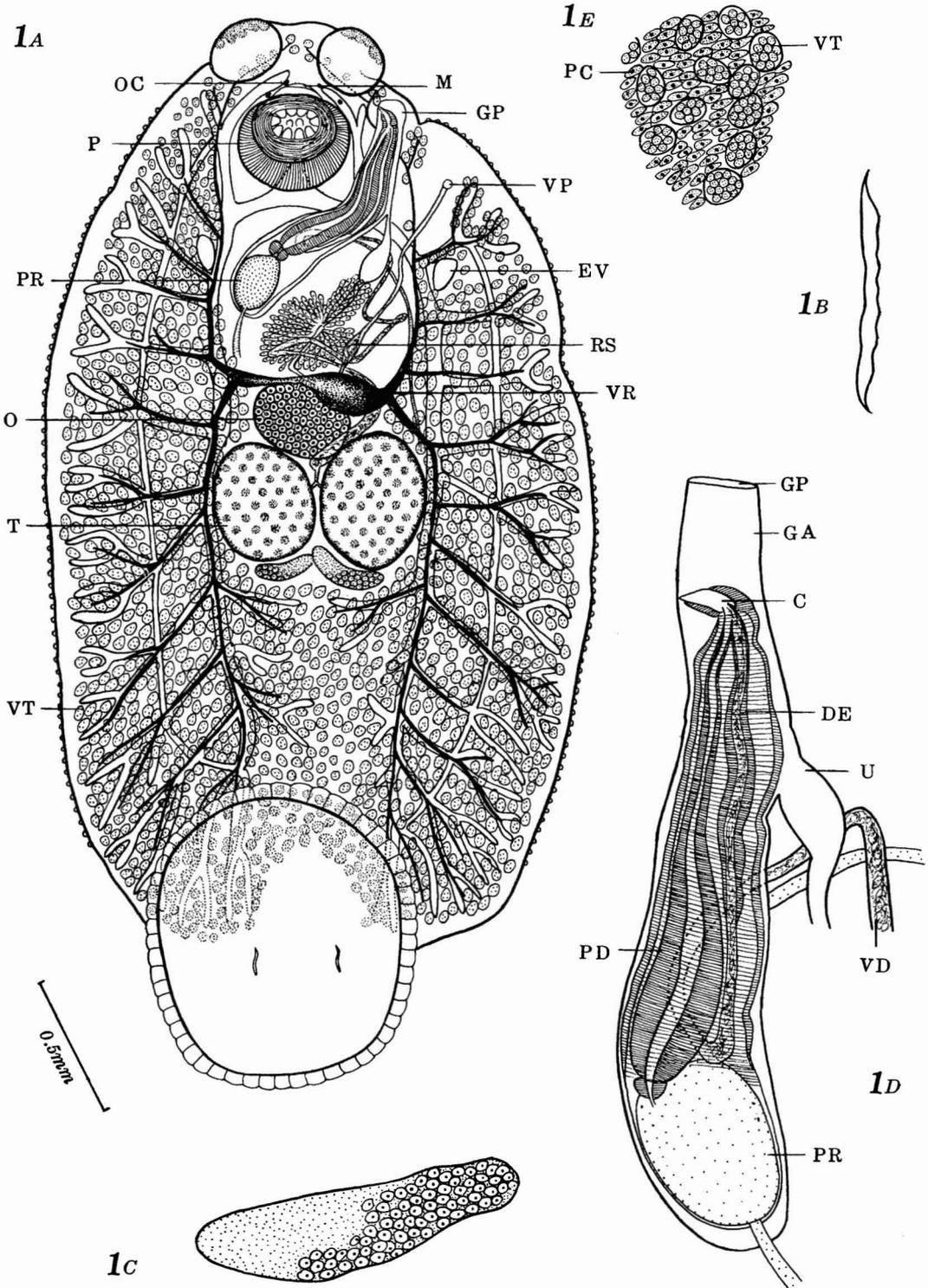


FIG. 1. *Dioncopsseudobenedenia kala* n. g., n. sp. 1A, Holotype, ventral view; 1B, haptor spine; 1C, Goto's gland; 1D, terminal genitalia, ventral view; 1E, prostate cells extensively developed among vitelline follicles.

ulatory duct and prostatic duct with thick wall of circular muscle fibers. Prostatic duct may or may not be provided proximally with a small sphincter-like bulb. Prostate cells extensively developed among vitelline follicles. Cirrus conical, unarmed, muscular, 10–15 $\mu$  long. Genital atrium thin-walled, apparently extending inwards down to the point where the uterus opens into it. Genital pore immediately posterolateral to left prohaptor.

Ovary subglobular to oval, 0.07–0.23  $\times$  0.09–0.32 mm; ootype medial to vas deferens curve; eggs about 120  $\times$  80 $\mu$ , with long filament. Uterus opening into genital atrium at a distance of about 0.3 mm from genital pore in the type. Vagina opening dorsally posterolateral to genital pore; vaginal duct crossing vas deferens coils ventrally and forming elongate seminal receptacle 50 $\mu$  wide in the type, latter opening into vitelline reservoir by a short narrow duct. Vitellaria co-extensive with intestinal branches; vitelline reservoir anterosinistral to ovary, 0.04–0.17  $\times$  0.05–0.3 mm.

DISCUSSION: This genus resembles *Pseudobenedenia* Johnston, 1931, in internal anatomy, especially in that the prostatic reservoir is enclosed in the cirrus pouch, but differs from it in possessing only one pair of rudimentary anchors instead of three pairs, and in the extensive development of prostate cells among the vitelline follicles.

#### *Dioncospseudobenedenia* n. g.

GENERIC DIAGNOSIS: Capsalidae, Benedeniinae. Prohaptor sucker-like, partly with glandular tissue. Opisthohaptor disclike, aseptate, with scalloped marginal membrane and only one pair of spines or anchors. Eyes present. Pharynx muscular or glandular. Intestinal limbs with inner and outer branches, not confluent posteriorly; outer branches united by longitudinal anastomosis parallel to principal limb. Testes juxtaposed, entire. Vas deferens winding in front of vitelline reservoir. Prostatic reservoir enclosed in cirrus pouch; prostate cells extensively developed among vitelline follicles. Common genital pore marginal or submarginal, immediately behind left prohaptor. Ovary entire, immediately pretesticular. Eggs filamented. Vagina with sub-

marginal dorsal opening near genital pore. Vitelline reservoir anterosinistral to ovary. Parasitic on gills of marine teleosts.

TYPE SPECIES: *D. kala* n sp., on *Naso unicornis*; Hawaii.

#### 2. *Oligoncobenedenia nasonis* n. g., n. sp.

Fig. 2

HABITAT: Gills of *Naso hexacanthus*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 2.

DESCRIPTION (based on 8 whole mounts): Body flattened, oval to elliptical, 1.6–2.2 mm in length, with maximum width of 0.7–1.0 mm at middle third. Opisthohaptor circular, 0.34–0.48 mm in diameter, with scalloped marginal membrane which is 25 $\mu$  wide in the type 2.0 mm long, with about 10 (14?) marginal hooklets at somewhat irregular intervals. Immediately behind the central pit of the opisthohaptor there is a pair of large anchors typical of *Benedenia*, 50–90 $\mu$  long, acute anteriorly and terminating in two blunt points posteriorly; middle pair occurring in *Benedenia* lacking entirely, posterior marginal anchor lacking in two out of 8 specimens; when present, it is 25–35 $\mu$  long, very narrow, undulating, almost filiform, terminating in a minute claw posteriorly. Prohaptor oval, saucer-shaped, 0.1–0.2 mm long, with glandular tissue along anterolateral margin; body fold between two prohaptors usually notched in median line. Two pairs of eye spots anterodorsal to pharynx. Pharynx glandular rather than muscular, 0.08–0.12  $\times$  0.12–0.15 mm, without marginal incision. Intestinal limbs ramified, but not united posteriorly.

Testes oval to elliptical, closely juxtaposed in midregion of body, 0.22–0.35  $\times$  0.18–0.33 mm, with two pairs of Goto's organs immediately behind in median field; in the type the granular contents of the organ are massed together anteriorly as if they were about to be emptied into the common efferent duct of the organ which passes forward between the two testes. Vas deferens containing granules of Goto's organ along with sperm at its proximal end between ovary and left testis. After crossing the uterus dorsally the vas deferens turns back on itself, forming an elongate seminal vesicle, and then enters the cirrus pouch at its base. Prostatic reservoir oval to elliptical, 100–180  $\times$  60–100  $\mu$ , situated longi-

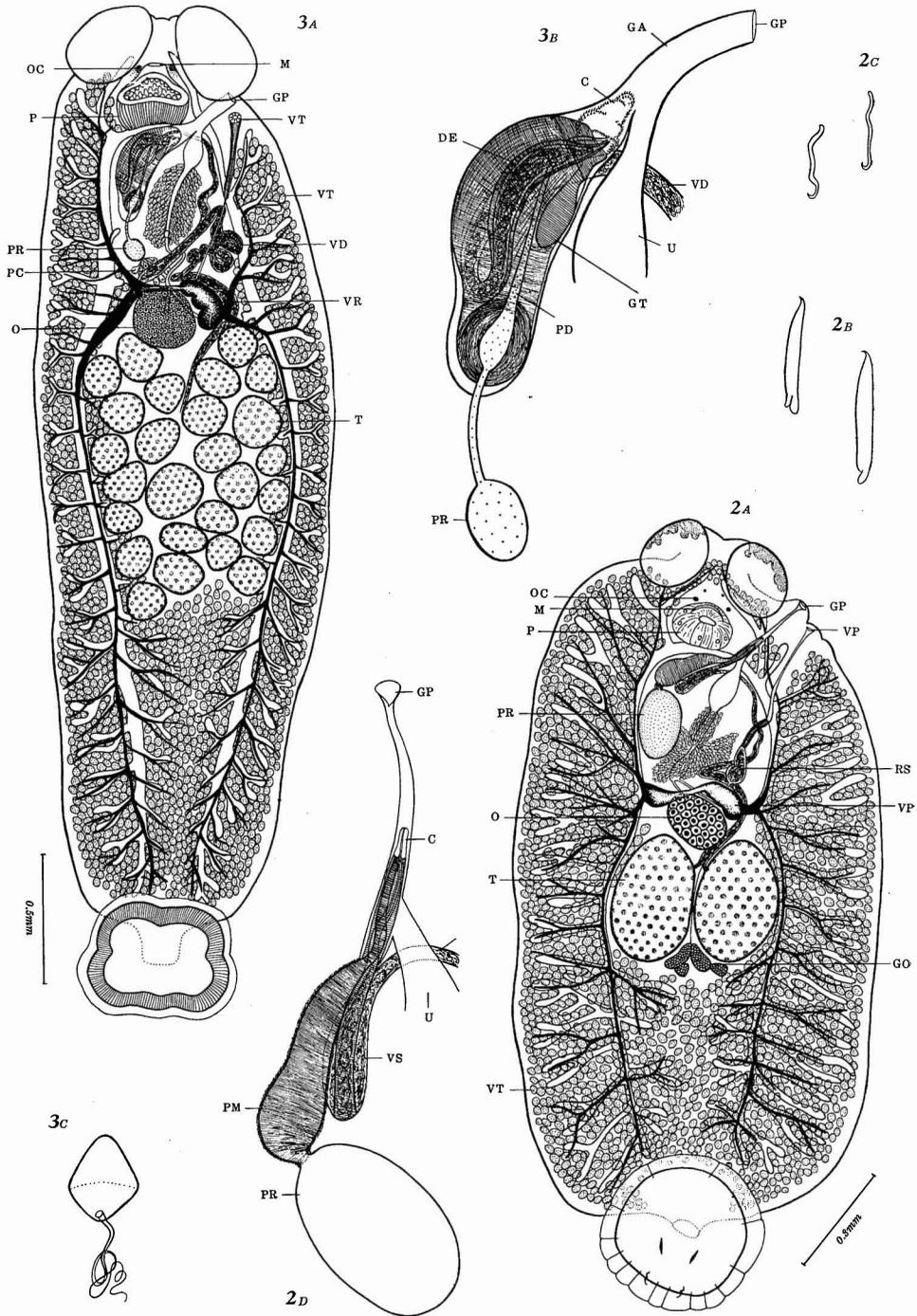


FIG. 2. *Oligoncobenedenia nasonis* n. g., n. sp. 2A, Holotype, ventral view; 2B, anterior haptor anchors; 2C, posterior haptor anchors; 2D, terminal genitalia, ventral view.

FIG. 3. *Pseudonitzschia uku* n. g., n. sp. 3A, Holotype, ventral view; 3B, terminal genitalia, ventral view; 3C, egg.

tudinally between right cecum and seminal vesicle, giving rise to a swollen tubular prostatic duct well provided with circular muscle fibers (pars muscosa). This duct  $110-200 \times 30-60\mu$ , lies transversely along the anterior surface of the seminal vesicle and tapering distally opens into the base of the cirrus pouch from the ventral side. Cirrus pouch subcylindrical, weakly muscular,  $100-175 \times 20-25\mu$ , containing a narrow ejaculatory duct and a narrow muscular prostatic duct, the latter two close parallel to each other. Cirrus rather short, narrow, unarmed. Genital atrium enclosing cirrus pouch, extending but a little beyond the point where the uterus opens into it. Genital pore opening on a prominent marginal papilla projecting immediately posterolateral to left prohaptor at level of eye-spots.

Ovary subglobular, pre-equatorial, median,  $0.13-0.2 \times 0.09-0.14$  mm. Shell gland well developed between prostatic reservoir and ascending vas deferens. Uterus opening into genital atrium close to its base. No eggs observed. Vagina opening at top of a papilliform protuberance on left body margin immediately behind genital pore; vaginal duct running obliquely backward, distinctly muscular for a distance of  $70-80\mu$  before leading into retort-shaped receptaculum seminis vaginae, which is  $80-100 \times 25-60\mu$  and lies in front of the vitelline reservoir, separated dorsally from this by the vas deferens. Vitellaria co-extensive with intestinal branches; vitelline reservoir anterosinistral to ovary,  $40-80 \times 70-130\mu$ .

DISCUSSION: The present genus is distinguished from *Benedenia* Dies., 1858, by possessing two pairs, occasionally only one pair, of haptoral anchors, and by the structure of the male terminalia. It is defined as follows.

### *Oligoncobenedenia* n. g.

GENERIC DIAGNOSIS: Capsalidae, Benedeniinae: Prohaptor in form of suctorial saucers, opisthohaptor with scalloped marginal membrane, provided usually with two pairs, occasionally one pair, of anchors similar to those of *Benedenia*. Pharynx not muscular. Intestinal limbs branched, not united posteriorly. Testes entire, juxtaposed in midregion of body; Goto's glands present. Vas deferens dilated and turning back on itself just before entering base of cirrus pouch. Prostatic

reservoir with its distal portion differentiated into swollen tubular pars muscosa, which penetrates the cirrus pouch at its base. Cirrus pouch weakly developed, enclosing a narrow muscular prostatic duct and a narrow ejaculatory duct; cirrus short, unarmed. Genital atrium extending to near base of cirrus pouch, opening on a prominent marginal papilla projecting immediately posterolateral to left prohaptor. Ovary entire, median, pretesticular. Vagina opening on left body margin immediately behind genital pore; vaginal duct muscular for a short distance before leading into receptaculum seminis vaginae. Vitelline reservoir anterosinistral to ovary. Parasitic on marine teleosts.

TYPE SPECIES: *O. nasonis* n. sp., on gills of *Naso hexacanthus*; Hawaii.

### 3. *Pseudonitzschia uku* n. g., n. sp.

#### Fig. 3

HABITAT: Gill of *Aprion virescens* (local name "uku"); Hawaii.

HOLOTYPE: U. S. Nat. Mus., Helm. Coll., S.Y. No. 3.

DESCRIPTION (based on 16 whole mounts): Body flattened subcylindrical, 2.15-3.7 mm long, with maximum width of 0.5-1.1 mm at level of midregion. Opisthohaptor discoid, attached to body proper halfway between anterior margin and center of disc, with thickened muscular margin distinctly notched midlaterally and inconspicuously at posterolateral margin and flat posterior margin. Delicate marginal membrane present, but anchors and marginal hooklets entirely absent. Prohaptor glandular, saucer-shaped, 0.28-0.4 mm long. One pair of eye spots anterodorsal to pharynx. Pharynx  $0.08-0.24 \times 0.1-0.28$  mm, without lateral constriction. Esophagus practically absent. Intestinal limbs with side branches, extending to near opisthohaptor without uniting together.

Testes rounded, 20-30 in number (most commonly 25-28), arranged in one layer, occupying anterior part of postovarian interintestinal field. Vas deferens frequently more or less swollen, rarely convoluted at very beginning between ovary and anterior testes, running forward along left margin of vitelline reservoir and then thrown into convolutions anterior to this reser-

voir; after crossing the distal end of the uterus dorsally it comes to lie on the dorsal side of the cirrus pouch where it enters the cirrus pouch and turning back on itself leads into the muscular ejaculatory duct. Ejaculatory duct joining narrow prostatic duct at base of cirrus; latter short conical, projecting into genital atrium, covered all over with very small recurved spines; from the base of the cirrus arises a claviform muscular gonotyl which is about  $100 \times 40 \mu$  in the type and directed obliquely backward. Cirrus pouch subcylindrical, curved,  $0.22-0.4 \times 0.08-0.15$  mm, situated almost longitudinally behind pharynx, provided with circular and oblique muscle fibers. Prostatic reservoir ovoid,  $75-140 \times 60-140 \mu$ , posterior to cirrus pouch; prostatic duct a little swollen and enclosed in a prominent muscle bulb of oblique fibers at posterior end of cirrus pouch, then running straight forward within cirrus pouch and finally uniting with ejaculatory duct. Genital atrium cylindrical, enclosing cirrus pouch, receiving uterus at level of cirrus, opening ventrally beneath left prohaptor.

Ovary subglobular,  $0.12-0.24 \times 0.08-0.21$  mm, situated nearly in median line at posterior end of anterior third of body. Ootype and shell gland well developed between cirrus pouch and convoluted vas deferens. Uterus opening into genital atrium distal to cirrus; eggs one at a time, pentagonal, about 0.1 mm in diameter, with filament at one pole. Vagina lined with thick corrugated cuticle, opening dorsally near left margin of body at level of pharynx; vaginal duct with fusiform swelling distally, united with vitelline reservoir near its distal end; no receptaculum seminis vaginae. Vitellaria co-extensive with intestine; vitelline reservoir on left side of ovary, more or less curved toward ovary,  $0.1-0.23 \times 0.06-0.12$  mm.

DISCUSSION: This new genus is characterized by the opisthohaptor being unarmed, although in general anatomy it resembles *Nitzschia* Baer, 1826. It is separated from all the known subfamilies of Capsalidae as representing a new subfamily on account of this unarmed opisthohaptor.

#### *Pseudonitzschia* n. subf.

SUBFAMILY DIAGNOSIS: Capsalidae. Opisthohaptor disc-shaped, unarmed, with indented

muscular margin and delicate marginal membrane, without septa, loculi, or papillae. Prohaptors saucer-shaped, paired. One pair of eye spots. Pharynx without constriction. Intestinal limbs with side branches, not united posteriorly. Testes numerous, confined to anterior postovarian interintestinal field. Vas deferens convoluted anterior to vitelline reservoir. Cirrus pouch muscular, postpharyngeal, enclosing ejaculatory duct and prostatic duct; cirrus short, armed. A muscular gonotyl present in genital atrium. Common genital pore opening ventrally beneath left prohaptor. Ovary entire, pretesticular. Ootype well developed. Uterus opening into genital atrium distal to male pore. Vagina opening dorsally close to left margin of body at level of pharynx. No receptaculum seminis vaginae. Vitellaria co-extensive with intestinal limbs and their branches. Vitelline reservoir immediately sinistral to ovary. Gill parasites of marine teleosts.

#### *Pseudonitzschia* n. g.

GENERIC DIAGNOSIS: Capsalidae, *Pseudonitzschia*: With characters of subfamily.

TYPE SPECIES: *P. uku* n. sp., on gills of *Aprion virescens*; Hawaii.

#### 4. *Diplobheterocotyla dasyatis* n. g., n. sp.

Fig. 4

HABITAT: Gill of *Dasyatis* sp. (? *D. hawaiiensis*); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 4.

DESCRIPTION (based on 7 whole mounts): Body elliptical in outline;  $0.9-1.2 \times 0.3-0.53$  mm, covered with smooth cuticle. Opisthohaptor circular,  $2.12-3.15 \mu$  in diameter, divided into a round central loculus  $65-115 \mu$  across and eight muscular marginal loculi, provided with a marginal membrane up to  $30-35 \mu$  wide and a pair of anchors measuring  $27-33 \mu$  long lineally from tip of ventral root to height of curve of blade and  $35-53 \mu$  lineally from tip of dorsal root to height of curve of blade; dorsal root inserted deeply into the septum between posterior submedian and posterolateral loculi. Marginal hooklets hardly recognizable at each interocular marginal notch. Oral sucker subterminal,  $65-100 \times 100-155 \mu$ , surmounted on its anterodorsal border by a transversely elongated pillow-like lobe.

Pharynx globular, 62–85 $\mu$  in diameter; prepharyngeal portion well differentiated from muscular pharynx. Ceca wide, with short inner and longer outer branches, terminating dorsal to opisthohaptor where the most medial branches appear to be united together.

Testes oval, about 100 $\mu$  long, almost symmetrical, one on each side of median ovarian curvature. Vas deferens turning round the bulbus ejaculatorius and penetrating it at its posterior end, forming two dilatations, one immediately in front of the bulbus and the other immediately behind the bulbus, both serving as seminoprostic reservoirs, because they contain spermatozoa and prostatic granules secreted from the neighboring prostatic cells. Bulbus ejaculatorius 75–110  $\times$  57–80 $\mu$ , containing abundant granules in wide space between its wall of circular muscles and the ejaculatory duct. Copulatory organ consisting of a well sclerotized, tubular, cirrus proper which is 30–45 $\mu$  long, more or less flared at each end and provided sideways with a sclerotized fold, and of a bundle of about 10, slightly curved, slender, accessory spines. To the base of the cirrus are attached special whirling muscle bundles merging into surrounding body parenchyma, probably associated with movements of the cirrus; the cirrus and its accessory spines project backwards toward the ventral genital pore situated immediately in front of the uterine pore.

Ovary 75–150  $\times$  150–250 $\mu$ , just postequatatorial; its greater proximal portion V-shaped, with its end more or less swollen and its right arm embracing right cecum. The germiduct arising from the distal end of the ovary joins the common vitelline duct and the duct from the vaginal seminal receptacle medial to the swollen proximal end of the ovary; the fertilization canal describes a sigmoid curve and after being surrounded by shell glands of two different types leads into the uterus proper. The latter is funnel-shaped, with distinct epithelial lining, opening midventrally by a large rounded aperture behind male pore. Eggs mitral, 75–83 $\mu$  long by 75–83 $\mu$  wide in life, 95–100  $\times$  80–95 $\mu$  in mounted condition, with prominent posterior lateral ends, from one of which arises the fine filament. Vagina strongly sclerotized basally, opening ventrally medial to left intestinal limb. Recep-

taculum seminis rounded, 40–60 $\mu$  in diameter, enclosed in proximal portion of vagina. Vitellaria co-extensive with intestine; transverse vitelline duct equatorial.

DISCUSSION: This monocotylid genus differs from any other members of the subfamily Monocotylinae by possessing two testes instead of one, although resembling *Heterocotyle minima* (MacCallum, 1916) Price, 1938, in general anatomy. The generic name refers to this feature.

*Diplobheterocotyla* n. g.

GENERIC DIAGNOSIS: Monocotyliidae, Monocotylinae: No eye spots. Opisthohaptor divided by eight septa into eight muscular marginal loculi and nonmuscular central loculus, with one pair of anchors. Interocular marginal hooklets hardly recognizable. No other sclerotized structures on opisthohaptor. Oral sucker surmounted anterodorsally by transversely elongated lobe. Pharynx strongly muscular, preceded by special prepharyngeal structure. Intestinal limbs with side branches, terminating dorsal to opisthohaptor. Testes two, subsymmetrical behind ovary. Bulbus ejaculatorius well developed, with wide space filled with fine granules between its wall of circular muscles and the ejaculatory duct penetrating it. Copulatory organ consisting of a well sclerotized, tubular cirrus proper, and a bundle of slender accessory spines; male genital pore immediately in front of uterine pore. Ovary curved, immediately pretesticular, embracing right intestinal limb. Uterine pore midventral, behind male pore; eggs mitral, filamented at one posterolateral end. Vitellaria co-extensive with intestine. Vagina present. Receptaculum seminis enclosed in vagina. Parasitic on gills of elasmobranchs.

TYPE SPECIES: *D. dasyatis* n. sp., on *Dasyatis* sp.; Hawaii.

5. *Neobaliootrema maomao* n. g., n. sp.

Fig. 5

HABITAT: Gill of *Abudefduf abdominalis* (local name "maomao"); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 5.

DESCRIPTION (based on 25 whole mounts): Body very small, elongate, 0.23–0.44 mm long, up to 60–90 $\mu$  wide in midregion. Opisthohaptor

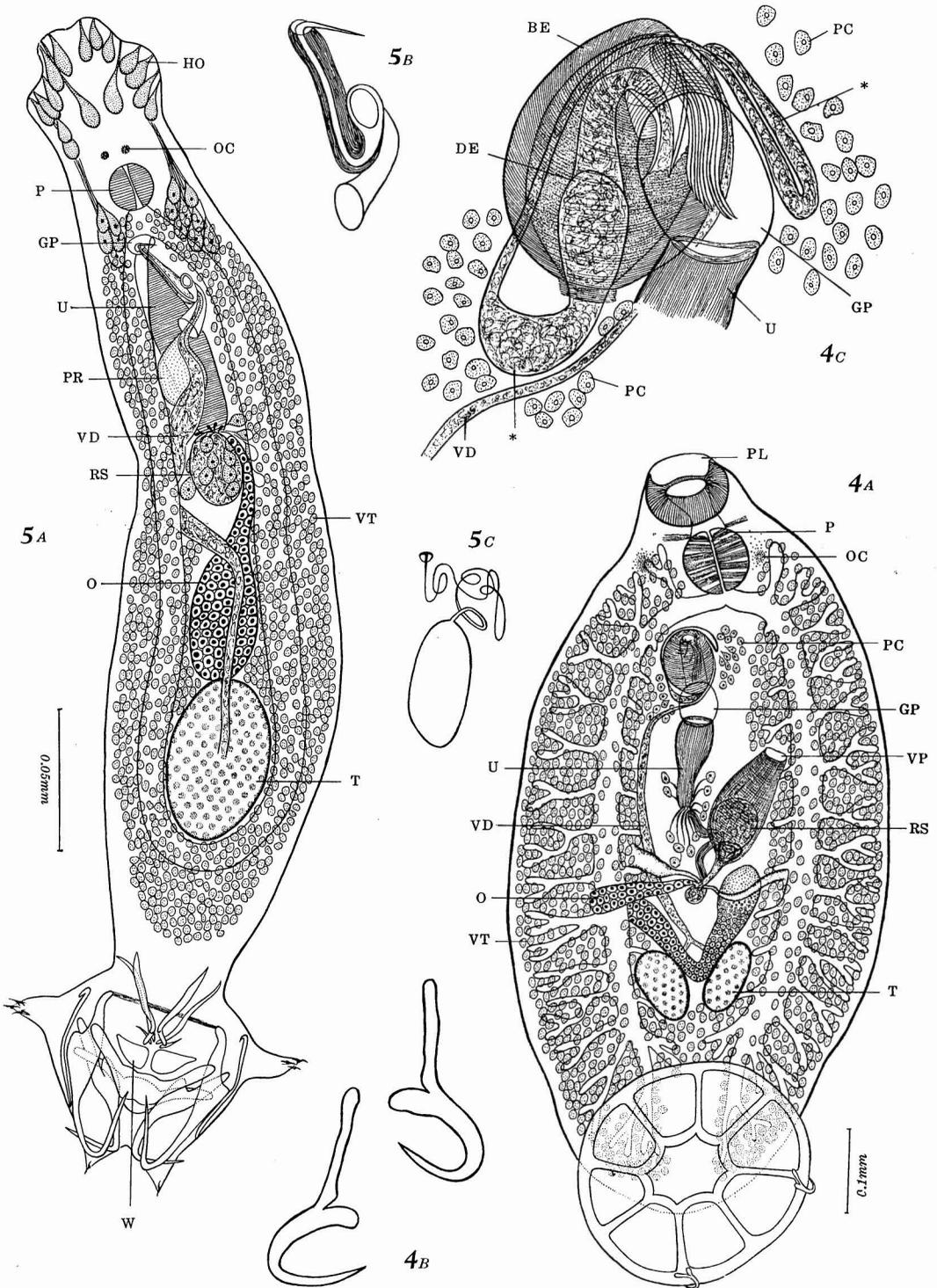


FIG. 4. *Diplobheterocotyla dasyatis* n. g., n. sp. 4A, Holotype, ventral view; 4B, haptor anchors; 4C, terminal genitalia, ventral view.

FIG. 5. *Neohaliotrema maomao* n. g., n. sp. 5A, Holotype, dorsal view; 5B, cirrus; 5C, egg.

well marked off from body proper, 42–100 $\mu$  wide at level of hornlike lateral projections, each tipped with a marginal hooklet about 10 $\mu$  long; at this level there is a pair of spines 25–35 $\mu$  long in form of a V in the dorsal median field with acute points directed anterolaterad; immediately ventrolateral to this is another pair of very slender spines of nearly the same length together with the anterior median pair of marginal hooklets; dorsal anchor 40–60 $\mu$  long from tip of dorsal root to height of curve of blade; dorsal bar V-shaped, 25–50 $\mu$  transversely from end to end; ventral anchor 32–53 $\mu$  long from tip of ventral root to height of curve of blade; ventral bar overlapping dorsal, curved angularly on each side of median line, 32–53 $\mu$  transversely from end to end. It is very interesting to note that there is a pair of round windows separated by a narrow median string of tissue immediately in front of the median bars. Head with two inconspicuous lobes studded with head organs on each side. Very conspicuous head glands massed together posterolateral to pharynx. Only one pair of compact eye spots immediately anterior to pharynx. Pharynx 12–20  $\times$  12–19 $\mu$ ; esophagus practically absent. Intestinal limbs united posterior to testis.

Testis elliptical, 25–81  $\times$  17–42 $\mu$ , situated at junction of middle with posterior third of body. Vas deferens running forward ventral to left intestinal limb, distended with sperm, up to 12 $\mu$  wide, and opening into base of cirrus. Cirrus narrow, tubular, twisted, sheathed except for base and pointed distal portion. Prostatic reservoir tubular or claviform, 6–9 $\mu$  wide, immediately behind cirrus, with its base directed backwards. Prostatic cells massed together around base of prostatic reservoir.

Ovary retort-shaped, 25–47  $\times$  12–26 $\mu$ , situated obliquely immediately in front of testis, with its distal end produced anteriorly. Shell gland complex rosette-shaped, very conspicuous. Vagina very much reduced; its rudiment may be recognizable ventral to seminal receptacle. Latter oval, 13–23  $\times$  10–16 $\mu$ . A large shrunken egg 70–77  $\times$  37–39 $\mu$  was often observed hanging out of genital pore, with its posterior polar filament 0.18–0.32 mm long enlarged at tip. Vitellaria co-extensive with intestine.

DISCUSSION: This species is characterized by possessing two pairs of spiniform sclerites on the dorsal side of the base of the opisthohaptor and a pair of round windows behind the sclerites; the vas deferens runs forward ventral to the left intestinal limb without looping around it. Of the eye spots there is only one pair, without exception. Considering all these features combined, I venture to propose a new genus, for which *Neobaliootrema* is suggested, because of resemblance to *Haliootrema* in other characters.

#### *Neobaliootrema* n. g.

GENERIC DIAGNOSIS: Dactylogyridae, Ancyrocephalinae: Body elongate, very small. Opisthohaptor distinctly set off from body proper, with two pairs of anchors, two haptor bars, small number of marginal hooklets and two pairs of slender spiniform sclerites, perforated between bars and spiniform sclerites by a window which is separated into two by a narrow median string of tissue. Only one pair of compact eye spots, exceptionally a single one, present. Intestinal crura simple, united posteriorly. Testis in posterior half of body; vas deferens distended with sperm, running forward ventral to left intestinal crus without looping around it. One prostatic reservoir present. Cirrus tubular, twisted, swollen at base, partly sheathed, without accessory piece. Genital pore median or nearly so. Ovary pretesticular, oblong. Vagina rudimentary or absent. Receptaculum seminis present. Vitellaria co-extensive with intestine. Parasitic on gills of marine teleosts.

TYPE SPECIES: *N. maomao* n. sp., on *Abudefduf abdominalis*; Hawaii.

#### 6. *Pseudempleurosoma carangis* n. g., n. sp.

Fig. 6

HABITAT: Gill and pharynx of *Caranx lugubris* (type host), *Caranx sexfasciatus*, and *Myripristis berndtii*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 6.

DESCRIPTION (based on 30 whole mounts): Body flattened subcylindrical, 0.8–1.32  $\times$  0.15–0.34 mm, tapered posteriorly. Opisthohaptor shallowly constricted off from body proper, truncate behind, 70–90 $\mu$  wide, with two pairs of dissimilar anchors and 14 marginal hooklets 10–

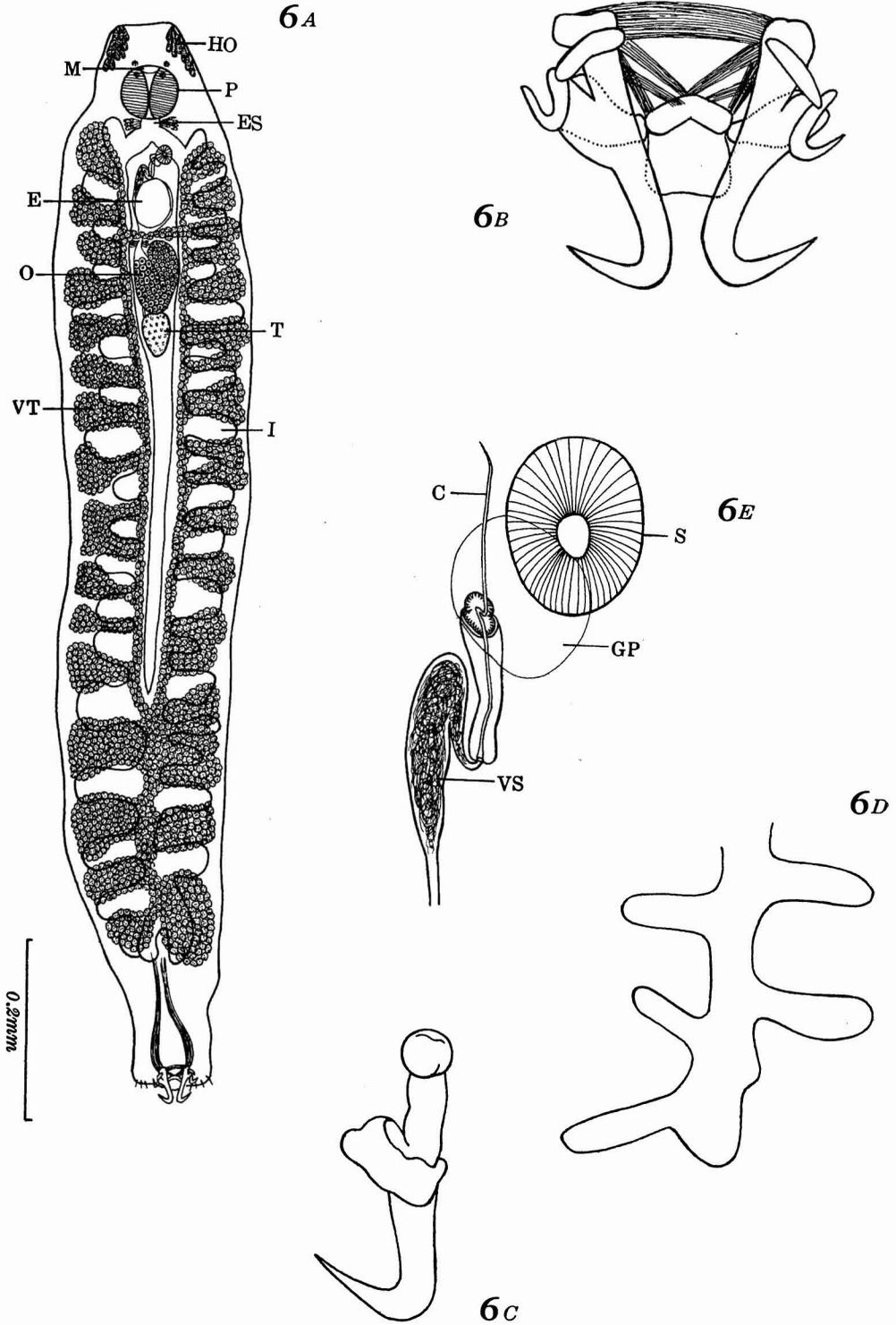


FIG. 6. *Pseudempleurosoma carangis* n. g., n. sp. 6A, Holotype, ventral view; 6B, anchor apparatus, ventral view; 6C, dorsal anchor, dorsal view; 6D, intestine; 6E, terminal genitalia, ventral view.

15 $\mu$  long; anterior medial hooklets abnormally large; dorsal anchor stout, 47–53 $\mu$  from tip of ventral root to height of curve of blade, its dorsal root shorter than ventral root, turned medially to form a dorsal swelling, at the inner end of which the anchor articulates with its fellow of the other side by means of a median bar; this bar looks like an approximately quadrangular shield, but its convex anterior border, 12.5–15 $\mu$  lineally from end to end, is thickened in form of an inverted V or an arc. The muscle fibers coming from the ventral median body wall are mainly attached to the dorsal root, whereas the ventral roots of the two stout anchors are connected with each other by a broad muscle band. Ventral anchor very small, simple, only 10–15 $\mu$  long, wider apart one from the other than stout dorsal anchors, with its root articulated with a simple oblique bar about 15 $\mu$  long. Head trapezoidal, with a compact group of head glands anterolaterally. Two pairs of eye spots dorsal to mouth. Pharynx globular, 45–65  $\times$  57–75 $\mu$ . Esophagus wide, up to 40–50 $\mu$  long, with a group of gland cells on each side; the ducts of these gland cells are directed toward the posterior end of the pharynx. Ceca comparatively wide, united posterior to testis at a variable distance in different individuals; sometimes far posteriorly, each with a number of undivided diverticula laterally; posterior common cecum also with diverticula on each side, terminating blindly some distance anterior to opisthohaptor.

Testis round to oval, 32–85  $\times$  25–60 $\mu$ , median, toward middle of anterior half of body. Vas deferens passing along right margin of ovary, leading to small seminal vesicle which lies at the base of the copulatory apparatus. Cirrus tubular, slender, about 50 $\mu$  long, enclosed in a cylindrical sheath for its proximal portion, but free in the distal portion and twisted at the junction of the two portions just at the level of the distal end of the sheath which is armed with a circle of very fine spiniform structures. Genital atrium median, just postbifurcal; into this atrium projects a small, muscular, acetabular disc 22–30 $\mu$  in diameter from the anterolateral side; the posteromedial border of the disc sometimes showing in the postbifurcal median genital pore.

Ovary 50–100  $\times$  50–78 $\mu$ , turned back on itself between testis and transverse vitelline duct,

with its distal end turned forward. Neither seminal receptacle nor vagina. Eggs oval, without polar filament, about 90  $\times$  70 $\mu$  in life, one at a time. Vitellaria forming numerous transversely elongated lobes intercalated between cecal diverticula and connected medially with paired longitudinal vitelline ducts commencing at level of intestinal bifurcation or genital pore; some of the posterior lobes of the two sides are confluent, although the level of the anterior limit of this union varies individually.

DISCUSSION: This genus resembles *Diplectanotrema* Johnston and Tiegs, 1922 on the one hand, and *Empleurosoma* Johnston and Tiegs, 1922, on the other; the differences are shown in the following table:

	<i>Diplectanotrema</i>	<i>Empleurosoma</i>	<i>Pseudempleurosoma</i>
Intestinal ceca	separate	united posteriorly	united posteriorly
Vagina	present	absent	absent
Receptaculum seminis	present	?	absent
Vitellaria	separate	separate	confluent posteriorly

#### *Pseudempleurosoma* n. g.

GENERIC DIAGNOSIS: Dactylogyridae, Ancyrocephalinae: Body more or less uniform in width; opisthohaptor truncate, shallowly constricted from body proper, with 14 marginal hooklets, of which the anterior medial pair is unusually large, 2 pairs of dissimilar anchors, an unpaired median shieldlike bar for larger anchors, and paired rod-shaped bars for smaller, widely separated anchors. Two pairs of eye spots present. Esophagus short, with gland cells on each side; ceca with numerous lateral diverticula, confluent posteriorly and terminating a short distance anterior to opisthohaptor. Testis about middle of anterior half of body; seminal vesicle near base of copulatory apparatus. Cirrus tubular, slender, enclosed in sheath proximally but free distally. Genital pore median, postbifurcal. A small, muscular, acetabular disc projecting into genital atrium. Ovary immediately pretesticular, turned back on itself. Neither seminal receptacle nor vagina. Eggs without polar filament, produced one at a time. Vitellaria divided into numerous, transversely elongated lobes, co-extensive with ceca

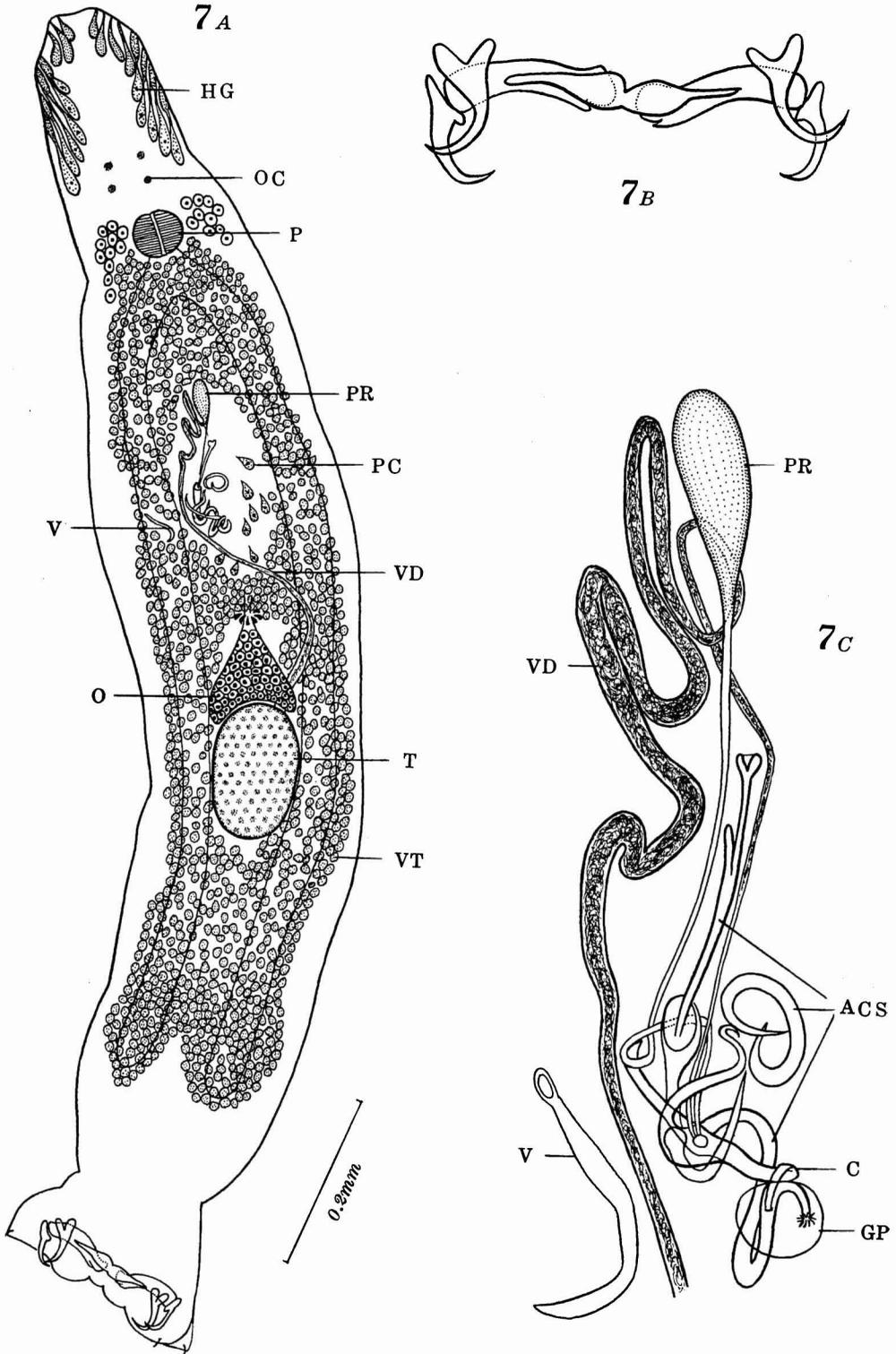


FIG. 7. *Nasobranchitrema pacificum* n. g., n. sp. 7A, Holotype, ventral view; 7B, anchor apparatus, ventral view; 7C, terminal genitalia, ventral view.

and their diverticula, united posteriorly; transverse vitelline duct and shell gland immediately preovarian. Gill parasites of marine teleosts.

TYPE SPECIES: *P. carangis* n. sp., on *Caranx lugubris*; *C. sexfasciatus*, and *Myripristis berndti*; Hawaii.

7. *Nasobranchitrema pacificum* n. g., n. sp.

Fig. 7

HABITAT: Gills of *Naso hexacanthus* (type host), *Naso lituratus*, and *N. brevirostris*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 7.

DESCRIPTION (based on 12 whole mounts): Body elongate subcylindrical, slightly tapering anteriorly, 0.95–1.5 mm long, 0.11–0.26 mm wide at level of testis. Opisthohaptor 0.14–0.25 mm wide, well set off from body proper, with two pairs of anchors, 3 separate bars, and several pairs of marginal hooklets about  $10\mu$  long at level of lateral prominences; dorsal anchors  $45\text{--}55\mu$  long lineally from tip of longer dorsal root to height of curve of blade, dorsal to lateral portion of ventral bar; ventral anchor  $35\text{--}50\mu$  long lineally from tip of base to height of curve of blade, with its obliquely flattened base articulating with ventral bar; of the three separate bars, the unpaired median dorsal  $50\text{--}80\mu$  long is constricted at middle, each half swollen medially and resting on transverse dorsal ledge of submedian bar, tapered laterally; submedian bars meeting in median line,  $55\text{--}80\mu$  long, each swollen at medial portion bearing above mentioned transverse ledge. Head trapezoidal, 0.07–0.15 mm wide at base, with several head organs along each lateral sloping margin; head glands well developed laterally at level of pharynx. Two pairs of eye spots anterior to pharynx. Pharynx globular,  $27\text{--}80\mu$  in diameter. Esophagus practically absent. Ceca simple, terminating separately posterior to testis at about middle of posterior third of body.

Testes oval,  $0.1\text{--}0.2 \times 0.045\text{--}0.12$  mm, situated at posterior end of middle third of body. Vas deferens running forward by right side of ovary and then along medial side of right intestinal limb, passing between copulatory organ and vagina, and describing N-shaped curve in right anterior intercecal area; ejaculatory duct

running backward alongside efferent duct of prostatic reservoir. Copulatory organ complex in structure; main portion consisting of C-shaped cirrus from which two winding tubules arise in opposite directions, one reaching to a ringlike independent tubular structure and the other looping around the distal portion of the cirrus which turns back on itself to open into the genital pore. The proximal portion of the cirrus is produced forward into a clawlike structure, but there is another wide cuticular tube arising from near origin of the two above mentioned tubules and terminating in a slight enlargement where the ejaculatory duct and the prostatic ducts empty into the cirrus. Prostatic reservoir elongate oval to elliptical,  $40\text{--}75 \times 25\text{--}50\mu$ , behind intestinal bifurcation, with its descending duct running alongside descending ejaculatory duct and opening into base of cirrus. Genital pore nearly median, some distance posterior to intestinal bifurcation.

Ovary heart-shaped or irregular in shape,  $50\text{--}100 \times 30\text{--}100\mu$ , immediately pretesticular, with shell gland complex in front. Vagina represented by a well cuticularized undulating, probably non-functional, tubule about  $50\mu$  long and lying obliquely posterodextral to the copulatory organ. It is not certain whether it opens outside ventrally or not. Vaginal duct narrow, descending from proximal end of vagina toward shell gland complex. No seminal receptacle. Shrunken egg observed *in utero* is about  $80\mu$  long, produced backward into a rigid filament. Vitellaria co-extensive with intestine; transverse vitelline duct in front of shell gland complex.

DISCUSSION: This genus is characterized by the possession of three separate haptor bars and a very complex copulatory organ. From the structure of the haptor apparatus there is no doubt that it belongs to the Diplectanidae Bychowsky, 1957, but differs from any of the known genera of this family by the absence of adhesive plaques or squamodiscs. It is defined as follows:

*Nasobranchitrema* n. g.

GENERIC DIAGNOSIS: Diplectanidae without adhesive plaques or squamodiscs. Body elongate, subcylindrical, very small. Opisthohaptor well marked off from body proper, with two pairs of anchors and three separate haptor bars, of

which the median is constricted into two portions, the paired submedian meeting in the median line. Two pairs of eye spots present. Intestinal limbs simple, terminating separately behind testis. Testis postequatorial; vas deferens not looping around intestinal limb, winding behind intestinal bifurcation. Copulatory organ complex in structure. Prostatic reservoir present. Genital pore some distance postbifurcal, median or submedian. Ovary pretesticular, with shell gland complex in front. Vagina present. Vitellaria co-extensive with intestine. Eggs produced backward into rigid filament. Gill parasites of marine teleosts.

TYPE SPECIES: *N. pacificum* n. sp., on *Naso hexacanthus*, *N. lituratus*, *N. brevirostris*; Hawaii.

#### 8. *Pseudodicrophora decapteri* n. g., n. sp.

Fig. 8

HABITAT: Gills of *Decapterus pinnulatus* (local name "opelu"); Hawaii.

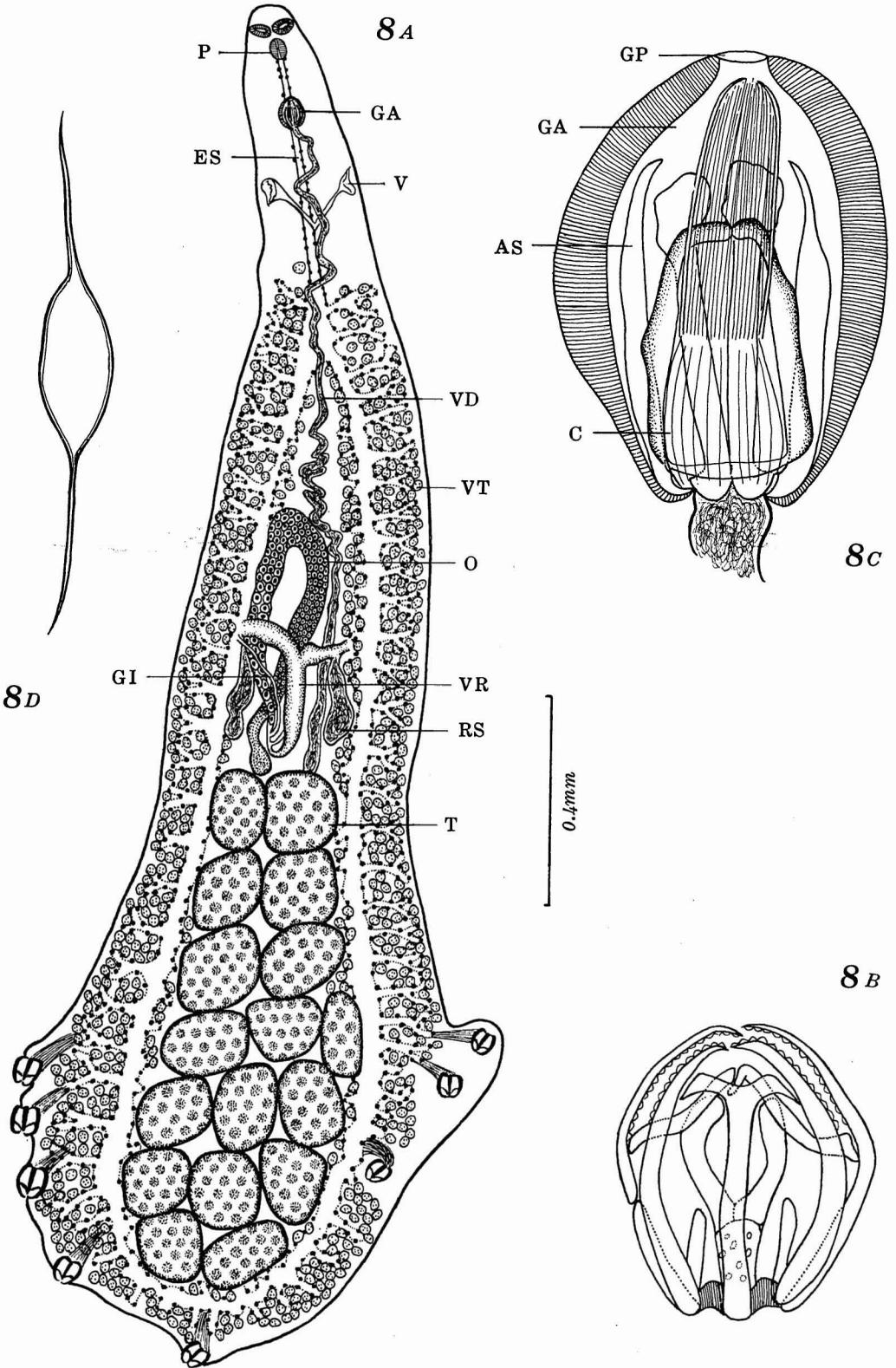
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 8.

DESCRIPTION (based on 21 whole mounts): Body 1.5–2.9 mm long, tapering anteriorly and rounded posteriorly, 0.35–0.7 mm wide immediately in front of opisthaptor. Opisthaptor extending asymmetrically along each posterior lateral margin of body, but separated at the truncate posterior end of body, consisting of 4 pairs of asymmetrically arranged sessile clamps. On the right side the fourth clamp is more or less wider apart from the third than the second is from the first, and on the left side the fourth clamp is separated from the third by a convex body margin 0.17–0.5 mm long; the third clamp is also wider apart from the second just like the third on the right. Clamp skeleton of the right side consisting of a U-shaped median piece, a pair of small basal pieces, 2 pairs of lateral springs and a pair of accessory sclerites; median piece widely bifid at end of ventral prong; shorter dorsal prong with U-shaped apical piece, surmounted by accessory sclerites. One of the lateral sclerites is much thinner than its fellow of the same side, almost membranous; the inner lateral sclerites nearly of same thickness. One of the accessory sclerites distinctly longer than its partner. Basal pieces not projecting into lumen

of clamp valve. Skeleton of left clamp different from that of right clamp; dorsal prong of U-shaped median piece divided into dissimilar branches, of which the larger articulates with the medial projection from the outer lateral sclerites on one side and also with the larger piece of the λ-shaped accessory sclerites on the other; two lateral sclerites of the outer side strongly developed, and denticulated distally on opposite sides, whereas one of those on the inner side is reduced to non-sclerotized piece, though its basal portion is distinctly sclerotized like that of its partner. Head 88–100 $\mu$  wide, with prominent rounded preoral lobe. Prohaptor oral suckers paired as in *Microcotyle*, aseptate, unarmed, 22–43  $\times$  25–53 $\mu$ . Pharynx rounded, 30–43  $\times$  25–43 $\mu$ . Esophagus simple, often very wide, 0.3–0.7 mm long. Ceca with numerous short inner and longer outer branches, confluent at posterior end of body.

Testes large, irregular in outline, 15–30 in number, occupying whole postovarian intercecal field. Vas deferens winding forward medial to left intestine in ovarian region, at the anterior end of which it takes the median course. No pars prostatica differentiated. Cirrus represented by a short cylindrical sclerotized structure opening at its tip and measuring 30–38 $\mu$  long by 15–23 $\mu$  wide; it lies ventral to semicircle of six longitudinal cuticular rods 38–50 $\mu$  long. This coronet in turn is enclosed in genital atrium provided with very fine circular muscle fibers. This atrium, 45–50  $\times$  30–47 $\mu$ , opens midventrally at a distance of 0.16–0.33 mm from head end.

Ovary inverted U-shaped, 0.25–0.6  $\times$  0.05–0.16 mm, situated in midregion of body with its proximal end on the right of vitelline reservoir and its distal end near genitointestinal duct. The latter duct arising from the germiduct just anterior to the junction of the germiduct with the vitelline reservoir runs obliquely forward and opens into the right intestine at the level of the two arms of the vitelline reservoir. Uterus ventromedian, apparently opening at common genital pore; eggs 180–220  $\times$  60–90 $\mu$ , with rigid filament 140–200 $\mu$  long at each end. Vitellaria co-extensive with intestine and its branches; vitelline reservoir Y-shaped; its stem just postequatorial, 0.1–0.24 mm long, largely overlapping ovary. A pair of elongate saccular seminal



receptacles filled with sperm, occasionally also with a mass of yolk cells, connected with arms of vitelline reservoir just medial to intestine, that of the same side as the vas deferens lies between the vas deferens and the intestine of that side. I propose to call this receptacle "receptaculum seminis vitellariorum." Vagina funnel-shaped, symmetrical, marginal, 0.28–0.6 mm from head end, nearer to genital pore than to intestinal bifurcation; vaginal ducts of two sides joining together in form of V, but no duct communicating with the vitelline reservoir has been detected.

DISCUSSION: This genus apparently belongs to *Diclidophoroidea* Price, 1936, but cannot be placed in any known families of this superfamily because of the constant peculiar asymmetry of the opisthaptor and the presence of symmetrical seminal receptacles connected with the arms of the vitelline reservoir in full-grown specimens. That the vaginal ducts are united and have connection neither with the vitelline reservoir nor with the seminal receptacles is worth noting.

#### *Pseudodiclidophorinae* n. subf.

SUBFAMILY DIAGNOSIS: *Pseudodiclidophoridae*: Opisthaptor asymmetrical, with four pairs of clamps along posterolateral margin of body. No anchor-bearing caudal appendage.

#### PSEUDODICLIDOPHORIDAE n. fam.

FAMILY DIAGNOSIS: *Diclidophoroidea*: Opisthaptor developed on posterior lateral part of body as marginal frills carrying 4 pairs of asymmetrical or symmetrical sessile clamps; each clamp with accessory sclerites. Caudal appendage present or absent. Symmetrical prohaptor suckers in buccal cavity. Intestinal crura with numerous branches, confluent posteriorly. Testes postovarian, variable in number. Copulatory organ complex in structure. Common genital pore median, esophageal. Ovary turned back on itself, pretesticular. Genito-intestinal duct present. Symmetrical seminal receptacles connected with vitelline reservoir. Vagina present. No communication between vagina and vitelline reservoir. Vitellaria entirely co-extensive with intestinal crura. Parasites of marine fishes.

TYPE GENUS: *Pseudodiclidophora* n. g.

This family includes two subfamilies, *Pseudodiclidophorinae* n. subf. and *Allopseudodiclidophorinae*. These subfamilies can be distinguished one from the other by the opisthaptor being symmetrical or asymmetrical, by the presence or absence of an anchor-bearing caudal appendage.

#### *Pseudodiclidophora* n. g.

GENERIC DIAGNOSIS: *Pseudodiclidophoroidea*, *Pseudodiclidophorinae*: Body markedly tapered anteriorly. Clamps sessile, 4 on each side of posterior part of body, arranged asymmetrically, the fourth clamp wider apart from the third than the second is from the third, especially on one side; clamp skeleton consisting of 2 pairs of lateral sclerites, an unpaired median piece, accessory sclerites and small basal sclerites. Prohaptor suckers aseptate, unarmed. Esophagus simple, long. Intestinal crura confluent posteriorly. Testes numerous, confined to postovarian interintestinal field. Cirrus forming a small sclerotized cylinder, ventral to semicircle of cuticular rods which is enclosed in the genital atrium of very fine circular muscle fibers. Common genital pore ventromedian, far anterior to intestinal bifurcation. Ovary inverted U-shaped, in midregion of body, with both ends directed backwards. Genito-intestinal duct long, opening into right intestinal crus. Symmetrical seminal receptacles connected with both arms of vitelline reservoir, very conspicuous in full-grown specimens. Eggs with filament at each pole. Vagina symmetrical, vaginal ducts united together, without any connection with vitelline reservoir or seminal receptacles. Vitellaria co-extensive with intestine and its branches. Vitelline reservoir Y-shaped. Gill parasites of marine teleosts.

TYPE SPECIES: *P. decapteri* n. sp., on *Decapterus pinnulatus*; Hawaii.

#### 9. *Allopseudodiclidophora opelu* n. g., n. sp.

Fig. 9

HABITAT: Gills of *Decapterus pinnulatus* (local name "opelu"); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 9.

FIG. 8. *Pseudodiclidophora decapteri* n. g., n. sp. 8A, Holotype, ventral view; 8B, clamp, ventral view; 8C, male terminal genitalia, ventral view; 8D, egg.

DESCRIPTION (based on seven whole mounts): Body markedly attenuated anteriorly, 2.9–4.6 mm in length exclusive of anchor-bearing caudal appendage, with maximum width of 0.96–1.8 mm in testicular region. Opisthohaptor symmetrical, consisting of four pairs of small sessile clamps about  $10\mu$  in diameter, extending along posterior margin of body, with caudal appendage between. Clamp skeleton similar to that of *Pseudodidiclidophora decapteri* with  $\lambda$ -shaped accessory piece; the left dorsal sclerite is slender and jointed, whereas the right ventral sclerite is slender and unjointed, so that the lateral sclerites are asymmetrical; median spring bifid at both ends, dorsal prong longer than ventral. Caudal appendage  $0.5\text{--}1.0 \times 0.1\text{--}0.12$  mm, provided at its somewhat swollen distal end with three pairs of hook-shaped anchors; outer anchor  $45\text{--}50\mu$  long, with very prominent guard; middle anchor similar in shape,  $18\mu$  long; inner anchor  $20\text{--}22\mu$  long, also with prominent guard and recurved root. Head rather pointed, about  $0.09\text{--}0.12$  mm wide. Prohaptor oral suckers paired, rounded, aseptate, unspined,  $30\text{--}45\mu$  in diameter; pharynx bulbous,  $35 \times 30\mu$  in the type; esophagus  $0.7\text{--}1.5$  mm long, intestinal limb with short inner and longer outer branches, apparently united with each other at posterior end of body proper.

Testes transversely elongated, irregular in outline,  $12\text{--}30$  in number, occupying whole post-ovarian interintestinal field in two longitudinal rows; vas deferens middorsal, distended with sperm and strongly winding in one of the paratypes, but very narrow and straight in the type. Cirrus terminating in form of a sclerotized cylinder projecting into genital atrium. This cirrus is supported dorsally by a pair of apically incurved rods  $35\mu$  long, a pair of also apically incurved lateral rods  $48\text{--}50\mu$  long and a pair of nearly parallel, apically enlarged, dorsal rods. Genital atrium  $55\text{--}62\mu$  long by  $40\text{--}50\mu$  wide, with wall of circular muscle fibers. Genital pore midventral,  $0.25\text{--}0.68$  mm from head end.

Ovary inverted U-shaped,  $0.4\text{--}0.8 \times 0.15\text{--}0.2$  mm, situated at junction of middle with posterior third of body, with both ends directed

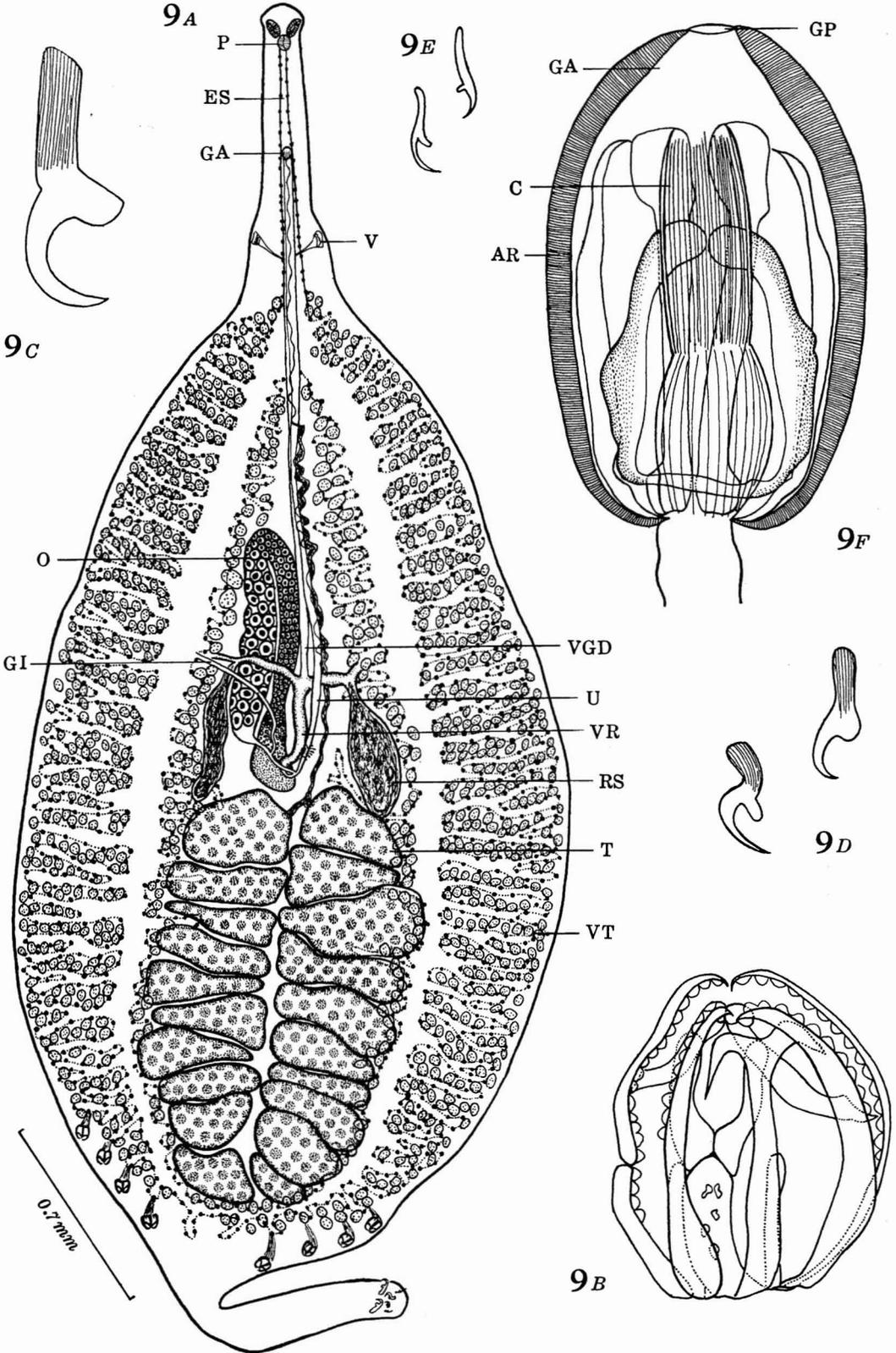
backwards; genito-intestinal canal crossing distal end of ovary and opening into right intestinal limb. One uterine egg observed,  $0.17 \times 0.07$  mm, with rigid filament  $0.16$  mm long at one pole and another  $0.2$  mm long at the other pole. Vitellaria co-extensive with intestinal branches; vitelline reservoir Y-shaped, nearly midventral; its arms widely divergent, each connected with seminal receptacle of its own side. Paired seminal receptacles elongate fusiform,  $0.2\text{--}0.43$  mm long, containing abundant yolk cells and sperm, situated one on each side of ovary at level of junction of middle with posterior third of body. Vaginae symmetrical, funnel-shaped at base, opening ventrolaterally by a small round pore at a distance of  $0.4\text{--}1.2$  mm from head end; the vaginal duct arising from the bottom of the vaginal funnel proceeds medioposteriad to unite with its fellow of the other side, the resulting unpaired median duct runs backward and apparently empties into the vitelline reservoir at junction of the two arms. It is worth while to note that sperm are seen scattered in various parts of the vitelline ducts. This fact may be accounted for by the presence of paired seminal receptacles connected with the arms of the Y-shaped vitelline reservoir.

DISCUSSION: Although this genus differs markedly from *Pseudodidiclidophora* (loc. cit.) in general body shape, it agrees completely with the latter in the most important characters such as clamp structure and internal anatomy, particularly in possessing paired receptaculum seminis vitellariorum. The presence of a long anchor-bearing caudal appendage, however, prevents its being assigned to the same genus. I would rather consider this character combined with the symmetrical arrangement of the opisthohaptor clamps to be of subfamily importance, hence a new subfamily Allospseudodidiclidophorinae is proposed.

#### Allospseudodidiclidophorinae, n. subf.

SUBFAMILY DIAGNOSIS: Pseudodidiclidophoridae: Opisthohaptor symmetrical, with 4 pairs of

FIG. 9. *Allospseudodidiclidophora opelu* n. g., n. sp. 9A, Holotype, ventral view; 9B, clamp, ventral view; 9C-E, caudal anchors; 9F, male terminal genitalia, ventral view.



clamps along posterior border of body, with a long anchor-bearing caudal appendage. Intestinal limbs united together at posterior end of body proper.

*Allo pseudodidolidophora* n. g.

GENERIC DIAGNOSIS: Pseudodidolidophoridae, Allo pseudodidolidophorinae: Body markedly attenuated anteriorly. Clamps sessile, 4 on each side on posterior margin of body, arranged symmetrically; clamp skeleton similar to that of *Pseudodidolidophora*. Prohaptor suckers aseptate, unspined. Esophagus very long, simple. Intestinal crura united posteriorly. Testes numerous, in two longitudinal rows in postovarian interintestinal field. Cirrus forming sclerotized cylinder, opening into genital atrium, latter with outer wall of circular muscle fibers and provided inside with a sheaf of sclerotized rods surrounding cirrus. Genital pore midventral, far anterior to intestinal bifurcation. Ovary inverted U-shaped, in midregion of body, with both ends directed backwards. Genito-intestinal duct opening into right intestinal limb. Symmetrical seminal receptacles connected with both arms of vitelline reservoir. Eggs with polar filament. Vaginae symmetrical, vaginal ducts united together; unpaired median vaginal duct opening into vitelline reservoir. Vitellaria co-extensive with intestinal branches; vitelline reservoir Y-shaped. Gill parasites of marine teleosts.

TYPE SPECIES: *A. opelu* n. sp., on *Decapterus pinnulatus*; Hawaii.

10. *Pseudopisthogyne lepidocybii* n. g., n. sp.  
Fig. 10

HABITAT: Gill of *Lepidocybium flavobrunneum*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 10.

DESCRIPTION (based on seven whole mounts): Body elongate, rather slender, gradually tapering anteriorly, 4.3–13.5 mm in total length including slender, hook-bearing caudal appendage which arises from the extreme posterior end of the body proper nearer to the small posteriormost clamp than to large posteriormost clamp, and measures 0.4–1.4 mm long and 0.07–0.18 mm wide at the slightly enlarged, truncate tip. Of the three pairs of anchors the largest outer

is 51–64 $\mu$  long from end of short root to height of curve of blade, with prominent guard curved toward the blade, the middle 18–26 $\mu$  long, with its incurved guard well apart from tip of root; the inner 27–31 $\mu$  long, its guard to which many muscle bundles are convergently attached is directed straight toward the tip of the blade. Opisthaptor asymmetrical, with four pairs of clamps, 0.34–0.9 mm long on the right (pore side), 0.7–2.5 mm long on the left; right clamps distinctly pedunculate, left ones sessile; skeleton of right clamp 90–160 $\mu$  in diameter, symmetrical, or only slightly asymmetrical because of different curvature of the lateral sclerites, consisting of median spring with bifid ends, a pair of accessory sclerites, two pairs of unjointed lateral arms and a pair of short basal sclerites; skeleton of left clamp 150–330 $\mu$  wide, consisting of two pairs of asymmetrical unjointed lateral arms, a median spring with bifid ends, a pair of accessory sclerites and a pair of basal sclerites; capsule of the clamp strongly muscular; proximal outer quadrant distinctly larger than proximal inner quadrant, bulging out at base, thus causing asymmetry of the lateral sclerites; the two lateral sclerites of the proximal outer quadrant showing gentle sigmoid curve in strong contrast with the opposite sclerites which are simply arcuate. Head blunt-pointed, 0.17–0.28 mm wide at level of oral aperture, with a pair of well-developed apical organs. Intrabuccal sucker elliptical, muscular, with a partition at middle, 50–90  $\times$  70–140 $\mu$ . Pharynx subglobular, cellular, 40–80  $\times$  40–70 $\mu$ . Esophagus 0.22–0.63 mm long, simple except at its diverticulate posterior portion, bifurcating at level of vagina. Intestinal limbs with numerous subdivided outer branches, terminating close to each other at base of caudal appendage.

Testes rounded, 90–170 in number, arranged in one layer, occupying whole interintestinal field of posterior part of anterior third and entire middle third of body. Vas deferens winding between two rows of anteriormost testes and also in pretesticular interintestinal field where there are numerous gland cells surrounding the vas deferens. Whether these gland cells are prostatic in nature or not is not certain. After passing dorsal to the vaginal pore it forms a

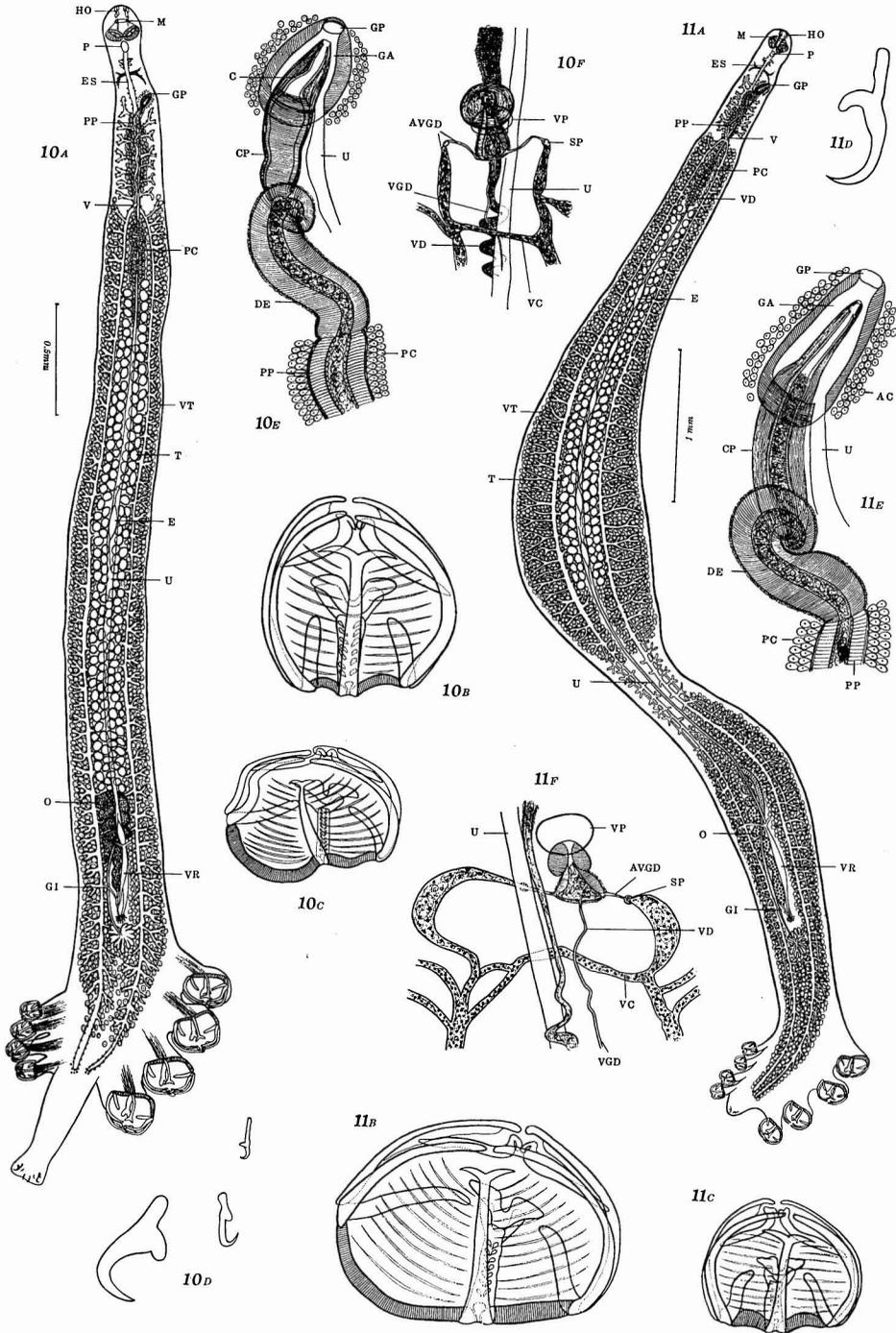


FIG. 10. *Pseudopisthogyne lepidocybii* n. g., n. sp. 10A, Holotype, ventral view; 10B-C, clamps, ventral view; 10D, caudal anchors; 10E, terminal genitalia, ventral view; 10F, vagina and its ducts, ventral view.

FIG. 11. *Allospseudopisthogyne constricta* n. g., n. sp. 11A, Holotype, ventral view; 11B-C, clamps; 11D, caudal anchor; 11E, terminal genitalia, ventral view; 11F, vagina and its duct, ventral view.

somewhat muscular sigmoid duct and leads into slightly winding pars prostatica 0.2–0.5 mm long and provided with circular muscle fibers and a coat of prostatic cells; ejaculatory duct sigmoid, 0.1–0.22 mm long, with a very thick coat of circular muscle fibers, with its anterior end usually turned back on itself to lead into cirrus pouch. Latter cylindrical, 0.12–0.26 mm long by 30–55 $\mu$  wide, with longitudinal muscles, projecting into genital atrium which consists mainly of circular muscle fibers. Immediately outside this genital atrium and cirrus pouch there is a thick coat of accompanying cells. Common genital pore on sinistroversal margin of body 0.35–0.8 mm from head end.

Ovary 0.5–1.15  $\times$  0.08–0.22 mm, occupying interintestinal field at anterior half of caudal third of body, consisting of multilobed proximal end situated posteriorly, a narrow tubular portion ascending medial to right intestinal limb, and a looped main portion situated anteriorly with distal end directed posteriad. Germiduct running straight backward from distal end of ovary, giving off narrow genito-intestinal duct just before joining vitelline reservoir; ootype just anterior to proximal lobe of ovary. Uterus midventral, finally running alongside muscular ejaculatory duct and cirrus pouch and opening into genital atrium. Eggs fusiform, 0.2–0.21 mm long, with rather rigid bipolar filament 0.18–0.28 mm long. Vagina provided with sphincter-like circular muscles, with wide midventral opening at a distance of 0.8–1.9 mm from head end. Accessory vaginal ducts arising sideways, one on each side of vagina, each provided with sphincter-like circular muscle fibers at the point where it turns backwards to join the transverse commissure between anastomosing anteriormost vitelline ducts of two sides; median vaginal duct proper arising from middle of base of vagina traceable some distance back of vagina, but its posterior termination not determined. Vitellaria co-extensive with intestine; vitelline reservoir Y-shaped, with long stem co-inciding with ovarian zone.

DISCUSSION: This genus grossly agrees with *Opisthogyne* Unnithan, 1962, in general anatomy, but differs in several important characters such as: (1) oblique body ridges, as observed in *Opisthogyne* and *Gemmacaputia*, are entirely

absent; (2) marked asymmetry of opisthohaptor; (3) sessile clamps with asymmetrical lateral sclerites due to unequal development of capsule of one proximal quadrant, whereas pedunculate clamps are symmetrical in skeleton; (4) ovarian complex shifted far backward by enormous number of testes; (5) vaginal pore midventral instead of middorsal. These differences, especially the asymmetrical opisthohaptor, the asymmetrical skeleton of sessile clamps, and absence of oblique body ridges, are sufficient to justify the erection of a separate genus, for which *Pseudopisthogyne* is suggested in recognition of its marked resemblance to *Opisthogyne* Unnithan, 1962. In *Opisthogyne* Unnithan states that the vaginal duct opens into the ootype, but this is obviously an error.

*Pseudopisthogyne* n. g.

GENERIC DIAGNOSIS: Discocotylidae, Opisthogyninae: Body elongate, nearly symmetrical, without oblique body ridges posteriorly. Opisthohaptor asymmetrical, with four larger sessile clamps on pore side, and four smaller pedunculate clamps on antiporal side; larger clamp with asymmetrical basal and lateral sclerites, smaller clamp with exactly or nearly symmetrical lateral sclerites. Caudal appendage with three pairs of anchors, attached to posterior end of body between posteriormost clamps of two sides nearer to small clamp than to large clamp. Head blunt-pointed, with well-developed paired apical organs. Esophagus diverticulate posteriorly, bifurcating at level of vagina; intestinal limbs not confluent posteriorly. Testes very numerous, preovarian; pars prostatica, ejaculatory duct, cirrus pouch and genital atrium well differentiated; cirrus unarmed. Common genital pore in esophageal zone, ventrosubmarginal. Ovary turned back on itself, posterior, with both ends directed backward. Eggs fusiform, with bipolar filaments. Vagina midventral, far posterior to genital pore, with paired accessory vaginal ducts, each of which is connected with the transverse commissure between the anterior anastomosing vitelline ducts of the two sides, median vaginal duct proper rudimentary. Vitellaria co-extensive with intestine; vitelline reservoir Y-shaped, in ovarian zone; anterior vitelline ducts containing sperm. Gill parasites of marine teleosts.

TYPE SPECIES: *P. lepidocybii* n. sp., on *Lepidocybium flavobrunneum*; Hawaii.

11. *Allo pseudopisthogyne constricta* n. g., n. sp.

Fig. 11

HABITAT: Gill of *Lepidocybium flavobrunneum*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 11.

DESCRIPTION (based on 20 whole mounts): Body elongate, 7.6–16.5 mm long by 0.8–1.6 mm, gently curved in widest testicular region to the left, but to the right posterior to region of body constriction which usually occurs behind the midregion of the body. Opisthaptor asymmetrical, with four larger sessile clamps on pore side and four smaller pedunculate clamps on other side. Skeleton of small clamps 90–130 $\mu$  wide, consisting of two pairs of symmetrical lateral sclerites, a pair of accessory sclerites, a pair of basal sclerites and a median spring with anchor-shaped tip for longer prong and V-shaped winglike apical piece for bifid end of shorter fenestrated prong. Skeleton of left larger clamp 190–270 $\mu$  wide, consisting of two pairs of asymmetrical lateral sclerites, a pair of accessory sclerites, a pair of basal sclerites, and a median spring with anchor-shaped tip for longer prong and V-shaped apical piece for bifid end of shorter fenestrated prong; the proximal outer quadrant of the clamp capsule is a little larger than the corresponding inner quadrant, thus causing asymmetry of lateral and basal sclerites which is, however, not so pronounced as in *Pseudopisthogyne*, in which the two lateral sclerites of the proximal outer quadrant show a gentle sigmoid curve. At the extreme posterior end of the body nearer to the small clamp than to the large clamp is a conical appendage 0.1–0.17 mm long and bearing a pair of hooks close to its rounded or truncate apex; this hook is 46–54 $\mu$  long from tip of root to height of curve of blade, with a very prominent guard curved toward the blade.

Head rounded at apex, 0.19–0.44 mm wide at level of ventral mouth aperture; apical gland complex present as in *Pseudopisthogyne* and *Pseudopisthogyneopsis*. Paired oral suckers elliptical, 60–100  $\times$  90–140 $\mu$ , with a median septum.

Pharynx small, containing cellular element only, 60–80  $\times$  40–70 $\mu$ . Esophagus nearly simple anteriorly but sending posteriorly a number of lateral branches at right angles, bifurcating dorsal to vagina. Intestinal limbs with few simple or ramified side branches and not accompanied by vitellaria in constricted region; in the region of the opisthaptor the side branches are markedly reduced and the limbs run parallel to each other in the median field, being surrounded by vitellaria, and terminate near the base of the hook-bearing caudal appendage.

Testes rounded, 120–185 in number, extending in 2–4 longitudinal rows in interintestinal field from about middle of anterior third to equatorial level far away from ovary and never reaching to it in strong contrast with those of *Pseudopisthogyne* and *Pseudopisthogyneopsis*. Vas deferens markedly winding between anterior-most testes and intestinal bifurcation, surrounded by prostate-like gland cells; in the region of the vaginal pore it forms a sigmoid muscular canal and leads into the pars prostatica a little anterior to the vaginal pore. Pars prostatica undulating, muscular, median, 0.16–0.5 mm long, surrounded throughout its length by numerous prostate cells. Ductus ejaculatorius cylindrical, 0.16–0.25 mm long, up to 50 $\mu$  wide, provided with a thick layer of circular muscles, usually with its anterior end turned back on itself before leading into cirrus. Cirrus simple, narrow, unarmed, enclosed in a cylindrical pouch of longitudinal muscles 0.11–0.23 mm long by 25–50 $\mu$  wide. Genital atrium consisting mainly of circular muscle fibers and surrounded by numerous accompanying cells, enclosing distal portion of cirrus pouch, cirrus and uterus. Common genital pore ventrosubmarginal, 0.38–0.7 mm from head end.

Ovary 0.9–1.8  $\times$  0.12–0.25 mm, composed of branched proximal lobe situated near posterior end of body proper, a long, tubular, ascending portion, and a winding, looped, distal portion, from the rather straight, descending, terminal portion of which arises the germiduct. Genito-intestinal duct opening into right intestinal limb anterior to distal end of ovary. Shell gland complex just anterior to branched proximal lobe of ovary. Uterus midventral except for its terminal portion running alongside cirrus pouch. Eggs

fusiform, 0.2–0.26 mm long, 60–90 $\mu$  wide; bipolar filament 0.25–0.32 mm long. Vagina opening midventrally at a distance of 0.82–1.55 mm from head end, provided with a bulb of circular muscles near its comparatively wide, circular aperture; paired accessory vaginal duct arising sideways from base of vagina, running transversely and then turning backward to join transverse commissure between anastomosing anteriormost vitelline ducts of two sides; median vaginal duct proper can be traced further back of this commissure, but its posterior termination is unknown. Vitellaria commencing in lateral fields at level of vaginal pore, confluent in post-ovarian region; vitelline reservoir Y-shaped with its stem between ovary and left intestinal limb.

DISCUSSION: This genus differs from the most closely related *Pseudopisthogyne* in the body being distinctly constricted posterior to the widest midregion, in the ovary being widely separated from the testes by this constricted area, and in the caudal appendage being reduced to a conical process bearing only one pair of hooks. That the lateral sclerites of the larger clamps do not show a sigmoid curve in contrast with those of *Pseudopisthogyne* or *Pseudopisthognopsis* is also worth noting.

*Allospseudopisthogyne* n. g.

GENERIC DIAGNOSIS: Discocotyliidae, Opisthognyninae: Body elongate, asymmetrical, constricted a little posterior to widest midregion, without oblique body ridges posteriorly. Opisthohaptor asymmetrical, with four large subsessile clamps on side of genital pore and four smaller pedunculate clamps on other side; larger clamp with asymmetrical basal and lateral sclerites, latter sclerites not showing sigmoid curve; smaller clamp with exactly symmetrical lateral sclerites. Caudal appendage reduced to conical process, with only one pair of hooks, attached to posterior end of body nearer to small clamp than to large clamp. Head blunt-pointed, with apical organs. Esophagus bifurcating at level of vaginal pore; intestinal limbs with side branches, not accompanied by vitellaria in constricted part of body, not confluent posteriorly. Testes very numerous, widely separated from ovary by body constriction. Pars prostatica, ejaculatory duct, cirrus pouch and genital atrium well differen-

tiated just as in *Pseudopisthogyne* and *Pseudopisthognopsis*. Cirrus unarmed. Common genital pore in esophageal zone, ventrosubmarginal. Ovary turned back on itself in posterior third of body, with both ends directed backwards. Eggs fusiform, with bipolar filaments. Vagina provided with sphincter, opening midventrally far posterior to common genital pore, at intestinal bifurcation; paired accessory vaginal ducts connected with transverse commissures between anteriormost anastomosing vitelline ducts of two sides; median vaginal duct proper rudimentary. Vitellaria co-extensive with intestine except at constricted part of body, confluent posterior to ovary; vitelline reservoir Y-shaped, sinistral to ovary; anterior vitelline ducts containing sperm. Gill parasties of marine teleosts.

TYPE SPECIES: *A. constricta* n. sp., on *Lepidocybium flavobrunneum*; Hawaii.

12. *Pseudopisthognopsis lepidocybii* n. g., n. sp.

Fig. 12

HABITAT: Gill of *Lepidocybium flavobrunneum*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 12.

DESCRIPTION (based on 50 whole mounts): Body elongate, 15–13 mm long, 0.55–1.4 mm wide just in front of opisthohaptor, tapering anteriorly, symmetrical except for posterior end, to which four larger subsessile clamps are attached on the side of the genital pore and four smaller pedunculate clamps on the other side, without hook-bearing appendage between two posteriormost clamps. Skeleton of small clamp 100–170 $\mu$  wide, consisting of two pairs of symmetrical or slightly asymmetrical, unjointed, lateral sclerites, a median spring with bifid ends of which the shorter prong has a V-shaped apical piece, a pair of accessory sclerites and a pair of short basal sclerites; skeleton of larger clamp 280–420 $\mu$  wide at base, consisting of two pairs of distinctly asymmetrical, unjointed, lateral sclerites, a median spring with bifid ends, a pair of accessory sclerites and a pair of basal sclerites. On the tip of the shorter, fenestrated prong of the median spring is set a V-shaped, more weakly sclerotized, apical piece. The capsule of the larger clamp is more muscular than that of the smaller

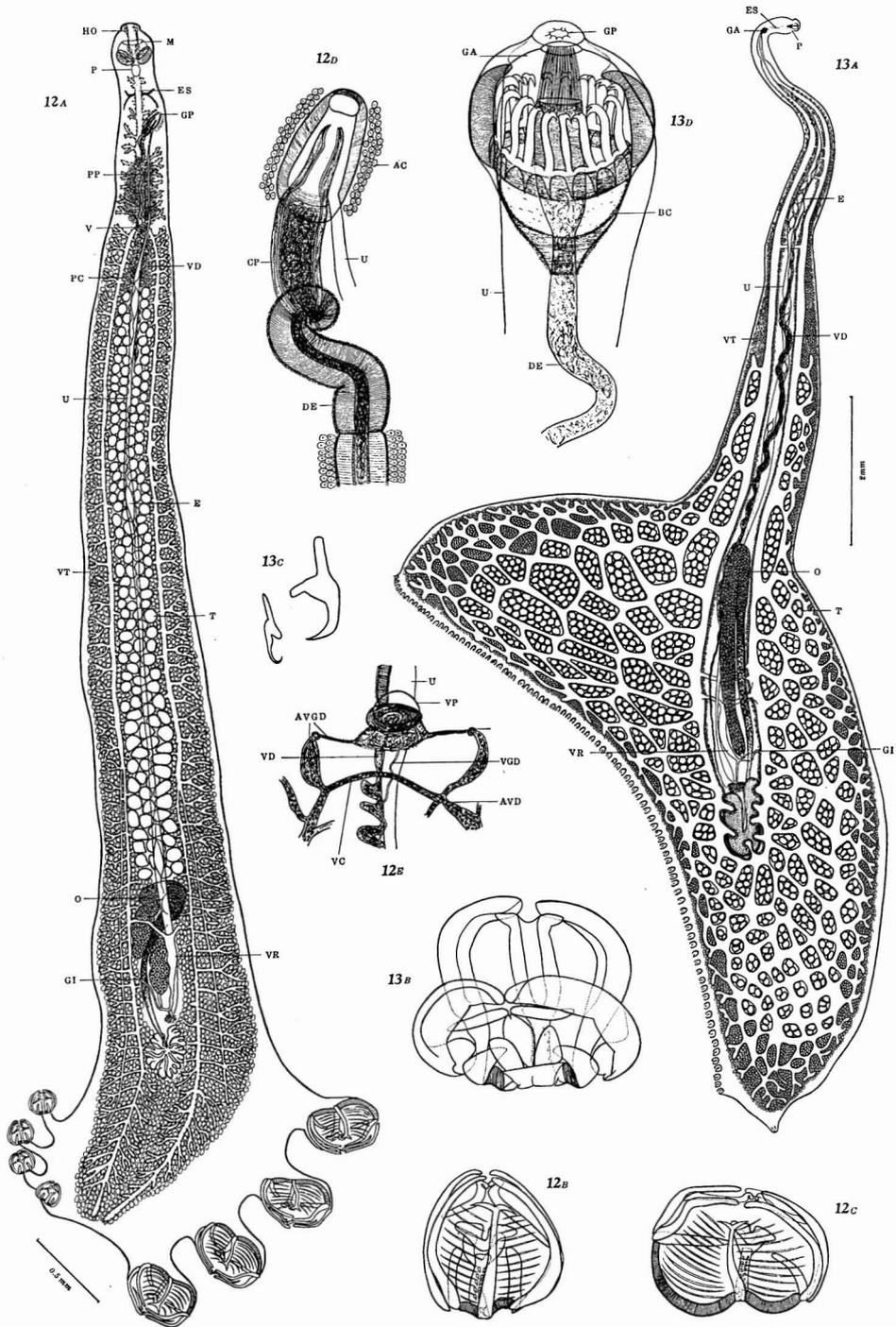


FIG. 12. *Pseudopisthogynopsis lepidocybii* n. g., n. sp. 12A, Holotype, ventral view; 12B-C, clamps; 12D, terminal genitalia, ventral view; 12E, vagina and its ducts, ventral view.

FIG. 13. *Areotestis sibi* n. g., n. sp. 13A, Holotype, dorsal view; 13B, clamp, dorsal view; 13C, caudal anchors; 13D, terminal genitalia, ventral view.

clamp, and its proximal outer quadrant is so much developed as to push the lateral and basal sclerites of its own side toward the apex of the clamp, thus causing asymmetry of the clamp skeleton; the lateral sclerites of the proximal outer quadrant showing a gentle sigmoid curve in contrast with opposite lateral sclerites.

Head blunt-pointed, 0.2–0.42 mm wide at level of ventral mouth aperture, with a pair of well-developed apical organs. Oral suckers elliptical,  $0.06\text{--}0.11 \times 0.1\text{--}0.18$  mm, with a septum at middle. Pharynx not muscular,  $40\text{--}90 \times 30\text{--}70\mu$ ; esophagus distinctly diverticulate posteriorly, 0.2–0.7 mm long, surrounded by pigment cells, bifurcating at level of vagina. Numerous outer intestinal branches extend outward through the very dense layer of vitellaria up to the very lateral margin of the body. In the postovarian area the intestinal limbs are close to each other and terminate near the extreme posterior end of the body.

Testes rounded, 90–185 in number, occupying whole interintestinal field in posterior half of anterior third and entire middle third of body, between vas deferens coils and ovary, in two longitudinal rows anteriorly and four zigzag rows posteriorly. Vas deferens winding first between two rows of anteriormost testes and then in postbifurcal interintestinal area, where it is surrounded by numerous prostate-like cells. From a little anterior to the vaginal pore extends forwards in the median field a slightly winding muscular pars prostatica 0.22–0.6 mm long by  $30\text{--}65\mu$  wide and surrounded by numerous prostate cells; it passes into the strongly muscular ejaculatory duct which is 0.1–0.25 mm long by  $30\text{--}60\mu$  wide and usually turns back on itself at its anterior end to be continued into the cirrus. Cirrus simple, unarmed, enclosed in cylindrical, muscular, cirrus pouch. Latter 0.16–0.25 mm long,  $40\text{--}60\mu$  wide, provided with longitudinal muscle fibers, extending obliquely toward left margin of body. Genital atrium  $93\mu$  wide in the type, surrounded by accompanying cells, provided with circular muscles, opening ventrosubmarginally at a distance of 0.44–1.0 mm from head end.

Ovary longitudinally elongated, shaped like an 8, situated in anterior half of caudal third of body, with both ends directed backwards,  $0.9\text{--}$

$2.3 \times 0.12\text{--}0.3$  mm; proximal part multilobulated in a rosette-shape, next ascending portion tubular, crossing descending distal portion dorsally; descending distal portion winding backward medial to right intestinal limb and then medial to ascending tubular portion. Genito-intestinal duct provided with circular muscle fibers, arising from germiduct just in front of junction of germiduct with stem of vitelline reservoir, opening into right intestinal limb at level of distal end of ovary. Shell gland cells massed closely together anterior to rosette-shaped portion of ovary. Uterus midventral, opening into genital atrium alongside cirrus pouch on its posteroventral side. Eggs elliptical, 0.22–0.25 mm long by  $50\text{--}70\mu$  wide; bipolar filament rather rigid, 0.2–0.35 mm long. Vagina surrounded by lamellae of circular muscle fibers like a sphincter, opening midventrally at a distance of 0.95–2.2 mm from head end; paired accessory vaginal ducts arising sideways from base of vagina, first running transversely, turning backward at the point provided with sphincter-like circular muscle fibers, may be distended with sperm together with yolk cells before uniting with transverse commissure of anastomosing anteriormost vitelline ducts; median vaginal duct proper traceable in median field for some distance back of vagina, but its posterior termination not determined. Vitellaria extending in lateral fields, commencing at level of vaginal pore, confluent in postovarian median field; vitelline reservoir Y-shaped; longer right arm crossing swollen distal portion of ovary on its ventral side; stem long, descending on left side of terminal descending portion of ovary.

DISCUSSION: This genus differs from *Pseudopisthogyne* only in the absence of the hook-bearing caudal appendage. It is defined as follows:

*Pseudopisthogyne* n. g.

GENERIC DIAGNOSIS: Discocotylidae, Opisthogyninae: Body elongate, nearly symmetrical, without oblique body ridges posteriorly. Hook-bearing caudal appendage absent. Opisthohaptor asymmetrical, with four larger sessile clamps on side of genital pore and four smaller pedunculate clamps on other side; larger clamp with asymmetrical, basal and lateral sclerites, smaller clamps with exactly or nearly symmetrical lat-

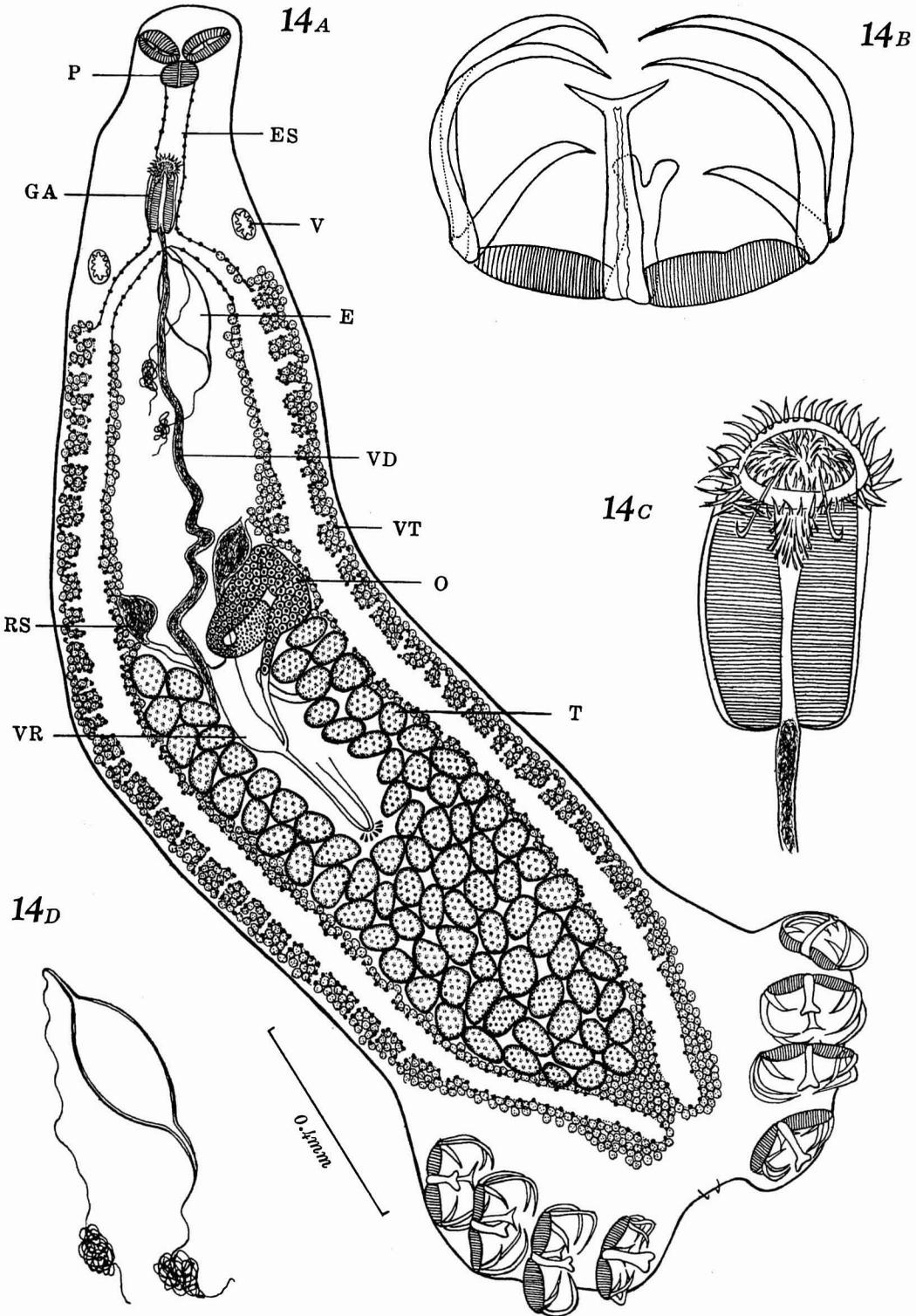


FIG. 14. *Pseudodiscocotyla opakapaka* n. g., n. sp. 14A, Holotype, dorsal view; 14B, clamp; 14C, male terminalia, ventral view; 14D, egg.

eral sclerites. Head blunt-pointed, with well-developed paired apical organs. Esophagus bifurcating at level of vagina; intestinal limbs not confluent posteriorly. Testes very numerous, preovarian; vas deferens winding and surrounded by numerous prostate-like gland cells in postvaginal median field; prostatic complex, muscular ejaculatory duct, cirrus pouch and genital atrium well differentiated. Cirrus unarmed. Common genital pore ventrosubmarginal, anterior. Ovary posterior, turned back on itself, with both ends directed backwards. Eggs fusiform, with bipolar filaments. Vagina simple, surrounded by circular muscle fibers in form of a sphincter, with midventral opening far posterior to genital pore; paired accessory vaginal ducts connected with transverse commissure of anteriormost anastomosing vitelline ducts, median vaginal duct proper rudimentary. Vitellaria co-extensive with intestine, confluent posteriorly; vitelline reservoir Y-shaped, to left of ovary; anterior vitelline ducts containing sperm. Gill parasites of marine teleosts.

TYPE SPECIES: *P. lepidocybii* n. sp. on *Lepidocybium flavobrunneum*; Hawaii.

13. *Pseudodiscocotyla opakapaka* n. g., n. sp.  
Fig. 14

HABITAT: Gill of *Pristipomoides microlepis* (local name "opakapaka") and *Aphareus rutilans*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 13.

DESCRIPTION (based on 20 whole mounts): Body tapering anteriorly, 1.6–2.7 mm in length, with maximum width of 0.22–0.6 mm at posterior half of body. Opisthaptor with a median pair of larval hooklets at posterior end, divided into symmetrical lobes, each bearing an oblique row of four subequal clamps; clamp skeleton 0.1–0.18 mm wide, consisting of a dorsal and a ventral pair of slender, unjointed, lateral arms, a median spring with bifid ends, and a pair of incurved basal rods. Head truncate, 0.15–0.2 mm wide. Paired oral suckers septate, 40–70 × 60–110 $\mu$ . Pharynx pyriform, 30–60 × 30–45 $\mu$ . Esophagus short, bifurcating just behind bulbus cirri. Ceca with short inconspicuous diverticles, extending into opisthaptor, terminating very close to each other near wide posterior sinus between two lobes of opisthaptor.

Testes 50–100 in number, occupying nearly whole postovarian intercecal field, divided into two lateral groups from behind ovary to level of shell gland. Vas deferens winding in median field dorsal to uterus. A stout ellipsoidal bulbus cirri about 75 × 60 $\mu$ , provided subapically with a median group of 12 minute acicular spines and a pair of longer, very slender, lateral spicules, and apically with a certain number of slightly curved spines massed together; genital atrium with a crown of two alternating rows of minute spines, opening midventrally at a distance of 0.17–0.35 mm from head end.

Ovary bent back on itself, with its distal end directed backward, 100–170 × 60–112 $\mu$ , situated on the right of median line just in front of middle of body. Germiduct arising from ovary soon gives off genito-intestinal duct opening into right intestine, and after joining the vitelline reservoir continues its backward course between the two submedian groups of testes, and then turns forward to be surrounded by shell gland cells. Uterus midventral, strongly distended with eggs in some specimens. Eggs elliptical, 160–180 × 60–70 $\mu$ , with a very long, fine, convoluted filament at each pole. On the ventrolateral surface of the body at a distance of 0.27–0.45 mm from the head end there is a pair of oval symmetrical vaginae lined with corrugated cuticle, but their vaginal ducts could not be made out. Vitellaria commencing behind vaginae, and extending along whole length of intestine except for its anteriormost portion; vitelline reservoir Y-shaped, median, with its arms at level of ovary and its stem between two submedian groups of testes. It is very remarkable that each arm is distended with sperm at its anterior end in the form of an oval sac.

DISCUSSION: This genus resembles *Discocotyle* Diesing, 1850, in general anatomy, but differs from it in the intestinal limbs not uniting posteriorly, in the heavily armed bulbus cirri and armed genital atrium, etc. It obviously belongs to Discocotylidae Price, 1936, but cannot be assigned to any known subfamilies, hence a new subfamily is proposed for its reception.

*Pseudodiscotylinae* n. subf.

SUBFAMILY DIAGNOSIS: Discocotylidae. Terminal anchor-bearing lappet absent. Haptoral

clamps of four pairs, subequal, of *Discocotyle* type, bivalved, sessile. Vagina double.

*Pseudodiscocotyla* n. g.

GENERIC DIAGNOSIS: Discocotylidae, Pseudodiscocotylinae. Body tapering anteriorly; opisthohaptor two-lobed, with a median pair of larval hooklets posteriorly and four pairs of subequal bivalved clamps; clamp skeleton consisting of two pairs of slender, unjointed, lateral arms, a median spring and a pair of incurved basal rods. Prohaptor oral sucker septate. Esophagus bifurcating posterior to genital pore; ceca slightly diverticulate, not united posteriorly. Testes very numerous, occupying nearly whole postovarian intercecal field. Armed bulbus cirri present. Genital atrium armed. Genital pore prebifurcal. Ovary turned back on itself, with its distal end directed backwards. Genito-intestinal duct present. Shell gland complex between two submedian groups of testes. Eggs elliptical, large, with convoluted filament at each pole. Vaginae lined with corrugated cuticle, situated ventrally near lateral margins of body at a level a little behind genital pore; vaginal duct not traced. Vitellaria extending along entire intestinal limbs posterior to vaginae; vitelline reservoir Y-shaped, with its arms distended with sperm at its anterior end in form of oval sac. Gill parasites of marine teleosts.

TYPE SPECIES: *P. opakapaka* n. sp. on gills of *Pristipomoides microlopis* and *Aphareus rutilans*; Hawaii.

14. *Allospseudaxinooides euthynni* n. g., n. sp.

Fig. 15

HABITAT: Gills of *Euthynnus yaito* (local name "kawakawa"); Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 14.

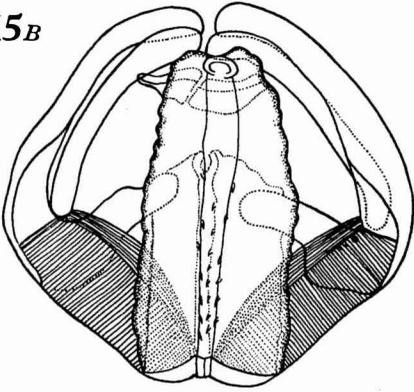
DESCRIPTION (based on 12 whole mounts): Body large, 5–8 mm long from head end to tip of caudal appendage, markedly tapered in head and esophageal regions, widest (2.9–5.5 mm) at opisthohaptor which extends obliquely along the posterior end of the body proper. Opisthohaptor unilateral, bearing a row of 13–15 clamps and a prominent digitiform caudal appendage which is provided at its blunt end with two pairs of anchors; outer anchor 47–53 $\mu$  long, inner one 22–25 $\mu$  long. Clamp bivalved, 0.15–

0.3 mm in diameter; median spring U-shaped, with rounded ends, consisting of sclerotized median piece and parallel-sided muscular flange which appears as a winglike lateral extension of the median piece in optical section; the dorsal valve of clamp is supported by a pair of arcuate lateral sclerites meeting at tip of valve and curved medially at base; the ventral valve is supported by a pair of apically slightly curved sclerites meeting in the median line and articulating at the base with the dorsal sclerites at the angle where they bend medially. Beneath the apical ends of the dorsal and ventral sclerites are paired sclerotized thickenings of the median apical margins of the capsules of the dorsal and ventral valves. Head rounded, 0.13–0.17 mm wide; mouth ventroterminal. Paired oral sucker 25–35  $\times$  30–43 $\mu$ ; pharynx pyriform, 40–70  $\times$  30–43 $\mu$ , sometimes protruding into buccal cavity. Esophagus simple, 0.38–1.05 mm long; bifurcating a short distance posterior to genital atrium; intestinal limbs with short inner and longer outer branches, terminating in distal portion of opisthohaptor, the right limb reaching to base of caudal appendage.

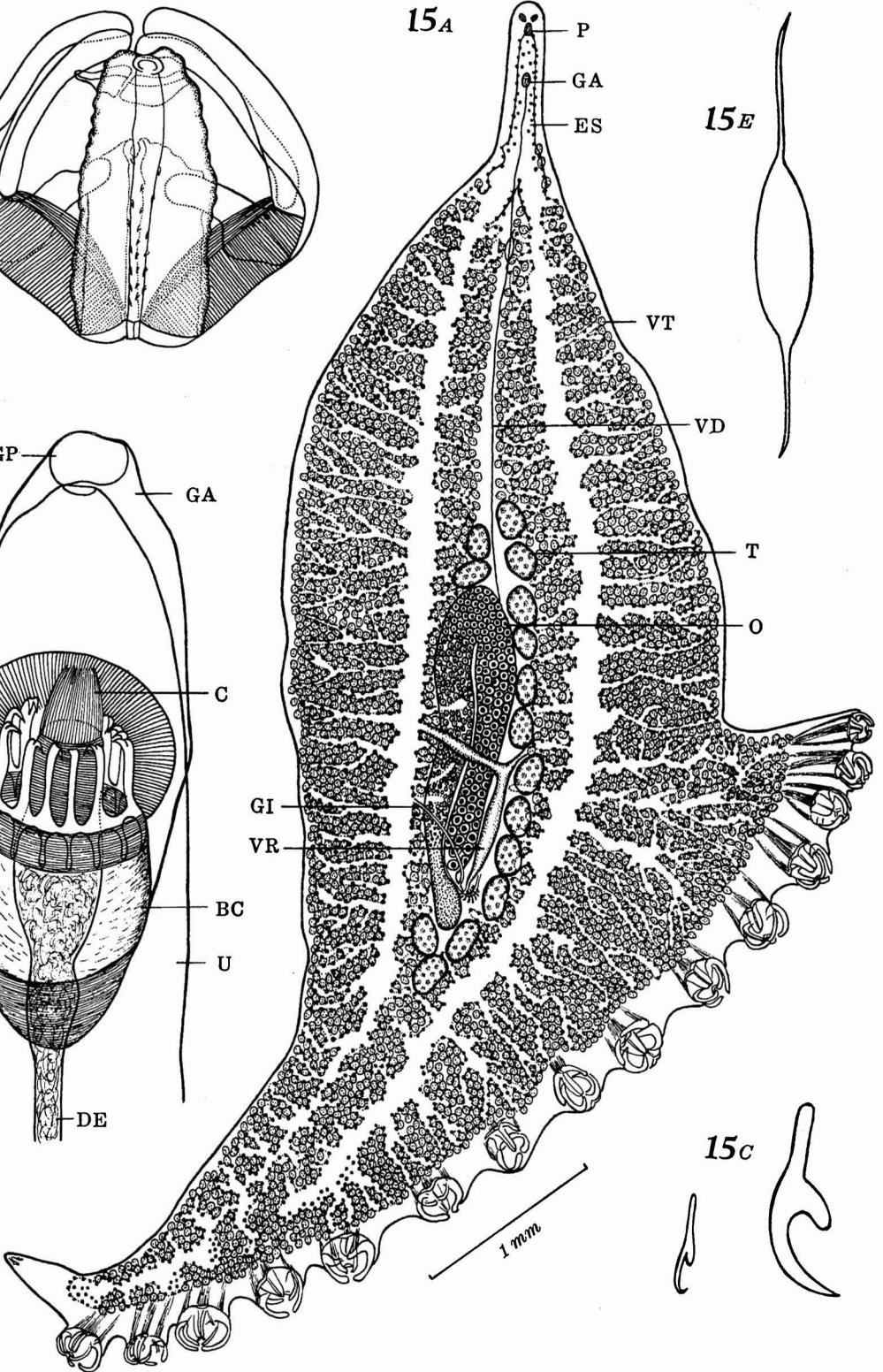
Testes up to about 20 in number, irregular in shape, extending in interintestinal field from preovarian area to postovarian area, passing in one row on left side of ovary. Vas deferens narrow, almost straight dorsal to uterus. Cirrus forming a bulb surrounded by fine circular muscle fibers, produced forward into a cuticularized short cylinder tipped with a circular row of delicate spiniform structures which projects into the lumen of the genital atrium. Genital atrium spherical, 42–45 $\mu$  in diameter, with thick wall of radial muscle fibers, armed inside with a corona of over a dozen (14–24?) spines 20–25 $\mu$  long whose bifid tips are curved inwards; these spines are supported at the base by another corona of stumpy denticles. Genital pore midventral, 0.25–0.6 mm from head end.

Ovary 1.3–1.8  $\times$  0.15–0.4 mm, turned back on itself in midregion of body, with both ends directed backwards. Genito-intestinal duct crossing proximal and distal ends of ovary and opening into right intestinal limb. Uterus midventral; eggs elliptical, 0.12–0.2 mm long by 70 $\mu$  wide, with polar filament 0.07–0.14 mm long at each pole. Vitellaria co-extensive with intestine and its branches. Vitelline reservoir Y-shaped; its

15B



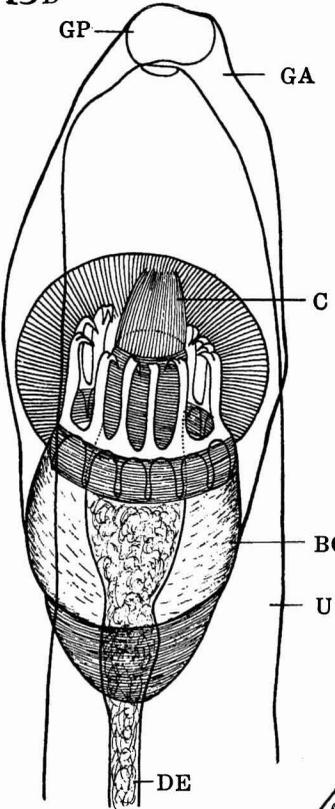
15A



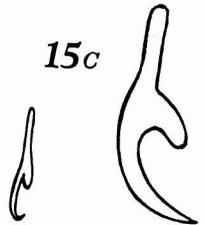
15E



15D



15c



stem 0.4–0.6 mm long, and its right arm crossing ovary at about its middle. Vagina entirely lacking.

DISCUSSION: This new genus differs from *Allo-pseudaxine* Yamaguti, 1943, in the complete absence of vaginae and the presence of cuticularized apical thickenings of clamp capsule beneath the apical ends of dorsal and ventral lateral sclerites.

Unnithan (1957) proposed a new genus *Uraxine* which is now regarded as a synonym of *Allo-pseudaxine* Yamaguti, 1943, and placed it in his new subfamily Monaxiniinae of his family Axinidae. Price (1962) created a new family for *Allo-pseudaxine*; but I prefer to assign this genus, along with the present new genus, to Allo-pseudaxiniinae Yamaguti, 1963, of Unnithan's Axinidae.

*Allo-pseudaxinoides* n. g.

GENERIC DIAGNOSIS: Axinidae, Allo-pseudaxiniinae. Body large, abruptly tapering anteriorly. Opisthohaptor unilateral, oblique; clamp skeleton consisting of a median U-shaped spring, a pair of dorsal lateral sclerites and a pair of ventral lateral sclerites; ventral lateral sclerite articulating with dorsal lateral sclerite at the angle where the latter turns medially. This pattern of clamp skeleton is exactly similar to that of *Allo-pseudaxine*, only differing from the latter in having paired sclerotized thickenings at the apex of clamp capsule beneath apex of dorsal and ventral lateral sclerites. Caudal appendage bearing two pairs of anchors. Esophagus bifurcating a short distance posterior to genital pore. Intestinal limbs with numerous side branches, terminating near base of terminal appendage. Testes not very numerous pre-, para-, and postovarian. Genital atrium sucker-like, provided inside with a corona of apically curved spines, at the base of which is another circle of denticles supporting the spines. Ovary tubular, turned back on itself in midregion of body. Eggs elliptical, with filament at each pole. Vaginae absent. Vitellaria co-extensive with intestine and its branches; vitelline reservoir Y-shaped, sinistral to ovary. Parasitic on gills of marine teleosts.

TYPE SPECIES: *A. euthynni* n. sp., on *Euthynnus yaito*; Hawaii.

15. *Allomonaxine carangoides* n. g., n. sp.

Fig. 16

HABITAT: Gills of *Carangoides* sp.; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 15.

DESCRIPTION (based on 9 whole mounts): Body moderately large, wedge-shaped in outline, tapering anteriorly, widest (0.2–0.27 mm) at the obliquely truncated posterior end, along which is attached a row of 40 to 50 clamps. Clamp skeleton up to 70–110 $\mu$  wide, of *Microcotyle* type, consisting of a U-shaped median piece without accessory apical pieces, two pairs of lateral sclerites and a pair of curved basal rods. Head end truncate, 0.3–0.4 mm wide, with wide ventroterminal mouth aperture. Oral suckers elliptical, septate, 0.08–0.11  $\times$  0.15–0.2 mm. Pharynx pyriform, 57–100  $\times$  47–63 $\mu$ ; esophagus 0.3–0.5 mm long, with few side branches, bifurcating immediately behind genital atrium. Intestinal limbs with numerous, subdivided, outer branches and fewer, simpler, inner branches, not confluent posteriorly; left limb extending beyond right limb to near extreme left end of body.

Testes rounded, very numerous, paved in one layer and occupying whole postovarian interintestinal field; under low power of magnification they appear like a single lobed organ subdivided by inner intestinal branches. Vas deferens winding regularly from one side of median line to the other among inner intestinal branches, convoluted behind intestinal bifurcation. No cirrus differentiated. Genital atrium reniform, 0.16–0.24  $\times$  0.24–0.27 mm, provided with well-developed radial muscle fibers, armed inside with spines of four different types; ventral spines 30–75 $\mu$  long, 34–40 in number, with straight shaft and clawlike point, arranged very close to one another in a transverse row intermingled dorsally at somewhat regular intervals with 14–16 shorter spines whose point is simple and whose shaft is outcurved dorsally about the middle; of the lateral spines four lie transversely on each side at the male genital pore, and 20–22, similar in shape to those longer ventral spines and 50–63 $\mu$  long, are arranged in a gently curved row immediately lateral to the shorter (30–40 $\mu$  long), stouter claw-like, medial

FIG. 15. *Allo-pseudaxinoides euthynni* n. g., n. sp. 15A, Holotype, ventral view; 15B, clamp, dorsal view; 15C, caudal anchors; 15D, terminal genitalia, ventral view; 15E, egg.

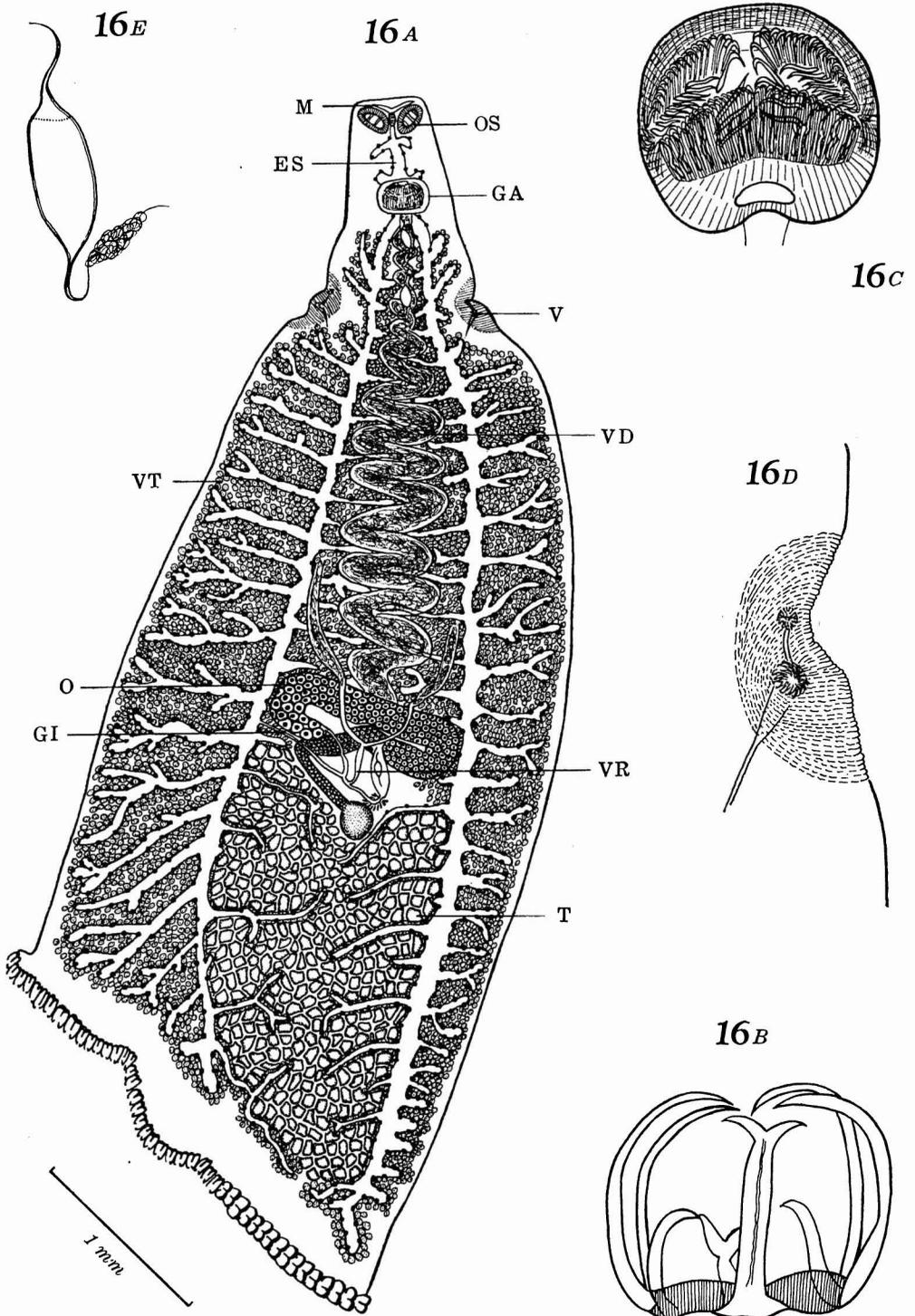


FIG. 16. *Allomonaxine carangoides* n. g., n. sp. 16A, Holotype, ventral view; 16B, clamp, ventral view; 16C, terminal genitalia, dorsal view; 16D, vagina, dorsal view; 16E, egg.

spines which are arranged in a dorsoventral row. Genital pore midventral, prebifurcal, 0.38–0.5 mm from head end.

Ovary equatorial, tubular, originating with or without enlargement, immediately in front of anteriormost testes, describing a double loop, with its distal end directed posteromesad, measuring 0.5–0.7 × 0.6–0.9 mm as a whole. Genito-intestinal duct short, opening into right intestinal limb at level of ootype. Uterus midventral; eggs elliptical, about 0.17 × 0.07–0.075 mm, with long convoluted filament at posterior pole and a shorter, nonconvoluted filament at opercular pole. Vitellaria commencing at a level halfway between intestinal bifurcation and level of vaginae, extending along intestinal branches; vitelline reservoir Y-shaped, overlapping ovary on its ventral side. Vaginae double, dorsolateral, symmetrical, opening a short distance behind intestinal bifurcation, 1.0–1.25 mm from head end; each opening provided densely with acicular spines, surrounded by extremely finely denticulated cuticle, with a conspicuous ventral lateral depression immediately in front; at the bottom of this pit is a mass of over a dozen minute conical teeth representing an accessory vaginal armature. This accessory vagina is connected with the vagina proper by a narrow duct. Vaginal ducts running posteromesad, each probably joining anterior part of collecting vitelline duct of its own side. Longitudinal collecting vitelline duct was seen filled with sperm in one paratype.

DISCUSSION: This genus bears a superficial resemblance to *Monaxine* Unnithan, 1957, but differs fundamentally in the vagina being paired and in having symmetrical, ventrolateral, prevaginal depressions, each of which is provided at the bottom with a small dense mass of conical teeth. These two characters are sufficient to justify the erection of a new genus, for which the name *Allomonaxine* is proposed.

#### *Allomonaxine* n. g.

GENERIC DIAGNOSIS: Axinidae, Monaxiniinae: Body relatively large, asymmetrically flattened conical. Clamp skeleton of *Microcotyle* type; median spring without apical piece; lateral sclerites unjointed. Esophagus slightly diverticulate; intestinal limbs with inner and other branches, not united posteriorly. Testes very numerous, oc-

cupying whole postovarian interintestinal field. Vas deferens undulating, but convoluted behind intestinal bifurcation. No cirrus differentiated. Genital atrium muscular, armed with spines of different types; genital pore prebifurcal. Ovary in midregion of body, forming a double loop, with its distal end directed posteromesad. No seminal receptacle. Eggs with filament at each pole. Vaginae double, opening dorsolaterally at a short distance posterior to intestinal bifurcation; a prevaginal depression present ventrolaterally, with a small dense mass of conical teeth at its bottom. Each vaginal duct probably opening into anterior part of longitudinal collecting vitelline duct of its own side. Vitellaria commencing a little behind intestinal bifurcation; vitelline reservoir Y-shaped, overlapping ovary. Gill parasites of marine teleosts.

TYPE SPECIES: *A. carangoides* n. sp., on *Carangoides* sp.; Hawaii.

Four specimens similar in structure but definitely smaller in size, from the gill of *Carangoides ferdau* gave the following measurements: Body 3–4 × 1.3–1.8 mm with 44–46 clamps; anterior sucker 40–60 × 70–100 $\mu$ ; pharynx 30–40 × 30–38 $\mu$ ; genital atrium 0.14–0.16 × 0.17–0.2 mm, with spines exactly similar in number, size and arrangement to those of *Allomonaxine carangoides*. Vagina 0.64–0.8 mm from head end. Ovary 0.36–0.48 × 0.36–0.56 mm. Although the above measurements are entirely different from those of gravid specimens of *Allomonaxine carangoides*, I prefer for the present to regard these four specimens as juvenile forms of this species.

#### 16. *Pseudochaubanea sphyraenae* n. g., n. sp.

Fig. 17

HABITAT: Gill of *Sphyraena barracuda*; Hawaii.

HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 16.

DESCRIPTION (based on five whole mounts): Body lanceolate, tapered anteriorly from level of vagina, usually 4.45–5.8 mm long, but may be up to 10 mm long when completely relaxed, with maximum breadth of 0.32–1.4 mm at post-testicular level. Opisthohaptor without terminal anchors, asymmetrical, without attenuated stalk as seen in *Chaubanea madrasensis* Ramalingam, 1953; clamps unequal, with skeleton of *Gastro-*

*cotyle* type, 28–50 on the right, 25–37 on the left, making a total of 58–87. Paired prohaptor suckers elliptical, muscular, with several septae,  $72-112 \times 37-60\mu$ . Head rounded, truncate at apex, with subterminal mouth opening. Pharynx globular,  $37-58 \times 35-50\mu$ , esophagus 0.83–2.0 mm long, giving off numerous simple or subdivided side branches at right angles, bifurcating just in front of vaginal pore, anteriormost esophageal branches apparently rosette-shaped; intestinal limbs with numerous subdivided branches laterally; each may give off posteriorly two secondary limbs which are also provided with side branches and run backward parallel to the main limbs; these limbs are not accompanied by the vitellaria posteriorly and may or may not reach the posterior end of the opisthaptor.

Testes rounded, 70–100 in number, pre-, para-, and postovarian, commencing a certain distance (0.5 mm in the type 4.45 mm long) behind vaginal pore, and terminating at level of anteriormost clamp. Distal portion of vas deferens running ventral to esophagus, strongly winding and provided with thick wall of circular muscles. Cirrus pouch fusiform,  $90-160 \times 30-45\mu$ , provided outside with well-developed longitudinal muscles, oblique to body axis on right side of esophagus; cirrus unarmed, opening into relatively wide genital atrium which in turn opens ventrally close to right margin of body at a distance of 0.36–0.84 mm from head end. In the region of the genital pore the body bulges out a little as shown in the figure.

Ovary with irregular outline, confined to middle third of body on right side of median line medial to right intestinal limb, commencing with a compact mass 0.18–0.2 mm wide and ascending for a distance of 0.86–1.4 mm and then descending alongside ascending portion, giving off germiduct just in front of compact proximal mass. The germiduct originating at the posterior distal end of the ovary soon gives off the genito-intestinal duct and then unites with the stem of the vitelline reservoir; the genito-intestinal duct crosses the distal end of the ovary ventrally and empties into the right intestinal limb. Shell gland confined to space between ovary and testes. Uterus midventral, finally running alongside cirrus pouch and opening into genital atrium near its margin. Eggs greatly elongated, 220–230 $\mu$  long by 40 $\mu$  wide, with

both ends produced into filaments 170–250 $\mu$  long. Vagina bulbous, about 0.11 mm in diameter in the type, opening midventrally just behind intestinal bifurcation, 0.95–2.4 mm from head end; vaginal duct could not be traced backwardly. A pair of narrow symmetrical ducts arising from base of vagina, each provided with a sphincter at distal end, probably united with vitelline duct passing nearby. Vitellaria commencing on each side at level of intestinal bifurcation, leaving posterior ends of intestinal limbs free; vitelline reservoir Y-shaped.

DISCUSSION: The present species differs from *Chaubanea madrasensis* Ramalingam 1953, from *Sphyaena acuitipinnis* in the body lacking the haptor stalk, septate anterior suckers, longer esophagus, larger number of testes, and post-bifurcal position of the vagina. Ramalingam states that the vagina is lateral on the left side, just beneath and parallel to the short unarmed cirrus, and that the vaginal pore is fringed with minute teethlike spines. This entirely different location of the vagina and the difference in the body shape justify the creation of a new genus, for which the name *Pseudochaubanea* is proposed with the following diagnosis.

*Pseudochaubanea* n. g.

GENERIC DIAGNOSIS: Gastrocotylidae, Gastrocotylinae: Body lanceolate, without stalk for opisthaptor. Opisthaptor asymmetrical, not distinctly set off from body proper, with large numbers of clamps of *Gastrocotyle* type; terminal anchors absent. Paired anterior suckers strongly muscular, conspicuously septate; esophagus long, with side branches; ceca also with numerous side branches, continued into opisthaptor, and terminating separately at or near posterior end of latter where they are not accompanied by the vitellaria. Testes numerous, pre-, para-, and postovarian, passing beside ovary. Vas deferens with thick muscular wall distally; cirrus pouch present; cirrus unarmed, may or may not protrude into genital atrium; genital pore submarginal, in anterior region of esophagus. Ovary in midregion of body, to right of median line, turning back on itself and giving germiduct at its backwardly directed end. Vagina unarmed, opening midventrally, postbifurcal, with paired narrow ducts, each of which probably unites with the vitelline duct passing nearby. Eggs elongate, filamented at both ends.

Vitellaria co-extensive with intestinal limbs except for their posteriormost portion. Gill parasites of marine teleosts.

TYPE SPECIES: *P. sphyraenae* n. sp., on *Sphyraena barracuda*; Hawaii.

17. *Areotestis sibi* n. g., n. sp.

Fig. 13

HABITAT: Gill of *Parathunnus sibi* (type host), *Neothunnus macropterus*, and *Thunnus alalunga*; Hawaii.

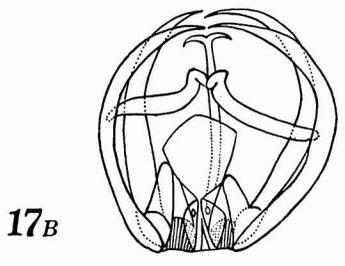
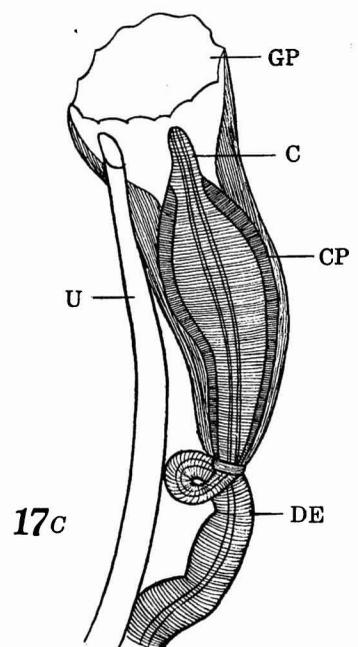
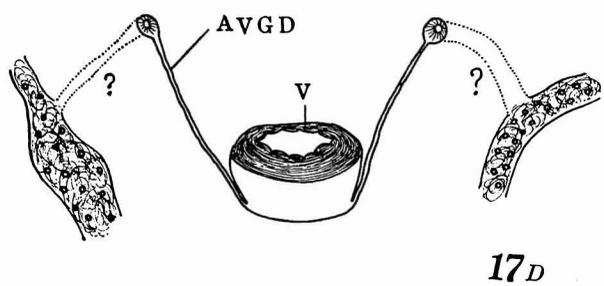
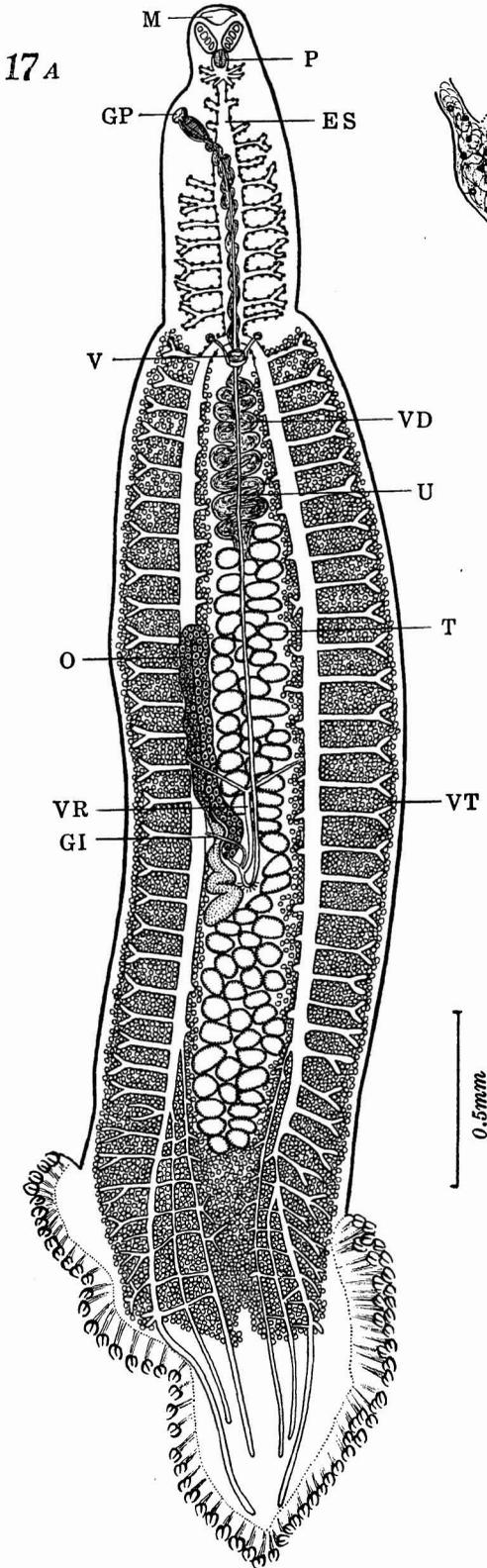
HOLOTYPE: U. S. Nat. Mus. Helm. Coll., S.Y. No. 17.

DESCRIPTION (based on 16 whole mounts): Body proper widened from level of anterior end of ovary to cotylophore, 11–25 × 4.5–16 mm, abruptly narrowed anterior to ovary and gradually tapering toward head which is 0.11–0.21 mm in diameter. There are 63–105 clamps arranged in an oblique row along entire posterior margin of body proper, whose posterior extremity is prolonged into a conical appendage bearing two pairs of hooks; clamp skeleton consisting of two pairs of arcuate lateral arms, a pair of short basal arms, a pair of accessory sclerites and a median spring; longer prong of median spring anchor-shaped, but shorter prong slightly truncate apically and bearing simple, paired, and a terminally bifid, unpaired, poorly sclerotized, apical pieces just beneath the simple accessory sclerites. Of the caudal hooks the outer pair is 40–54 $\mu$  long and the inner pair 22–30 $\mu$  long, both with a very prominent guard and a long, well-curved blade. Head end usually rounded, with wide mouth aperture ventrally; at the bottom of the buccal cavity is a pair of comparatively small, aseptate, muscular suckers 20–33 $\mu$  by 27–50 $\mu$ ; pharynx oval, 45–60 × 35–50 $\mu$ . Esophagus simple, 0.6–1.6 mm long, bifurcating a little behind genital pore; intestinal limbs simple anteriorly, sooner or later giving diverticles which unite with one another and form network extending throughout enlarged portion of body proper, enclosing variable number of testes in the meshes.

Testes rounded, separated into 70–170 flat areolae, very irregular in size and outline, commencing at junction of anterior with middle third of body; each areola comprising 1 to 20 testes. Vas deferens strongly twisted posteriorly

when distended with sperm, running in interintestinal field dorsal to uterus but more loosely winding anteriorly and differentiated into a sigmoid pars prostatica surrounded by prostate cells a short distance posterior to genital pore. Ejaculatory duct narrow, winding; cirrus pouch funnel-shaped, containing bulbus cirri at its widest anterior portion, continued into genital atrium; cirrus consisting of a basal bulb 45–50 $\mu$  in diameter and an apical bundle of elongate cuticular shingles projecting into genital atrium. The structure and number of the shingles could not be made out, because they are massed tightly together. They appear to arise from the anterior border of the truncate conical, membranous extension of the bulbus cirri. Genital atrium 65–93 $\mu$  in diameter, provided with thick wall of circular muscle fibers, provided inside with a crown of 13 to 18 hooks which measure 40–55 $\mu$  in length including the cylindrical base 14–19 $\mu$  long, each being bifid at the incurved tip. Genital pore ventral to esophagus, 0.36–0.75 mm from head end.

Ovary tubular, arising from posterior end of interintestinal field at anterior end of posterior third of body in form of a compact V-shaped mass of very small primordial germ cells, extending forward just medial to left intestinal limb, turning back on itself at about midbody and descending along medial side of ascending portion; as a whole the ovary measures 2.6–6.5 mm in length and 0.12–0.6 mm in maximum width. The germiduct arising from the distal end of the ovary joins the genito-intestinal duct on the left and then the vitelline reservoir on the right at the posterior end of the middle third of the body. Genito-intestinal duct frequently forming a rounded or elliptical seminal receptacle 12–25 $\mu$  in diameter near its origin from germiduct, opening into left intestinal limb, usually at a level a little anterior to its origin. Eggs fusiform, thick-shelled, 175–265 × 70–120 $\mu$  in mounted condition, produced at each end into rigid process which is 70–200 $\mu$  long and may or may not terminate in a disc 8–25 $\mu$  in diameter. Vagina entirely lacking. Vitellaria completely co-extensive with intestine and its network; their rudimentary follicles commencing along esophagus at varying levels posterior to genital atrium; vitelline reservoir Y-shaped, its stem 0.45–1.3 mm long, imme-



diately dextral to distal portion of ovary.

**DISCUSSION:** This obviously gastrocotylid species cannot be assigned to any known genus on account of absence of a vagina and peculiar arrangement of the testes. A new genus and a new subfamily are, therefore, proposed for its reception, referring to the areolate testes.

**Areotestiinae** n. subf.

**SUBFAMILY DIAGNOSIS:** Gastrocotylidae: Clamps unilateral, symmetrical in structure, with accessory sclerites. Hook-bearing caudal appendage present, prehaptor larval anchors absent. Testes divided into numerous groups which are isolated one from another by anastomosing intestinal branches.

**Areotestis** n. g.

**GENERIC DIAGNOSIS:** Gastrocotylidae, Areotestiinae: Haptor clamps nearly of *Gastrocotyle* type, arranged along straight or arcuate posterior margin of body, the distal end of which is produced into a terminal lappet bearing 2 pairs of anchors. Esophagus simple, long; intestinal limbs with numerous branches anastomosing one another in form of extensive network. Testes divided into numerous areolae of different size and outline and enclosed in meshes of this intestinal network. Pars prostatica distinct, surrounded by prostate cells. Genital atrium muscular, provided inside with a crown of hooks, enclosing armed bulbous cirrus, opening ventral to esophagus. Ovary folded back on itself in posterior interintestinal field, with both ends directed backwards. Genito-intestinal duct short, frequently forming rounded or elongate seminal receptacle. Eggs fusiform, produced into rigid processes at both ends. Vagina absent. Vitellaria co-extensive with intestine and its network, some follicles extending forwards along esophagus; vitelline reservoir in ovarian zone. Gill parasites of marine teleosts.

**TYPE SPECIES:** *A. sibi* n. sp., on gills of *Parathunnus sibi*, *Neothunnus macropterus*, and *Thunnus alalunga*; Hawaii.

18. *Allomicrocotyla onaga* n. g., n. sp.

Fig. 18

**HABITAT:** Gill of *Etelis carbunculus* (local name "onaga"); Hawaii.

**HOLOTYPE:** U. S. Nat. Mus. Helm. Coll., S.Y. No. 18.

**DESCRIPTION** (based on five whole mounts): Body proper fusiform to elliptical; opisthaptor shaped like an asymmetrical fan fringed with two rows of clamps along its semicircular posterior margin which is 0.8–1.4 mm long. At one end of the opisthaptor there are two pairs of anchors of different size and shape. Total body length 2.5–4.0 mm, maximum width 0.8–1.6 mm in midregion of body proper. Clamps 40–63 in number, arranged in two rows of equal or subequal length, 20–31 in one row and 20–33 in the other; clamp skeleton of uniform structure, consisting of a basally jointed median spring, two pairs of unjointed lateral arms, and a pair of basal sclerites, each of which articulates with the base of the two lateral arms at one end and with the enlarged end of dorsal prong of the median spring at the other end; the narrow solid ventral prong tapers toward its bifid tip reaching the tips of the ventral lateral arms, while the short dorsal prong curves ventrad and terminates in a transversely enlarged solid pad which is united by muscle with another ventrally curved hollow median sclerite reaching to tip of dorsal lateral arms. Head more or less pointed anteriorly, 0.11–0.13 mm wide at level of oral suckers; at the apex is a compact group of gland ducts originating from the group of parapharyngeal, postsuctorial gland cells and passing dorsal to the oral suckers. I prefer to designate the apical group of gland ducts as apical organ, and the parapharyngeal mass of gland cells as apical gland, although the structural details of the gland cell could not be made out except for the granular cytoplasm surrounding the dark-staining nucleus which is definitely larger than the adjoining parenchymatous nuclei. Mouth comparatively wide, opening ventrally at level of base of head. Oral suckers opening into buccal cavity, one on each side of anterior end of pharynx, strongly muscular, aseptate, 40–55 $\mu$  by 50–56 $\mu$ . Pharynx pyriform, 37–65  $\times$  32–51 $\mu$ , cellular except at the apex which is provided with circular muscle fibers. Nerve commissure

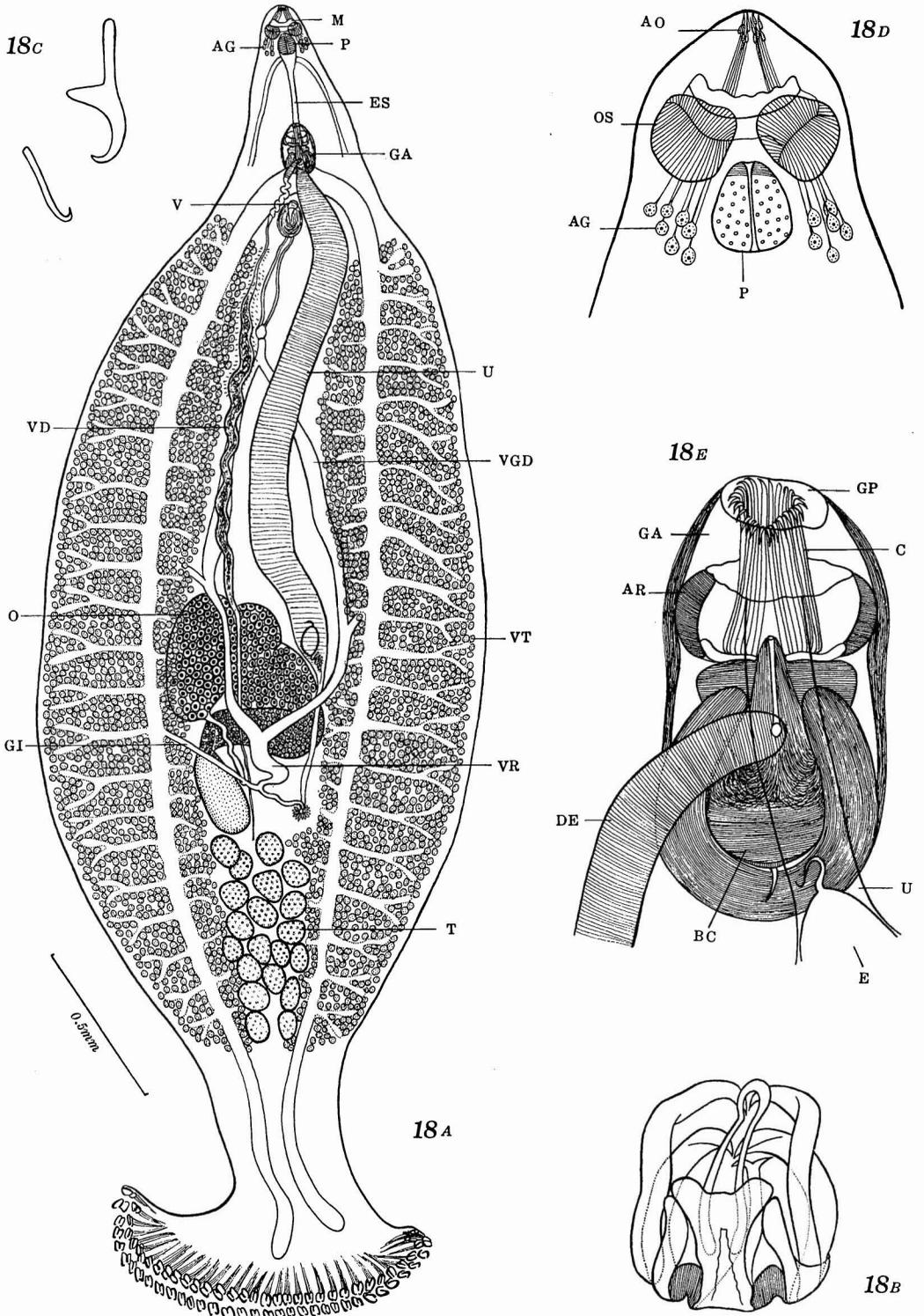


FIG. 18. *Allomicrocotyla onaga* n. g., n. sp. 18A, Holotype, ventral view; 18B, clamp; 18C, caudal anchors; 18D, anterior extremity; 18E, terminal genitalia, ventral view.

and paired nerve trunks conspicuous, former dorsal to anterior end of esophagus. Esophagus simple, without diverticles; intestinal limbs simple at the beginning as well as at the posterior portion intruding into the opisthohaptor, giving off numerous short inner and longer outer branches in swollen region of body proper.

Testes rounded, 10–20 in number, arranged irregularly in postovarian interintestinal field, but not beyond level of posterior end of vitellaria. Vas deferens slightly winding on the right of median line, provided with a dense coat of prostatic cells along greater distal portion. No pars prostatica differentiated. Ductus ejaculatorius wider than distal end of vas deferens, provided with circular muscle fibers. Cirrus complex, consisting of a more or less pointed pyriform bulbus cirri of lamellar muscles enclosed in a horseshoe-shaped pad of lamellar muscles, and an inverted cone, on the anterior base of which is set a midventrally interrupted crown of long, apically outcurved spines projecting into the genital atrium. The pointed conical apex of the bulbus cirri fits into the midventral groove of the above-mentioned cone and projects a little into the base of the genital atrium, whereas the apex of the inverted cone is attached to the mid-dorsal side of the bulbus cirri. The ejaculatory duct leads into the bulbus cirri ventral to this point of attachment. Genital atrium forming a powerful ring (69–84 $\mu$  in outside diameter) of circular muscle fibers basally, but thin-walled distally, provided with circular and longitudinal muscles; the latter fibers extend backward over the atrial ring and continue to the outer surface of the horseshoe-shaped muscle pad, thus simulating the cirrus pouch. Common genital pore ventral to posterior part of esophagus, 0.28–0.35 mm from head end.

Ovary shaped like an interrogation mark, 0.5–0.7  $\times$  0.35–0.4 mm, originating at posterior end of middle third of body to right of median line; its swollen distal portion with three constrictions in the type and occupying whole breadth of interintestinal field; germiduct arising from backwardly directed distal end of ovary, giving off genito-intestinal canal just before joining vitelline duct; ootype immediately anterior to anteriormost testes medial to left intestinal limb.

Genito-intestinal duct crossing proximal portion of ovary and emptying into right intestinal limb. Uterus midventral, very wide, may be distended with numerous eggs, thus occupying greater part of preovarian interintestinal field, opening into genital atrium across anterior rim of atrial ring mentioned above. Uterine eggs elongate oval, 130–152  $\times$  65–72 $\mu$ ; anterior filament rather rigid, 35–70 $\mu$  long; posterior filament extremely long and slender, forming close coils at posterior end of egg. Vagina funnel-shaped, 58 $\mu$  by 30 $\mu$  in the type, provided with circular and longitudinal muscle fibers, opening dorsally just on the right of median line shortly behind intestinal bifurcation; vaginal duct arising from posterior end of vagina, provided with heavily sclerotized walls down to end of its fusiform swelling, then reduced to a narrow duct, but soon becoming enlarged to a small ampulla 23–39 $\mu$  long by 18–26 $\mu$  wide. The comparatively wide duct arising from the posterior end of this ampulla soon (70 $\mu$  behind the ampulla in the type) divides into inverted V-shaped duct distended with yolk cells. Each limb of this duct empties into the lateral arm of the Y-shaped vitelline reservoir of its own side, so that the vagina is directly connected with the vitelline reservoir. Vitellaria co-extensive with intestine and its branches in fusiformly enlarged portion of body proper, leaving simple anterior and posterior portions of intestine free. Vitelline reservoir Y-shaped, largely overlapping ovary.

DISCUSSION: This genus bears a certain resemblance to *Pyragraphorus* Sproston, 1946 and *Allopyragraphorus* Yamaguti, 1963, in general anatomy, but differs fundamentally from either of them in the structure of the clamp skeleton, especially in the paired basal pieces articulating with the median piece. Moreover, the structure of the cirrus is entirely different from that of any of the known members of the Monogenea. In view of these characteristics there is no doubt that the present genus, apparently of microcotyloid type, represents a distinct family.

#### *Allomicrocotyla* n. g.

GENERIC DIAGNOSIS: Microcotyloidea, Allo-microcotylidae: Body proper fusiform; opisthohaptor semicircular, asymmetrical, strongly constricted off from body proper, fringed with

two rows of clamps, with two pairs of anchors of different size and shape at one end. Clamp skeleton quite different from those of *Microcotyle*, *Gastrocotyle*, *Pyragraphorus*, *Allopyragraphorus*, etc. Head with apical organ at front end. Oral suckers strongly muscular, pharynx cellular except for anterior end. Esophagus without diverticles; intestinal limbs simple at beginning and posterior portion intruding into opisthohaptor, branched elsewhere. Testes not very numerous. Cirrus consisting of inverted cone of lamellar muscles inclosed in a horseshoe-shaped pad of lamellar muscles and a crown of stavelike spines set on base of cone; common genital pore ventral to esophagus. Ovary bent back on itself in midregion of body, with its distal end directed backward. Genito-intestinal duct present. Eggs elongated oval, with filament at each pole. Vagina opening dorsally to right of median line shortly behind intestinal bifurcation; vaginal duct connected with paired arms of vitelline reservoir by means of inverted V-shaped duct. Vitellaria largely co-extensive with intestine and its branches; vitelline reservoir Y-shaped, largely overlapping ovary. Gill parasites of marine teleosts.

TYPE SPECIES: *A. onaga* n. sp., on *Etelis carbunculus*; Hawaii.

#### ALLOMICROCOTYLIDAE n. fam.

FAMILY DIAGNOSIS: Microcotyloidea: Opisthohaptor asymmetrical; clamp without apical accessory sclerites; short prong of median spring enlarged at tip and articulated on each side with basal sclerites and also with another dorsal median piece which is stout, hollow and curved ventrad. Anchor-bearing terminal lappet and prehaptor hooks absent. Testes postovarian; cirrus pouch absent; cirrus armed. Genital atrium unarmed. Vaginal pore nearly middorsal; postbifurcal. Parasites of marine fishes.

TYPE GENUS: *Allomicrocotyla* n. g.

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