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CONTENTS

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A NEW BRITTLE STAR FROM THE GALAPAGOS ISLANDS

By FRED ZIESENHENNE

The University of Southern California Publications
The Hancock Pacific Expeditions
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A NEW BRITTLE STAR FROM THE GALAPAGOS ISLANDS

(With One Plate)

By FRED ZIESENHENNE
The University of Southern California Invertebrate Laboratory

During the winters of 1932-33 and 1933-34 it was a privilege to be a member of a party of scientists on a zoological survey of the Galapagos Islands under the leadership of Captain G. Allan Hancock, who sponsored the Hancock Pacific Expeditions of 1932, of 1933, of 1934, and of 1935. One of the most interesting specimens taken on the 1933 Expedition was a new species of the genus *Ophioplocus* taken in the waters of the Galapagos Islands.

The author wishes to express his indebtedness to H. L. Clark, Museum of Comparative Zoology, for his personal and invaluable help in connection with the description of this new species and to express his appreciation to the staff of the Museum of Comparative Zoology for the opportunity of spending some weeks studying their collections.

OPHIOPLOCUS HANCOCKI, new species

Plate 1, figures 1, 2

Locality.—The original specimen was taken shore collecting on the north sandy beach of Cartago Bay, Albemarle Island of the Galapagos Islands at low tide, Feb. 13, 1933. It was collected from beneath surface rocks in a sandy-covered tide pool in a foot of water and partially imbedded in the sand. Its coloration blended in with the sand so that it could easily be overlooked.

An additional specimen was taken on a rocky tide flat, again embedded in sand under surface rocks on Jan. 20, 1934, Station 168-34. Another was collected at low tide in Academy Bay, Indefatigable Isle of the Galapagos Islands.

Three specimens were taken shore collecting in a tide pool a quarter mile south of Ritter's Landing at Black Beach, Charles Isle of the Galapagos Islands, Station 199-34.

Description.—Disk 13 mm. in diameter, arms 35-37 mm. long. Disk covered with a coat of rather coarse scales, smaller ones mingled with the larger, the latter slightly swollen making the whole surface rough and irregular; primary plates small but distinct; radial shields very small, nearly or quite concealed by numerous small disk scales; interradial margins of disk sharply defined by 5-7 large plates, of which the median is largest. Arm segments wider than long; dorsal plates broken up into a large number (20-30) of small polygonal plates of diverse sizes, forming a remarkably smooth pavement continuous with the disk covering; the distal lateral plate on each side is larger than the rest. Interbrachial areas below covered with fine scales; genital slits about equal to the three basal arm segments. Oral shields pentagonal with lateral and distal corners rounded; madreporite nearly circular; adoral plates medium, swollen, longer than the distal width, separated distally by the first ventral armplate but meeting within; oral papillae five or six on each side, penultimate twice as large as others. First under arm plate small, triangular, or low pentagonal, succeeding plates squarish, as wide as long. Side arm plate more or less covered, especially orally, by a shagreen-like skin; each one bears three stout flattened, bluntly pointed spines, as long as segment; lowest spine slightly the longest. Tentacles scales three or four, two larger ones on proximal side of pore and two or one much smaller on distal side; distally the scales become less distinct and often only one is evident.

Color in alcohol, disk cream yellow with irregular brown markings, in some of which the radial shields are usually included; arms cream color with brown bands on every sixth segment; arm spines nearly white; interbrachial areas below cream color speckled with about a dozen dull purple spots; proximal ventral plates more or less dusky; distally the brown bands of the arm are indicated by dusky ventral plates. In the dried specimen the yellow tint is lost and the disk and upper surface of the arms are a light grey with the dark markings conspicuous.

Types.—The type is deposited at the United States Museum. The co-types are deposited at: the Museum of Comparative Zoology, Cambridge, Mass., number 4834; the Zoological Museum, University

of Copenhagen, Denmark; The University of Southern California, Los Angeles, Calif., and the Velero III Collection, Los Angeles, Calif.

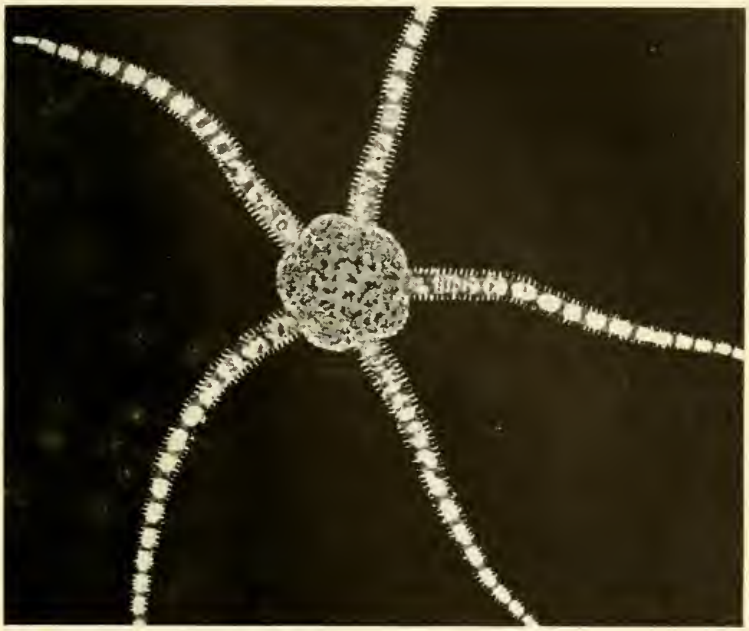
Remarks.—This species is remarkably interesting because the genus has a curious discontinuous distribution. There is one species in Japanese waters, one in the East Indies and Tropical Australian regions, one on the Southern Australian Coast, one in New Zealand, one along the Central American coast and north to Southern California, and now this new and particularly well-marked species from the Galapagos and presumably endemic there. It is instantly recognizable by the numerous plates on the upper side of the arm segments, their small size, and the closely fitted smooth pavement which they form. More material may show that the coloration is also distinctive.

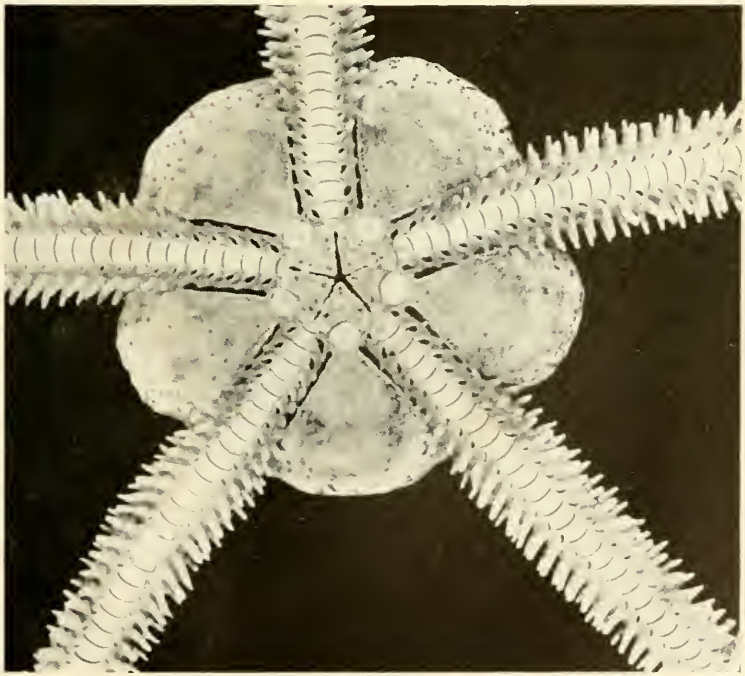
EXPLANATION OF PLATE

Fig. 1. *Ophioplocus hancocki*, new species, dorsal view x .7

Fig. 2. *Ophioplocus hancocki*, new species, ventral view x 2.3

(Photograph of para-type at The University of Southern California)





ORPHIOPLOCUS HANCOCKI

REPORTS ON THE COLLECTIONS OBTAINED BY THE HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, AND IN 1935.

DESCRIPTION OF A NEW BLENNIOID FISH OF THE GENUS *ACANTHEMBLEMARIA* FROM THE PACIFIC COAST OF PANAMA

By GEORGE S. MYERS *and* EARL D. REID

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DESCRIPTION OF A NEW BLENNIOID FISH OF THE GENUS *ACANTHEMBLEMARIA* FROM THE PACIFIC COAST OF PANAMA*

By GEORGE S. MYERS, Stanford University, and EARL D. REID
United States National Museum

Among the fishes obtained by Dr. Waldo L. Schmitt, Curator of Marine Invertebrates in the United States National Museum, during the 1935 cruise of Capt. G. Allan Hancock's yacht *Velero III*, we find a most interesting new species of the genus *Acanthemblemaria*. The three hitherto-known species of the genus are all West Indian (Metzelaar, 1919, p. 159; Beebe and Tee-Van, 1928, pp. 244-249).

Acanthemblemaria hancocki, new species

Holotype.—U.S.N.M. 102015, a specimen 31.8 mm. in standard length, taken February 4, 1935, on the outer side of the smaller, westernmost island of the Secas Islands, Pacific coast of Western Panama. Hancock Pacific Expedition, 1935.

Paratypes.—U.S.N.M. 102016, two specimens 30.8 and 31 mm. in standard length; same data as holotype.

Dorsal XXII to XXIII, 13 to 14. Anal II, 24 to 25. Pectoral 13. Pelvic 3. Caudal 16. Body moderately elongate, trunk compressed, greatest depth at origin of pectoral. Occipital region of skull rather bulging on each side, but upper profile of head continuously decurved from dorsal fin to snout tip. Head 3.7 to 3.9 in standard length, depth 5.8 to 6.1, predorsal distance 5 to 5.2, preanal distance 2.3 to 2.5. Pectoral 1.2 in head length (measured to upper angle of gill opening), pelvics 2.3, caudal 1.5, snout 7.7 to 7.9, interorbital 6.4 to 6.7, maxillary 1.8 to 2.3, extending slightly past posterior rim of orbit.

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Teeth in upper jaw in a strong outer row which extends backward to opposite middle of palatine patch, and a series of extremely minute inner teeth. Vomer with four strong teeth arranged in a square. Palatine patches with two rows of teeth, the patches being elongate-oval in shape. Teeth of lower jaw in a single strong outer row with a few very small teeth set in two irregular rows behind the main one at front of jaw. Both upper and lower jaws are rather expanded and flattened in front (the symphyses indented) and then rather suddenly constricted as the rami turn and run backwards. This formation of the jaws is apparently that described by Beebe and Tee-Van (in other species) as that of an old-fashioned key-hole. It might better be described as like the jaws of *Hippopotamus*. The main jaw teeth are strong though rather short, pointed, and slightly compressed in front. The front teeth in each jaw flare outward slightly.

Entire front of upper part of head, forward of the vertical of the posterior rim of orbit, covered with fine blunt spines. The spinous area includes the whole frontal and preocular region, the suborbitals, and a patch on top of the head behind the eyes extending backward in a blunt point toward (but not reaching) the vertex of the supraoccipital region. The interorbital is strongly concave, forming a trough in the middle, and is armed with three rows of spines on each side, the outer row being part of the single circumorbital spiny ring. This ring is complete except directly behind the eye. Orbital tentacle short, apparently simple. Nasal tentacle longer and multifid, but not as long as that of *A. arborescens*. Opercle and preopercle naked. A group of five or six pores on either side of nape about opposite origin of dorsal fin. Opercle ends above in a free, hook-like membrane supported by the branchiostegal rays, which reach notably above the point of attachment of the gill-cover.

Vertical fins of moderate height, soft rays longer than spines, the last rays attached at caudal base by a membrane. Origin of dorsal above preopercle, directly at base of cranium, which has no supraoccipital crest. Pelvics inserted in front of pectoral base.

Body light straw-colored, the head blackish with darker spots and lighter marblings, the principal dark area being a large hourglass-shaped saddle set transversely across the occiput and extending down on opercles to opposite lower rim of eye. About four brown dots on margin of opercle. Body with two main longitudinal rows

of dark brown spots, as large as eye in front but diminishing rapidly posteriorly, the upper row along the base of the dorsal and encroaching a little on the basal fin membranes, the lower row at mid-line of body. Another less conspicuous row of spots along anal base, these chiefly on the membranes. A single row of very fine dots just below the dorsal series and set alternately with each dorsal blotch. A similar row between the main central series of blotches and the anal series; this row may be very indistinct or nearly absent. Dorsal and anal faintly and narrowly bordered with dark. Pectorals and caudal clear. Pelvics brownish. Often the first few dorsal spines and their membranes dark brownish, fading posteriorly. The entire color effect is that of a black-headed, straw-colored fish with longitudinal series of spots which decrease in size posteriorly.

We are not certain to which of the three described species of *Acanthemblemaria* our new species is most closely related. Beebe and Tee-Van separate *spinosa* of Metzelaar from the others by the supposed lack of small teeth behind the main jaw series. It seems probable to us that Metzelaar's fish also had these small teeth, as they are very difficult to detect without the use of tooth-impressions made with modeling clay. Beebe and Tee-Van further separate *arborescens* from *variegata* on the profile of the head and the area of its spinosity, on the structure of the orbital tentacle, and on the color. The head profile of our form differs from that of the other three, and the area of spinosity on the top of the head is hard to compare without actual specimens of the other species in hand. Our species differs from *arborescens* and *spinosa* and agrees with *variegata* in the simple ocular tentacle, but agrees with *arborescens* and differs from the other two in the shape of the jaws and mouth as illustrated in the figures. It differs widely from all three in the unusual coloration.

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REPORTS ON THE COLLECTIONS OBTAINED BY THE HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, AND IN 1937.

A NEW GENUS OF DISTOMES (TREMATODA) WITH LYMPHATIC VESSELS

By H. W. MANTER

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A NEW GENUS OF DISTOMES (TREMATODA) WITH LYMPHATIC VESSELS*

(With One Plate)

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The trematodes described in this paper are but two of over 100 species collected from marine fishes in 1934, during the third G. Allan Hancock Expedition to the Galapagos Islands. The author's presence on this expedition was sponsored in part by the Carnegie Institution of Washington. A brief preliminary report on the trematodes collected has been made (Manter, 1934) and a more complete report on the digenetic forms is in preparation. An early description of these two forms is felt justified in view of their significance in connection with the phylogeny of the Distomata. The author has already indicated (Manter, 1935) a relationship between certain allocreadiid-like distomes (Megasolena Linton and Hapladena Linton) and amphistomes. The new genus described below further substantiates such a view and indicates that the Anallocreadiinae in particular may be involved. A discussion of these relationships will follow a description of the new species.

Apocreadium mexicanum, new genus, new species
(Plate 2, figs. 1-3)

Host: *Labrisomus xanti* Gill
Position: Intestine
Locality: Tangola Tangola, Mexico
Incidence: 18 specimens from a single host

The body is elongate, tapering slightly and bluntly rounded at the anterior end, pointed at the posterior end, much flattened, especially posterior to midbody where the edges of the body become very thin and thrown into frill-like folds. The cuticula is scaled as far back as midbody. Mature specimens measure from 2.151 to 4.110 mm. in length by 0.757 to 1.096 mm. in greatest width. The body

* Studies from the Zoological Laboratories, the University of Nebraska, No. 191.

is approximately equally wide, except at the anterior and posterior fourth. The acetabulum is well anterior to midbody, the forebody being usually 1/4 to 1/5 total body length. Both suckers are subcircular with a tendency to be slightly longer than wide. The oral sucker is 0.225 to 0.315 mm. in diameter. The acetabulum is 0.352 to 0.502 mm. in diameter. Its aperture is transverse. The sucker ratio is approximately 2:3 or 3:5. Young specimens show a few pigment granules dorsally in the forebody but these are lacking in older specimens.

There is a short but distinct prepharynx. The pharynx is longer than wide, 0.142 to 0.202 by 0.112 to 0.165 mm. Its anterior fourth is modified as a sphincter region composed of circular muscles (suggesting the character of the pharynx in Gyliauchen) while the posterior region is composed of radial muscles. There is a distinct esophagus somewhat shorter than the pharynx. The intestinal bifurcation is approximately midway between the suckers. The ceca are narrow and extend to a point a short distance from the posterior end where the body begins its rather abrupt tapering to the posterior tip. Each cecum ends blindly.

The excretory vesicle is a long narrow tube extending anteriorly from the pore at the posterior tip of the body to the posterior testis where it spreads slightly to right and left and narrows to become a collecting tube on each side. Each collecting tube shortly after it leaves the vesicle forks into two tubules both extending forward, both at first median to the cecum, the larger tubule median to the smaller. Anterior to the acetabulum they are both lateral to the cecum. They seem to end near the level of the pharynx. Posterior to the level of the testes a very small excretory tubule can be seen on each side. These two posteriorly directed tubules arise at the same point where the anterior tubules unite. They extend to the posterior end of the body.

The lymphatic system consists of four longitudinal vessels close to the intestinal ceca, sometimes median, sometimes dorsal and ventral. Two of these lymphatic vessels extend anterior to the oral sucker to the extreme anterior end of the body where they end blindly. The longitudinal vessels do not give off side branches except in the posterior half of the body. Shortly behind the testes vesicle-like portions of the lymphatic system appear in the extreme lateral regions of the body. These are especially numerous near the

posterior end of the body where they are obvious in toto-mounts. Posterior to the testes each of the four vessels splits to form two making a total of four pairs. Each vessel is much branched, the ends of the branches extending to near the edge of the body. These tips are often swollen (plate 2, fig. 2).

The genital pore is median close to the anterior edge of the acetabulum. The testes are more or less rectangular in outline, slightly lobed, tandem, close together, approximately in the middle of the body. Except in young individuals (where the testes are of about equal size) there is a distinct tendency for the anterior testis to be wider than long, smaller and less lobed while the posterior testis tends to be longer than wide, larger and more deeply lobed. The posttesticular space is very long, sometimes more than ½ body length. A large, elongated sac-like seminal vesicle occurs immediately posterior to the acetabulum and overlapping the ovary. Anteriorly it narrows into a fine tube which continues without modification to near the anterior edge of the acetabulum where it joins the uterus to form a simple tubular genital sinus. Prostate gland cells are lacking unless represented by a few scattered cells around the male duct. A cirrus and cirrus sac are lacking. The narrow straight tube from seminal vesicle to genital pore is not muscular and since the pars prostatica cannot be distinguished from a cirrus portion, the tube might be termed the ejaculatory duct. It seems to have the same structure after its union with the uterus to form the ductus hermaphroditicus or genital sinus.

The ovary is spherical, midway between the anterior testis and the acetabulum, slightly to the right, just median to the right cecum. Mehlis' gland is well-developed, lying between ovary and anterior testis. A large flask-shaped seminal receptacle extends anterior to the ovary almost to the acetabulum. Laurer's canal is well-developed, coiled, and opens dorsally at mid-ovary level. The uterus is pretesticular filling most of the area between testes and acetabulum, wholly to the left of the ovary and largely to the left of midbody axis. It becomes a straight tube dorsal to the acetabulum and joins the male duct near the anterior edge of the acetabulum. The eggs are fairly thin-shelled, 61 to 67 by 31 to 34 μ. The vitelline follicles extend from the level of the ovary to near the posterior end of the body. In 13 specimens studied the follicles reached the posterior border of the acetabulum in 2 (in which the ovary also was far for-

ward) and in none did they reach the extreme posterior tip of the body. The vitellaria largely fill the body posterior to the testes and form two longitudinal intercecal, posttesticular areas.

GENERIC DIAGNOSIS OF APOCREADIUM

Elongate distomes with body much flattened posterior to midbody where the edges are very thin. Acetabulum anterior to midbody, larger than oral sucker. Pharynx well developed with an anterior region of circular muscles. Ceca extending not very far apart to near posterior end. Testes in midbody region, tandem, intercecal, close together. Seminal vesicle large, undivided, sac-like. Cirrus and cirrus sac lacking. Prostate cells poorly developed. A tubular genital sinus present. Genital pore median at anterior edge of acetabulum. Ovary spherical, pretesticular, slightly to the right. Mehlis' gland large, postovarian; Laurer's canal and seminal receptacle present. Uterus pretesticular, largely to the left. Vitellaria follicular in sides of body, confluent posterior to testes. Excretory vesicle I-shaped with 2 pairs of anterior and 1 pair of posterior tubules. Lymphatic system of 4 large longitudinal vessels branching at least in posterior half of body. Type species: *Apocreadium mexicanum.*

SPECIFIC DIAGNOSIS OF **Apocreadium mexicanum**

(Measurements in mms.)

Body rounded anteriorly, pointed posteriorly; scaled to midbody; 2.151 to 4.110 by 0.757 to 1.096. Acetabulum 1/4 to 1/5 from anterior end, 0.352 to 0.502 in diameter, with transverse aperture; oral sucker 0.225 to 0.315 in diameter. Prepharynx and esophagus present; intestinal bifurcation midway between suckers. Four longitudinal vessels branched in posterior half of body. Genital pore median at anterior edge of acetabulum. Seminal vesicle just posterior to acetabulum, overlapping ovary; genital sinus tubular, shorter than ejaculatory duct. Ovary spherical; seminal receptacle extending anterior to ovary; uterus to left of ovary; eggs 61 to 67 by 31 to 34 μ; vitellaria from near posterior edge of acetabulum to near posterior edge of body.

Host: *Labrisomus xanti* Gill

The name Apocreadium is from *apo*: away from and *creadium* and implies the fundamental differences between this trematode and the Allocreadiidae. The name *mexicanum* is for the locality.

Apocreadium longisinosum, new species
(Plate 2, figs. 4-7)

Hosts: *Cheilichthys annulatus* (Jenyns)
Albermarle Island and Charles Island, Galapagos Islands
Spheroides angusticeps (Jenyns)
Charles Island, Galapagos
Position: rectum
Incidence: 2 to 10 in a host, total of 15 collected from 3 hosts.

The body is orange-yellow in its posterior half, unspined, more or less flattened, 6.57 to 9.65 by 1.552 to 2.403 mm., widest about at midbody, tapering toward each end. A 4.650 mm. specimen was immature. The posterior third of the body is thin and flexible with numerous lateral folds. It tapers sharply to a pointed posterior end. The anterior half of the body is more plump, smooth, and tapers gradually. A small, fleshy preoral lobe is present. The oral sucker is subcircular but usually slightly longer than wide, 0.375 to 0.532 mm. in transverse diameter. The acetabulum is about ¼ body length from the anterior end, is longer than wide, 0.675 to 0.885 mm. in transverse diameter. Its aperture is longitudinal. The sucker ratio is approximately 5:8. The forebody measures 1.360 to 2.430 mm.

There is a fairly short prepharynx (about ½ pharynx length). The pharynx is usually somewhat pyriform in shape. The anterior third is more narrow, provided with a larger number of circular muscles, and separated from the posterior region by a very slight constriction. Muscles extend from the oral sucker to the pharynx outside the prepharynx. The esophagus is approximately the same length as the prepharynx. The intestinal bifurcation is usually a little nearer the oral sucker than the acetabulum but it may be approximately midway between the suckers. The narrow ceca extend some distance in from the body margins to within a short distance of the posterior end. They do not reach the posterior end and may fail to do so by some distance. One curious abnormality involved the left cecum which was almost completely degenerate except for a short normal-appearing stub barely reaching beyond the bifurcation and ending abruptly. The remainder of the cecum was represented by a few strands of fine fibrous tissue.

The genital pore is median very closely anterior to the acetabulum. It may even be directly ventral to the anterior edge of the acetabulum. The testes are immediately posterior to midbody, tandem, close together, lobed, squarish in shape. The posterior testis is usually slightly longer. The posttesticular space varies from 2.497 to 4.455 mm. being always considerably longer than the forebody. The seminal vesicle is a large, elongate, thin-walled sac, free in the parenchyma, extending backward from near the posterior edge of the acetabulum almost to the ovary from which it is separated by the seminal receptacle. The pars prostatica is about the same length as the seminal vesicle. It extends uncoiled diagonally forward dorsal to the acetabulum or, rarely, along the right side of the acetabulum. Its lumen is narrow and smooth, its wall fairly thick and cellular, surrounded by a few prostatic gland cells. These flattened and granular gland cells lie free in the parenchyma and are most numerous near the vesicle. The uterus enters the pars prostatica dorsal to the acetabulum to form a long tubular slightly muscular ductus hermaphroditicus or genital sinus. This tube bends ventrally toward the genital pore at the anterior edge of the acetabulum or may seem to bend back to reach the genital pore from an anterior direction (plate 2, fig. 5) but this appearance may be due to flattening of the specimen. The genital sinus is approximately the same length as the pars prostatica. Its lumen is wide, its wall fairly thin but muscular and surrounded by a few rounded non-granular cells.

The ovary is globular, pretesticular, to the right near the right cecum. It is separated from the anterior testis by a short space occupied by Mehlis' gland and the yolk reservoir. The uterus arises from the posterior side of the ovary and extends back as far as the anterior testis whence it coils forward to occupy the intercecal space to the left and anterior to the ovary. It joins the pars prostatica dorsal to the acetabulum as noted. A large seminal receptacle is present anterior to the ovary adjacent to the seminal vesicle. It connects to the oviduct posterior to the ovary. Laurer's canal is well developed, coiled, opening on the dorsal surface just anterior to the ovary. Eggs measure 88 to 102 by 48 to 60 μ, usually about 95 by 54 μ. The vitelline follicles extend from the level of the ovary to the posterior end of the body. At first extracecal, they become confluent posterior to the testes.

The excretory system is like that of *Apocreadium mexicanum.* The narrow excretory vesicle gives rise near the posterior testis to 2 pairs of anteriorly directed tubules, one pair larger than the other. Both pairs extend forward at least as far as the acetabulum but only one pair seems to reach as far as the oral sucker. From the common stem of each pair near the median vesicle a single sinuous tubule passes posteriorly on each side.

The lymph vessels are well developed. They are considerably branched in the posterior half of the body as in *A. mexicanum.* The branches run almost parallel with the stems, diverging gradually toward the body surface. They are not swollen at their tips as are such branches in *A. mexicanum.* The lymph vessels of the forebody also branch but here the branches are shorter and may extend in any direction. Because of the courses taken by the branches, the number of main stems of the lymph system is very difficult to determine. For some distance posterior to the testes there seem to be 4 pairs of longitudinal tubes, although 2 pairs extend farther back than the others. In the region of the acetabulum there seem to be 2 pairs. An accurate count was not possible in the forebody. In most specimens one pair extended into the preoral lobe. Evidently the lymph system is very similar to that of *A. mexicanum.*

Lymphocytes or at least large cells of some kind (plate 2, fig. 7) are not infrequent within the lymph vessels. These cells seem to have been amoeboid. They measure 14 to 19 μ in diameter which is as great as the diameter of most of the lymph vessels. The cytoplasm of these cells is finely granular, the nucleus staining very deeply, much more deeply than those of other cells.

SPECIFIC DIAGNOSIS OF **Apocreadium longisinosum**

(Measurements in mms.)

Body tapering toward each end, pointed at posterior end, widest at midbody, 6.57 to 9.65 by 1.552 to 2.403, in life orange-yellow in color. Oral sucker 0.375 to 0.532 in diameter; acetabulum ¼ from anterior end, 0.675 to 0.885 in diameter, with longitudinal aperture. Genital pore median close in front of acetabulum. Short prepharynx, pharynx 0.210 to 0.292 (length) by 0.225 to 0.315 (width), anterior third slightly modified; esophagus short; bifurcation about midway between suckers; ceca narrow extending to near posterior end. Testes tandem, close together, slightly lobed, squarish, just poster-

ior to midbody. Seminal vesicle elongated sac-like from acetabulum to near ovary; pars prostatica about as long as vesicle, straight; ductus hermaphroditicus a simple muscular tube as long as pars prostatica. Ovary globular; Mehlis' gland posterior to ovary; seminal receptacle anterior to ovary; uterus between testes and acetabulum; eggs 88 to 102 by 48 to 60μ; vitellaria from ovary to posterior end, confluent behind testes. Excretory vesicle extending to testes; 2 pairs of anterior and 1 pair posterior collecting tubules. Lymph vessels well developed, much branched, apparently fundamentally 2 pairs of longitudinal stems forking to form 4 pairs along much of body length. Type host: *Cheilichthys annulatus*. Other host: *Spheroides angusticeps,* a related fish. Type locality: Galapagos Islands.

The name *longisinosum* refers to the long genital sinus.

Comparisons. A. longisinosum is more than twice larger than *A. mexicanum* and the body is relatively wider. The aperture of the acetabulum is longitudinal rather than transverse. The vitellaria do not nearly reach the acetabulum as they do in *A. mexicanum,* a difference correlated with the larger uterus in *A. longisinosum.* In *A. longisinosum* the genital sinus is much longer; the eggs much larger (maximum length 102 μ compared with 67 μ); the lymph vessels more branched anteriorly. In spite of these differences the species are very similar and clearly congeneric.

There are genera of the Allocreadiidae with the cirrus sac weakly developed or lacking, for example the Anallocreadiinae and Opecoeliinae, but Apocreadium differs from most in its tubular genital sinus and from all in its lymphatic system. It is probably significant that the Anallocreadiinae which lack a cirrus sac also possess a tubular genital sinus described as "a common tube" in the form of an "unspecialized cloacal invagination" by Simer (1929, p. 564) for *Anallocreadium armatum;* as a "long genital sinus" by Manter (1926, p. 87) for *Homalometron pallidum;* as "an invaginated cloaca" by Hunter & Bangham (1932, p. 138) for *Anallocreadium pearsei;* but as a "genital atrium" by Manter (1936, p. 34) for *Crassicutis cichlasomae.* In this latter case however, the "atrium" may be tubular in form.

The genus Apocreadium then shows evidence of relationship to the Anallocreadiinae. On the other hand, however, its lymphatic vessels, the structure of the pharynx and the excretory system sug-

gest the genera Megasolena and Hapladena for which Manter (1935, p. 438) named the subfamily Megasoleninae. The essential difference is the presence of an hermaphroditic sac in the Megasoleninae. Apocreadium seems to stand almost midway between these two subfamilies. If included in the Megasoleninae, the subfamily (and family) description must be altered to include forms with neither hermaphroditic nor cirrus sac; if included in the Anallocreadiinae the subfamily must be extended to include forms with a lymphatic system. For the present, the writer prefers to recognize the lymphatic vessels as of fundamental significance, especially since their presence is again associated with pharyngeal modifications and to classify Apocreadium in the Megasoleninae.

Discussion. For many years it has been the custom to classify digenetic trematodes into three groups, the Amphistomata, Monostomata, and Distomata. But it has been increasingly apparent that these divisions are heterogeneous and not natural. Some monostomes (e. g. the Angiodictyidae) are actually amphistomes which have lost their posterior sucker. Other monostomes are evidently distomes which have lost the ventral sucker. In other words, members of these groups may show closer relationship to one of the other groups than to members of its own group. Amphistomes are generally considered as the most primitive. Little study has been made of possible relationship between amphistomes and distomes. Dawes (1936, p. 177) remarks: "Nous savons vraiment peu de chose sur les relations qui existent entre les Distomata et les Paramphistomida; c'est un point qui est visiblement négligé par les zoologistes." The author, however (Manter, 1935), has found strong evidence of such relationship exactly where it would be most expected, namely among trematodes of fish. It even seemed necessary to classify two distome genera (Megasolena and Hapladena) among the Paramphistomida. These two genera showed certain features suggesting the family Allocreadiidae where Megasolena at least was once classified.

Apocreadium is still more evidently allocreadiid-like. It serves to link the Paramphistomida not only to the Allocreadiidae but to the Anallocreadiinae. But Apocreadium can be included in the Megasoleninae especially if the lymphatic system is to be emphasized. There is, in fact, a fairly well graded series of forms between the amphistomes such as Gyliauchen and Opistholebes through Paragyliauchen, Apocreadium and the Anallocreadiinae to the Lepo-

creadiinae. Even the position of the acetabulum is intermediate in some forms such as *Paragyliauchen chaetodontis* Yamaguti. Megasolena and Hapladena are definitely associated with such a series but differ from the others in their peculiar hermaphroditic sac. There results a plausible conclusion that the large distome family Allocreadiidae probably evolved from amphistome ancestors. Or the amphistomes may have evolved from allocreadiid ancestry.

Type specimens of the new species described in this paper are deposited in the United States National Museum. Paratypes are deposited at The University of Southern California and in the author's collection.

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EXPLANATION OF PLATE 2

All figures were drawn with the aid of a camera lucida. The projected scale has the value (in mms.) indicated for each figure. Abbreviations: *ac*, acetabulum; *ce*, intestinal cecum; *ex*, excretory vesicle; *gp*, genital pore; *gs*, genital sinus; *l*, lymphatic vessel; *pp*, pars prostatica; *sr*, seminal receptacle; *sv*, seminal vesicle; *ut*, uterus.

FIG. 1. *Apocreadium mexicanum*. Dorsal view.

FIG. 2. *A. mexicanum*. Frontal section through posterior half of the body, showing the branching lymphatic vessels.

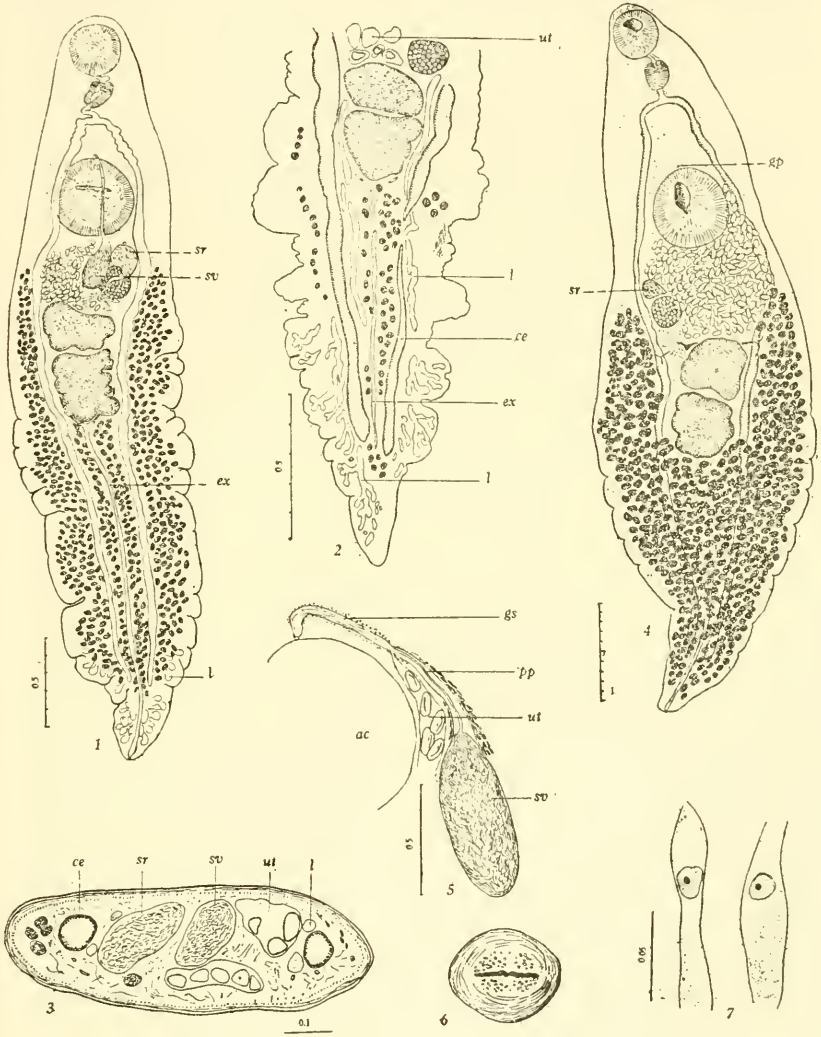
FIG. 3. *A. mexicanum*. Cross-section through the region of the seminal receptacle.

FIG. 4. *A. longisinosum*. Ventral view.

FIG. 5. *A. longisinosum*. Terminal reproductive organs.

FIG. 6. *A. longisinosum*. Cross-section through anterior portion of the pharynx.

FIG. 7. *A. longisinosum*. Portion of two lymphatic vessels showing lymphocytes.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REPORTS ON THE COLLECTIONS OBTAINED BY THE HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, AND IN 1937.

PARASITIC COPEPODS TAKEN DURING THE THIRD HANCOCK EXPEDITION TO THE GALAPAGOS ISLANDS

By CHARLES BRANCH WILSON

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PARASITIC COPEPODS TAKEN DURING THE THIRD HANCOCK EXPEDITION TO THE GALAPAGOS ISLANDS

(With One Plate)

Charles Branch Wilson

The New England Museum of Natural History, Boston, Massachusetts

The valuable collections made during the third Hancock Expedition to the Galapagos Islands included the copepods parasitic upon fish. These were gathered not only from the local fish around the islands but also from those captured during the passage to the islands and back. There are thus included among the hosts, fish from the Pacific coasts of Mexico, Central America, Colombia, and Ecuador as well as those from the immediate vicinity of the Galapagos Islands.

The parasites were collected and preserved by Dr. H. W. Manter of the University of Nebraska, who accompanied the expedition, and were sent to the author for identification. The host identification is incomplete in one or two instances since the personnel of the expedition did not include an ichthyologist.

Upon examination the collection of parasitic copepods thus obtained has proved to possess peculiar value and interest. This is due chiefly to the exceptional confirmation they afford of species already established but far removed in time, host, or habitat. Practically every one of the species here enumerated contributes new and important information to supplement previous records. This appears in the re-establishment of one species which had been virtually forgotten, since it had never been reported after its first discovery 75 years ago. Two other species almost as old have hitherto included but a single sex, in the one case the male, in the other the female. In both instances the missing sex is here supplied and is described and figured for the first time. Furthermore, these records furnish an abundance of new hosts and localities, some of which are very far removed from those previously reported.

With the exception of the two new sexes, whose types have been deposited in the National Museum, all the specimens have been returned to The University of Southern California. For the privilege

of reporting upon this collection thanks are hereby returned to the sponsor and the officials of the expedition and to Dr. Manter who collected the specimens.

CALIGOIDA
CALIGIDAE

Caligus balistae Steenstrup & Lütken

Caligus balistae Steenstrup and Lütken, Kong. Danske Vid. Selsk. Skrift., ser. 5, vol. 5, p. 356, pl. l, fig. 1, 1861.

A single male was washed from the gill chamber of an unidentified fish at Albermarle Island. The genital segment and abdomen of this specimen differed somewhat from the figures hitherto published as can be seen in plate 3, fig. 1. The abdomen is relatively shorter, the caudal rami are semicircular, and the lobes at the posterior corners of the genital segment nearly reach the distal end of the caudal rami.

Caligus bonito Wilson

Caligus bonito, Wilson, Proc. U. S. Nat. Mus., vol. 28, p. 589, pl. 13, 1905.

A single female was taken from the gill cavity of a grouper peculiar to the Galapagos Islands, *Cratinus agassizii* Steindachner, at Tagus Cove, Albermarle Island. A single male was found on the red snapper, *Lutianus novemfasciatus* (Gill), at Tangola, Mexico. This species was originally discovered in the Woods Hole area and has been reported by Brian from the coast of Mauretania and by Yamaguti from Japan. These specimens add two new hosts as well as two new localities and indicate that the species is cosmopolitan.

Caligus chorinemi Kollar

Caligus chorinemi Kollar, mss. Krœyer, Natur. Tidssk. 3 raekke, 2 bind, p. 67, pl. 5, fig. 1, a-h, 1863.

A single female from an unidentified fish at Albermarle Island; 3 females and 3 males from the gills of *Seriola dorsalis* (Gill), at Port Culebra, Costa Rica; 3 females and 3 males from the same host at Port Utria, Colombia. The species was first described by Krœyer from female museum specimens taken off the coast of Brazil. Both sexes were afterwards obtained from the same locality by Heller and the male was described and figured. But during the long interval since then the species has never been reported by any investigator and its validity had become doubtful. These specimens

restore in full the original recognition, add a new host and two new localities, and afford some information with regard to development, since the females of the Colombian species were only half grown. Accordingly a figure and description of one of these young females are here included (plate 3, fig. 2).

Young Female. Carapace a little longer than wide and about two thirds of the entire length; frontal plates wide and prominent, the lunules projecting as much as in the adult. The posterior median lobe is not much wider than the lateral lobes but projects considerably behind them. The lateral lobes curve inward as in the adult and are more angular at their outer corners. The free segment is two thirds as wide and almost half as long as the genital segment and is not contracted posteriorly. The genital segment is obovate, considerably narrowed anteriorly and a little wider than long, and is less than half its adult size. Its posterior margin is rounded instead of scalloped and it carries rudiments of a fifth pair of legs at its posterior corners. The abdomen closely resembles that of the adult in shape and proportion and already shows signs of segmentation in the form of lateral indentations. The appendages are the same as those of the adult except that the fourth legs appear larger and reach behind the posterior margin of the genital segment.

CALIGUS CONSTRICTUS Heller (plate 3, figs. 3, a-i.)

Caligus constrictus Heller, Reise der Novara, p. 175, pl. 15, fig. 5, 1865.

Heller established this species upon a single male specimen taken from the gills of a Stromateus species in the Indian Ocean, and no other specimens have ever been reported. The present collection includes 2 females from the gills of *Caranx hippos* (Linnaeus), at Secas Island, Panama, a single female from the gills of the same host at San Francisco, Ecuador, and 4 females from the gills of a runner, *Elagatis bipinnulatus* (Quoy & Gaimard), at Bahia Honda, Panama. These 7 specimens are referred to Heller's species because they certainly are not identical with any described Caligus females. And they agree so closely in structural details with Heller's male as to preclude any idea of creating a new species for them. They thus confirm the establishment of Heller's species and complete the species diagnosis by supplying the female.

Female. Carapace orbicular, slightly wider than long; frontal plates with a nearly straight anterior margin, scarcely indented at

the center; lunules small, semilunar, and projecting but little. Median posterior lobe one third of the carapace width, not reaching behind the lateral lobes, with rather angular corners; lateral lobes curved strongly inward. Free segment one fourth the width of the carapace and considerably widened through the bases of the fourth legs; genital segment longer than the carapace, and half as wide as long, with nearly parallel sides and rounded lobes at the posterior corners. The anterior end of the segment is contracted into a long neck, narrower than the free segment and more or less wrinkled. On the ventral surface of the segment near the posterior end the two sexual openings, which lead to the semen receptacles, project backward a little side by side, and to their outer ends are attached the spermatophores. The latter are nearly spherical and reach back to about the center of the abdomen, thus forming a structure which at first sight suggests the rudimentary segment in Pandarus, to which however, it bears no analogy. The abdomen is one-jointed, one fourth the length and one third the width of the genital segment; the caudal rami are minute and armed with tiny setae.

The terminal joint of the first antennae is linear and elongate; the second antennae are of medium size with a stout claw curved into a half circle. The maxilliped has a considerably inflated basal joint and a strong terminal claw. The first leg carries a rudimentary endopod which is finger-like and shows traces of segmentation and is tipped with a very short spine. The spine on the basal segment of the third exopod is exceptionally large and very strongly curved; the fourth leg is four-jointed with 5 spines, the three terminal joints combined a little shorter than the basal joint. These legs are weak and slender and scarcely reach the thickened portion of the genital segment. Total length, 5 mm. Carapace 2 mm. long, 2.2 mm. wide. Ovisacs 5 mm. long.

One of the females from *Caranx hippos,* with ovisacs, has been selected and given Cat. No. 69866 U.S.N.M.

Caligus isonyx Steenstrup & Lütken

Caligus isonyx Steenstrup & Lütken. Kong. Danske Vidensk. Selsk. Skrifter, 5 raekke, p. 18, pl. 3, fig. 5, 1861.

This species was based upon a single female taken from a great barracuda, *Sphyraena barracuda,* in the West Indies and no other specimen has been obtained during the 75 years since then. The present collection, however, includes 3 females from a flying fish,

Cypselurus callopterus (Günther), at Charles Island, and thus confirms Heller's species, adding a new host and locality. The excellent description of the species in the reference given above was translated by the present author and published in *Proceedings* U. S. National Museum, vol. 28, p. 602. The present specimens conform to that description in every particular.

Caligus latifrons Wilson

Caligus latifrons Wilson, Proc. U. S. Nat. Mus., vol. 28, p. 587, pl. 12, figs. 140-149.

A single female was taken from the flying fish, *Cypselurus callopterus,* in company with the 3 females of *C. isonyx* just mentioned. When the type of this species was described from the Woods Hole area the host was unknown, and it has so remained. The present specimen supplies a definite host as well as a new locality.

Caligus lunatus Wilson (plate 3, fig. 5)

Caligus lunatus Wilson, Results Swedish Zool. Exped. to Egypt, No. 26B. p. 4, pl. 1, figs. 7-12; pl. 2, figs. 13-17. 1924.

A single male was found on the gills of the yellowtail, *Seriola dorsalis* (Gill), at Bahia Honda, Panama. The original types were taken from another species, *aurovittatus,* of the same genus of fish captured in the Red Sea. Although this new locality is so far removed from the original one there is no doubt of the identity of the specimen.

Caligus mutabilis Wilson

Caligus mutabilis Wilson, Proc. U. S. Nat. Mus., vol. 28, p. 573, pl. 8, figs. 91-102.

One male and four females were found on the skin of a Spanish mackerel, *Scomberomorus maculatus,* at White Friars, Mexico. This species has not before been found outside the Woods Hole area where it was originally discovered, and the host as well as the locality is new.

Caligus aliuncus Wilson (plate 3, figs. 4, a-f.)

Caligus aliuncus Wilson, Proc. U. S. Nat. Mus., vol. 28, p. 576, pl. 9, figs. 103-111.

A single male was taken from the skin of a yellowtail, *Seriola dorsalis* (Gill), and six males from the skin of an oceanic bonito, *Gymnosarda pelamis* (Linnaeus), both from Tagus Bay, Albermarle Island. Females of this species were found upon the skin of a bonito at the Dry Tortugas by Dr. Manter, but these are the first males to be discovered. The correspondence in the detail of the appendages

is amply sufficient to identify them as the two sexes of the same species even though the present locality is so far removed from the previous ones. Accordingly, one of these males has been selected to serve as the type of its sex and has been given Cat. No. 69865 U. S.N.M. and a description and figures are here given.

Male. Carapace more than half the entire length and longer than wide, with nearly parallel sides; median posterior lobe half the width of the carapace and scarcely projecting behind the lateral lobes; the latter narrow and rather bluntly rounded. Free segment almost as wide as the genital segment, but much narrowed where it joins the carapace. Genital segment subovate, narrowed to the width of the abdomen posteriorly, with strongly convex sides. Two pairs of leg rudiments on the ventro-lateral margins nearer the posterior end. Abdomen two-segmented, the segments about equal in length and width; caudal rami as wide as long, each armed with 3 stout setae densely plumose. These setae afford excellent anchorage for various symbiotic organisms both vegetable and animal and are often densely tufted with them.

The appendages are similar to those of the female with these agreements. The stout terminal claw of the maxilliped shuts into a groove on the inner surface of the basal segt, the latter being considerably enlarged. This claw bears on its ventral surface a much larger accessory claw than that of the female, and a second accessory claw considerably smaller than the first. The basal segment of the third exopod has a stout flanged spine blunt at its tip, and the second and third segments also have spines along their outer margins. The fourth leg is four-segmented with five spines; the four proximal spines have serrated flanges, the distal spine is without a flange. The proximal spine (on the second segment) has two flanges, the outer one more coarsely toothed than the inner; the next three spines have but a single flange, the size of the teeth diminishing so that those on the flange of the fourth spine are only one fourth as large as those on the first spine. There are rudiments of a fifth and sixth pair of legs on the sides of the genital segment near its posterior margin. Each of the fifth pair consists of a small papilla tipped with one long and densely plumose seta and three or four very short ones. Each of the sixth pair is made up of a single medium-sized seta attached directly to the segment with no papilla.

Total length, 6 mm. Carapace, 3.50 mm. long, 2.95 mm. wide.

Lepeophtheirus dissimulatus Wilson

Lepeophtheirus dissimulatus Wilson, Proc. U. S. Nat. Mus., vol. 28, p. 631, pl. 22.

Seven females were taken from the skin of a yellow grouper, *Mycteroperca olfax* (Jenyns); one female from a small mackerel; one female from the gills of a second grouper, *Cratinus agassizii* Steindachner; three females and a male from the skin of a third grouper, *Mycteroperca xenarcha,* Jordan, all these four lots from Albermarle Island. Eight females and four males from the skin of a cabrilla, *Paralabrax humeralis* (Cuv. & Val.), at James Island. This species came originally from the Galapagos Islands, but with nothing to show its abundance. These new specimens from the same locality but from five new hosts show that the parasite is well distributed among the groupers around the islands.

ERGASILIDAE

Artacolax saetiger Wilson

Artacolax saetiger Wilson, Proc. U. S. Nat. Mus. vol. 39, p. 361, pl. 51.

A single female from the gills of a flying fish, *Cypselurus callopterus* (Günther), at Charles Island. The species was founded upon specimens obtained from a closely related flying fish at Woods Hole. This record adds a new host and a widely removed locality, and is the first to be made outside the original area.

Bomolochus attenuatus Wilson

Bomolochus attenuatus Wilson, Proc. U. S. Nat. Mus., vol. 44, p. 198, pl. 21.

One female from the gills of the ringed swellfish, *Cheilichthys annulatus,* at San Francisco, Ecuador; two females washed from the body cavity of a dredged Lophius at Bahia Honda, Panama; one female from the gills of a small Lophius-like fish at Port Utria, Colombia. The species was originally found at Montego Bay, Jamaica, so that the present record adds two new hosts and three new localities.

DICHELESTHIIDAE

Nemesis Pallida Wilson

Nemesis pallida Wilson, Bull. 158, U. S. Nat. Mus., p. 464, pl. 33, figs. a-p.

Two females from the gills of an unidentified shark at Bahia Honda, Panama. This species is very common upon the large sharks captured in the fish nets on Martha's Vineyard but these are the first specimens to be reported outside of that locality.

Lernanthropus micropterygis Richiardi

Lernanthropus micropterygis Richiardi, Atti del Soc. Toscana, vol. 4, p. 82.

Two females from the gills of a Seriola sp. at Port Culebra, Costa Rica, and one female from the gills of Seriola dumerili at White Friars, Mexico. The species was originally obtained from the same host, but in the Mediterranean, and has been found on another species of Seriola in the Red Sea. We can now add the two localities given above.

Krœyeria papillipes Wilson

Krœyeria papillipes Wilson, Bull. 158, U. S. Nat. Mus., p. 454, pl. 30, figs. a-i.

Ten specimens including both sexes from the gills of an unidentified shark at Bahia Honda, Panama, and ten females from the gills of a gray shark at Socorro Island, Mexico. Like the Nemesis above, this parasite was common on the large sharks captured in the fish nets on Martha's Vineyard, but has never before been reported from any other place.

Hatschekia oblonga Wilson

Hatschekia oblonga Wilson, Proc. U.S. Nat. Mus., vol. 44, p. 242, pl. 42, figs. 222-226.

A single female from the gills of a crevalle, *Caranx hippos* (Linn.), at Secas Island, Panama, and eight females from the gills of a Caulolatilis sp. at Tagus Cove, Albermarle Island. The species originally came from Montego Bay, Jamaica, and thus gains two new hosts and two new localities.

EXPLANATION OF PLATE 3.

Fig. 1. The fifth and genital segments and abdomen of a male Caligus balistae.

Fig. 2. Dorsal view of a young female Caligus chorinemi 2 mm. in length.

Fig. 3. The female of Caligus constrictus. a. Dorsal view. b. Side view of genital segment and abdomen, showing the attachment of the spermatophores. c. Ventral view of same. d. Maxilliped. e. Furca. f. First leg. g. Rudimentary endopod of same. h. Fourth leg. i. Third leg showing basal claw.

Fig. 4. The male of Caligus aliuncus. a. Dorsal view. b. Maxilliped. c. Third leg showing flanged spine. d. Fourth leg. e. Proximal spine of same showing toothed flanges.

Fig. 5. The male of Caligus lunatus.

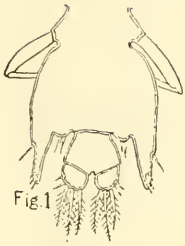
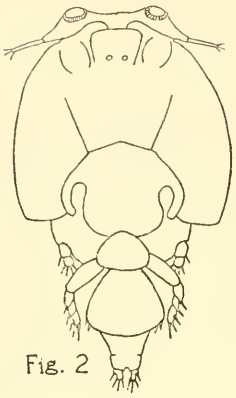


Fig. 1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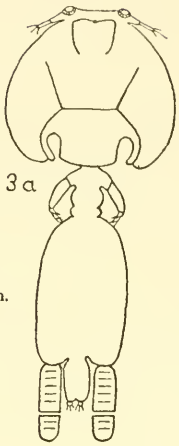
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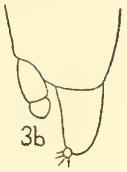
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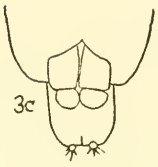
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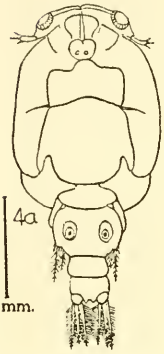
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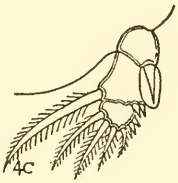
2 mm.


3d


4b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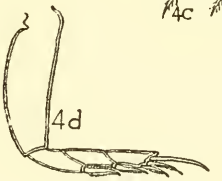
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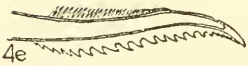
3h


3g

1 mm.

Fig. 5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REPORTS ON THE COLLECTIONS OBTAINED BY THE HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, AND IN 1937.

SOME MONOGENETIC TREMATODES FROM THE GALAPAGOS ISLANDS AND THE NEIGHBORING PACIFIC

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TABLE OF CONTENTS

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

(With Seven Plates)

Frank G. Meserve

University of Nebraska

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

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

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

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No new methods of technique were used. The animals were killed in formol-alcohol-acetic acid solution (formalin 6½ parts, 50 per cent alcohol 100 parts, glacial acetic acid 2½ parts) under a cover glass to flatten the specimen. After several hours the killing solution was removed and the specimens were preserved in 70 per cent alcohol. Specimens were stained in Delafield's haematoxylin. Some were counterstained with orange G, eosin, or erythrosin. Serial sections were made except where there were few specimens. Toto mounts were cleared in cedar oil and serial sections in xylol. All were mounted in balsam.

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

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

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

Family: CAPSALIDAE Baird, 1853

Subfamily: Benedeniinae Johnston, 1931

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

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

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

Johnston (1929) says:

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

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

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

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

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

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

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

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

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

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

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

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

Benedenia isabellae, new species
(Plate 4, figs. 1-2)

Host: Unidentified, spotted, grouper-like fish
Location: Gills
Locality: Isabel Island, Mexico
Number: 5 specimens

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

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

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

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

Benedenia adenea, new species
(Plate 4, figs. 3-4)

Host: *Mycteroperca sp.*
Location: Gills
Locality: Socorro Island, Mexico
Number: 5

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

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

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

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

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

Host: *Mycteroperca sp.*
Location: Gills
Locality: Socorro Island, Mexico
Number: 12

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

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

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

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

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

Genus: Entobdella Blainville, 1818

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

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

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

Entobdella muelleri, new species
(Plate 4, fig. 9)

Host: *Cratinus agassizii* Steindachner*
Location: Gills
Locality: Tagus Cove, Albemarle Island, Galapagos Islands
Number: 1

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

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

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

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

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

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

Encotyllabe pagrosomi MacCallum, 1917

(Plate 5, figs. 10-12)

Host: *Caulolatilus sp.*
Location: Gills
Locality: James Island, Galapagos Islands
Number: 1

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

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

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

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

Family: DICLIDOPHORIDAE Cerfontaine, 1896

Subfamily: Diclidophorinae Cerfontaine, 1896

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

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

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

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

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

Diclidophora caulolatili, new species
(Plate 5, figs. 13-15)

Host: *Caulolatilus princeps* (Jenyns)
Location: Gills
Locality: Tagus Cove, Albemarle and Chatham Islands, Galapagos Islands
Number: 2

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

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

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

D. caulolatili is named after the genus of the host, Caulolatilus.

Heterobothrium ecuadori, new species
(Plate 5, figs. 16-19)

Host: *Cheilichthys annulatus* (Jenyns)
Location: Gills
Locality: Tagus Cove, Albemarle Island, Galapagos Islands, San Francisco, Ecuador
Number: 4

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

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

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

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

Heterobothrium galapagensis, new species
(Plate 5, figs. 20-21)

Host: *Paranthias furcifer* (Cuv. and Val.)
Location: Gills
Locality: Tagus Cove, Albemarle Island, Galapagos Islands
Number: 1

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

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

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

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

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

Family: HEXOSTOMATIDAE Price, 1936

Hexostoma euthynni, new species
(Plate 6, figs. 22-24)

Host: *Euthynnus alletteratus* (Rafinesque)
Location: Gills
Locality: James Island, Galapagos Islands
Number: 1

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

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

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

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

Family: MAZOCRAEIDAE Price, 1936

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

Host: Unidentified species of mackerel
Location: Gills
Locality: Tagus Cove, Albemarle Island, Galapagos Islands
Number: 8

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

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

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

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

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

Family: MICROCOTYLIDAE Tachenberg, 1879

Genus: Microcotyle van Ben. and Hesse, 1863

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

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

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

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

Microcotyle priacanthi, new species
(Plate 6, figs. 30-32)

Host: *Priacanthus sp.*
Location: Gills
Locality: Hood Island, Galapagos Islands
Number: 4

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

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

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

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

Gotocotyla acanthocybii, new species
(Plate 6, figs. 33-36)

Host: *Acanthocybium solandri* (Cuv. and Val.)
Location: Gills
Locality: Galapagos Islands
Number: 15

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

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

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

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

Gotocotyla elagatis, new species
(Plate 7, figs. 37-40)

Host: *Elagatis bipinnulatus* (Quoy and Gaimard)
Location: Gills
Locality: Bahia Honda, Panama
Number: 4

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

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

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

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

Genus: Thoracocotyle MacCallum, 1913

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

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

Thoracocotyle paradoxica, new species
(Plate 7, figs. 41-43)

Host: *Scomberomorus maculatus* (Mitchill)
Location: Gills
Locality: Tangola-Tangola, Mexico
Number: 1

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

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

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

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

Genus: Axine Abildgaard, 1794

The following species of Axine have been described to date:

A. aberrans Goto, 1894 on *Belone schismatorhynchus.*
A. belones Abild., 1794 on *Belone acus.*
A. carangis MacCal., 1918 on *Caranx hippos.*
A. heterocerca Goto, 1894 on *Seriola quinqueradiata.*
A. triangularis Goto, 1894 on *Anthias schlegelii.*

Axine oligoplitis, new species
(Plate 8, figs. 44-47)

Host: *Oligoplites saurus* (Bloch and Schneider)
Location: Gills
Locality: San Francisco, Ecuador
Number: 4

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

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

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

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

Axine seriolae, new species
(Plate 8, figs. 48-52)

Host: *Seriola dorsalis* (Gill)
Location: Gills
Locality: Hood Island, Galapagos Islands
Number: 4

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

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

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

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

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

Axine elongata, new species
(Plate 8, figs. 53-58)

Host: *Xurel malampygus* (Cuv. and Val.)
Location: Gills
Locality: Secas Island, Panama
Number: 5

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

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

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

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

Axine aberrans Goto, 1894
(Plate 9, fig. 59)

Host: *Tylosurus fodiator* (Jordan and Gilbert), agujón, or hound fish
Location: Gills
Locality: Port Utria, Colombia
Number: 6

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

Pseudaxine mexicana, new species
(Plate 9, figs. 60-63)

Host: *Scomberomorus maculatus* (Mitchill)
Location: Gills
Locality: Tangola-Tangola, Mexico
Number: 2

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

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

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

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

Protomicrocotyle pacifica, new species
(Plate 9, figs. 64-74)

Host: *Xurel marginatus* (Hill)
Location: Gills
Locality: Port Culebra, Costa Rica
Number: 11

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

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

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

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

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

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

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

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

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

Host: *Cypselurus callopterus* (Gunther)
Location: Gills
Locality: Charles Island, Galapagos Islands
Number: 2

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

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

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

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

GENERIC DIAGNOSIS OF CESTRACOLPA

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

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

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

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

Cestracolpa yamagutii, new species
(Plate 10, figs. 81-85)

Host: Unidentified flying fish
Location: Gills
Localities: Clarion Island, Mexico, and open sea off coast of Mexico
Number: 2

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

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

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

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

SUMMARY AND CONCLUSIONS

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

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

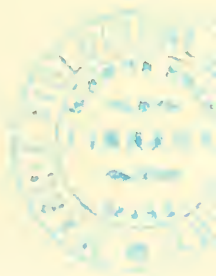
One new genus is proposed: Cestracolpa, which has a characteristic lateral vaginal opening and a spine imbedded in the wall of the distal end of the vagina.

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

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

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

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



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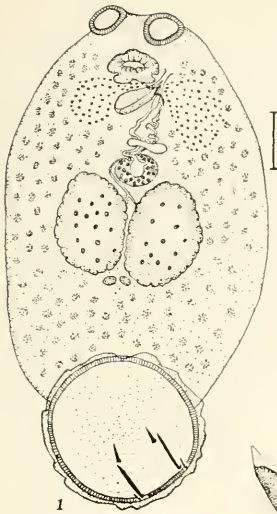
EXPLANATION OF PLATES

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

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

PLATE 4

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



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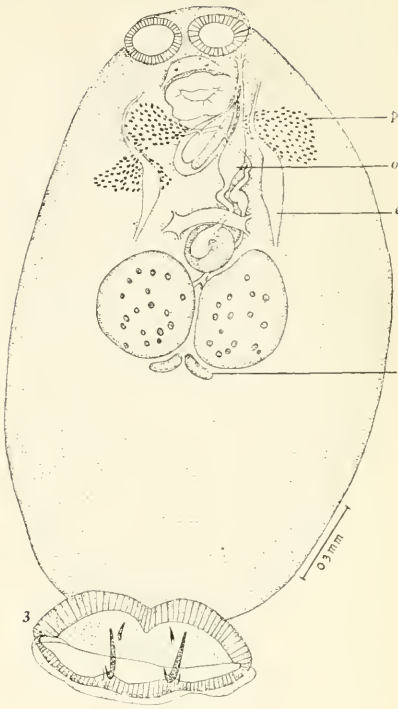

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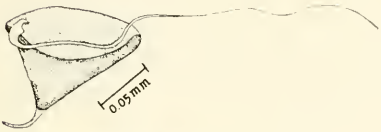

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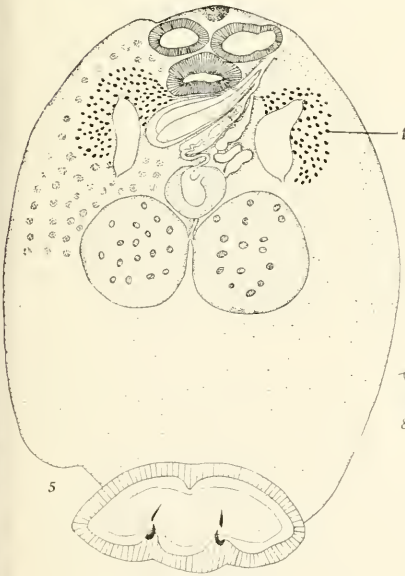

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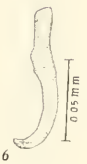

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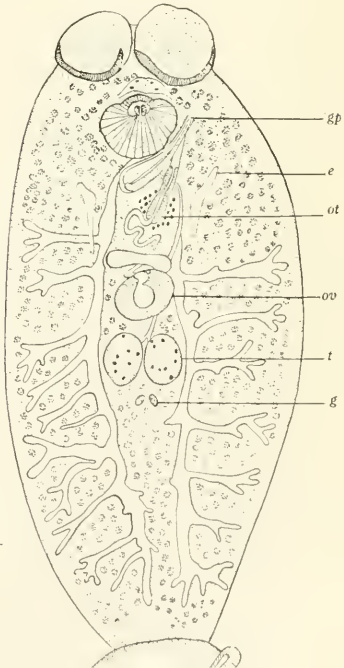
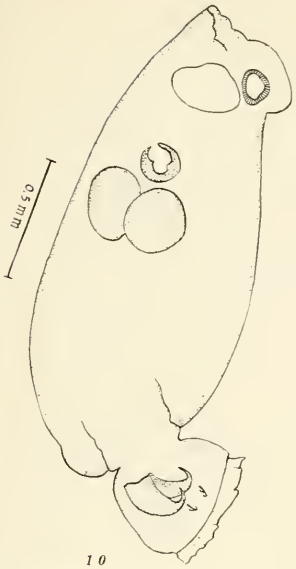


PLATE 5

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



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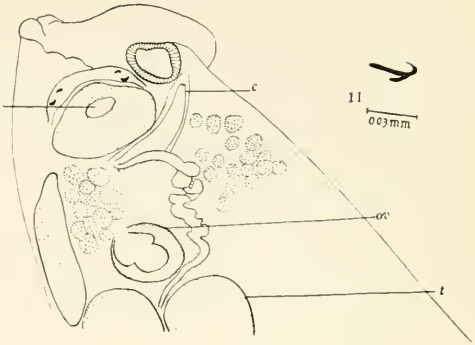

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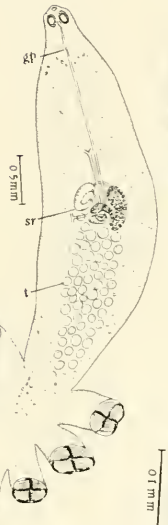

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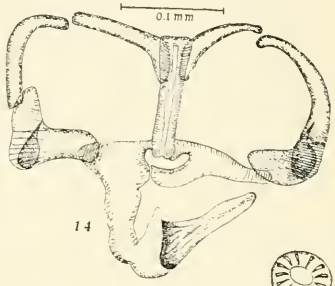

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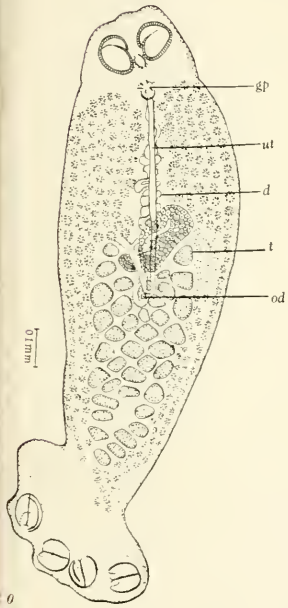

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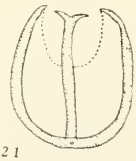

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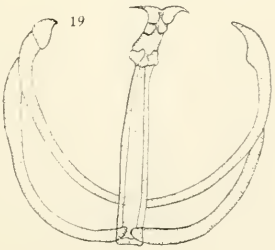

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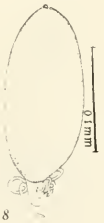

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PLATE 6

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

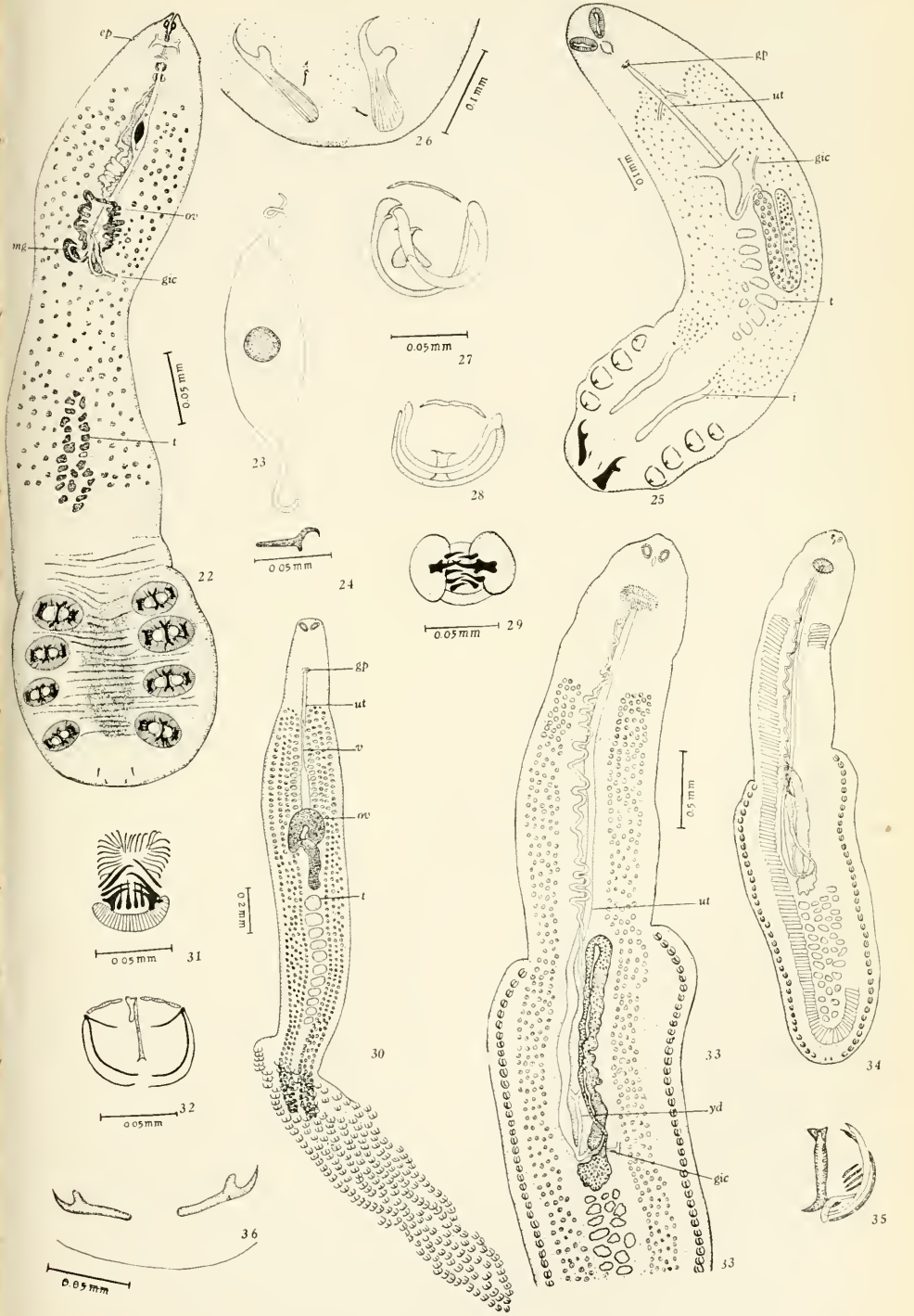
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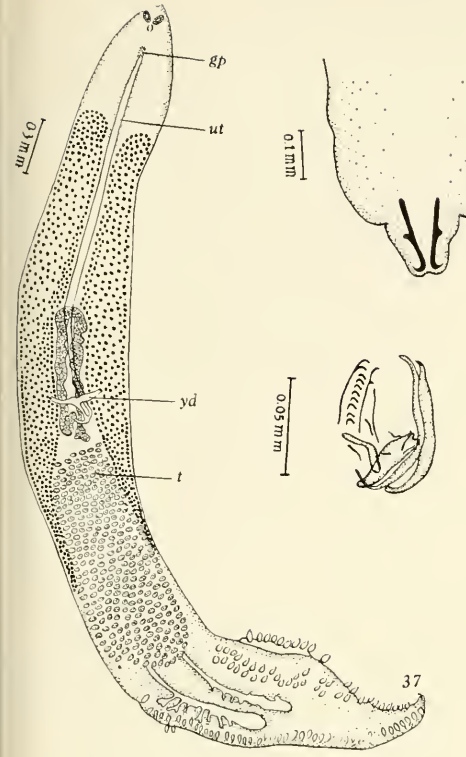
PLATE 7

FIG. 37. *Gotocotyla elagatis.* Ventral view.
FIG. 38. Posterior end of *G. elagatis* showing hooks. Ventral view.
FIG. 39. Chitinous skeleton of posterior sucker of *G. elagatis.*
FIG. 40. Anterior end of *G. elagatis* showing mouth, anterior suckers, genital pore and pigment granules.
FIG. 41. *Thoracocotyle paradoxica.* Ventral view.
FIG. 42. Posterior end of *T. paradoxica* showing hooks.
FIG. 43. Chitinous skeleton of posterior sucker of *T. paradoxica.*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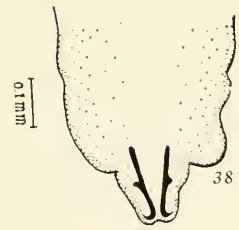
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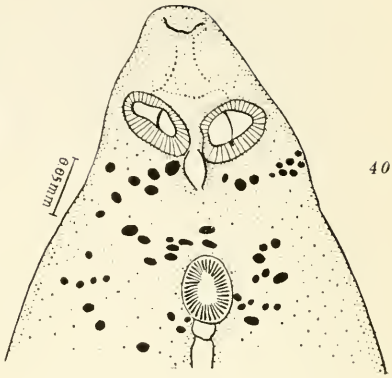
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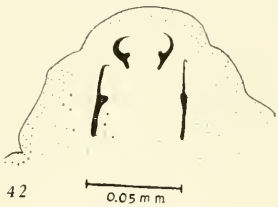
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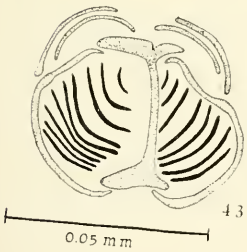
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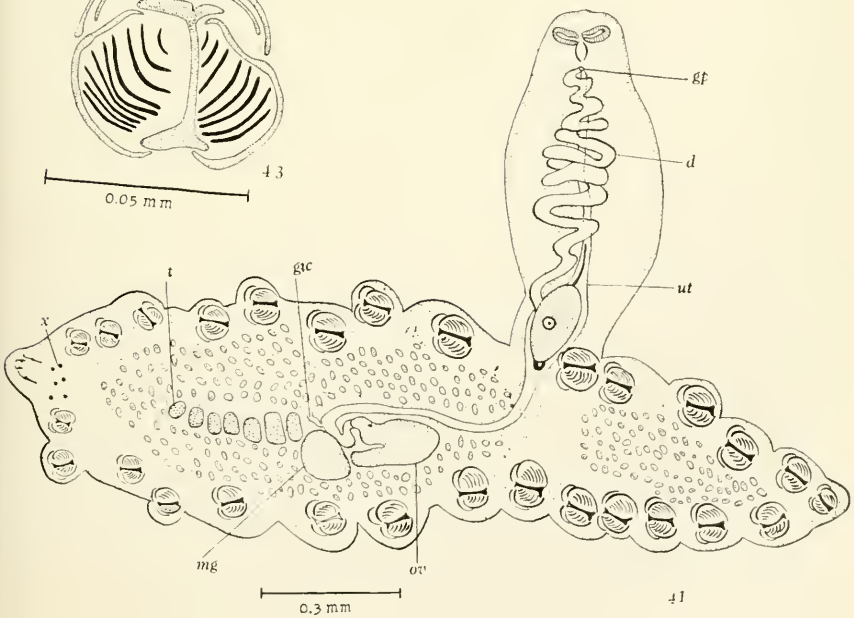
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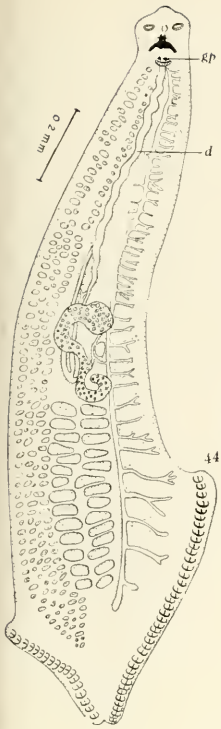
PLATE 8

FIG. 44. *Axine oligoplitis*. Dorsal view.
FIG. 45. Chitinous skeleton of posterior sucker of *A. oligoplitis*.
FIG. 46. Ovary and reproductive ducts of *A. oligoplitis*. Ventral view.
FIG. 47. Genital atrium of *A. oligoplitis* showing hooks. Ventral view.
FIG. 48. *Axine seriolae*, ventral view of adult vitellaria and testicular region diagrammatic.
FIG. 49. Chitinous skeleton of *A. seriolae*. The lateral pieces are paired; one half not shown.
FIG. 50. Ventral view of ovary and reproductive ducts of *A. seriolae*.
FIG. 51. Eggs of *A. seriolae*.
FIG. 52. Anterior end of *A. seriolae*. Ventral view.
FIG. 53. *Axine elongata*. Dorsal view.
FIG. 54. Eggs of *A. elongata*, one of which has a detached operculum.
FIG. 55. Anterior end of *A. elongata* showing anterior suckers and genital pore. Ventral view.
FIG. 56. Ventral view of genital pore of *A. elongata*.
FIG. 57. Chitinous skeleton of posterior sucker of *A. elongata*.
FIG. 58. Dorsal view of ovary and reproductive ducts of *A. elongata*.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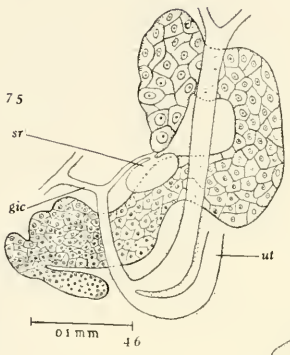
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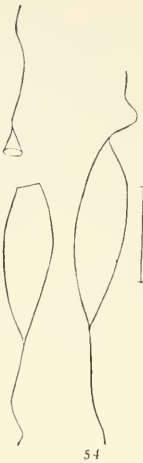
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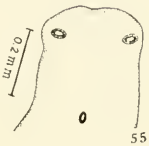
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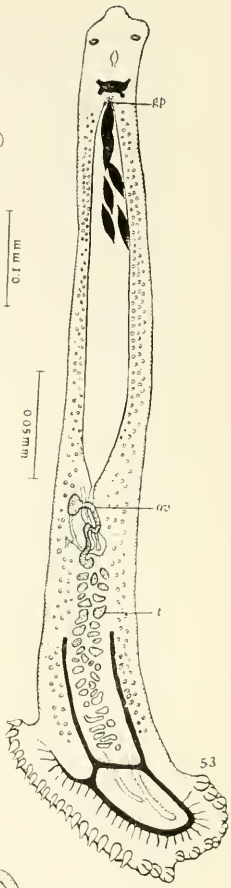
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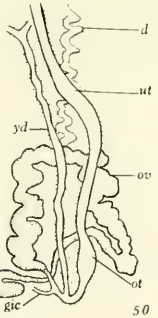
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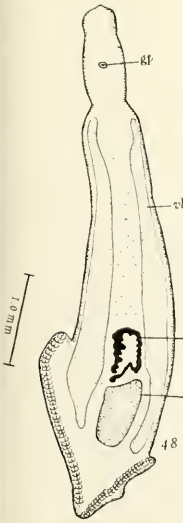
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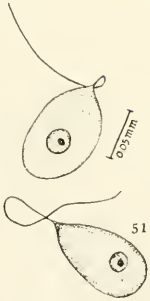
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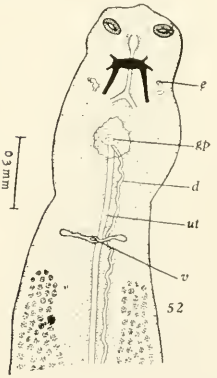
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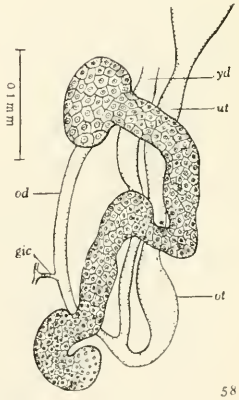
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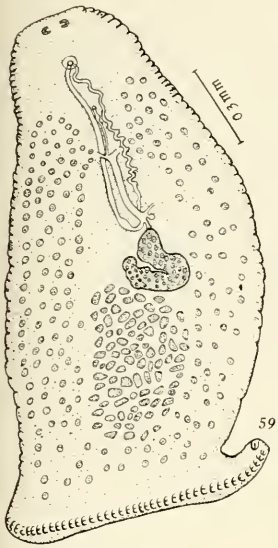
PLATE 9

FIG. 59. *Axine aberrans* Goto. Dorsal view.
FIG. 60. *Pseudaxine mexicana*. Ventral view.
FIG. 61. Chitinous skeleton of posterior sucker of *P. mexicana*.
FIG. 62. Upper end of vas deferens of *P. mexicana* showing hooks.
FIG. 63. Posterior hooks of *P. mexicana*.
FIG. 64. *Protomicrocotyle pacifica*. Posterior haptor not shown. Ventral view.
FIG. 65. Chitinous skeleton of posterior sucker of *P. pacifica*.
FIG. 66. Posterior haptor and posterior suckers of *P. pacifica*.
FIG. 67. Cross section through genital atrium showing cirrus and atrial spines of *P. pacifica*.
FIG. 68. Large outer hook of posterior haptor of *P. pacifica*.
FIG. 69. Inner hook of posterior haptor of *P. pacifica*.
FIG. 70. Ventral view of anterior end of *P. pacifica*.
FIG. 71. *P. pacifica*. Ventral view.
FIG. 72. Hooks of genital atrium of *P. pacifica*
FIG. 73. Posterior hooks of *P. pacifica*.
FIG. 74. Vaginal opening and spines in enlarged upper end of vagina of *P. pacifica*. Ventral view.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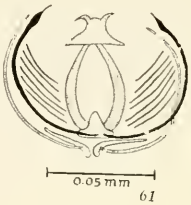
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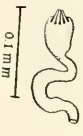
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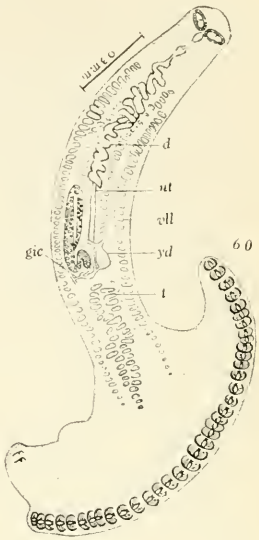
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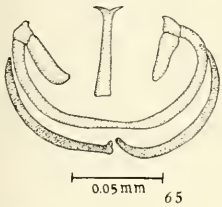
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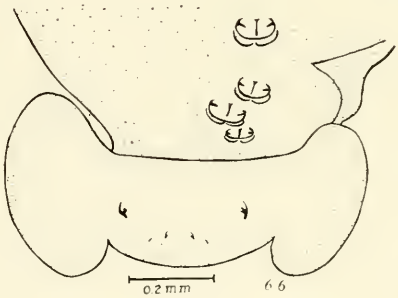
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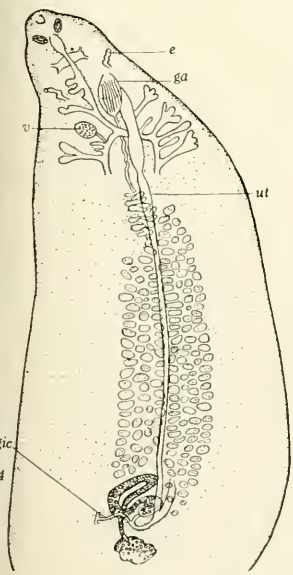
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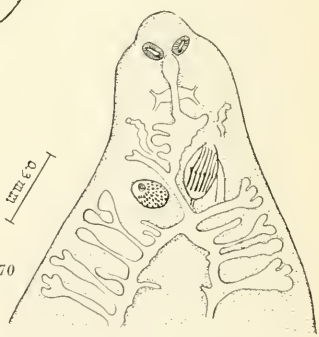
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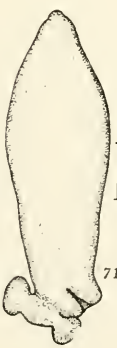
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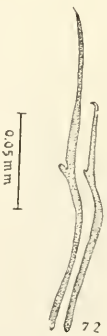
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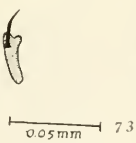
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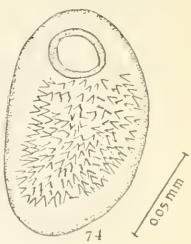
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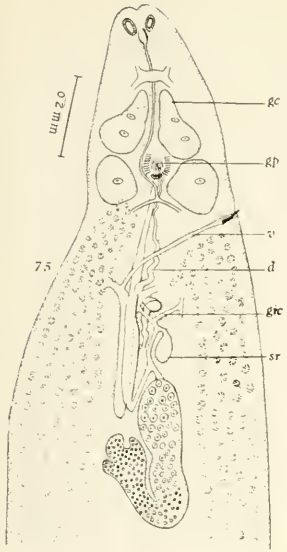
PLATE 10

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



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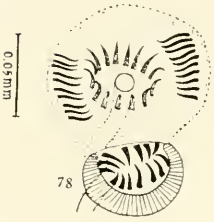

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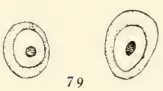

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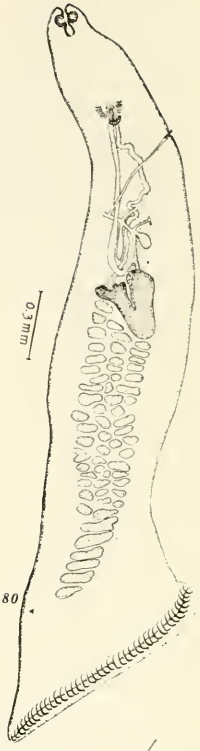

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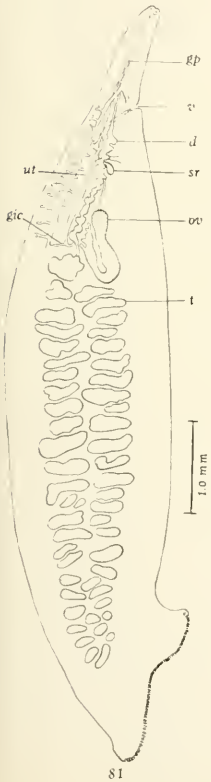

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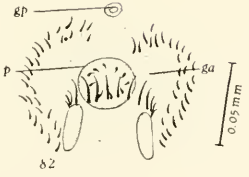

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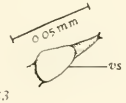

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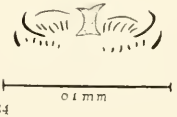

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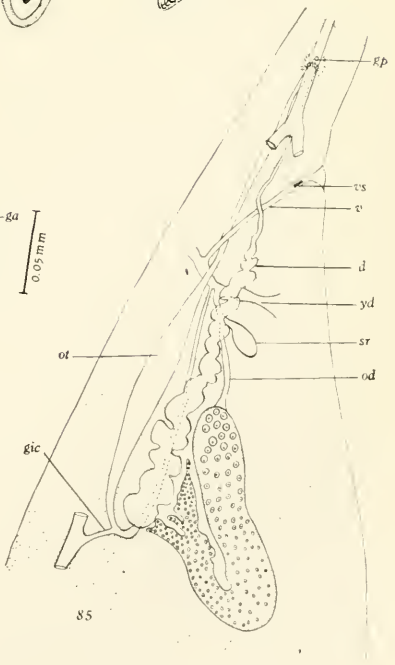

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REPORTS ON THE COLLECTIONS OBTAINED BY THE HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, AND IN 1937.

THREE NEW TREMATODES FROM THE GALAPAGOS MARINE IGUANA *AMBLYRHYNCHUS CRISTATUS*

By PAUL T. GILBERT

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THREE NEW TREMATODES FROM THE GALAPAGOS MARINE IGUANA *AMBLYRHYNCHUS CRISTATUS**

(With Two Plates)

Paul T. Gilbert
University of Nebraska

The trematodes described below were collected during the Allan Hancock Expedition to the Galapagos Islands in 1934, by Dr. H. W. Manter under whose direction this study was made.

Three species of trematodes were secured from the marine iguana, *Amblyrhynchus cristatus* (Bell). All three species seem to represent new genera of Pronocephalidae. Two of the new genera are in the subfamily Pronocephalinae, and one in the subfamily Teloporinae.

At present the family Pronocephalidae contains five subfamilies and consists of monostomes chiefly from marine turtles. There are thirteen species recorded from *Chelone midas* alone. Although no Pronocephalids are hitherto known from Lacertilia, it is not surprising that the trematodes of *Amblyrhynchus* should belong to this family since the food and habitat of this iguana are so much like those of marine turtles. This iguana lives along a rocky coast line and feeds upon seaweed.

The type specimens of the three new species described are deposited in the United States National Museum and paratypes are in the collection of The University of Southern California.

Family: PRONOCEPHALIDAE Looss, 1902

Subfamily: Pronocephalinae Looss, 1899

Iguanacola navicularius, new genus, new species
(Plate 11, figs. 1-4)

Host: *Amblyrhynchus cristatus*
Location: Intestine
Locality: Albemarle Island

The following description is based on a study of four mounted and two sectioned specimens. Of the four toto mounts only two were

* Studies from the Zoological Laboratories, University of Nebraska, No. 194.

extended enough to give complete measurements. When extended the body is elongate, about four and one-half times longer than wide, flattened, and without spines or special skin glands. It is evenly rounded posteriorly and anteriorly. One extended specimen measured 8.795 mm. in length and 1.993 mm. in width, the widest portion being near the posterior end of the body. Near the anterior end is a collar in the form of a muscular ridge which is comparatively weak when contrasted with this structure in other genera of the subfamily. It is interrupted ventrally by a concave, oval depression which occupies the median half of the ventral surface of the anterior third of the body. When contracted the body is boat shaped (fig. 3). The anterior ventral depression then seems to extend the entire length of the worm. A contracted specimen measured 6.629 mm. in length. The body is highly muscular with an abundant concentration of transverse bundles in the anterior region, especially in the region of the ventral depression.

The oral sucker measures 0.6 mm. in width and 0.57 mm. in length. The esophagus is slender with an expanded anterior portion, and measures 0.375 mm. in length. The ceca are narrow and extend nearly to the posterior end of the body, bowing medianly in the region of the testes. The walls of the ceca are irregular with small outpocketings hardly long enough to be considered branches.

The testes are large and strongly lobed, lying opposite each other near the posterior end of the body. The intestinal ceca pass between the testes and overlap the inner margins of them ventrally. Each testis is divided into about seven large lobes, some of which may be subdivided to form secondary lobes. The tubular seminal vesicle is voluminous, lying free in the parenchyma, passing from the posterior fourth of the body to the posterior portion of the large cirrus sac located about at mid-body. The extreme posterior portion of the vesicle is straight but as it passes anteriorly it becomes coiled. The cirrus sac is large and divided by a constriction into two parts which form an angle of ninety degrees with each other. The posterior half of the sac passes diagonally forward from the seminal vesicle to the inner edge of the right cecum. The anterior half of the sac returns to the mid-line and genital pore (fig. 1). The prostatic portion of the cirrus sac occupies about nine tenths of the whole sac and is made up of large cells which appear to project into the central lumen. The cirrus is in the form of a muscular papilla projecting

nipple-like into a terminal chamber which surrounds the cirrus except at its basal portion (fig. 2). The ejaculatory duct is thick-walled, but narrow. At its distal end it communicates with the terminal chamber; at its proximal end it joins a narrow, flattened chamber which appears to be a horizontal widening of the ejaculatory duct at the base of the cirrus (fig. 2) and communicates posteriorly with the lumen of the prostatic region. The genital pores are separate, the male pore lying slightly to the right of the female pore. Both pores are located just anterior to mid-body level and a little to the left of the median line.

The ovary is slightly lobed, lying in the median line just anterior to the testes. The large shell gland complex lies close to the posterior margin of the ovary. The gland is surrounded by a capsule of connective tissue. There is no seminal receptacle. Laurer's canal is present, extending from the anterior level of the shell gland to the dorsal surface, a little anterior to the ovary. The large follicles of the vitellaria are arranged in a linear series lateral to the ceca, and at the outermost boundaries of the uterine coils, fifteen on the right side and seventeen on the left. These follicles extend from the anterior level of the testes to the anterior level of the seminal vesicle (fig. 1). The uterus extends from the region of the ovary in transverse coils which overlap the ceca, to the very weak metraterm to the left of and slightly posterior to the anterior portion of the cirrus sac. The small eggs have thick shells which continue terminally to form a single long filament at each pole (fig. 4). The eggs measure 18 to 22 by 8 to 13 μ. The longest filaments are 63 μ and are found on eggs in the anterior portion of the uterus.

The excretory pore is on the dorsal median surface, near the posterior end of the body. The excretory vesicle is narrow, and extends to the level of the shell gland where it branches to form two limbs which continue anteriorly, lateral to the ceca. Blunt projections or pockets are present on the outer margins of the limbs and the inner margins give off numerous branches which not only anastomose with branches from the opposite limb, but also with other branches anteriorly and posteriorly, forming a network of excretory vessels especially in the anterior half of the body. The limbs of the excretory vesicle do not unite at their anterior extremities, but end bluntly at the level of the esophagus (fig. 1).

GENERIC DIAGNOSIS OF IGUANACOLA

Medium sized Pronocephalids, body smooth and elongate in extended forms, bearing a low muscular collar complete dorsally, interrupted ventrally by oval depression. Oral sucker subterminal; esophagus simple; intestinal ceca narrow, irregular, but without distinct side branches. Genital pores separate, close together near inner edge of left cecum. Testes symmetrical, lobed, near posterior end of body; seminal vesicle long and coiled; cirrus small, conical, and muscular, in a terminal chamber. Ovary pretesticular, in median line; shell gland just posterior to ovary. Uterine coils overlap ceca. Vitellaria extracecal from anterior level of testes to posterior level of cirrus. Eggs with a long filament at each pole. Excretory vesicle Y-shaped with anastomosing branches. Parasitic in intestine of marine iguana, *Amblyrhynchus cristatus*. Type species: *Iguanacola navicularius*.

SPECIFIC DIAGNOSIS OF IGUANACOLA NAVICULARIUS

(Measurements in mm.)

Body smooth, elongate, four and one-half times longer than wide, highly muscular, cup-shaped when contracted. Length 6.63 to 8.80, width 1.30 to 2. Oral sucker on ventral surface at anterior end, slightly wider than long, 0.6 wide, 0.57 long. Esophagus short with enlargement at anterior end. Ceca narrow, reaching nearly to posterior end of body, ventral to inner edges of testes, with short irregular outpocketings on outer margins. Genital pores separate but close together, slightly to left of and anterior to mid-body. Testes with distinct lobes, symmetrical, near posterior end of body. Seminal vesicle coiled, free in parenchyma, extending from just anterior to testes to posterior end of cirrus sac. Cirrus sac large, about five times as long as wide, extending from seminal vesicle diagonally to margin of right cecum, and continuing diagonally in opposite direction to mid-line and genital pore; prostatic region large, occupying greater portion (about nine tenths) of cirrus sac, with strong constriction present in middle portion. Cirrus small, muscular, projecting nipple-like into terminal chamber which surrounds it except at basal portion. Ejaculatory duct communicates with anterior terminal chamber of cirrus, and posteriorly with flattened sinus at base of cirrus. Ovary

slightly lobed, on median line anterior to testes; shell gland complex well developed, just posterior to ovary; seminal receptacle absent; Laurer's canal present; vitellaria of fifteen to seventeen large follicles on each side, extending lateral to ceca from level of testes to posterior level of cirrus sac. Uterus in transverse coils overlapping ceca from ovary to female pore; eggs 18 to 22 by 8 to 13 μ, thick shells, with single filament at each pole.

The genus name is for the host. The species name is from *navicula* (small boat), which describes the boat-shaped body in contracted specimens.

Comparisons. This genus combines characteristics of several other genera in the subfamily. The magnitude of the prostate, the constriction present in this organ, and the relatively small cirrus and large cirrus sac appear to be new characteristics. The excretory system is apparently like that of Epibathra Looss, 1901 but most of the other characteristics seem more related to Cricocephalus Looss, 1899; Adenogaster Looss, 1901; and Pleurogonius Looss, 1901. Cricocephalus, however, has definite branches on the ceca, posterior terminal glands on the body, a simple excretory system, no ventral depression, and a much smaller prostate gland. Adenogaster has a large prostate gland but it fills only half of the cirrus sac; the cirrus is long, and the seminal vesicle lies coiled in a small area near the prostate and does not continue posteriorly. Furthermore, numerous glands cover the ventral surface of the body in Adenogaster but are lacking in Iguanacola. Pleurogonius differs from Iguanacola in that the limbs of the excretory vesicle do not have side branches and unite anteriorly, the cirrus is simple, and the seminal vesicle not so long.

Myosaccus amblyrhynchi, new genus, new species
(Plate 11, figs. 5-8)

Host: *Amblyrhynchus cristatus*
Location: Intestine
Locality: Albemarle Island

The following description is based on a study of five mounted, and one sectioned specimen.

The smooth, equally broad, weakly muscular body measures 4.66 by 1.77 mm. There are two papillae at the posterior end. The weak muscular collar near the anterior end of the body is complete both

dorsally and ventrally, and extends as a small protuberance at each side. The oral sucker is subterminal, 0.33 by 0.34 mm. Its opening is just anterior to the muscular ridge. Immediately posterior to the collar is a deep ventral depression extending only a short distance posteriorly. The esophagus is short and simple, measuring 0.15 mm. in length. The ceca are voluminous with broad outpocketings along their outer margins (fig. 5).

The male and female pores are close together, opening ventrally on the left side of the body about one fourth the body length from the anterior end. The testes are in the extreme posterior end of the body. They are large, deeply lobed, and directly opposite each other. There are about eight primary lobes on each testis, but these may be broken up into secondary lobes. The seminal vesicle is a narrow, tightly coiled tube extending in the mid-body line from about the anterior end of the vitellaria to the base of the short cirrus sac (fig. 5). It connects with the cirrus sac by an uncoiled portion passing to the left from the mid-line. The cirrus sac lies almost horizontally, and extends from the left side of the body to a point slightly beyond the inner margin of the left cecum. It is divided into two portions, one being wide, muscular, and prostatic, the other short, narrow, and containing the cirrus. The prostatic portion is broad and spindle-shaped with numerous small prostatic cells surrounded by a wide sheath of thick longitudinal muscle bands (fig. 6). The short stout cirrus is surrounded by a thin band of longitudinal muscles which are continuous with some of those of the larger portion of the sac.

The female pore lies to the left of the male pore. The ovary is slightly lobed, and lies to the right of the mid-line immediately anterior to the right testis. The ovary is less than half as large as the right testis. The large shell gland lies on the mid-line between the anterior portions of the testes. There is no definite membrane present around the shell gland. Laurer's canal was not seen. There is no seminal receptacle. The large irregular follicles of the vitellaria are definitely arranged in a single, linear, extracecal series on each side, extending from the anterior level of the testes to the posterior level of the seminal vesicle. There are about sixteen follicles on the right side, and eighteen on the left. The yolk ducts extend from the anterior vitellaria posteriorly passing to the shell gland at the level of the ovary. The uterus terminates in a very weak metraterm (fig. 6). The eggs measure about 63 μ in length and 29 μ in width. Ap-

proximately five long filaments, about 133 μ in length, extend from each pole of the egg. The excretory pore is found on the median dorsal surface near the posterior end of the body. The excretory vesicle is Y-shaped, forking near the shell gland. The crura extend to the region of the esophagus where they end blindly. Blunt, voluminous branches are present mostly on the outer margins of the limbs.

GENERIC DIAGNOSIS OF MYOSACCUS

Medium sized Pronocephalids; body smooth, truncated, musculature weak; collar complete. Ventral anterior depression present. Oral sucker subterminal; esophagus simple; intestinal ceca voluminous with short blind outpocketings. Genital pores separate, near left body edge. Testes opposite, lobed, in posterior end; seminal vesicle narrow, coiled anteriorly; cirrus sac short, divided into larger, very muscular prostatic region, and smaller cirrus region. Ovary pretesticular, to right of mid-line. Uterine coils intercecal. Vitellaria extracecal, from anterior level of testes to posterior level of seminal vesicle. Eggs with many long filaments. Excretory vesicle Y-shaped with many secondary branches on crura. Crura not uniting anteriorly. Parasitic in intestine of marine iguana, *Amblyrhynchus cristatus*. Type species: *Myosaccus amblyrhynchi*.

SPECIFIC DIAGNOSIS OF MYOSACCUS AMBLYRHYNCHI

(Measurements in mm.)

Body measuring 3.270 to 4.665 by 1.455 to 1.776. Anterior end with weak muscular collar complete. Short ventral depression present. Body rounded anteriorly, and bluntly rounded posteriorly with terminal papillae present. Oral sucker subterminal and ventral, slightly wider than long. Esophagus short, simple. Ceca voluminous, to near posterior end, bowing towards median line in anterior fifth, and between testes, short outpocketings present, no branches. Genital pores separate but close together near left body edge, one fourth from anterior end. Testes distinctly lobed, directly opposite each other near posterior end. Seminal vesicle narrow, coiled free in parenchyma from level of genital pores to level of second or third uterine coil. Cirrus sac divided, large portion containing narrow spindle-shaped prostate surrounded by wide bundles of longitudinal muscles; smaller portion containing small, stout cirrus with few longitudinal

muscles. Female pore to left of male pore. Ovary slightly lobed, to right of mid-line, anterior to testes. Shell gland posterior to ovary, median, well developed, without outer membrane. Seminal receptacle and Laurer's canal apparently absent. Vitellaria in large irregular follicles extending lateral to ceca from anterior level of testes to posterior level of seminal vesicle. Uterus in transverse coils, intercecal, from ovary to female pore. Eggs 59 to 63 μ by 25 to 36 μ, with many long filaments, about 133 μ long, at each pole. Excretory vesicle Y-shaped, with numerous short branches on limbs.

The generic name is from the Greek *myo* (muscle) and *saccus* (sac), descriptive of the very muscular cirrus sac. The species name is for the host.

Comparisons. Myosaccus differs from Iguanacola in its body form, cirrus sac, and excretory system. Epibathra Looss, 1902 differs in that the cirrus is not divided, the prostate is not surrounded by muscles, and the collar and excretory system are very different. Adenogaster Looss, 1901 has a divided cirrus, and the position of the ovary, testes, and shell gland are almost the same as in Myosaccus. Adenogaster, however, differs in its long simple prostate, the lack of a muscular sheath about the prostate, the absence of posterior papillae and the presence of four rows of ventral glands. The cirrus of Diaschistorchis Johnston, 1913 resembles this genus in its musculature, but almost all other characters are different. Pyelosomum Looss, 1899 has a horizontal cirrus sac but it is undivided and thin-walled and no papillae occur at the posterior end of the body.

Subfamily: Teloporiinae Stunkard, 1934

Cetiosaccus galapagensis, new genus, new species
(Plate 12, figs. 9-11)

Host: *Amblyrhynchus cristatus*
Location: Intestine
Locality: Albemarle Island

The body is very long and narrow, measuring 7 to 13 mm. in length by 1 to 1.3 mm. in greatest width. The width is greatest in the anterior fourth of the body. The body is without spines or posterior papillae. The excretory pore is located on a muscular protu-

berance at the extreme posterior end. In extended compressed specimens the collar is not visible. In contracted specimens there is a weak muscular collar which projects slightly laterally and dorsally, but is interrupted ventrally by a depression. The oral sucker is muscular, subterminal, and measures 0.22 to 0.4 mm. long and 0.30 to 0.42 mm. wide.

The mouth is located in the posterior portion of the oral sucker. The esophagus is short, slightly less than the length of the oral sucker. The ceca are simple, narrow, and unbranched, extending to the posterior fourth of the body. Near their posterior ends the ceca seem to twist considerably, resembling a corkscrew. The ceca do not unite posteriorly, nor bow in at the testes.

The common genital pore is located on the median line, one fourth the body length from the anterior end. The testes are located in the posterior half of the body, somewhat anterior to the terminations of the ceca. They are round or oval, unlobed, intercecal, tandem, separated by about half their length. The cirrus sac is spherical and surrounded by a layer of circular muscles. The seminal vesicle opens into the posterior end of the cirrus sac, and a long ejaculatory duct passes through it. The cirrus is in the form of a stout papilla projecting into a large chamber which surrounds all but its basal portion. Longitudinal muscles line the cirrus chamber and also cover the outer surface of the papilla (cirrus). The chamber of the cirrus sac opens on the ventral surface of the body through the genital pore. The seminal vesicle is a voluminous, highly coiled tube to the right of and posterior to the cirrus sac. It extends posteriorly about one and one-half times the length of the cirrus sac. The more anterior, prostatic portion of the vesicle is enlarged and coiled. This part of the vesicle possesses an outer layer of longitudinal muscle, and numerous prostatic cells which fill its greater portion (fig. 10). The posterior portion of the vesicle is without the heavy muscle layer or prostatic cells, and is the true seminal vesicle.

The ovary is located on the mid-line just anterior to the anterior testis. It is rounded, unlobed, and slightly smaller than the testes. The shell gland is large, lying posterior to, and in most specimens, a little to the right of the ovary. The gland is made up of many large cells radiating about the oviduct which is coiled in the anterior portion of the gland. A definite sheath surrounds the gland. Laurer's canal is long, and opens dorsally anterior to the ovary. The vitelline

follicles are closely grouped, about twenty-seven on each side, immediately ventral to the ceca, extending forward from the anterior border of the ovary, for about four lengths of the ovary. The uterus is highly coiled, especially in the anterior region. It extends, between the ceca, from the ovary to the level of the genital pore. The anterior portion of the uterus enters a moderately developed metraterm with thick glandular walls and a narrow internal layer of longitudinal muscles (fig. 10). The metraterm lies to the left of the cirrus sac, and tapers to the genital pore. The eggs measure 19 to 23 by 9 to 11 μ, with a single long filament at each pole. The filaments are about 83 to 106 μ in length.

The excretory pore is at the extreme posterior end of the worm, and is surrounded by muscles. The excretory vesicle is unusual. It is very large and voluminous, filling at least the posterior fifth of the body (fig. 9). It has thick glandular, highly folded walls. The vesicle divides just posterior to the terminals of the ceca. In all specimens the right limb was greatly enlarged in the region of the division. The limbs pass anteriorly, dorsal to the ceca as irregular, unbranched, narrow tubes which unite dorsal to the oral sucker. Each limb twists upon itself to form a complete circle at the level of the sucker before uniting with the other limb.

GENERIC DIAGNOSIS OF CETIOSACCUS

Elongate Teloporiinae. Body smooth, collar weak, anterior ventral depression present. Both ends of body rounded. Ceca simple. Genital pore median, one fourth body length from anterior end. Testes round or oval, smooth, intercecal, median and tandem, in posterior half of body. Seminal vesicle coiled, entirely anterior to mid-body, just posterior to cirrus sac, with anterior prostatic portion. Cirrus papilla-like in terminal chamber. Ovary spherical median, pretesticular. Shell gland large. Seminal receptacle absent. Laurer's canal present. Uterus intercecal, preovarian. Eggs with single polar filament at each pole. Excretory vesicle voluminous, walls highly folded, in posterior fifth or more of body, limbs simple and uniting anteriorly. From intestine of marine iguana, *Amblyrhynchus cristatus*. Type species: *C. galapagensis*.

SPECIFIC DIAGNOSIS OF CETIOSACCUS GALAPAGENSIS

(Measurement in mm.)

This species has the following characters in addition to those mentioned above: size 7 to 13 by 1 to 1.3. Oral sucker 0.30 to 0.42 in diameter. Esophagus short, ceca narrow, twisted posteriorly, ending separately. Testes separated by a short distance. Cirrus sac spherical containing a male genital papilla projecting into a terminal chamber; ovary separated from anterior testis by a short distance; shell gland posterior to ovary, with enclosing membrane; vitellaria lateral just anterior to ovary, about twenty-seven follicles on each side; metraterm extending posterior to cirrus sac; eggs 19 to 23 by 9 to 11 μ. Host: *Amblyrhynchus cristatus*.

The genus name Cetiosaccus is from *cetio* (monstrous) and *saccus* (vesicle) referring to the very large excretory vesicle. The species name *galapagensis* is for the locality.

Comparisons. The only closely related genus is Teloporia with which Cetiosaccus agrees in its simple ceca, shape and position of the testes and ovary, lack of seminal receptacle, its median genital pore and egg shape. But Cetiosaccus differs very widely from Teloporia in many respects, especially: the excretory system with its glandular vesicle and united crura; the spherical cirrus sac and peculiar genital papilla; and the compactly coiled seminal vesicle of two regions.

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EXPLANATION OF PLATES

All figures were drawn with the aid of a camera lucida or projector. The value of the projected scale is indicated in each figure. The following abbreviations are used:

cir.....cirrus
cs.....cirrus sac
ej.....ejaculatory duct
ep.....excretory pore
ev.....excretory vesicle
glc.....gland cells
gp.....genital pore
lm.....longitudinal muscles
mt.....metraterm
pcs.....posterior portion of cirrus sac
pp.....pars prostatica
sv.....seminal vesicle
ut.....uterus

PLATE 11

FIG. 1. *Iguanacola navicularius.* Ventral view of extended specimen.

FIG. 2. *Iguanacola navicularius.* Diagram of cirrus sac and metraterm, ventral view.

FIG. 3. *Iguanacola navicularius.* Lateral view of contracted specimen.

FIG. 4. *Iguanacola navicularius.* Egg.

FIG. 5. *Myosaccus amblyrhynchi.* Ventral view of extended specimen.

FIG. 6. *Myosaccus amblyrhynchi.* Cross section through region of the genital pores.

FIG. 7. *Myosaccus amblyrhynchi.* Diagram of excretory system.

FIG. 8. *Myosaccus amblyrhynchi.* Egg.

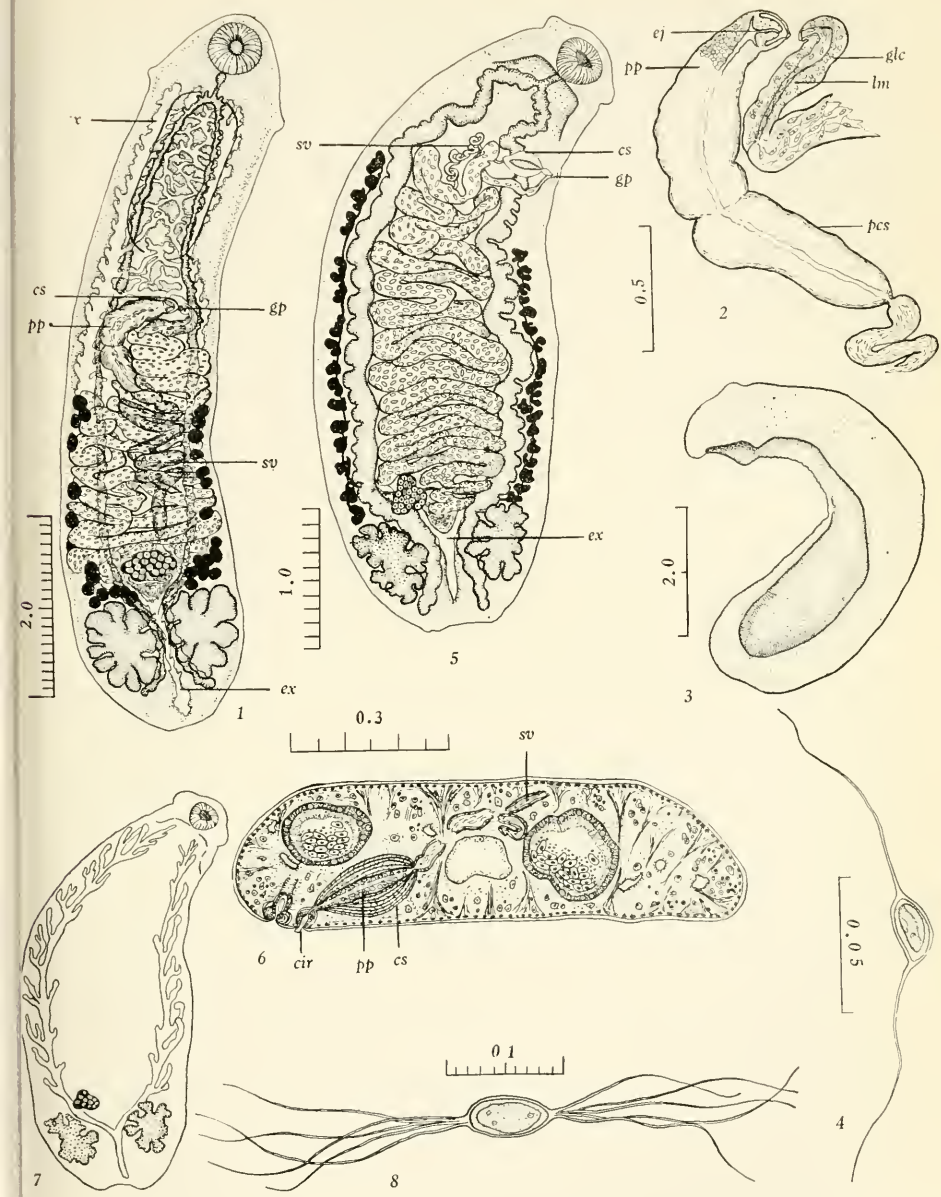
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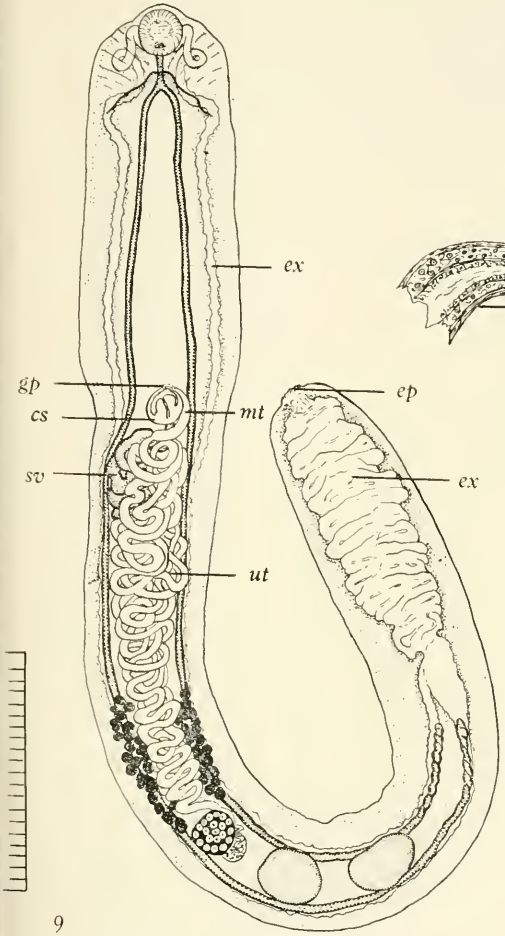
PLATE 12

FIG. 9. *Cetiosaccus galapagensis*. Extended specimen, ventral view.

FIG. 10. *Cetiosaccus galapagensis*. Diagram of cirrus sac and metraterm, ventral view.

FIG. 11. *Cetiosaccus galapagensis*. Ventral view of anterior end of contracted specimen.



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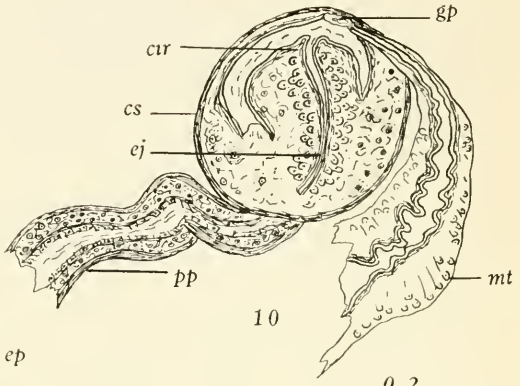

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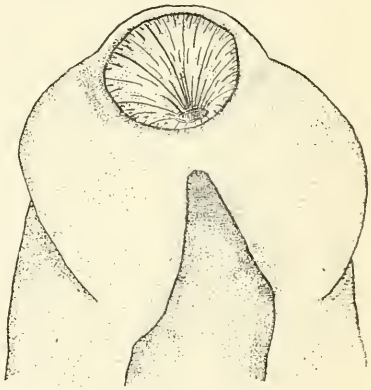

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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

EIGHT NEW SPECIES OF GOBIOID FISHES FROM THE AMERICAN PACIFIC COAST

By ISAAC GINSBURG

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EIGHT NEW SPECIES OF GOBIOID FISHES FROM THE AMERICAN PACIFIC COAST[1]

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Five new species of gobies obtained in the course of several expeditions made by Captain G. Allan Hancock, to the Gulf of California in 1936 and 1937, and to the Secas Islands, off Panama, incidental to an investigation of the Galapagos Islands in 1935, are here described. In addition I take this opportunity to offer brief diagnoses of three other new species from the Gulf of California, discovered by me in an extensive investigation of American gobies. They will be treated more fully in a future paper which will contain revisions of their respective genera. One new genus and one new subgenus, based on two of the species, are established.

All proportional measurements stated below refer to percentages in the standard length. The given length of specimens refers to the total length, including the caudal fin, unless otherwise specified.

Chriolepis zebra, new species

Description.—Form elongate, body compressed, head strongly depressed. Snout notably blunt when viewed from dorsal aspect. Mouth moderately oblique, subsuperior, a horizontal through distal margin of upper lip passing approximately through upper margin of pupil; lower jaw projecting. Maxillary short, its end falling under anterior margin of pupil. Interorbital of medium width. Tongue very moderately emarginate. Teeth in outer and inner rows in both jaws strongly enlarged; one or two irregular rows of much smaller teeth in between at symphysis, one row posteriorly; in lower jaw outer row confined to front, the teeth subequal, inner row extending about half the distance from symphysis to angle of mouth, the last two teeth larger than others, caninoid, the small teeth continued posteriorly in a single row to angle of mouth; in upper jaw outer row extending nearly to angle of mouth, the posteriormost three or four teeth somewhat smaller, the others subequal, inner enlarged teeth confined to front. No spine at angle of pre-

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opercular margin. Isthmus wide, attachment of branchiostegal membrane at lower angle of pectoral base. Posterior part of body and caudal peduncle covered with scales, in about 17 oblique rows from a vertical through base of fifth dorsal ray to end of hypural, some nonimbricate scales extending a little more forward, to a vertical through base of second dorsal ray; the anteriormost scales very small, gradually increasing in size, the posteriormost scales large; scales cycloid, except a few of the larger scales in the last three or four rows ctenoid; a row of four scales on caudal, at its base; the two outer scales conspicuously large, ovoid, the lateral spinules markedly long, decreasing gradually in length toward a median line, the spinules on outer side somewhat larger than those on inner side; the two inner scales in the row much smaller and cycloid. (In the single specimen examined only one smaller, cycloid scale is present next to the lower, large scale, on both sides. However, a bare space is present to fit exactly another such small scale, and the upper of the two scales evidently has fallen off.) First dorsal with 7 flexible spines, none especially prolonged. Second dorsal and anal with 10 rays; posterior anal rays just reaching a vertical through end of hypural, those of dorsal falling slightly short. Pectoral with 18 rays; its tip falling on a vertical a little in front of origin of second dorsal. Ventrals completely separated, the tip falling a little short of anus. Caudal of moderate length, pointed.

Cross-banded color pattern sharply marked; ground color light straw yellow; body crossed for its entire width by seven dark bands from origin of first dorsal to near base of caudal; color of bands generally a little more intense at lateral margins; the bands only a little narrower than the interspaces, except last band markedly narrower than others; a more diffuse band directly behind base of pectoral, nearly interrupted at middle of body; two similar bands on dorsal aspects of nape, continued and becoming narrower on side of head, the posterior one on posterior part of opercle, rather diffuse, the anterior one on anterior part of opercle, narrower, more intensely pigmented, curving forward and becoming broader on under side of head over branchiostegal membrane; two transverse, parallel, approximated, rather narrow, very dark bands on interorbital space, interrupted by eye and continued below eye, the posterior one making a broad curve on cheek, convex posteriorly, the anterior one nearly vertical, under anterior margin on pupil, each extending to ventral aspect of head to nearly meet its fellow from opposite side, both becoming broad and more diffuse on ventral aspect of

head; a band, similar to the two on interorbital, from anterior lower quadrant of eye, extending obliquely forward to upper lip; chin and upper lip dark; caudal light, crossed by four very dark, broad, curved bands, the anterior one, at its base, very broad, concave posteriorly, the others gradually decreasing in width, the second and third somewhat sinuous, the fourth convex posteriorly; second dorsal with very narrow dark streaks running downward and backward; anal dusky, the pigment increasing in intensity from its base distad, the margin hyaline; a dark, diffuse blotch at lower part of fleshy pectoral base; a diffuse, obliquely elongate blotch on upper rays, near their base; rest of pectoral, ventral and first dorsal light, devoid of chromatophores.

Measurements.—Male 27 mm (the only specimen examined). Caudal 31, ventral 26.5, pectoral 26.5, depth 18.5, least depth of caudal peduncle 13.5, head 30, postorbital part of head 16, maxillary 10.5, snout 7, eye 7.5, interorbital 3, antedorsal distance 40.5.

Holotype.—In Hancock Coll. San Gabriel Bay, Espiritu Santo Island, Gulf of California; shore collecting; March 7, 1937.

Distinctive characters and relationship.—This species is easily distinguished from all known American eleotrids by its striking, sharply marked, banded color pattern. It is rather intermediate in its squamation between *Chriolepis minutillus* Gilbert and *Gymneleotris seminudus* (Günther), and largely bridges the gap between those two genera with respect to the squamation, the only substantial character hitherto employed for their separation. It has the characteristic row of four scales on the caudal and some large ctenoid scales at the posterior part of the caudal peduncle, like *C. minutillus*, and it also has smaller cycloid scales anteriorly, like *G. seminudus*. Unlike the latter species, it lacks mucous pores and the interorbital is not notably wide. In this respect it agrees with *C. minutillus* and of the known American eleotrids it is structurally nearest to that species. The difference in the squamation together with the strikingly distinctive color pattern shows that *minutillus* and *zebra* are widely divergent, to an extent to be placed in distinct subgenera at least, and a new subgenus is therefore established for *zebra*.

Eleotriculus, new subgenus

Genotype.—Chriolepis zebra, new species.

A definition of the subgenus is included in the description of the genotype. How it differs from the typical subgenus is discussed above in comparing the two genotypes.

Coryphopterus urospilus, new species

Description.—Form moderately elongate; body compressed, rather stout; head subtriangular in cross-section, the height directly behind eyes subequal to the greatest width at same point. Mouth rather small, terminal, a horizontal through distal margin of upper lip passing approximately through lower margin of pupil; lower jaw about equal to upper anteriorly. Maxillary rather short, its end falling under anterior margin of pupil in male, slightly short of that point in female. An elongate, soft, pad-like translucent area present under anterior half of eye. Tongue entire, rather broad. Teeth in narrow bands of about four rows at symphysis, tapering to two rows posteriorly; teeth in outer and inner rows moderately enlarged; in upper jaw outer row extending to angle of mouth, a few enlarged teeth in inner row at symphysis; in lower jaw outer row confined to front, enlarged teeth in inner row extending a little farther backward; no caninoids. Shoulder girdle without papillae. A rather feebly developed, short, fleshy ridge in front of spinous dorsal, sometimes hardly perceptible. Scales on body ctenoid, large, in 25-26 oblique rows to base of caudal; anterior boundary of scales marked by a line extending approximately from origin of first dorsal to upper posterior angle of opercle; no scales on antedorsal distance in front of that line, none on side of head; rather large cycloid scales on base of pectoral, on throat and on midline of belly. First dorsal with 6 flexible spines (in all 8 specimens), the fin rather high, but none especially prolonged, the third or fourth reaching base of first to third ray of second dorsal in male, somewhat lower in female. Second dorsal with 10 rays (in all 8); anal rays usually 10 (in 6), often 9 (in 2); posterior dorsal rays in the larger males reaching a vertical through end of hypural or falling a little short, in smaller males and females falling considerably short; those of anal not quite reaching as far back as those of dorsal. Pectoral with 19 (in 4) or 20 (in 4) rays, all connected by an interradial membrane, its posterior margin reaching a vertical through base of second or third dorsal ray. Ventral with the interspinal membrane of medium development, posterior margin of fin reaching slightly past anus in male, reaching anus or falling a little short in female. Caudal of medium length, truncate.

Body with longitudinal rows of small dark spots; five rows on lateral aspect of body, four on caudal peduncle; spots in lower two rows somewhat larger and darker, spots in upper three rows often connected by faint lines, forming a network effect; the spots, especially those in the

two lower rows, characteristically lighter in the center, darker around the periphery; a row of eight rather diffuse, elongate blotches saddled on back from origin of first dorsal to base of caudal; dorsal aspect of nape with five irregular longitudinal rows of small, more or less elongate spots; side of head with three lengthwise bands; a band on a line with middle of eye, usually somewhat interrupted and nearly continuous with fourth from lowermost row of spots on body; a band from lower posterior margin of eye running somewhat obliquely to upper posterior part of opercle; a third band from posterior end of maxillary, somewhat converging posteriorly with, but not meeting, middle band; two or three blotches in a row, one behind the other, on upper part of pectoral and its fleshy base, directly behind the bands, sometimes the bands and blotches nearly continuous; a similar blotch on lower part of fleshy base; a sharply marked, very dark spot on base of caudal, directly below the median line; a very faint smudge over it, above the median line; fins more or less dusky, without spots, pectoral lightest.

Holotype.—In U. S. Nat. Mus. San Jose Island, Pearl Islands, Panama; in tide pools; March 15, 1937; S. F. Hildebrand; male 41 mm.

Paratypes.—4 males 35-42 mm., 3 females 34-37 mm; obtained with the type. I wish to take this opportunity to express my sincere thanks to Dr. Hildebrand for turning over to me for study, the Gobiidae obtained during 1935 and 1937 as a result of and incidental to his studies of the fish fauna of the Panama Canal locks.

I also examined one small specimen, 23 mm., in the Hancock collection. It is in bad condition but appears to belong to this species. Its fin ray counts are D. 10, A. 10, P. 20. The characteristic spot on the lower part of the caudal base is present. Feeble traces of the general color pattern as described above are discernible. The data for this specimen are: Tiburon Island, Gulf of California; March 28, 1937.

Distinctive characters and relationship.—Of the two known species of its genus, *urospilus* differs from *(Gobius) Coryphopterus nicholsii* (Bean) in having fewer rays in the dorsal, anal and pectoral and in lacking a black band on the distal margin of the first dorsal. It is evidently most nearly related to and agrees with *Coryphopterus glaucofrenum* Gill in the fin ray counts and the form of the head and body. It differs in having the predorsal fleshy ridge poorly developed or nearly obsolescent, and in color. The color pattern is similar in both, but the differences are striking on direct comparison. The spots in the longi-

tudinal rows are smaller and better marked in *urospilus,* and there are more rows. The caudal base has the lower spot very intense and the upper very faint, while in *glaucofrenum* both spots are of equal intensity in color.

Lythrypnus pulchellus, new species

Description.—Form moderately elongate, head and body well compressed. Mouth small, oblique, subsuperior, a horizontal through distal margin of upper lip approximately bisecting eye; lower jaw projecting. Maxillary short, its posterior end approximately under anterior margin of pupil. Tongue entire, narrow. Outer row of teeth in both jaws enlarged, approaching caninoids in size, widely spaced; inner teeth minute, in a narrow band. Shoulder girdle without papillae. No ridge or crest in front of dorsal. Isthmus moderate, attachment of gill membrane on a vertical approximately setting off anterior third of opercle. Scales ctenoid, about 28; none on antedorsal distance, side of head, base of pectoral, throat or midline of belly (many scales missing in type and nearly all missing in the three paratypes, and above description subject to correction). First dorsal with 6 flexible spines (in all 4 specimens); the first spine notably prolonged in large male, more moderate in smaller (to base of ninth ray in a male 22 mm, to base of third in a male 18 mm); second spine more moderately prolonged (reaching to base of fourth ray in 2 males 19 and 22 mm, to base of first ray in a male 18 mm); the first two spines not notably prolonged in female (25 mm). Dorsal rays usually 13 (in 3), sometimes 12 (in 1); anal rays 10 (in all 4); posterior rays falling more or less short of a vertical through end of hypural, those of dorsal usually extending slightly farther back than those of anal; in both fins a little longer in male than in female. Pectoral with 18 (in 1) or 19 (in 3) rays, all connected by membrane, its tip reaching a vertical through base of second to fourth dorsal ray. Ventral having the interspinal membrane of medium development, tip of fin reaching vent or origin of anal. Caudal short, rounded. Anal papilla of male rather well developed.

Body and head cross-banded; 12-13 bands from origin of first dorsal to base of caudal; the bands narrower than the interspaces, the two sharply delimited except sometimes posterior ones on caudal peduncle; each band having a transverse, median, dark streak; interspaces nearly uniformly colored, except sometimes those on caudal peduncle; a similar band over base of pectoral continued around back from one side to the

other, becoming more or less diffuse on fleshy base of fin; five similar bands on top of head and nape, nearly spaced the same as bands on body, the anteriormost one on interorbital space, these bands on dorsal aspect forming broad curves, convex posteriorly, from a lateral view appearing to run obliquely downward and forward at the back, becoming nearly vertical on side of head, one on opercle, one just behind eye, one under middle of eye and two hardly perceptible ones from anterior lower quadrant of eye running forward to maxillary.

Measurements.—Male, standard length 17.5. Depth 25, depth of caudal peduncle 15, head 30, postorbital part of head 17.5, maxillary 12.5, snout 8.5, eye 11, antedorsal distance 36.5.

Holotype.—In Bingham Coll. Espiritu Santo Island, Gulf of California; male 17.5 mm in standard length.

Paratypes.—All three in Hancock Coll. San Gabriel Bay, Espiritu Santo Island, Gulf of California; March 7, 1937; 2 males 18-19 mm. Puerto Refugio, Angel de la Guarda, Gulf of California; March 20, 1937; female 25 mm.

Distinctive characters and relationship.—This species is very closely related to (Gobius) *Lythrypnus zebra* (Gilbert) from the Pacific coast of Southern California and Lower California. A most striking difference shown by the specimens compared, is found in the color pattern. The narrow cross bands in *pulchellus* are divided by a median, narrow, clear-cut, dark streak, which under the microscope shows definitive chromatophores, while the areas on either side of the streak are either uniformly dusky or of a plain light color; in *zebra* the definitive chromatophores spread out and what represents the clear cut dark streak of *pulchellus* becomes diffuse to cover nearly the entire cross-band. Again, the interspaces in *pulchellus* are uniformly colored, except some of the posterior ones, while in *zebra* the chromatophores in the interspaces are more concentrated along a transverse median area. In gross effect, the bands in *pulchellus* are lighter than or of approximately the same intensity as the interspaces, while in *zebra* the bands are darker than the interspaces.

Of structural characters the only difference that I can point out now is the number of pectoral rays, but they intergrade in this character, 18-19 in *pulchellus,* 19-20 in *zebra.*

It is evident that the corresponding populations on the Pacific coast proper and in the Gulf of California, respectively, should be recognized at least as distinct subspecies. However, the specimens examined are not

in good enough condition to permit the comparison of characters that are of importance in distinguishing the species of *Lythrypnus,* namely, the length of the dorsal spines and the posterior rays in the dorsal and anal, and the number of scales. The two populations are therefore tentatively recognized as distinct species, pending the comparison of more specimens in a better state of preservation.

PARRELLA, new genus

Genotype.—Parrella maxillaris, new species.

A definition of the genus is included in the description of the genotype. *Parrella* is structurally nearest to *Microgobius.* The genotype differs from all known species of *Microgobius* by having large scales, fewer rays in the dorsal and anal, a subterete head, a notably more slender body and longer pectoral, and a different color pattern. The most striking differences, however, are found in the distribution of the lateral line organs. These structures which are of considerable importance in classification will be considered in a systematic manner in a forthcoming paper.

I take pleasure in naming this genus after Professor Albert E. Parr of Yale University.

Parrella maxillaris, new species

Description.—Body notably slender, compressed; head subterete, the depth slightly less than the width. Mouth terminal, very moderately oblique, a horizontal through distal margin of upper lip passing approximately through lower margin of eye; lower jaw equal anteriorly to upper. Maxillary long (at least in male), its posterior end falling only about a pupil's diameter in front of preopercular margin in two males 41-43 mm, almost to the same relative point in one male of 28 mm. Tongue moderately emarginate. Teeth in 3 or 4 irregular rows at symphysis, tapering to one or two rows on side; teeth in outer row in both jaws larger than posterior ones, those in outer row of upper jaw somewhat larger than corresponding teeth of lower jaw; a few innermost teeth at symphysis of lower jaw subequal to those in outer row of upper jaw; no caninoids. No papillae or flaps on shoulder girdle. No sharp ridge or crest in front of dorsal. Isthmus rather broad, attachment of gill membrane nearly at lower angle of pectoral base. Scales large, about 32; none on antedorsal distance, side of head, base of pectoral,

throat or ventral aspect of belly; scales on middle of body extending to within a short distance of base of pectoral; anterior boundary of scales marked by a line passing approximately from origin of first dorsal to upper angle of pectoral base; scales along middle part of body, posteriorly, ctenoid; anterior scales under base of second dorsal, and those near profiles, cycloid (most scales missing in specimens examined and description of squamation possibly subject to correction). First dorsal with 7 flexible spines (in all 4 specimens examined), rather high, but none notably filamentous, the fourth reaching base of second or third dorsal ray. Second dorsal rays usually 12 (in 3), sometimes 11 (in 1); anal rays 11 (in all 4); posterior dorsal rays extending a little beyond a vertical through end of hypural in 2 males 41-43 mm, those of anal just reaching that vertical or slightly beyond in the same two males; those of both fins just about reaching that vertical in a specimen 35 mm, and falling a little short in a male 28 mm. Pectoral rays 19 (in 1) or 20 (in 3), all connected by an interspinal membrane, the fin rather long, the longest rays reaching a vertical through base of third to fifth ray of second dorsal. Ventrals united, interspinal membrane rather well developed, its posterior margin with notably pronounced fimbriae; posterior end of fin reaching anus or falling a little short. Caudal rather long, equal to or a little less than half the standard length in the large males. Anal papillae of male rather short and pointed.

A longitudinal, rather narrow, dark streak slightly below a median line, approximately from base of pectoral to under origin of second dorsal; a similar less well marked, interrupted and parallel streak a little above a median line; (a longitudinal series of four rather diffuse blotches on the 28 mm specimen, the first at posterior end of and confluent with lower dark streak, the last at base of caudal; only the last blotch perceptible in the larger specimens examined, but these specimens probably faded); two spots on base of caudal, one below the other, more or less confluent, and more or less also confluent with the last spot—in the longitudinal series of four spots—on the base of the caudal; a small oval spot on fleshy base of pectoral, a more diffuse, transverse, rather arched shaded area on fin, at its base; upper part of caudal with longitudinal rows of narrow elongate dark spots (in one specimen, the dark spots very intense, alternated with whitish spots, and with a whitish submarginal band; this pronounced development of color probably showing a sexually ripe male), lower part dusky (dorsals and anal more or less injured and color cannot be described).

Measurements.—Two males 41-43 mm. Caudal 46.5-50, ventral 29.5, pectoral 35-39.5, depth about 12.5 (cannot be measured accurately in these specimens), least depth of caudal peduncle 8.5-9, head 28-28.5, postorbital part of head 15.5, head depth directly behind eye 14-14.5, head width at same point 15-15.5, maxillary 21-22, snout 8, eye 7.5-8, antedorsal distance 35.5-37.5.

Holotype.—In Hancock Coll. La Paz Bay, Gulf of California; dredged in 7 fathoms, sandy mud; February 21, 1936; male 43 mm.

Paratypes.—Two obtained with the type, male 41 mm, specimen of 35 mm in bad condition. Also, Escondido Bay, Gulf of California, dredged in 20 fathoms; March 12, 1937; male 28 mm.

Distinctive characters.—This species is easily distinguished from all known gobies of the Pacific coast of North and South America by a combination of striking characters, especially, its long maxillary, the large scales and the medium count of dorsal and anal rays. Its relationship is discussed under the genus.

Gobulus hancocki, new species

Description.—Form very slender; body moderately compressed; head notably depressed. Mouth rather small, terminal, moderately oblique, a horizontal through distal margin of upper lip passing approximately through lower margin of eye; lower jaw slightly projecting. Maxillary rather short, its end falling under posterior margin of pupil. Eye rather small, interorbital wide. No ridge or crest in front of dorsal. Shoulder girdle without flaps or papillae. Isthmus restricted, attachment of branchiostegal membrane near lower angle of pectoral base. No scales anywhere. First dorsal with 7 flexible spines, none prolonged. Second dorsal and anal with 12 and 11 rays, respectively; tip of posterior dorsal rays ending at some distance from end of hypural. Pectoral short, with 16 rays, its end nearly attaining a vertical through base of sixth spine. Ventral short, failing to reach anus by a wide margin. Caudal rather short, somewhat pointed.

Dorsal and ventral aspects rather light colored, lateral aspect for greater part of its extent notably darker; fins uniformly light, except caudal having a somewhat curved, broad, dark band not far from its base; no other spots or color marks anywhere.

Measurements.—Male 29 mm. Caudal 23.5, ventral 18, pectoral 18.5, depth 12.5, least depth of caudal peduncle 9, head 24.5, postorbital

part of head 16, head depth 9.5, head width 11, maxillary 10, snout 6.5, eye 4.5, antedorsal distance 34.5.

Holotype.—In U. S. Nat. Mus. Secas Island, Panama; shore, coral tide flat; W. L. Schmitt; Feb. 6, 1935; the only specimen examined.

Distinctive characters and relationship.—This species is evidently near *Gobulus crescentalis* (Gilbert), the only known species of its genus, differing in its markedly more slender body, and in having the mid-ventral area light colored like the back—darker than the back in *crescentalis.*

This species is named after Captain Hancock in recognition of his interest in the scientific exploration of Pacific waters.

Lepidogobius seta, new species

Diagnosis.—Scales cycloid, small, about 65; none on antedorsal distance, side of head, base of pectoral or throat. Maxillary very long, nearly reaching margin of preopercle. No definite papillae on shoulder girdle. D.6 to 7-11 to 12; A. 9 to 10; none of the dorsal spines notably elongated. Pectoral rays 21. Tongue slightly emarginate. Teeth in a notably broad band. Skull with a rather narrow ridge over orbit; no other ridges in posterior orbital region of skull.

Holotype.—In U. S. Nat. Mus. Puerto Refugio, Angel de la Guarda Island, Gulf of California; Albatross; March 29, 1889; 58 mm in standard length, the caudal broken.

Paratype.—In U. S. Bur. Fish., obtained with the type, 64 mm.

Relationship.—This species is nearest to *Lepidogobius (Gillichthys) detrusus* (Gilbert and Scofield), differing chiefly in having fewer anal rays, a less extensive squamation, a narrower supraorbital ridge, and in lacking a median occipital ridge on the skull.

Lepidogobius luculentus, new species

Diagnosis.—Scales small, cycloid, embedded, very moderately overlapping in large specimens; none on antedorsal distance, side of head, base of pectoral or throat. Maxillary rather short, ending approximately under posterior margin of pupil in large specimens. Shoulder girdle with flaps of moderate size, usually 2, sometimes 1 or 3. First dorsal nearly always with 5 spines, varying 3-6; the first spine more or less prolonged in some individuals, not prolonged in others (probably males and females, respectively). Second dorsal nearly always with 18 or 19 rays, infrequently 17; anal rays nearly always 16 or 17, infrequently

18; pectoral rays 23-26. Tongue bilobate. Supraorbital ridge expanded posteriorly.

Holotype.—In Bingham Oceanog. Coll. Puerto Refugio, Angel de la Guarda Island, Gulf of California; 51 mm.

Paratypes.—In Bingham Oceanog. Coll. 47 specimens 35-53 mm taken together with the type. San Francisquito Bay, one specimen 33 mm.

Distinctive characters and relationship.—This species is nearest to *Lepidogobius gilberti* Eigenmann and Eigenmann and differs in having two instead of one papillae on the shoulder girdle, with very few exceptions, and in the male having the first dorsal spine prolonged. It lacks the dark, obliquely elongate spot or blotch on the opercle which is characteristic of *gilberti*. The color of this species, in general, is lighter than in any known species of *Lepidogobius*.

Microgobius erectus, new species

Diagnosis.—Mouth nearly vertical, end of maxillary assuming a ventral position, a vertical tangent through posterior margin of maxillary passing approximately through anterior margin of eye. Teeth in two rows, notably small, no caninoids. Scales rather large, in 38 rows to base of caudal, cycloid; a small patch of weakly ctenoid scales on middle of body, under first dorsal; scales extending forward to a vertical through origin of first dorsal; none on antedorsal distance, side of head, base of pectoral or throat. A membranous ridge on midback, in front of first dorsal, rather well developed. D. 7-15; A. 15; the spines not especially prolonged. Pectoral rays 22-23, its tip reaching a vertical variably situated between bases of first to third dorsal rays. Ventral approximately reaching anal opening. Caudal comparatively rather long, about two-fifths the standard length. Body and head conspicuously compressed.

Holotype.—In Bingham Oceanog. Coll. Northern part of Gulf of California; 26 fathoms; female 82 mm.

Paratypes.—In Bingham Oceanog. Coll. obtained with the type; 2 females 56-58 mm, 4 males 56-66 mm, 1 small specimen 40 mm, sex not determinable by external examination. All specimens not in very good condition; the largest, a female, in somewhat better condition than others selected as the holotype, although the belly appears to be somewhat abnormally distended.

Distinctive characters and relationship.—This species differs markedly from all known species of *Microgobius* by its small teeth and

comparatively large scales. The nearly vertical mouth is more extreme in its position than in any known species of its genus. In the position of the mouth it resembles most nearly *Microgobius signatus* Poey, and it has an antedorsal ridge like the older species. However, it has notably smaller teeth, larger scales, and fewer fin rays and it is evidently not closely related to *signatus*. Because *erectus* has some important characters more extremely developed than any of its congeners, and in general, because of the very distinctive combination of all characters, its precise affinities are not patent.

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

LAND AND BRACKISH WATER MOLLUSCA OF COCOS ISLAND

By G. DALLAS HANNA and LEO GEORGE HERTLEIN

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The collections upon which this paper is based were made by members of the Expedition of the California Academy of Sciences to the Galapagos Islands in 1905-1906;[1] by the junior author during an expedition to the Galapagos Islands in Captain G. Allan Hancock's motor cruiser, *Velero III,* in 1931-1932;[2] and by members of the Templeton Crocker Expedition of the California Academy of Sciences in 1932.[3]

Cocos Island[4] lies in 5°32′57″ N. Lat., 86°59′17″ W. Long., about half way between the Galapagos Islands and the Central American coast. Politically, it belongs to Costa Rica. The island is about 500 kilometers from the mainland. It is composed, at least for the most part, of volcanic agglomerate and other volcanic rocks. The circumference is about 23.3 kilometers (about 13 nautical miles or 14.6 land miles) and the area is approximately 46.6 square kilometers. The highest point of elevation is in the western part of the island and has been reported[5] to reach a height of 849.8 meters (2,788 feet). There is much rainfall and the largest stream, which flows into Wafer Bay, is in the Arroyo del Genio. The coast is abrupt at many places and there

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[1] Slevin, J. R., Log of the Schooner *Academy* on a voyage of Scientific Research to the Galapagos Islands, 1905-1906. California Academy of Sciences, Occasional Paper 17, 1931, 162 pp., 17 pls. [General account.]

[2] For a general account of this Expedition see: Sam T. Clover, A Pioneer Heritage. Los Angeles, California, 1932. Saturday Night Publishing Co., pp. 1, II, 1-291. 97 pls., 4 maps. 1 text figure. See especially pp. 182-218 and map showing itinerary and route, inside front cover.

[3] Grunsky, C. E. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. Foreword, Proc. Calif. Acad. Sci., ser. 4, vol. 21, no. 1, March 14, 1933, pp. 1-2. Introductory statement by Templeton Crocker, pp. 3-9, pl. 1. ——— Hanna, G. D., Science, vol. 76, no. 1974, October 28, 1932, pp. 375-377.

[4] See handbooks prepared under the direction of the Historical Section of the Foreign Office, London, vol. 22, no. 141, 1920, pp. 7-30. ——— Campbell, M. Searching for Treasure in Cocos Island. New York, 1932. Frederick A. Stokes Co., VIII, 279 pp., frontispiece colored, 4 pls.

[5] South America Pilot, H. O. no. 174, Ed. 2, vol. 3, 1920, p. 405. ——— Mexico and Central America Pilot (West Coast), H. O. no. 84, Ed. 7, 1928, p. 69.

are numerous waterfalls. This beautiful and picturesque island, covered with dense tropical vegetation, has been the object of much interest due to the legends of treasure which is reported to have been hidden there by pirates.

Schmidt[6] in his discussion of the zoogeography of Cocos Island concluded that the few native species of vertebrates, four land birds and two lizards, are mostly distinct from those of any other part of the world, but that they are allied to Central America, the nearest land mass. The forms are such that transport or passage[7] across the intervening ocean is understandable. He further stated: "The species have probably arisen in consequence of geographic isolation, without indication of adaptive change or changes due to natural selection."

Papers on the marine mollusks have been published by von Martens,[8] Pilsbry and Vanatta,[9] Biolley,[10] Dall,[11] Hertlein,[12] and Tomlin.[13] The majority of the marine species from Cocos Island are the same as those found on the mainland of the adjoining coast.

Pfeiffer,[14] von Martens,[15] Kobelt,[16] Dall,[17] Ancey,[18] Biolley,[19] and Pilsbry[20] have published information dealing with the land shells and

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[6] Schmidt, K. P., Essay on the Zoogeography of the Pacific Islands, in Shurcliff, S. N. Jungle Islands. Putnam Press, New York, 1930, pp. 278-280. See also Biolley, P., Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, 30 pp. 2 maps.

[7] For a general discussion of the faunas and floras of oceanic islands, see Gulick, A., Biological Peculiarities of Oceanic Islands. The Quarterly Review of Biology, vol. 7, no. 4, 1932, pp. 405-427.

[8] von Martens, C. E., Die Meeres-Conchylien der Cocos-Insel. Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 6, pp. 137-141.

[9] Pilsbry, H. A., and Vanatta, E. G., Proc. Washington Acad. Sci., vol. 4, 1902, p. 559.

[10] Biolley, P., Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, pp. 19-30.

[11] Dall, W. H., Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, pp. 436-437; Proc. U. S. Nat. Mus., vol. 38, 1910, p. 225; Proc. U.S. Nat. Mus., vol. 51, 1917, p. 578.

[12] Hertlein, L. G., Nautilus, vol 46, no. 2, 1932, pp. 44-45; Proc. Amer. Philos. Soc., vol. 78, no. 2, 1937, pp. 303-312, 1 pl.

[13] A few species have been cited from Cocos Island by Tomlin, J. R. le B., in Jour. Conch., vol. 18, no. 6, 1927, pp. 153-170; no. 7, 1928, pp. 187-198.

[14] Pfeiffer, L., Symb. ad Hist. Helic., sect. 3, 1846, p. 66.

[15] von Martens, E. C., Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1898, no. 9, pp. 156-160; Jahrg. 1902, no. 3, pp. 59-62.

[16] Kobelt, W., Nach. Deutsch. Malak. Ges., Jahrg. 31, 1899, pp. 26-28.

[17] Dall, W. H., Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, pp. 96-99.

[18] Ancey, C. F., Journ. de Conchyl., vol. 51, no. 2, 1903, pp. 97-104.

[19] Biolley, P., Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, pp. 13-19.

[20] Pilsbry, H. A., Manual Conch., ser. 2, vol. 18, 1907, pp. 325-330.

references to these works are found under various species in the following pages.

After reducing some of the names to synonymy we are able to recognize only five definitely endemic species of land snails from the island. Two others, an *Opeas* and a *Leptinaria*, may have been introduced. The endemic forms belong to the genera *Ochrodermella, Nesopupa, Succinea,* and *Guppya.* The representatives of all except the last have their closest relatives in Polynesia. All of the species are rather inconspicuous and this makes the anomaly in distribution the more difficult to explain. It hardly seems possible that collectors would have missed getting some representatives of the rich Central American or Galapagan faunas if they were present. Therefore we are forced to admit, for the present, the Polynesian affinities of the land shells. This conclusion is in agreement with the opinion expressed by Kobelt, who explained the Polynesian affinities of the land snails as being due to the eastward direction of the equatorial countercurrent which flows past Cocos Island. It should be mentioned that all of the species of land snails recorded herein have been secured on the lower levels of the island. It seems possible from conditions found elsewhere that there may be others at higher elevations.

The four brackish water species listed herein, belonging to *Auricula* and *Melampus,* wide-ranging tropical genera, are of no great value in deciphering the origin of insular faunas. They have been determined as forms which also inhabit the adjacent coast of the mainland, some 500 kilometers to the east.

Siphonaria gigas Sowerby and its variety *characteristica* Reeve, and *Neritina pilsbryi* Tryon (referred to as *N. latissima* var. *globosa* Broderip, by von Martens, and Biolley) occur at Cocos Island, but these have been placed with the marine mollusks in the faunal lists of Cocos Island.

Ochrodermella cumingiana (Pfeiffer)

Tornatellina cumingiana Pfeiffer, Proc. Zool. Soc., London, January-June, 1850, p. 134. "Real Llejos (H. Cuming)" [Nicaragua]. —Pfeiffer, Conchyl.-Cab., vol. 1, abt. 15, 1841-1855, *Pupa,* p. 148, pl. 18, figs. 6, 7.—Pfeiffer, Monogr. Helic. Viv., vol. 3, 1853, p. 525. —— von Martens, Biol. Centrali-Americana, Moll., 1898, p. 324. —— von Martens, in Albers, Die Helic., ed. 2, 1860, p. 260. —— Kobelt, Nach. Deutsch. Malak. Ges., Jahrg. 31, 1899, p. 27. Cocos Island.

Leptinaria cumingiana (Pfeiffer), Clessen Ed., Nomen. Helic. Viv., 1878-1881, p. 336.

Ochroderma cumingianum (Pfeiffer), Ancey, Journ. de Conchyl., vol. 51, no. 2, 1903, p. 102. Cocos Island.

Ochroderma cumingiana (Pfeiffer), Pilsbry, Man. Conch., ser. 2, vol. 18, 1907, p. 327, pl. 47, fig. 20. [Records repeated.]

Tornatellina pittieri von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1898, no. 9, p. 157. "Cocos-Insel bei Costa Rica." —— Kobelt, Nach. Deutsch. Malak. Ges., Jahrg. 31, 1899, p. 26. ——von Martens, Biol. Centrali-Americana, Moll., 1901, p. 640, pl. 44, fig. 10. —— von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 60. Cocos Island. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 15. Cocos Island.

Leptinaria (Neosubulina) pittieri (von Martens), Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, p. 96. Cocos Island.

Ochroderma pittieri (von Martens), Pilsbry, Man. Conch., ser. 2, vol. 18, 1907, p. 328, pl. 47, figs. 15, 16.

Leptinaria (Neosubulina) martensi Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, April 16, 1900, p. 97, pl. 8, fig. 10. "Cocos Island, under stones, Heller and Snodgrass."

Tornatellina martensi (Dall), von Martens, Biol. Centrali-Americana, Moll., 1901, p. 640. Type locality cited.

Ochroderma martensi (Dall), Pilsbry, Man. Conch., ser. 2, vol. 18 1907, p. 329, pl. 47, figs. 22, 23, 24. Cocos Island. [Previous records cited and new sect. *Ochrodermella* formed with *martensi* as type.] —— Ancey, Journ. de Conchyl., vol. 51, no. 2, 1903, p. 102. Cocos Island.

Many specimens of *Ochrodermella* are in the collection from Cocos Island. Those obtained by the Hancock Expedition were found among leaves and mosses along the creeks draining into Wafer and Chatham bays. Only sinistral shells were taken at the first locality and only dextral ones at the last, but except for being reversed the specimens seem indistinguishable. The description and figures of *cumingiana* fit dextral shells from Cocos Island almost exactly; it is therefore practically certain that Cuming's Nicaragua locality record was an error.

This seems more plausible when it is noted that Pfeiffer had already described *Helix pacifica* from Cocos Island when he described *cumingiana*. *O. martensi* has nothing we can find to distinguish it from *cumingiana,* and *pittieri* is an exact sinistral counterpart. Apparently the last is the dominant form and the identity has been recognized by von Martens (1902, p. 60), Dall (letter May 24, 1902, quoted by Biolley), and Biolley (1907, p. 15).

Pilsbry segregated the Cocos Island species under a new section, *Ochrodermella*. The type of *Ochroderma* is *gigas,* a very much larger and heavier shell from the Caroline Islands. As genera are now constituted, it seems rather difficult to reconcile the union so we have given the section generic standing.

Ochrodermella biolleyi (von Martens)

Text figure 1

Tornatellina biolleyi von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 60. "Cocos-Island." —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 16. Cocos Island.

Tornatellina hopkinsi Sykes, Zool. Record, vol. 39, for 1902 [Issued 1903], Moll. p. 45. Costa Rica [*Nomen nudum*. See Biolley, 1907, p. 16, footnote 2.]

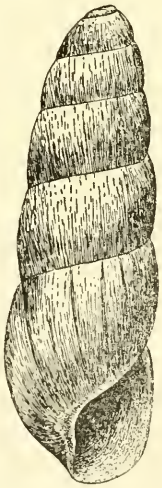

FIG. 1. *Ochrodermella biolleyi* (von Martens). Length, 13 mm.

Shell much longer than *O. cumingiana* but with about the same coloration, olive brown, glossy, streaked with narrow axial lines of burnt umber; apex flatly obtuse, minutely and irregularly wrinkled; whorls seven with suture slightly impressed; aperture entirely without teeth or plications of any kind; outer margin thin, without callus; columella, slightly twisted; base imperforate. Length, 13 mm., diameter, 4 mm.

Hypotype, no. 524 (Calif. Acad. Sci. type coll.) from Cocos Island collected by W. H. Oschner, a member of the Expedition of the California Academy of Sciences to the Galapagos Islands in 1905-1906.

The specimen figured is the largest available specimen in our collection and is 2½ mm. longer than von Martens' type. Our other two measure 9.5 and 10 mm. in length. These specimens were found among a large series of *O. cumingiana* which passed through Dall's hands without detection.

The nuclear whorls appear to be identical with *cumingiana* and the chief distinguishing features are the greater length and the lack of plications in the aperture. Although the species has not been illustrated heretofore, von Martens' description seems to fit our shells so exactly that we have confidence in the correctness of the identification.

Leptinaria biolleyi von Martens

Leptinaria biolleyi von Martens, Biol. Centrali-Americana, Moll., June, 1898, p. 319, pl. 18, fig. 14. "Central Costa Rica: environs of San José, 1135 metres above the sea, among moss (Biolley)." "E. Costa Rica: Talamanca (Pittier, March, 1895)."—— von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 61. "in der Nähe von Wohnungen an der Bucht von Wafer, und nicht zahlreich." —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 16. Wafer Bay, Cocos Island. —— Pilsbry, Manual Conch., ser. 2, vol. 18, 1907, p. 316, pl. 41, fig. 18. Cocos Island.

This species was described from Costa Rica by von Martens. Its presence on Cocos Island (not numerous and found in the vicinity of the habitation at Wafer Bay) led von Martens to suspect that the species may have been recently introduced on the island on vegetation or by some other method.

Nesopupa cocosensis (Dall)

Vertigo cocosensis Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, April 16, 1900, p. 98, pl. 8, fig. 13. "Cocos Island, on leaves, Heller and Snodgrass." —— Ancey, Journ. de Conchyl., vol. 51, no. 2, 1903, p. 103. Cocos Island. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 17. Chatham Bay, Cocos Island.

Pupa cocosensis (Dall), von Martens, Biol. Centrali-Americana, Moll., 1901, p. 640. Type locality cited.

Vertigo cocoënsis Dall, von Martens, Sitz. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 61. Chatham Bay, Cocos Island.

Nesopupa cocosensis (Dall), Pilsbry, Man. Conch., ser. 2, vol. 25, April, 1920, p. 232, pl. 30, figs. 10, 11. [Former records cited and much information given as to the relationship of this Polynesian group; a new section, *Cocopupa* Pilsbry and Cooke, is made for the species.]

About 40 specimens of this species were found by L. G. Hertlein and J. T. Howell on leaves and mosses a short distance up the creek which drains into Wafer Bay, near the house erected by Gissler. An additional one was taken in a similar situation at Chatham Bay.

Succinea globispira von Martens

Succinea globispira von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1898, no. 9, p. 158. Cocos Island. —— Kobelt, Nach. Deutsch. Malak. Ges., Jahrg. 31, 1899, p. 26. —— von Martens, Biol. Centrali-Americana, Moll., 1901, p. 641, pl. 44, fig. 12. —— Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, p. 99. "Cocos Island, on leaves, Heller and Snodgrass." —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 17. Cocos Island.

? Succinea dalli Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 18. Cocos Island.

Seven specimens of *Succinea globispira* were collected on Cocos Island along the banks of the creek which empties into Wafer Bay. The thin shell, low spire, and very large, sloping body whorl seem to be the chief distinguishing features. Von Martens pointed out that the

species is "Aehnlich *S. crocata* A. Gould von den Samoa-Inseln und *modesta* A. Gould von den Samoa-und Tonga-Inseln, aber etwas schmaler und das Gewinde noch stumpfer, knopfförmig."

One of the specimens of *Succinea* submitted to Dall by Biolley was stated to have " 'a more depressed spire, much lighter color, smaller coil, proportionately wider aperture, and the surface quite regularly, minutely ribbed.' " Biolley listed this form as *Succinea* sp., but stated that if it is found to be new in the future, he would propose the name *Succinea dalli*. In view of the variability of members of this genus, we hesitate to recognize the species on the evidence available.

Opeas gracile (Hutton)

Bulimus gracile Hutton, Jour. Asiatic Soc. Bengal, vol. 3, 1834, pp. 84, 93.

Bulimus junceus Gould, Proc. Boston Soc. Nat. Hist., vol. 2, Dec. 1846, p. 191. "Hab. Society and Sandwich Islands." —— U.S. Explor. Exped., vol. 12, 1852, p. 76, Atlas, Moll. & Shells, 1856, pl. 6, figs. 87, 87a. "Inhabits Tahiti and Eimeo."

Opeas junceum (Gould), von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1898, no. 9, p. 156. Cocos Island. —— Kobelt, Nach. Deutsch. Malak. Ges., Jahrg. 31, 1899, p. 26. —— von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 61. —— Ancey, Journ. de Conchyl., vol. 51, no. 2, 1903, p. 102. Cocos Island. Also Polynesia. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica. 1907, p. 17. Wafer Bay, Cocos Island.

Opeas juncea (Gould), Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, p. 96. Cocos Island.

Opeas gracile (Hutton), Pilsbry, Man. Conch., ser. 2, vol. 18, 1906, pp. 125-132, 188, 198-200, pl. 18, figs. 3-6; pl. 22, fig. 6; pl. 28, figs. 70, 71. "India, type locality." Generally distributed throughout the tropics including America.

Von Martens first listed *O. junceum* (Gould) from Cocos Island and was followed by Dall and Ancey. Pilsbry (1906, p. 131) has shown that the name "was based upon the small Polynesian race of *gracile*." He also reduced many other names to synonomy and showed

that this tropical species has probably the widest geographic range of any land snail. We have two specimens from Cocos Island, one taken by the Hancock Expedition along the creek draining into Wafer Bay and the other by the Expedition of the California Academy of Sciences in 1906 without restricted locality. It must be abundant at favorable places on the Galapagos Islands because the 1906 Expedition obtained a very large series on Charles Island.

According to von Martens (1902, p. 61) this species was found by Biolley only at Wafer Bay near the settlement where it occurred upon palm leaves and banana leaves, and may have been recently introduced on the Island.

Guppya pacifica (Pfeiffer)

Helix pacifica Pfeiffer, Symb. ad Hist. Helic., sect. 3, 1846, p. 66. Cocos Island. —— Pfeiffer in Martini and Chemnitz, Conch.-Cab., Ed. 2, vol. 1, abt. 12, *Helix,* no. 549, pl. 88, figs. 3-5. Cocos Island. —— Pfeiffer, Monogr. Helic. Viv., vol. 1, 1847, p. 52. Cocos Island. —— Reeve, Conch. Icon., vol. 7, *Helix,* 1852, pl. 112, fig. 640. Cocos Island. —— Tryon, Manual Conch., ser. 2, vol. 3, 1887, p. 78, pl. 14, fig. 28. Cocos Island.

Nanina (Nigritella) pacifica (Pfeiffer), Clessin Ed., Nom. Helic. Viv., 1878-1881, p. 80. Cocos Island.

Guppya pacifica (Pfeiffer), Ancey, Journ. de Conchyl., vol. 51, no. 2, 1903, p. 101. Cocos Island. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 14. Cocos Island.

Conulus sp., von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1898, no. 9, p. 156. Cocos-Insel. —— Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, p. 96.

Guppya pacifica var. *conulus* von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 59. Cocos Island.

Guppya hopkinsii Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, April 16, 1900, p. 97, pl. 8, figs. 5 and 6; Pilsbry, p. 105, 4 text figs. "Cocos Island, on leaves, Heller and Snodgrass."

Guppya hopkinsi Dall, von Martens, Biol. Centrali-Americana, Moll., 1901, p. 620. Cocos Island.

Guppya fultoni Gude, Proc. Malacol. Soc. London, vol. 5, no. 4, April, 1903, p. 265, pl. 7, figs. 18, 19, 20. "Cocos Island, Pacific Ocean." —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 14. Cocos Island.

Pfeiffer's description of *pacifica* fits almost exactly the large series of shells which we have available. The same is true of the figure reproduced by Tryon. One of our sets was collected by the 1905-1906 Expedition of the Academy (19 specimens); these passed through Dall's hands and were identified as *Guppya hopkinsi* by him. They may therefore be considered as authentic. In all of the specimens there is a definite tendency toward angulation of the body whorl at the periphery, a feature not shown in Dall's drawings, which may have been made from a senile specimen. Numerous specimens were taken by Hertlein and Howell of the Hancock and Templeton Crocker Expeditions, respectively, on leaves and mosses along the creeks draining into Wafer and Chatham bays.

According to a note by Dall (published by Biolley, 1907, p. 15) he agreed with von Martens that the keeled and smooth forms are not more than varietally distinct. Under the circumstances and in view of insular conditions in general, we do not believe that there are sufficient differences in the series of available *Guppya* from Cocos Island to warrant the recognition of more than one name.

Auricula stagnalis d'Orbigny

Auricula stagnalis d'Orbigny, Mag. de Zool. . . . . 1835, p. 23. —— d'Orbigny, Voy. Amér. Mérid., Moll., vol. 5, 1837, p. 325, pl. 42, figs. 7 and 8. Guayaquil, Ecuador. —— Reeve, Conch. Icon., vol. 20, 1878 (on title page), *Auricula,* sp. 3, pl. 2, fig. 3. *"Hab.* S. America." —— Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 48, 1896, p. 452. Earlier records cited. —— von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg. 1902, no. 3, p. 62. Cocos Island. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 19 (as *Auricula* (?) *stagnalis* Orb.) "En colonies nombreuses contre troncs d'arbres morts à demi submergés dans le lit de l'Arroyo del Genio, à peu de distance de son embouchure dans le Baie de Wafer." ——— Dall and Ochsner, Proc. Calif. Acad. Sci., ser. 4, vol. 17, no. 5, 1928, p. 178. Galapagos Islands, various localities.

Nine living specimens of *Auricula* were collected by Hertlein of the Hancock Expedition from beneath the bark of a fallen palm tree near the creek in Arroyo del Genio, which drains into Wafer Bay. They were found about 50 meters above the outlet of the creek. The water was apparently entirely fresh, at least during the ebb tide. The shells are uniform in size, about one half as long as those from the Galapagos Islands and the spire is much shorter. The series of spiral markings just below the suture is much stronger than in the specimens of *stagnalis* which we have examined. The shape is very similar to the species *pellucens* from Florida and the West Indies and if it were not for the known great variation of *stagnalis* we would not hesitate to identify the Cocos Island shells with the east coast species.

Melampus panamensis (C. B. Adams)

Auricula panamensis C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, July, 1852, pp. 433, 542. "Panama and Taboga. 600 spec." —— Reeve, Conch. Icon., vol. 20, 1878, *Auricula,* sp. 59, pl. 7, fig. 59. "*Hab.* Jamaica."

Melampus panamensis (C. B. Adams), Pfeiffer, Monogr. Auric. Viv., 1856, p. 48. —— Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 52, 1900, p. 97. Cocos Island. —— von Martens, Biol. Centrali-Americana, Moll., 1900, p. 561, pl. 43, figs. 10, 10*a*. Previous records cited. —— Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 436. Cocos Island.

Tralia panamensis (C. B. Adams), Dall, Proc. Acad. Nat. Sci. Philadelphia, vol. 48, 1896, p. 452. Cocos Island.

This species is not represented in our collections from Cocos Island. It is a slender shell with a high, sharply pointed spire, apparently one of the most distinct of this genus on the west coast. The color is dark reddish brown and the spire has a few faint spiral striations. For diagnostic characters, reliance must be placed almost entirely upon Adams' description and von Martens' excellent figure. Its presence on Cocos Island rests upon the authority of Dr. Dall.

Melampus tabogensis (C. B. Adams)

Auricula tabogensis C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, July, 1852, pp. 435, 542. "Taboga and Panama. 800

spec." —— Reeve, Conch. Icon., vol. 20, 1878 (on title page), *Auricula,* sp. 47, pl. 6, fig. 47. "*Hab.* Jamaica."

Melampus tabogensis (C. B. Adams), Pfeiffer, Monogr. Auric. Viv., 1856, p. 47.—— von Martens, Biol. Centrali-Americana, Moll., 1900, p. 560, pl. 43, fig. 8. Panama. —— von Martens, Sitz. Ges. Naturf. Freunde zu Berlin, Jahrg., 1902, no. 6, p. 137. Cocos Island. —— Biolley, Mollusques de L'Isla del Coco. Mus. Nac. de Costa Rica, 1907, p. 24. "Est abondant sur les plages sablonneuses de la Baie de Wafer et à l'embouchure de l'Arroyo del Genio."

The members of the 1905-1906 Expedition (Calif. Acad. Sci.) obtained about 100 specimens of this dark reddish brown species. It is a much heavier and slightly larger species than *trilineatus* and is usually more highly polished. The columella usually bears not more than three teeth, the lowermost of which is very thick and heavy.

Melampus trilineatus (C. B. Adams)

Auricula trilineata C. B. Adams, Ann. Lyc. Nat. Hist. New York, vol. 5, July, 1852, pp. 436, 543. "Panama, 1 spec." —— Carpenter, Rept. British Assoc. Adv. Sci. for 1856 (issued 1857), p. 275.

Melampus trilineatus (C. B. Adams), Pfeiffer, Monog. Auric. Viv., 1856, p. 44. —— von Martens, Biol. Centrali-Americana, Moll., 1900, p. 559, pl. 43, fig. 7. Panama.

The members of the California Academy of Sciences Expedition of 1905-1906 secured a number of specimens of this species estimated at 5,000. All of these are rather smaller than the dimensions which Adams gave for his single specimen but they do not differ greatly from the one figured by von Martens. Naturally very great variation is displayed in so large a series. Light color bands vary from none to as many as five; there are usually four or five teeth on the columella, the lowermost one being the largest. One of the most constant characters in the lot is the presence of a series of spiral threads on the spire above the periphery. These are not present on the dark reddish brown species which we refer herein to *tabogensis,* and do not seem to be present on a spirally banded beach-worn shell from Panama which Mr. A. M. Strong has identified for us as *trilineatus.* A considerable number of the Cocos

Island shells have a series of longitudinal, light-yellowish stripes, similar to those described and illustrated by von Martens on the species which he named *strigosus,*[21] the arrangement of the teeth on the columella, however, differs greatly from that species.

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[21] von Martens, C. E., Biol. Centrali-Americana, Moll., 1900, p. 560, pl. 43, fig. 9. "W. Costa Rica; in a small tributary of the Rio Boto, Golfo Dulce, on dead leaves (Pittier, March 1896)."

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

NEMATODE PARASITES OF THE GALAPAGOS LAND IGUANA

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NEMATODE PARASITES OF THE GALAPAGOS LAND IGUANA*

(With Three Plates)

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The nematode parasites which are the basis of this study were collected by Dr. H. W. Manter from the intestine of the Galapagos land iguana, *Conolophus subcristatus* Gray, during the 1934 Allan Hancock Pacific Expedition. All parasites were from a single host taken on South Seymour Island, Galapagos.

The writer wishes to express his indebtedness to Dr. Manter for the opportunity to study this material and for aid and advice during the work.

The parasites had been fixed in hot 70 per cent alcohol. They were cleared with glycerine and mounted in this fluid for study. The preparation and examination of the *en face* views of the lips were by the method suggested by Chitwood and Wehr (1935).

The nematodes occurred in very large numbers in the intestine of the iguana. Nearly 4,000 specimens were collected and these represented but a small part of the entire infection of a single host.

It was found that five species of nematodes, all of the family *Oxyuridae,* subfamily *Syphaciinae,* were represented in this single collection. All of these 5 species are considered to be new. They can be referred to two genera, one of which is described as new.

Five genera of *Syphaciinae* occur in reptiles. Two of these, *Alaeuris* Thapar, 1925 and *Thaparia* Ortlepp, 1933, are characterized in part by the presence of caudal alae in the males, which is also a characteristic of the species from the Galapagos land iguana. These species further resemble *Thaparia* in the absence of lateral alae, the presence of two uteri and two ovaries, usually four genital papillae, and a single spicule and an accessory piece. However, the short esophagus of three regions,

* Studies from the Zoological Laboratories, University of Nebraska, No. 199.

the position of the vulva near the anus, and the length of the spicule in *Thaparia* seem sufficient to exclude the Galapagos species from this genus.

The genus *Alaeuris* is characterized by Thapar (1925) as follows: "Oxyurids of small or medium size; simple lips; both lateral and caudal alae present, the latter very prominent; vulva behind the middle of the body; ovejector present terminating in a bulb; uteri two; spicule single; accessory piece present; only pre-anal papillae pedunculated, others sessile."

Four of the five species of nematodes from the Galapagos land iguana are apparently of the genus *Alaeuris*. These four species agree with the generic diagnosis as given by Thapar except for one characteristic, namely, the lateral alae do not seem to be present. However, Sandground (1929) has assigned to this genus a species, *A. hirsutus* Sandground, 1929 (from a Central American iguana, *Iguana rhinolopha*), which apparently does not have lateral alae. The type species of *Alaeuris, A. alaeuris* Thapar, 1925, has lateral alae only at the posterior end of the male. The second species, *A. iguanae* Thapar, 1925, apparently possesses lateral alae, but no mention is made of them in the specific diagnosis, and no figures show them.

Until 1933, then, only one of the three species of *Alaeuris* has well-defined lateral alae, one is doubtful, and the third apparently lacks them. A nematode from *Testudo verreauxi* of South Africa was assigned to the genus *Alaeuris* by Ortlepp in 1933. This species, *A. conspicua* Ortlepp, 1933, possesses well-developed lateral alae in both sexes. The species from the Galapagos land iguana are like *A. hirsutus* in respect to the absence of lateral alae. Since this is the only important characteristic in which the Galapagos forms differ from the diagnosis of *Alaeuris,* and it is evident that there are various degrees of development of this characteristic within the known members of the genus, this characteristic does not seem to be of sufficient importance to exclude the four Galapagos species from the genus *Alaeuris*. Consequently, four of the five species of nematodes from the Galapagos land iguana are assigned to the genus *Alaeuris* Thapar, 1925. The fifth species in the collection is considered to represent a new, but rather closely related genus. Its relationship will be pointed out with its description.

Type specimens are deposited in the United States National Museum and in the Allan Hancock Foundation at The University of Southern California.

Alaeuris galapagensis, new species

(Plate 13, figs. 1-7)

This species was the most abundant in the collection. An identification and count of the entire collection revealed 668 males and 2,045 females of this species.

These are medium-sized oxyurids with slender, spindle-shaped bodies. The anterior end is truncated, but the posterior end of the female is extended as a long, straight, pointed tail. The male tail is short and rounded. The females (fig. 1) range from 4.52 mm. to 6.49 mm. in length by 0.39 mm. to 0.48 mm. in width. The length of the male (fig. 2) ranges from 2.75 mm. to 3.80 mm. and the width from 0.20 mm. to 0.30 mm.

The body is covered with a clear, thin cuticula, which has indistinct transverse striations about 0.005 mm. apart. There are no cervical or lateral cuticular alae in either sex. The males have well-developed caudal alae.

The cephalic region is distinct and truncate terminally (fig. 3). The terminal, triangular-shaped mouth (fig. 4) is formed by three simple lips which are distinctly separated from one another by small grooves. The dorsal lip is slightly taller than the ventrolateral lips. There are ten cephalic papillae and two amphids. The papillae are arranged in two circles. In the external circle are four papillae, two of which are situated near the posterior margin of each of the ventrolateral lips. There are no corresponding papillae on the dorsal lip. In the internal circle there are six papillae (fig. 4); two papillae are near the anterior margin of each of the lips. The amphids terminate slightly posterior to the level of the internal circle of papillae. Two uncertain papilla-like structures could usually be seen in the *en face* view of the lips but could not be distinguished in the lateral or dorsal views of the cephalic region.

The lips bound a triangular-shaped mouth. The buccal cavity, about 0.025 mm. in depth, has six toothlike projections extending into it from the esophageal wall. Three of the projections are continuous with the external surface of the esophagus, and three smaller, sharp projections arise from the inner surface of the esophagus. A small projection is found on the median anterior margin of the dorsal lip; no similar structures were observed on the other lips.

The conspicuous nerve ring encircles the anterior end of the esopha-

gus about 0.22 mm. in the male and 0.26 mm. in the female from the anterior end of the body.

The excretory pore is ventral and prebulbar in both sexes. In the male it ranges from 0.96 to 1.45 (average 1.03) mm. and in the female from 1.38 to 1.99 (average 1.63) mm. from the anterior end of the body. The excretory pore is minute; it communicates with an oval-shaped vesicle into which the excretory canals enter. The vesicle is about 0.09 mm. in the male and 0.14 mm. in the female in length. There are four excretory canals which emerge from the lateral line areas in such a manner as to form an "X" with the vesicle at the junction. The posterior canals are wider than the anterior.

The esophagus is of the usual oxyurid type. It is of the same muscular structure throughout its length, except for the anterior cuticularized end which projects into the buccal cavity. There is a slight bulge in the esophagus about 0.05 mm. from its anterior end; from this point the width remains the same, 0.043 mm. in the female and 0.036 mm. in the male, to the slight constriction which marks the junction between the esophagus and the esophageal bulb. The bulb averages 0.165 mm. in the female and 0.125 mm. in the male in diameter. It contains a valvular apparatus, consisting in part of three cuticularized blade-like structures. The length of the esophagus, bulb included, ranges from 1.66 to 2.08 (average 1.84) mm. in the female and from 1.02 to 1.70 (average 1.43) mm. in the male. Thus it is nearly one half the body length of the male and one third the body length of the female.

Anteriorly the intestine is enlarged to a diameter greater than that of the esophageal bulb. The diameter of the flask-shaped enlargement is about 0.254 mm. in the female and 0.153 mm. in the male. From this maximum size the diameter of the intestine gradually decreases to approximately 0.10 mm. in the female, slightly less in the male, which is the size maintained throughout the remainder of its length.

Male: The male reproductive system is composed of a single, coiled testis which has a diameter of about 0.036 mm. The testis extends anteriorly to about the level of the intestinal bulb. An expanded region of the testis connects with the seminal vesicle through an attenuated neck-like portion. The seminal vesicle is about 0.40 mm. in length and has a maximum diameter of 0.095 mm.

The accessory reproductive structures (figs. 5 and 6) consist of the spicule, accessory piece, and the genital papillae. There is a single spicule, which ranges from 0.415 to 0.589 (average 0.496) mm. in length. The

proximal end of the spicule is slightly expanded at the point of attachment of the spicular muscles. The spicule width at this point is about 0.042 mm.; from this region the spicule gradually tapers to end in a fine sharp point. The accessory piece is well developed, V-shaped, and has a maximum width of 0.046 mm. and a length of about 0.076 mm. Posteriorly it tapers to a bluntly rounded, ventrally directed, hooked tip.

There are four pairs of genital papillae located at the ventral body cleft (fig. 6). Three pairs are circumcloacal and one pair is caudal in position. Two of the pairs of circumcloacal papillae are precloacal in position. The most anterior and ventral pair of this group is well developed and situated on projections from the body. These papillae, as well as the second pair of precloacal papillae, are considered to be sessile. The second pair of precloacal papillae can not be seen in the ventral view of the caudal region because they are small and dorsal to the large precloacal pair. The third pair of circumcloacal papillae is pedunculated and is adcloacal in position. These papillae are situated on stalks which extend nearly to the posterior extremity of the accessory piece. The fourth or caudal pair of papillae arises from the caudal stalk at about the junction of its fourth and last fifths. These papillae are well developed and pedunculated. Summarizing, there are two pairs of precloacal sessile papillae, one pair of adcloacal pedunculated papillae, and one pair of pedunculated caudal papillae.

The caudal alae are wide and deep, and extend from the base of the tail to the base of the caudal papillae. The deepest point of the ala is at about its mid-region, where it extends ventrally to the level of the ventral precloacal papillae. The alae extend laterally to about the body width at the anterior end of the tail, but taper slightly at their posterior limits.

Female: The vulva is situated posterior to the middle of the body; it ranges from 2.6 to 3.4 (average 2.9) mm. from the anterior end. In the mature animals the vulva is surrounded anteriorly by a prominent cuticular expansion. The vagina is a well-developed muscular organ, which meets the body wall at an oblique angle. A common uterine stem connects the divergent uteri to the ovejector and vagina. The vagina varies in length from 0.49 to 0.56 mm., and its width is about 0.08 mm. Between the vagina and the common stem of the uteri there is a less muscular structure, the ovejector. This structure is about 0.20 mm. in length by 0.07 mm. in width. At both ends it is equipped with valvular, bulblike structures.

The uteri are divergent. The ovaries are large and club-shaped in the adult. Their average diameter is 0.070 mm.

The eggs are segmented *in utero* and the uteri may contain many or few eggs, depending upon the degree of maturity. The eggs (fig. 7) are large, with thin clear shells, ellipsoidal, and with an asymmetrically flattened surface on one side. The eggs range from 0.182 to 0.210 mm. in length by 0.077 to 0.098 mm. in width. The average size is 0.192 mm. by 0.089 mm.

SPECIFIC DIAGNOSIS OF ALAEURIS GALAPAGENSIS

Principal characters of genus. Oxyurids of medium size; males from 2.75 to 3.80 mm. by 0.20 to 0.30 mm.; females from 4.52 to 6.49 mm. by 0.39 to 0.47 mm. Thin cuticula, striations 0.005 mm. apart. No cervical or lateral alae; caudal alae in male. Cephalic region distinct and truncate; mouth surrounded by three simple lips. Ten cephalic papillae and two amphids present; papillae in two circles; ventrolateral lips each with four papillae and an amphid; dorsal lip with two papillae, and a median anterior toothlike projection. Buccal cavity present containing six toothlike projections from anterior end of esophagus. Nerve ring about 0.22 mm. in male and 0.26 mm. in female from anterior end. Excretory pore prebulbar, about 1.03 mm. in male and 1.69 mm. in female from anterior end. Esophagus long and slender, about one half body length in male and one third body length in female. Intestine rectilinear, enlarged anteriorly into a bulb.

Male: Bluntly rounded tail, 0.11 mm. long; wide caudal alae from base to distal fourth of tail. Spicule from 0.415 to 0.589 mm. in length, sharply pointed. Accessory piece well developed, 0.046 mm. by 0.076 mm. Four pairs of genital papillae; three pairs circumcloacal, of which two pairs are sessile, one pair pedunculated; one pair pedunculated caudal papillae at point alae join tail.

Female: Straight pointed tail 0.57 mm. long. Vulva posterior to mid-body, 2.97 mm. from anterior end. Vagina very muscular, ovejector less muscular, connected to divergent uteri by a common uterine stem. Short oviducts connect large club-shaped ovaries to uteri. Eggs large, ellipsoidal, flattened on one side; measure 0.192 mm. by 0.089 mm.; segmented *in utero*.

This species is named for its geographic location, the Galapagos Islands.

Affinities: This species conforms to Thapar's diagnosis of the genus *Alaeuris* except that no lateral alae are present, and there is a difference in the character and disposition of the genital papillae.

This species may be distinguished from *A. alaeuris* on the basis of the prebulbar excretory pore, the number of cephalic papillae, the pedunculated adcloacal papillae, and the difference in the length of the spicule and accessory piece.

The characters which distinguish this species from *A. iguanae* are: its larger size, the distinct cephalic region, the distinct lips, the presence of a common uterine stem, unstriated caudal alae, the character of the genital papillae, and the longer spicule and accessory piece.

This species may be distinguished from *A. hirsutus* by its smaller size, longer relative length of esophagus, shorter spicule, longer accessory piece, difference in number of cephalic papillae, the character of the genital papillae, and the male tail which extends posterior to the border of the caudal alae.

The following characters distinguish this species from *A. conspicua:* the absence of lateral alae, the size and shape of the spicule, the prebulbar position of the excretory pore, the absence of a spike on the male tail, and the character and number of genital papillae.

Alaeuris longispicula, new species

(Plates 13 & 14, figs. 8-14)

This species was less numerous in the collection than *A. galapagensis*. Approximately 8 per cent of the specimens from the heavily infected host are of this species.

These are medium-sized oxyurids with relatively slender bodies. The length of the male (fig. 12) is from 3.01 to 4.27 (average 3.58) mm., and the greatest body width is from 0.25 to 0.32 mm. The body gradually tapers from about mid-body to the extremities. The females (fig. 8) range in length from 5.28 to 7.77 (average 6.16) mm. and in maximum body width from 0.44 to 0.56 mm.

The cuticula is thin and has striations about 0.010 mm. apart. There are no lateral or cervical cuticular alae. Caudal alae are present in the male.

The cephalic region is distinct (fig. 10) and terminates anteriorly in the rounded lips. The three lips are separated from one another by distinct grooves. The lips bound a Y-shaped mouth (fig. 11) which

communicates with the shallow buccal cavity. The anterior end of the esophagus is rounded and extends into the buccal cavity. There are two papillae near the anterolateral margin of each of the lips. Each of the ventrolateral lips has two additional papillae situated near the median anterior margin; these papillae could be seen distinctly in the lateral view but were not apparent in the *en face* view. There is thus a total of 10 papillae on the lips. The well-developed amphids terminate near the median anterior margins of the ventrolateral lips.

The excretory pore is ventral and prebulbar in both sexes, being 1.48 mm. in the male and 1.73 mm. in the female from the anterior end. The pore communicates with an excretory vesicle which connects with the excretory canals. The canals form an "X" where they lead to the vesicle. The nerve ring is 0.258 mm. in the male and 0.263 mm. in the female from the anterior end. The position of the nerve ring seems to be quite constant, varying little in the specimens of different sizes. The esophagus varies in length from 1.43 to 1.69 (average 1.55) mm. in the male and from 2.01 to 2.13 (average 2.08) mm. in the female. Its posterior end terminates in the subspherical bulb, which is equipped with cuticularized valvular structures. There is a constriction, the isthmus, between the bulb and the anterior portion, or the corpus of the esophagus. The rectilinear intestine is enlarged into a bulblike region at its anterior end.

Male: The body of the male ends in a ventrally directed, bluntly rounded tail, which varies in length from 0.11 to 0.20 mm. Laterally the tail is provided with wide caudal alae (fig. 14), extending from the base of the tail to the base of the caudal papillae.

There are two pairs of precloacal genital papillae (figs. 13 and 14), one pair of adcloacal papillae, and one pair of caudal papillae located at the posterior end of the alae. The precloacal pairs seem to arise from the same base on each side, and thus are interpreted as double papillae. Each has a separate nerve ending and the nerve fibers could be seen to branch from a common stem to each of the papillae. These papillae are considered sessile. Adjacent to these papillae are two fingerlike projections, the cloacal lips. The adcloacal papillae are situated on long slender stalks which arise from the body anterior to the cloacal aperture. These two papillae are well developed and are between the cloacal lips and accessory piece. The pedunculated caudal papillae are situated at the anterior of the distal quarter of the tail. Thus there are four pairs of genital papillae, two of which are sessile and two are pedunculated.

There is a single spicule (fig. 12). The length varies from 1.36 to 1.58 (average 1.47) mm., about two fifths of the body length. The proximal end of the spicule is dilated to form a head where the muscles are attached. The distal end of the spicule is sharply pointed. A short distance from the distal end the spicule is enlarged laterally and at this point possesses a curve which is ventrally directed.

There is a well-developed, V-shaped accessory piece (fig. 14), which measures 0.084 mm. in width by 0.080 mm. in length. The distal point of the accessory piece is directed ventrally, forming a conspicuous hooked tip. At the base of the accessory piece on each side there is a tubular cavity which seems to open to the outside at the base of the tail. The significance of this structure was not determined.

Female: The vulva is situated on the ventral surface 0.35 mm. posterior to the middle of the body. It varies from 2.83 to 3.96 (average 3.40) mm. from the anterior end. In the fully mature specimens there is a cuticular flap around the anterior margin of the vulva. Surrounding the distal end of the vagina and near the body wall, large gland cells can be distinguished in the immature specimens, but they are not apparent in the fully mature individuals. It seems probable that these gland cells are concerned with the development of the flap around the vulva. The vulva communicates with the muscular vagina which is directed anteriorly and then curves posteriorly where it is continued as a less muscular region, the ovejector. Following this region is the egg reservoir or common uterine stem. In the mature specimens the lengths of the parts of the genitalia average as follows: the vagina 0.90 mm., the ovejector 0.90 mm., and the common uterine stem 0.96 mm. The uteri are divergent, thin-walled tubes continuous with the ovaries. The ovaries are about 0.08 mm. in diameter near their mid-regions. The number of eggs in the uteri is variable; some specimens have nearly the whole body filled with them, while others have very few eggs. The eggs (fig. 9) are large and possess a relatively thin shell. The eggs vary from 0.077 to 0.098 mm. in width by 0.175 to 0.196 mm. in length, with an average size of 0.086 by 0.185 mm. The eggs are segmented *in utero*.

SPECIFIC DIAGNOSIS OF ALAEURIS LONGISPICULA

Principal characters of genus. Mature females 5.28 to 7.77 mm. by 0.47 mm.; males 3.01 to 4.27 mm. by 0.28 mm. Cephalic region distinct; three conspicuous lips; lateroventral lips each with four papillae and an amphid; dorsal lip with two papillae. Lateral cuticular alae ab-

sent; caudal alae in male. Nerve ring about 0.26 mm. from anterior end. Excretory pore ventral and prebulbar, 1.48 mm. in male and 1.73 mm. in female from anterior end. Esophagus typical and about one-third body length in female and about three-sevenths body length in male.

Male: Tail 0.14 mm. long. Spicule 1.36 to 1.58 mm. long. Accessory piece well developed, V-shaped, 0.084 by 0.080 mm. Four pairs genital papillae. Two precloacal pairs sessile, adcloacal pair on long stalks, and caudal pair stout and pedunculated. Ventral cloacal lips prominent. Caudal alae wide but only slightly extended ventrally; posteriorly extend from body to caudal papillae.

Female: Vulva slightly posterior to middle of body. Prominent anterior vulvar flap. Uteri divergent; connected to ovejector by a common uterine stem. Eggs ellipsoidal, asymmetrically flattened, 0.086 by 0.185 mm. Tail long and pointed, measuring 0.76 mm.

The species name refers to the long spicule.

Affinities: *A. longispicula* may be distinguished from *A. alaeuris* on the basis of the prebulbar position of the excretory pore, the greater number of cephalic papillae, the character of the precloacal papillae, the well-developed, pedunculated caudal papillae, the much longer spicule, and the larger accessory piece.

A. longispicula may be distinguished from *A. iguanae* on the basis of its larger size, the prebulbar position of the excretory pore, the distinct cephalic region, the presence of the common uterine stem, the unstriated alae, the precloacal sessile papillae, and the longer spicule and accessory piece.

The characteristics which distinguish this species from *A. hirsutus* are its smaller size, the relatively greater length of the esophagus, the larger number of cephalic papillae, the character of the genital papillae, the fact that the caudal alae extend to the anterior of the distal fourth of the tail, and the slightly longer spicule.

A. longispicula may be differentiated from *A. conspicua* on the basis of the absence of lateral alae, the prebulbar position of the excretory pore, the greater length and different shape of the spicule, the absence of the spike on the male tail, and the character and number of genital papillae.

The characteristics which distinguish *A. longispicula* from *A. galapagensis* are the following: the stouter and longer body, the relatively more posterior vulva, the more distinctly separated lips, and bluntly

rounded rather than truncate cephalic region, the absence of cuticularized structures on the anterior end of the esophagus, the differences in the genital papillae, and the longer spicule.

Alaeuris labicula, new species

(Plate 14, figs. 15-21)

This species of *Alaeuris* composed about 10 per cent of the entire collection.

These are medium-sized oxyurids. The length of the male (fig. 15) varies from 3.11 to 3.45 mm., with an average of 3.28 mm. The maximum body width is from 0.19 to 0.26 (average 0.24) mm. The size of the mature female (fig. 16) ranges from 5.51 to 6.08 (average 5.34) mm. in length by 0.44 to 0.53 (average 0.47) mm. in width.

The cuticula is thick and has distinct transverse striations about 0.005 mm. apart. There are no lateral or cervical alae, although the male has wide caudal alae.

The anterior end of this species is bluntly rounded, and the cephalic region (fig. 17) is indistinct. The lips are inconspicuous. The mouth is terminal and triangular in shape; it is surrounded by three lips which are best seen *en face* view. In some specimens examined a slight indentation about mid-way between the corners of the mouth could be seen on the anterior margin of each lip. It was considered at first that this perhaps indicated a slightly bilobed condition of the lips, but when other specimens were examined the same condition was not found. There is apparently a slight variation in the lip margins but the lips are never distinctly bilobed.

There are eight cephalic papillae and two amphids. The amphids are conspicuous. They terminate near the posterior margins of the ventrolateral lips. The papillae are arranged in two circles, each containing four papillae. The papillae in the outer circle are larger than those of the inner circle. Two of the outer circle papillae are arranged on the dorsal lip, opposite the dorsal corners of the mouth. The other two external circle papillae are on the ventrolateral lips, and are located lateral to the ventral corner of the mouth. The internal circle papillae are situated on the ventrolateral lips. The papillae are arranged in an unusual manner, as they seem to show bilateral symmetry, rather than radial symmetry, as might be expected from the radial arrangement of the lips.

There is a shallow buccal cavity which is followed by the esophagus. The anterior end of the esophagus is cuticularized, and the inner margins of the esophageal walls are extended anteriorly and outward to form a buccal cavity rim. In an optical section of the lateral surface of the cephalic region, the buccal cavity rim may be seen as a toothlike projection arising from the wall of the esophagus.

The nerve ring encircles the anterior end of the esophagus from 0.175 to 0.210 (average 0.186) mm. in the male and from 0.196 to 0.224 (average 0.200) mm. in the female from the anterior end of the body. The excretory pore is slightly prebulbar in both sexes. The distance the pore is located from the anterior end of the body varies from 1.08 to 1.51 mm. in the male and from 1.28 to 1.70 mm. in the female. The excretory pore and canals are similar to those described for the other species of *Alaeuris*. The esophagus is elongated, slender and muscular throughout its length. It terminates posteriorly in a subspherical bulb. The entire esophagus varies in length from 1.12 to 1.37 (average 1.26) mm. The ratio of esophagus to body length is about two fifths in the male and one fourth in the female. The anterior part of the esophagus which is in contact with the buccal cavity is bluntly rounded and heavily cuticularized. Posteriorly the esophagus connects with the enlarged bulblike region of the intestine.

Male: The reproductive organs are similar to those described for the other species of *Alaeuris*. There are three pairs of genital papillae (figs. 19 and 20). Two of the pairs are circumcloacal and the third is caudal in position. The precloacal papillae are sessile, but situated on prominent body eminences. Dorsal and slightly lateral to these papillae are two stalks which project posteriorly beyond the limits of the papillae. These structures are the cloacal lips which are similar in appearance to the papillae-bearing stalks, but a careful examination of all of the specimens studied was made and no papillae were distinguished. The second pair of circumcloacal papillae is located on long peduncles which arise from the posterior body wall. They are lateral to the accessory piece. The third pair of papillae is situated on relatively stout peduncles which arise from the tail.

The caudal alae (fig. 20) are smooth. They extend laterally almost the body width, but ventrally only a short distance, almost to the dorsal side of the accessory piece.

There is a single sharply pointed spicule (fig. 15). The length varies from 0.689 to 0.792 mm., with an average of 0.739 mm. Near the

anterior of the distal quarter the spicule is dorsoventrally thickened. There is a well-developed, V-shaped accessory piece, measuring 0.052 mm. in width by 0.075 mm. in length. The tip of the accessory piece is directed posteriorly and laterally, usually to the right. In no instance was the tip ventrally directed or hooked.

Female: The reproductive system is typical. The vulva is slightly anterior to the middle of the body. The average distance from the anterior of the body to the vulva is 2.96 mm., which is about 0.01 mm. less than half the body length. The anterior margin of the vulva is surrounded by a cuticular expansion. The vagina is large and muscular, being 0.80 mm. in length by 0.09 mm. in width. The internal end of the vagina is swollen into a bulb-shaped enlargement; connected with this structure is a less muscular region, the ovejector, about 0.56 mm. in length. The uteri are joined to this by a common stem which has an average length of 0.41 mm. and a width of 0.05 mm.

The eggs (fig. 21) are segmented *in utero*. The eggs are large, thin-shelled, asymmetrically flattened, and have an average size of 0.087 by 0.192 mm.

SPECIFIC DIAGNOSIS OF ALAEURIS LABICULA

Principal characters of genus. Medium-sized oxyurids, the males ranging from 3.11 to 3.46 mm. by 0.19 to 0.26 mm. and the females from 5.57 to 6.80 mm. by 0.44 to 0.53 mm. Posterior extremity of female has a pointed tail about 0.72 mm. long; male with a short bluntly rounded tail about 0.12 mm. long. No lateral or cervical alae; wide caudal alae in male. Cephalic region indistinct; three inconspicuous lips. Mouth triangular. Eight cephalic papillae and two amphids. Papillae arranged lateral to mouth, exhibiting bilateral symmetry, rather than radial. Nerve ring encircles esophagus 0.18 mm. in male and 0.20 mm. in female from anterior end. Excretory pore slightly prebulbar in both sexes, varying from 1.08 to 1.31 mm. in the male and from 1.28 to 1.70 mm. in the female from anterior extremity. Esophagus ranges from 1.12 to 1.37 mm. in the male and from 1.34 to 1.42 mm. in the female in length.

Male: Three pairs genital papillae; precloacal papillae sessile and on body eminences; adcloacal papillae on long peduncles; caudal papillae on short, stout peduncles, anterior to tip of tail. Cloacal lips conspicuous, resemble papillae-bearing stalks. Caudal alae wide. Spicule sharply pointed, about 0.73 mm. long. Accessory piece well developed,

V-shaped, 0.052 mm. wide by 0.075 mm. long; its tip is directed laterally, never ventrally.

Female: Vulva slightly anterior mid-body. Muscular vagina and ovejector; divergent uteri connected to ovejector by a common uterine stem. Eggs thin-shelled, asymmetrically flattened; average size 0.087 by 0.192 mm.; segmented *in utero*.

The species name refers to the small lips.

Affinities: The structures which distinguish this species from *A. alaeuris* are: the prebulbar position of the excretory pore, the longer (0.030 mm.) eggs, the much longer spicule, an accessory piece nearly twice as long, the indistinct cephalic region, the inconspicuous lips, two pairs of circumcloacal papillae instead of three, and the character of the cloacal lips.

It may be distinguished from *A. iguanae* on the basis of its larger size, the prebulbar excretory pore, the absence of tooth-like processes along the inner edge of the lips, the presence of the common uterine stem, the character of the circumcloacal papillae, the longer spicule, and the longer accessory piece.

The characters which differentiate this species from *A. hirsutus* are its smaller size, the indistinct cephalic region, the inconspicuous lips, the greater number of cephalic papillae, the extension of the tail posterior to the caudal alae, the character and disposition of the circumcloacal papillae, the shorter spicule, and the longer accessory piece.

This species may be distinguished from *A. conspicua* by the absence of lateral alae, the inconspicuous lips, the greater number of cephalic papillae, the structure of the esophagus, the prebulbar position of the excretory pore, the more anteriorly situated vulva, the absence of the spike on the male tail, and the shorter spicule.

The characters which distinguish this species from *A. galapagensis* are the following: the indistinct cephalic region, the inconspicuous lips, the number of cephalic papillae, the absence of cuticularized projections on the anterior end of the esophagus, the more anterior position of the vulva, the differences in the genital papillae, the greater length of the spicule, and the laterally directed tip of the accessory piece.

This species may be distinguished from *A. longispicula* on the basis of the indistinct cephalic region, the inconspicuous lips, the number and position of the cephalic papillae, the much shorter spicule, the shape and direction of the tip of the accessory piece, the number of genital papillae, and the differences in the cloacal lips.

Alaeuris conolophi, new species

(Plate 15, figs. 22-27)

The following description is based upon a study of the least numerous animals in the collection. There were 40 males and 90 females of this species, approximately 3 per cent of the entire collection. The females that are assigned to this species are all immature, but they possess certain resemblances to the males, especially in the structure of the lips and the anterior end of the esophagus. There is a slight difference in the relative position of the excretory pore, which is postbulbar, but this difference may be due to the immaturity of the specimens.

The animals are slender and spindle-shaped. From the mid-body region the body gradually tapers anteriorly to the rounded cephalic region and posteriorly to the short, blunt tail of the male, or to the slender, long pointed tail of the female. The length of the male (fig. 22) ranges from 3.10 to 3.91 (average 3.42) mm. The females (fig. 23) range from 2.81 to 3.26 (average 2.98) mm. in length by 0.18 to 0.24 (average 0.21) mm. in maximum width.

There is a thin, clear cuticula which has striations about 0.008 mm. apart. The females have no cervical or lateral alae, but the males possess a thickened cuticula in the lateral line region of the posterior extremity of the body. This region extends anteriorly from the cloacal region for about 0.144 mm. and at this point the cuticula becomes the same thickness as that which covers the rest of the body. Whether or not these thickened regions of the cuticula are evidences of lateral alae would be a matter of individual interpretation. It is interesting to note, however, that this is the only indication of possible lateral alae encountered in this study of four species of *Alaeuris*.

The cephalic region (fig. 24) is evident in the female, but slightly less evident in the male. The lips are slightly lobed. The mouth is terminal and is surrounded by three simple lips. The cephalic papillae (fig. 25) are located on the anterior margins of the lips. There are six cephalic papillae and two amphids. Each of the lips has two papillae near the median anterior margin; amphids are present on the ventrolateral lips. The number and arrangement of the papillae are the same in the male and the immature female.

There is a very shallow buccal cavity. The anterior end of the esophagus is bluntly rounded and cuticularized. No projections arise from the esophageal wall. The nerve ring encircles the anterior end

of the esophagus 0.189 to 0.210 mm. in the male and 0.175 to 0.182 mm. in the female from the anterior end of the body. The excretory pore is ventral. In the male the pore is located from 1.01 to 1.19 mm. from the anterior end, and in the female it is located 0.86 to 0.99 mm. from the anterior end. The esophagus is of the same muscular structure throughout its length, except the anterior end which is cuticularized for a short distance. The posterior end of the esophagus has a subspherical bulb which averages 0.140 mm. in diameter in the males and 0.082 mm. in the females. The esophageal bulb is equipped with valvular structures. The length of the esophagus, including the bulb, is from 1.21 to 1.35 mm. in the male and 0.70 to 0.79 in the female; the width of the anterior portion of the esophagus is about 0.035 mm. The esophagus in the male is about one third the body length, and one fourth the body length in the female.

The anterior end of the intestine is enlarged into a flask-shaped region 0.187 mm. in the male and 0.129 mm. in the female in diameter. The diameter of the intestine gradually diminishes from this point to the mid-region where it continues uniformly to the posterior.

Male: The posterior end of the body has a ventrally directed, bluntly rounded tail, varying from 0.096 to 0.115 mm. in length. The tail has wide alae which extend from the ventral body cleft to the anterior of the distal fourth of the tail. The seminal vesicle has a length of about 0.5 mm. and a width of about 0.15 mm. The acicular spicule varies in length from 0.384 to 0.480 (average 0.437) mm. The accessory piece is 0.048 mm. wide by 0.056 mm. long. It is straight and widely V-shaped.

Three pairs of genital papillae (figs. 26 and 27) are situated around the cloaca at the ventral body cleft and on the ventral side of the tail. One pair is precloacal and sessile, although situated on prominent projections from the body. The adcloacal papillae are on long peduncles. The third pair of papillae is located at the anterior of the distal fourth of the tail. These papillae are situated on prominent, stout peduncles.

Female: The tail averages 0.49 mm. in length and is finely pointed. The vulva ranges from 1.40 to 1.59 (average 1.44) mm. from the anterior end. None of the reproductive organs are fully developed.

SPECIFIC DIAGNOSIS OF ALAEURIS CONOLOPHI

Principal characters of genus. Medium-sized oxyurids; mature males average 3.42 mm. in length by 0.23 mm. in width; immature females

average 2.98 mm. in length by 0.21 mm. in width. No lateral alae in female; thickened cuticular regions along posterior end of male may indicate lateral alae; wide caudal alae in male. Cephalic region evident; three simple lips each with two papillae; ventrolateral lips each with an amphid. Esophagus typical, about one third body length in mature male, and about one fourth body length in immature female. Excretory pore slightly prebulbar in male, and slightly postbulbar in immature female.

Male: Single acicular spicule, 0.437 mm. long. Straight accessory piece 0.048 mm. wide by 0.056 mm. long. Three pairs genital papillae. One precloacal pair of sessile papillae; one pair of adcloacal pedunculated papillae; one pair of stout, pedunculated caudal papillae. Caudal alae wide, extend posteriorly to caudal papillae.

Female: Immature specimens only available. Vulva slightly posterior to mid-body. Tail 0.49 mm. in length.

This species is named after the genus of its host, *Conolophus.*

Affinities: This species may be distinguished from *A. alaeuris* by the absence of conspicuous lateral alae in the male, the relatively longer female tail, the character and disposition of the genital papillae, and the length of the spicule.

It differs from *A. iguanae* in the absence of toothlike processes on the inner edges of the lips, the relative length of the female tail, the unstriated caudal alae, the number and disposition of the genital papillae, and the length of the spicule.

Its differences from *A. hirsutus* are the size, the character and number of the genital papillae, the extent of the male tail beyond the caudal alae, and the much shorter spicule.

The distinguishing differences between this species and *A. conspicua* are the absence of conspicuous lateral alae, the absence of the spike on the male tail, the number and position of the genital papillae, and the length of the spicule.

It differs from *A. galapagensis* in the number of cephalic papillae, the absence of toothlike processes arising from the anterior end of the esophagus, the character of the genital papillae, the shape of the tail of the male and the shape of the caudal alae, the slight difference in the size of the spicule, and the size and shape of the accessory piece.

This species may be distinguished from *A. longispicula* on the basis of the form of the lips and the number of cephalic papillae, the length and shape of the tail of the male, the great difference in the length of

the spicule, the size and shape of the accessory piece, the fewer genital papillae, and the shape of the caudal alae.

The following characters distinguish this species from *A. labicula:* the number of cephalic papillae, the shape of the mouth, the more distinct lips, the nature of the genital papillae, the absence of distinct cloacal lips, the size of the spicule, the size and shape of the caudal alae, and the size and form of the male tail.

Paralaeuris dorochila, new genus, new species

(Plate 15, figs. 28-33)

The following description is based on the study of the smallest worms in the collection. About 8 per cent of the collection consisted of animals of this species.

The body is spindle-shaped, tapering from about mid-body region to the bluntly rounded cephalic region, and posteriorly more abruptly to the long, finely pointed tail. The length of the male (fig. 28) varies from 1.12 to 1.81 (average 1.41) mm. and the width varies from 0.084 to 0.147 (average 0.110) mm. The length of the female (fig. 29) varies from 2.17 to 3.80 (average 2.79) mm. and the width varies from 0.161 to 0.245 (average 0.188) mm.

The body is covered with a clear cuticula which has distinct striations about 0.008 mm. apart. There are no lateral or cervical alae in either sex. The male has well-developed caudal alae.

The cephalic region (fig. 30) is indistinct. The diameter of the cephalic region at the base of the lips is about 0.030 mm. There are three simple lips which are bluntly rounded and slightly separated from each other, and difficult to distinguish. The shape of the mouth and the relation of the lips to the mouth were not determined as no satisfactory *en face* views of the lips were secured.

There are six cephalic papillae; two papillae are situated near the anterior margin of each of the lips. Amphids were not observed. Each of the ventrolateral lips has a small, sharply pointed, cuticularized anteriorly projecting structure which arises from the inner margin of the lip.

The esophagus is of the typical oxyurid structure. It is muscular throughout its length and is terminated posteriorly by a subspherical bulb. The anterior end of the esophagus is bluntly rounded and slightly larger than the mid-region. There is no constriction or isthmus between

the bulb and the corpus of the esophagus. The bulb possesses the usual valvular structures. The length of the esophagus including the bulb varies from 0.252 to 0.371 (average 0.315) mm. in the male, by 0.011 to 0.019 mm. in width; the esophagus length in the female varies from 0.280 to 0.601 (average 0.375) mm. by 0.017 to 0.024 mm. in width. The anterior end of the intestine is slightly enlarged where it joins the esophageal bulb. The diameter of this region is about 0.044 mm. in the male and 0.065 mm. in the female.

The excretory pore is ventral and postbulbar, averaging 0.408 mm. in the male and 0.522 mm. in the female from the anterior end. The excretory pore is situated near the center of the excretory vesicle, which is oval in shape and 0.034 mm. in length. The excretory canals may be traced from the lateral line areas to the vesicle. The nerve ring encircles the esophagus at a point 0.106 mm. in the male and 0.116 mm. in the female from the anterior end.

Male: The tail is 0.202 mm. long, about one seventh of the body length. The male reproductive organs consist of a single testis, the anterior end of which is coiled on itself at the anterior of the intestine, and a slightly enlarged seminal vesicle which communicates with the cloaca. There is a single sharply pointed spicule (fig. 32) varying from 0.056 to 0.075 (average 0.065) mm. in length. A V-shaped accessory piece is present, which measures 0.018 mm. in length.

There are four pairs of genital papillae (figs. 32 and 33). Three pairs of the papillae are precloacal and pedunculated; two pairs of these seem to arise from common stalks, forming a double papilla on each side. The other pair of precloacal papillae arises from independent, elongated peduncles which are lateral and dorsal to the double papillae. The fourth pair of papillae is caudal in position, arising 0.040 mm. posterior to the cloacal aperture, and their long stalks support the caudal alae. The caudal alae are wide and well developed. Anteriorly the alae arise from the cloacal region and extend posterior to the caudal papillae. There are cuticular bands in the cloacal region, both ventrally and dorsally, extending from one side of the body to the other.

Female: The tail is relatively long, measuring 0.723 mm., about one fourth of the entire body length. The vulva is anterior to the middle of the body, varying from 0.805 to 1.701 (average 1.160) mm. from the anterior end. The vagina, about 0.372 mm. long, connects with the vulva obliquely; it is directed anteriorly and then curves posteriorly to connect with the ovejector which terminates in a bulb. The ovejector

is about 0.35 mm. in length, and joins the divergent uteri. The thin-shelled, asymmetrically flattened eggs are segmented *in utero*. The eggs vary in size from 0.038 to 0.049 mm. wide by 0.075 to 0.105 mm. long, with an average size of 0.042 by 0.092 mm.

GENERIC DIAGNOSIS OF PARALAEURIS

Small slender oxyurids; tail long in both sexes, about one seventh body length in male and about one fourth body length in female. Male tail with wide caudal alae. No lateral alae in either sex. Cephalic region indistinct; three simple lips, each with two papillae; ventrolateral lips each with a small anteriorly directed cuticular process. Esophagus relatively short, muscular throughout its length. Excretory pore postbulbar. Vulva slightly anterior to mid-body; ovejector present; two uteri and two ovaries present. Eggs small, elongated. Male with single, short, stout, and sharply pointed spicule. V-shaped accessory piece present. Four pairs pedunculated papillae, three of which are precloacal, and the fourth pair support wide caudal alae.

Type species: *Paralaeuris dorochila* from the intestine of *Conolophus subcristatus* Gray.

Affinities: The presence of a single spicule and an accessory piece places this genus in the subfamily *Syphaciinae* Railliet, 1916. There are five genera in this subfamily all of which are parasites of reptiles. Only two of the genera, *Alaeuris* Thapar, 1925 and *Thaparia* Ortlepp, 1933 have caudal alae in the males. This genus resembles *Alaeuris* and *Thaparia* in the presence of caudal alae. However, the smaller size, the relative length of the esophagus to the body, the shape and length of the spicule, the position of the vulva, the position of the excretory pore, the relative length of the tail, the character of the genital papillae, and the structure of the caudal alae are characters in which this genus differs from *Alaeuris* and *Thaparia*.

This genus has a superficial resemblance to *Pharyngodon* Diesing, 1861 of the subfamily *Oxyurinae* Hall, 1916. It differs from it in the presence of the accessory piece, the absence of lateral alae, the relative position of the vulva to the excretory pore, and the presence of an ovejector.

The closest resemblance between this genus and the known genera of reptilian oxyurids is with the genus *Alaeuris* Thapar, 1925. Thus the name *Paralaeuris* is proposed for this genus.

SPECIFIC DIAGNOSIS OF PARALAEURIS DOROCHILA

Characters of the genus. Males from 1.11 to 1.80 mm. in length by 0.08 to 0.14 mm. in width; females from 2.17 to 3.80 mm. in length by 0.16 to 0.24 mm. in width. Thick cuticula, striations about 0.008 mm. apart. No cervical or lateral alae; caudal alae in male. Cephalic region indistinct; three simple lips, slightly lobed; each lip with two papillae; each ventrolateral lip with a short, anteriorly directed, pointed process. Esophagus 0.31 mm. long, about one fourth body length, in male and 0.37 mm., about one seventh body length, in female. Nerve ring 0.108 mm. in the male and 0.116 mm. in female from anterior end. Excretory pore postbulbar, 0.40 mm. in male and 0.52 mm. in female from anterior end.

Male: Alate tail 0.20 mm. long, about one seventh body length. Single short, pointed spicule, 0.065 mm. in length. V-shaped accessory piece 0.018 mm. long. Four pairs of pedunculated genital papillae. Three pairs precloacal, one pair caudal in position. Two pairs arise from common stalks, forming double papillae; third pair on long peduncles, lateral and dorsal to double papillae; fourth pair on long ray-like peduncles supporting caudal alae. Wide caudal alae extend slightly posterior to caudal papillae.

Female: Long finely pointed tail 0.723 mm. in length, about one fourth body length. Vulva anterior to mid-body, averaging 1.16 mm. from anterior end. Vagina about 0.37 mm. long, and ovejector about 0.035 mm. in length. Eggs average 0.042 mm. by 0.092 mm.; segmented *in utero.*

The species name refers to the cuticular projections on the lips.

Summary

1. Five species of nematode parasites are reported from the Galapagos land iguana, *Conolophus subcristatus* Gray. Apparently, these are the first nematode parasites reported from this iguana.

2. Of the five species of parasites reported, four are assigned to the genus *Alaeuris* Thapar, 1925. Each of these species is new. The new species described are: *A. galapagensis, A. longispicula, A. labicula,* and *A. conolophi.*

3. The other species reported is assigned to a new genus. The name *Paralaeuris* is proposed for this genus. A new species, *P. dorochila,* is described in this genus.

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EXPLANATION OF PLATES

All figures were drawn with the aid of a microprojector or camera lucida. The value of the projected scale is indicated in millimeters beside each figure. The following abbreviations are used:

a	ala
ep	excretory pore
gc	accessory piece
lc	cloacal lip
nr	nerve ring
oe	ovejector
ov	ovary
p and number	genital papilla
sp	spicule
sv	seminal vesicle
ts	testis
v	vagina
vl	vulva

PLATE 13

Fig. 1. *Hlaeuris galapagensis,* female, lateral view.

Fig. 2. *H. galapagensis,* male, lateral view.

Fig. 3. *H. galapagensis,* cephalic region, female, lateral view.

Fig. 4. *H. galapagensis, en face* view lips, female.

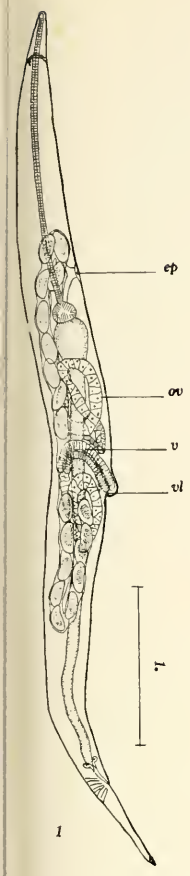
Fig. 5. *H. galapagensis,* posterior extremity male, ventral view.

Fig. 6. *H. galapagensis,* posterior extremity male, lateral view.

Fig. 7. *H. galapagensis,* egg.

Fig. 8. *H. longispicula,* female, lateral view.

Fig. 9. *H. longispicula,* egg.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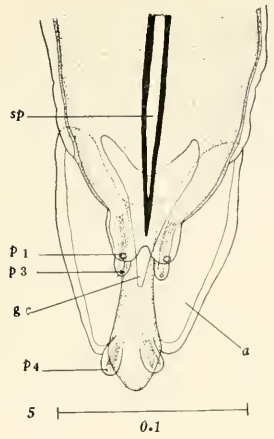
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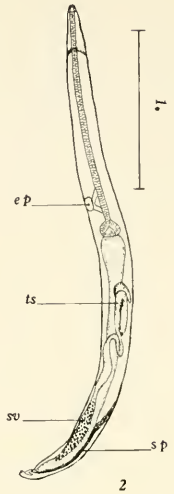
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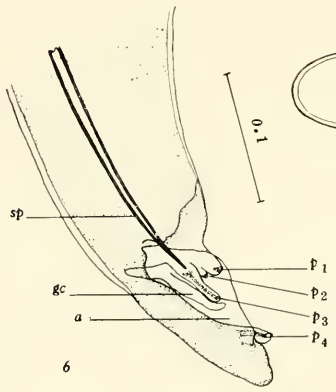
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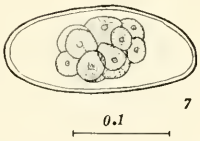
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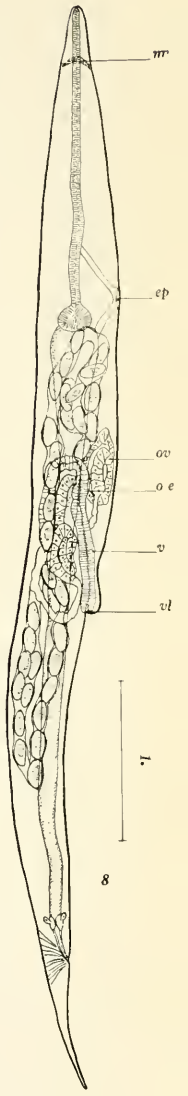
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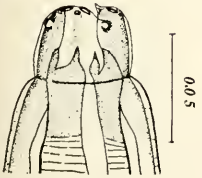
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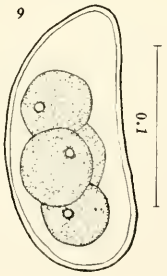
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PLATE 14

Fig. 10. *Ilacuris longispicula,* cephalic region, female, lateral view.

Fig. 11. *A. longispicula, en face* view lips, male.

Fig. 12. *A. longispicula,* male, lateral view.

Fig. 13. *A. longispicula,* posterior extremity male, ventral view.

Fig. 14. *A. longispicula,* posterior extremity male, lateral view.

Fig. 15. *A. labicula,* male, lateral view.

Fig. 16. *A. labicula,* female, lateral view.

Fig. 17. *A. labicula,* cephalic region female, lateral view.

Fig. 18. *A. labicula, en face* view lips, female.

Fig. 19. *A. labicula,* posterior extremity male, lateral view.

Fig. 20. *A. labicula,* posterior extremity male, ventral view.

Fig. 21. *A. labicula,* egg.

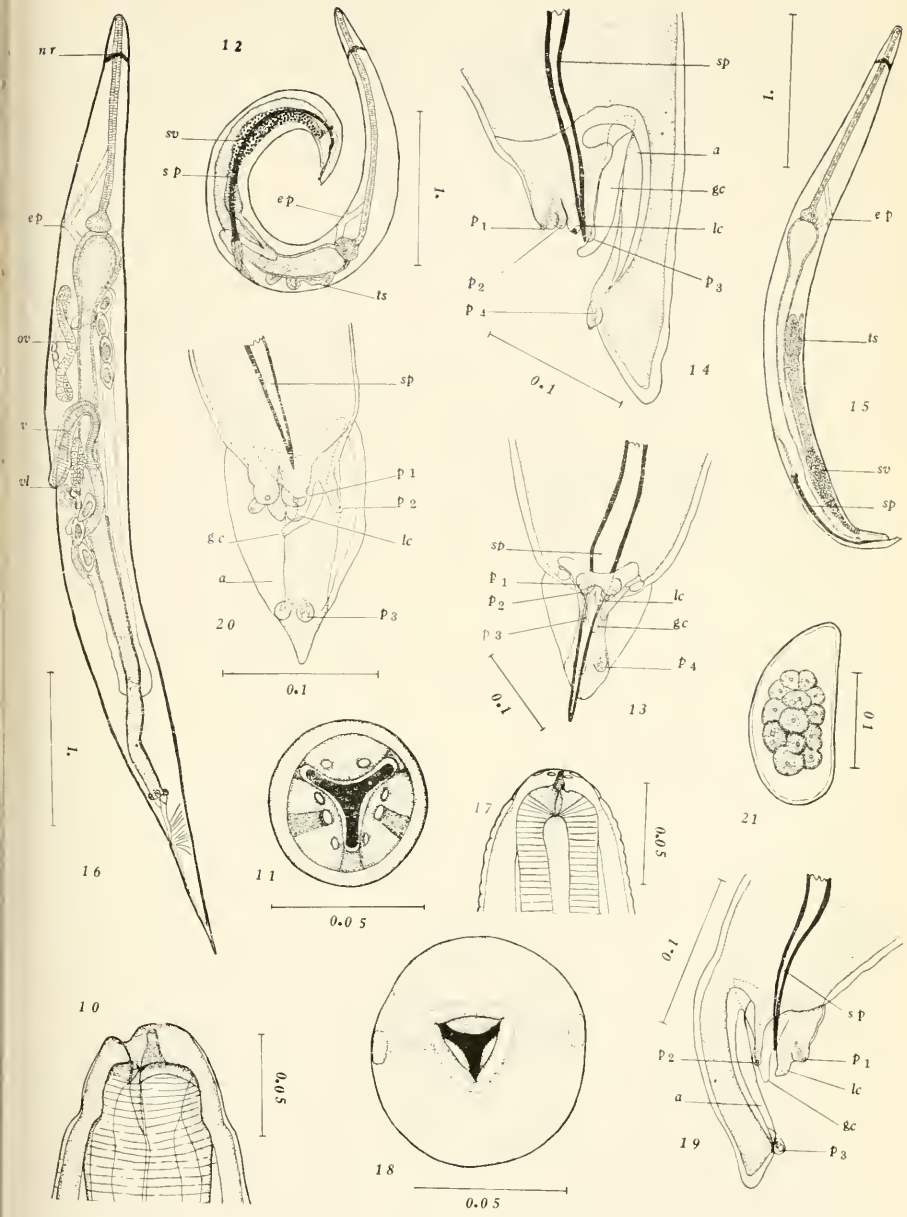
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PLATE 15

Fig. 22. *Alaeuris conolophi,* male, lateral view.

Fig. 23. *A. conolophi,* female, lateral view.

Fig. 24. *A. conolophi,* cephalic region female, lateral view.

Fig. 25. *A. conolophi, en face* view lips, female.

Fig. 26. *A. conolophi,* posterior extremity male, lateral view.

Fig. 27. *A. conolophi,* posterior extremity male, ventral view.

Fig. 28. *Paralaeuris dorochila,* male, lateral view.

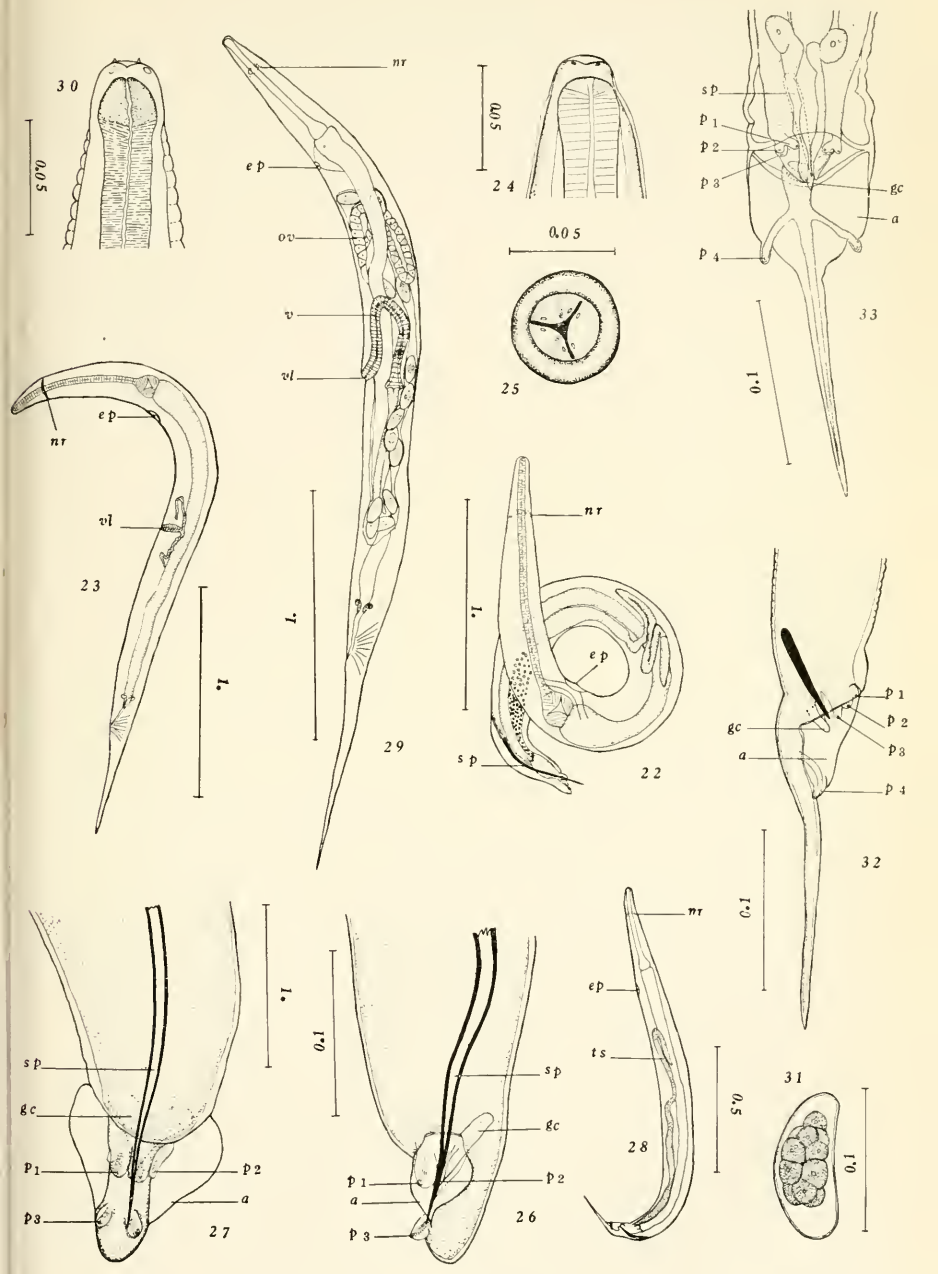
Fig. 29. *P. dorochila,* female, lateral view.

Fig. 30. *P. dorochila,* cephalic region female, lateral view.

Fig. 31. *P. dorochila,* egg.

Fig. 32. *P. dorochila,* posterior extremity male, lateral view.

Fig. 33. *P. dorochila* posterior extremity male, ventral view.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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

A NEW SPECIES OF NYCTERIBIIDAE (DIPTERA PUPIPARA) FROM ISLANDS IN THE GULF OF CALIFORNIA

(PLATE 16)

By HUGH SCOTT, Sc.D., F.L.S.

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Los Angeles, California

A NEW SPECIES OF NYCTERIBIIDAE (Diptera Pupipara) FROM ISLANDS IN THE GULF OF CALIFORNIA

(Plate 16)

By

Hugh Scott, Sc.D., F.L.S.

Department of Entomology, British Museum (Natural History)

The specimens on which the following description is based form part of the collections of the Allan Hancock Pacific Expeditions, under the leadership of Captain G. Allan Hancock, master-owner of the vessel *Velero III*. They were collected during a voyage made early in 1937, and were submitted to me in August, 1937, by Commander C. M. Dammers, R. N. (retd.), of Riverside, California, through Dr. K. Jordan, F.R.S., of the Zoological Museum, Tring, Hertfordshire. I was then on the point of leaving for an expedition in southwestern Arabia, and could do no more than report, in a letter to Dr. Jordan, that the material belongs to a new species of *Basilia*.

The comparatively small number of Nycteribiidae recorded from North, Central, and South America consists of species of *Basilia*. The genus closely resembles *Penicillidia,* but is distinguished principally by the eyes, which consist of two facets instead of a single facet. *Basilia* is represented in the Old World, up till now, by only one European and one Oriental species; but in a paper published early in 1936, entitled "Descriptions and records of Nycteribiidae, with a discussion of the genus *Basilia,*"* I enumerated thirteen American species. The species described below must now be added, and the present paper may be regarded as supplementary to that cited. Had the latter not appeared shortly before, I should have hesitated to publish an isolated description of the form under review.

In my paper just cited, I redescribed as well as possible *Basilia mexicana* [Bigot] and explained that this species is represented only by the unique type, with the bare record "Mexico" and no record of its host. The type is in such condition that *B. mexicana* cannot be fully described, even in the female sex, but certain of the characters are so

* Journ. Linn. Soc. London, Zool., xxxix, pp. 479-505, April, 1936; general remarks on *Basilia,* pp. 495-98.

distinct that the species must be maintained. I hoped that the specimens from the Gulf of California islands, also part of Mexico, would prove to belong to *B. mexicana,* so that the latter could be fully described and figured in both sexes. But such is not the case; they represent a new and distinct species, not (as far as I can make out) very close to any of those previously known, but best compared with a species from Costa Rica.

The bat on which the parasites were found is the first representative of the genus *Pizonyx* from which any Nycteribiid has been recorded. *Pizonyx* is, however, closely related to *Myotis,* several species of which are hosts of species of *Basilia* (though the latter also infest bats of other genera*). I am told that the only representative of *Pizonyx* is the species mentioned below, and that this bat is very localized, being known only from northwestern Mexico. If the host is really as restricted in distribution as appears, the parasite may also prove to be localized and taxonomically somewhat isolated.

The description has been drawn up, and the drawings made, from specimens in alcohol. Pencil sketches were made by myself with the aid of a Zeiss drawing apparatus, and the finished drawings were done by Miss D. Fitchew from these sketches, checked by viewing the actual specimens.

Basilia pizonychus, new species

Length about 2.25-2.50 mm. The general form is shown sufficiently in the figures. The *eyes* are distinctly two-faceted, conforming to the characters of the genus. The *mesonotum* is not raised behind into any erection (neither a chitinous erection, as in *B. mexicana* [Bigot] nor a finger-like process, as in *B. boardmani* Rozeboom). The *ctenidium* on the hind margin of the basal abdominal sternite consists, in both sexes, of about 52 teeth.

The species is most nearly comparable to *B. ferrisi* Scott *(B. speiseri* Ferris, *nec* Ribeiro),† from Costa Rica. The external distinguishing characters lie mainly in the *abdomen of the female: B. pizonychus* has the basal tergite much shorter, with fewer setae on its surface, shorter

* See the table of American species of *Basilia* and their hosts in my 1936 paper cited above, p. 497.

† *B. ferrisi* was described and figured, under the name *B. speiseri,* by Ferris, Ent. News, xxxv, pp. 198-9, pl. iii, 1924. I made it a distinct species in 1936 *(op. cit.,* p. 502), thereby confirming the opinion of Curran, who had recognized the distinction between it and the true *B. speiseri* (Ribeiro).

setae on its lateral edges, and only two groups of about 3 or 4 short setae at either angle of the hind margin, instead of an almost unbroken series of 12 or more very long setae across this margin (the side margins and hind margin of this tergite in *B. pizonychus* are slightly sinuate). The divided second tergite is also much shorter, has rather numerous short setae on the lateral parts of its surface, while the marginal setae on either lobe are much more numerous, longer and stronger, hence the 2 or 3 very long ones at the inner angle of either lobe contrast less with the rest of the marginal series than do the two very long setae near the inner angle of either lobe in *B. ferrisi.* The third tergite consists of two rather widely separated chitinous lobes, each having two long and several short setae at the inner hind angle, and several other short setae along the arcuate lateral margin. The anal prominence is the hindmost part of the abdomen when seen from above. It has three setae of medium length at either hind angle and several short setae on either lateral margin. The posterior part of the abdomen, therefore, also differs from that of *B. ferrisi,* in which there is no counterpart to the divided third tergite, and the anal prominence is posterodorsal in position. (In the female specimen of *B. pizonychus* figured, and in several others, the posterior dorsal part of the abdomen is occupied by a large dark patch rounded in front, with several lighter spots, and extending into the anal prominence; it is uncertain to what this condition is due, but it is apparently not due to the presence of a larva seen through the translucent outer wall of the body.) Ventrally, the basal sternite in *B. pizonychus* is short; the whitish connexivum behind this has two transverse rows of longer setae marking the hind margins of segments, the surface of the anterior is covered with shorter setae, while the posterior of the two has shorter setae in a single series near the hind margin in the middle, and covering most of the surface at the sides. Behind this, three segments, more or less chitinized, can be traced; the front of these three consists of a single series of longer setae, and has a very short transverse chitinized strip at either side; the next is bluntly produced in the middle behind, chitinized except for a narrow median strip, with short setae on its surface and longer ones on the margin; the hindmost (*i.e.,* the subgenital plate) has an arcuate hind margin, a chitinized area on either side, with shorter and longer setae on the surface of the chitinized parts, and along the margin. (In *B. ferrisi* the basal sternite is long, and the remainder of the ventral surface almost entirely membranous and less setose.)

Abdomen of male: the characters are shown in the figures. The basal tergite is very small and has short, erect bristles at the corners. The second, third, and fourth tergites have a very few short setae on the surface in the middle; otherwise, the surfaces of these tergites are bare, as are those of the fifth and sixth. Ventrally, the second sternite has rather numerous short setae on its surface; the third has a very few setae on its surface, a little in front of the marginal series, but rather more setae at the sides; the surface of the fourth is bare except for a submarginal series (some of which, especially the outer ones, are very long) across the middle part; the stout blackish teeth on the middle of its hind margin are about 26, in two rather irregular series, with a single long one at either extremity. The claspers are not very darkly pigmented except at the apex; lying nearly parallel, but tapering and curving a little upward and inward at the apex.

MEXICO: Gulf of California, Angel de la Guardia Island, 20. iii. 1937, 6 ♂, 4 ♀, and Patos Island, 26. iii. 1937, 2 ♂, 5 ♀ (*J. Garth* coll.). The collecting-stations are, respectively, nos. 707-1937 and 727-1937. Host-bat, in both cases, *Pizonyx vivesi* Menegaux. One of the female parasites from Angel de la Guardia Island carries a partly extruded larva.

TYPES (♂, ♀) and paratypes in the collections of the Allan Hancock Foundation, The University of Southern California; other paratypes in the British Museum (Natural History).

The specific name is a transliteration of the genitive of the generic name of the host-bat. The genus *Pizonyx* is characterized by the compression of its long claws, from which character the generic name was apparently taken.

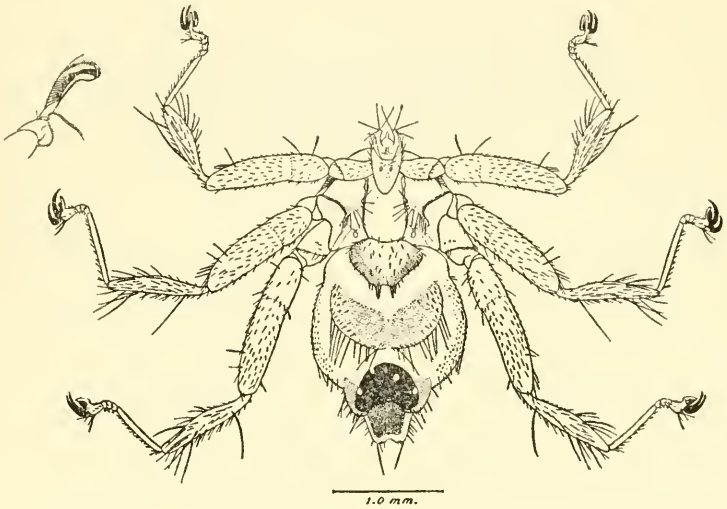
Plate 16

LEGENDS OF FIGURES

Fig. 1. *Basilia pizonychus,* new species, ♀, dorsal view; on left, the left thoracic ctenidium and base of middle leg, more highly magnified.

Fig. 2. *Basilia pizonychus,* ♂, ventral view of thorax and abdomen.

Fig. 3. *Basilia pizonychus:* left, ♀, ventral view of abdomen; right, ♂, dorsal view of abdomen.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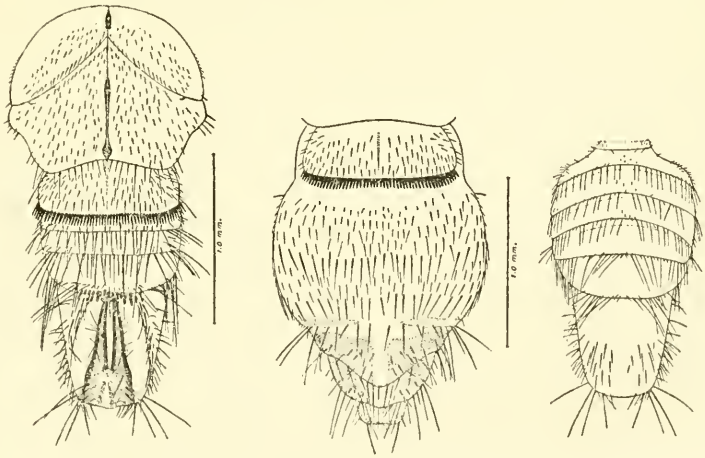
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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

A REMARKABLE NEW GENUS OF SEA-URCHIN (SPATANGIDAE)

(PLATE 17)

By HUBERT LYMAN CLARK

The University of Southern California Publications
Allan Hancock Pacific Expeditions
Volume 2, Number 11
Issued May 15, 1939

The University of Southern California Press
Los Angeles, California

A REMARKABLE NEW GENUS OF SEA-URCHIN (SPATANGIDAE)

(PLATE 17)

HUBERT LYMAN CLARK
Museum of Comparative Zoölogy

On January 16, 1938, while the *Velero III* was at Darwin Bay, Tower Island, Galapagos, two specimens of a small spatangoid were dredged which proved to be of exceptional interest. They were taken at Station 783-38 on a bottom of white sand and rock, in 40-70 fms. The small size and the complete absence of genital pores indicate that they are very young but their conspicuous peculiarities leave no doubt that they represent a hitherto unknown genus for which I have selected the name Idiobryssus (ἴδιος=*peculiar, distinct*+βρύσσος=the name of an Aristotelian sea-urchin almost universally transliterated incorrectly as *brissus*). For the species name *coelus* (κοῖλος=hollowed) is chosen in reference to the concave dorsal surface.

The holotype of

Idiobryssus coelus

is 12 mm. long, 10 mm. wide, just back of petals II and IV, 4 mm. high at center of abactinal system, about 4.5 mm. anteriorly and 5 mm. posteriorly; these high points are midway between the abactinal system and the anterior and posterior ends of the test. The upper surface (figure 1) is thus very definitely concave and the lower surface is correspondingly convex. This unusual and very noticeable form is clearly shown in figure 2. Abactinal system (it can scarcely be called "apical" since it is at the *bottom* of a notable depression!) at the approximate center of the upper concave surface but anterior to the actual middle of the test which projects considerably below and beyond the periproct; no distinct sutures can be made out between the plates; there are no genital pores but what are apparently ocular pores seem to be present and there are 5 or 6 madreporic pores in a small indistinct group.

Ambulacrum III not at all depressed and so ill-defined its exact limits cannot easily be made out. Petals I and V somewhat elliptical,

distinctly but very slightly depressed, about 2 mm. long by 1 mm. wide; there are 9 or 10 pore-pairs on each side with an insignificant interporiferous area. Petals II and IV, not quite so depressed as I and V but much larger, nearly 4 mm. long and more than a millimeter wide; they extend outward at almost right angles to the long axis of the test. Peripetalous fasciole rather wide but not very conspicuous on the bare test as the minute spinelets which compose it are not very densely crowded. Periproct on the sloping upper end of the test, relatively large and entirely visible from above. It is a broad, pointed oval, nearly as wide as long, with the largest covering plates in the upper angle, the smallest around the anus near the lower margin of the area.

Subanal plastron large, about 6 mm. across, nearly circular but somewhat pointed where in contact with the sternum; the enclosing fasciole is evident but not at all densely spinulose; near the periproct the fasciole is somewhat diffuse but there are no definite anal branches. Sternum very small, triangular, about 5 mm. long by 3 wide, almost completely covered with tubercles. Peristome approximately circular, 2 mm. across, with the mouth at center, covered with delicate but relatively large, angular plates; most of these plates carry each, a single spine; on the plates close to the mouth these spines are short and thick, elsewhere they are long and slender, similar to those of the test but much smaller; the mouth itself is not quite 5 mm. from the anterior end of the test.

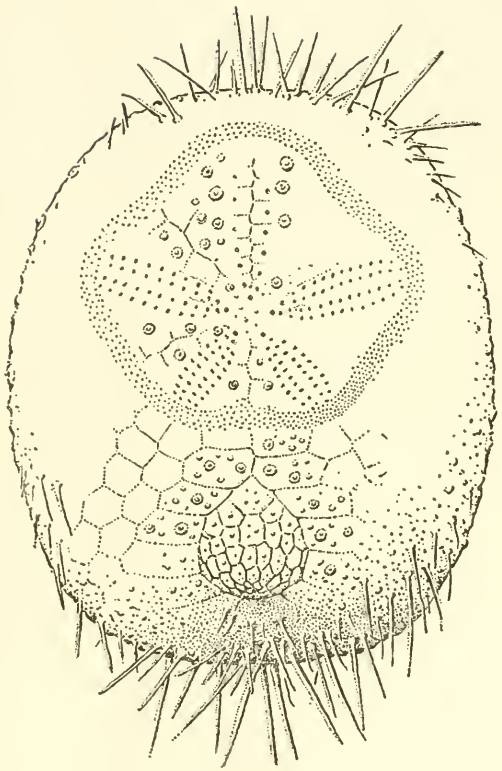
Under a magnification of 95 diameters, several sphaeridia are noticeable on the oral portion of each ambulacrum, except III which apparently lacks them. Spines cover practically all parts of the test but are smallest and most scattered on the ventral ambulacra. They are largest and longest on the most elevated parts of the interambulacra 2 and 3, on the sternum and especially on the posterior portion of the test where many are 3-5 mm. long. They are delicate, more or less curved and usually somewhat tapering and pointed, but not a few are distinctly thickened at the tip. No pedicellariae were detected with a hand lens but prolonged search with a magnification of 95 diameters revealed 4 thick-headed tridentate pedicellariae in ambulacrum V. These are not essentially different from those of Hemiaster; the heads are .25 mm.

long and .12 mm. in diameter through the stout basal half. The stalks are .10 to .18 mm. long. The valves become narrower abruptly, just beyond the middle.

In life, Idiobryssus was white, very similar to the color of the sand in which it was living. In preservation and ultimate drying, the spines have taken on a slight tint of cream-color and at the base are often quite brownish. The minute spines of the fascioles are very distinctly brownish. The dried muscular tissue at the base of the larger spines, and the heads of the pedicellariae are quite brown, and the dorsal side of the test has a faintly brownish tinge.

The paratype is distinctly smaller than the holotype, about 11 mm. long, rather more than 8 mm. wide and fully 4 mm. high. The fascioles are very distinct and the peripetalous seems to be relatively a little larger. But in all essentials, this smaller specimen is like the larger one and is convincing evidence that the unusual form of the test is not accidental but is a distinctive character of this odd spatangid.

As for the relationships of Idiobryssus, there can be no doubt that it is rather sharply set off from the other Spatangidae by the nearly circular, scarcely depressed peristome. This suggests at once the juvenal condition of Abatus as figured by Mortensen (1910, Echinoidea of Swedish South Polar Expedition, pl. 9, fig. 19) but when Abatus is 12 mm. long, the peristome has assumed its short, wide, curved form. There is no indication whatever in Idiobryssus that the peristome might ultimately assume such a shape. In spite of this remarkable oral area, the new genus is best referred to the Spatangidae and is apparently as near Rhynobrissus as it is to any Recent genus. It may be diagnosed thus: *Spatangidae with concave abactinal surface, a dorsally exposed periproct, no anal branches to the subanal fasciole and a nearly circular, scarcely depressed peristome.* It is of course greatly to be hoped that additional and adult material will soon be secured, for this spatangoid is one of the most noteworthy echinoderms that the current explorations of the eastern tropical Pacific Ocean have brought to light. I am very grateful to Captain Hancock and to Professor Irene McCulloch for the privilege of describing it without further delay.



1

2

Idiobryssus coelus, new species. Spines and tuberculation are largely omitted in order to bring out clearly the characteristic concave petaloid area, surrounding fasciole and elevated periproct. ×6+.

Fig. 1. Seen from above.
Fig. 2. Seen from right-hand side.

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

MARINE MOLLUSKS FROM PANAMA COLLECTED BY THE ALLAN HANCOCK EXPEDITION TO THE GALAPAGOS ISLANDS, 1931-1932

By A. M. STRONG and LEO GEORGE HERTLEIN

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A. M. Strong and Leo George Hertlein

Introduction

During the course of an expedition to the Galapagos Islands on Captain Allan Hancock's motor cruiser *Velero III,* the junior author had the opportunity to collect marine mollusks on shore and by dredging at four localities along western Panama. This occasion is taken to thank Captain Hancock, whose generosity made the collection of the material for this report possible. Acknowledgment is also due to Mr. Charles Swett, chief officer on the *Velero III,* as well as members of the crew; also Mr. Karl Koch and Mr. C. B. Perkins, of the Zoological Society of San Diego, and Mr. John Garth of Long Beach, and other members of the party who accompanied the expedition, all of whose genial co-operation made collecting a pleasure. Acknowledgment is due the late Mr. Herbert N. Lowe of Long Beach, California, for assistance in the determination of certain of the species; also to Dr. G. Dallas Hanna of the California Academy of Sciences, for criticism of the manuscript and for many helpful suggestions during the course of the work. Mr. Allyn G. Smith gave helpful suggestions regarding the arrangement of some of the plates. The photographs illustrating the species in this paper were made by Mr. Frank L. Rogers. These photographs are the result of work accomplished during a government Works Progress Administration project.

Only the more important papers on Panama mollusks will be mentioned here. The first comprehensive report on the marine mollusks of Panama was made by C. B. Adams[1] in 1852. A few years later, Car-

[1] Adams, C. B., Catalogue of Shells collected at Panama, with Notes on Synonymy, Station, and Habitat. Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 229-548 [also unnumbered page "Concluding Remarks"]. [Also separate of the same.] See also Carpenter's review of this work in the Proc. Zool. Soc. London, 1863, pp. 339-369. Reprinted in Smithsonian Miscellaneous Collections, No. 252, 1872, pp. 173-205.—See also, Presbrey, E. W., Collecting in Panama. Nautilus, vol. 26, no. 11, 1913, pp. 121-125.

penter[2] in several papers added many species to the known fauna of Panamanian mollusks. De Folin[3] published three volumes, now rather rare, which included descriptions of a number of species, mostly small gastropods, from Panama. Dall[4] in 1908 published a report describing the mollusks dredged by the U. S. Fish Commission Steamer *Albatross*. In this paper he described many new species from Panama and also cited many other species from that region. The following year the same author published an excellent paper on the marine mollusks of Peru[5] in which he cited and gave references to many species known to occur at Panama.

Dall and Bartsch[6] in 1909 described and figured many species of the Pyramidellid mollusks from western North America, including those known to them from Panama. Zetek[7] in 1918 published a paper listing the marine mollusks of Panama and mentioned their distribution and synonymy. Olsson[8] in 1924 cited a number of marine mollusks from Peru and Ecuador, many of which also occur in Panamanian waters. Tomlin[9] in 1928 cited a number of species from Panama which were

[2] Carpenter, P. P., Report on the Present State of our Knowledge with Regard to the Mollusca of the West Coast of North America. Rept. Brit. Assoc. Adv. Sci., for 1856 (issued in 1857), pp. 159-368.—Supplementary Report on the Present State of our Knowledge with Regard to the Mollusca of the West Coast of North America. Rept. Brit. Assoc. Adv. Sci., for 1863 (issued August, 1864), pp. 517-686.—Catalogue of the Collection of Mazatlan Shells in the British Museum collected by Frederick Reigen. [July, 1855-] June, 1857, 552 pp. —See also reprints of many of Carpenter's papers in Smithsonian Miscellaneous Collections, No. 252, 1872, pp. 1-325.

[3] De Folin, A. G. L., Les Méléagrinicoles (Havre), 1867, 74 pp., 6 pls. A critical review of this paper is given by H. Crosse, Journ. de Conchyl., vol. 16 (ser. 3, vol. 8), no. 2, April 1, 1868, pp. 217-219.—Les Fonds de la Mer. (Paris), vol. 1, 1867-71, 316 pp., 22 pls.; vol. 2, 1875, 362 pp., 11 pls.

[4] Dall, W. H., Reports on the Dredging operations off the west coast of Central America. . . . U. S. Fish Commission Steamer *Albatross,* during 1891. . . . XVII. Reports on the Scientific Results of the Expedition to the eastern tropical Pacific. . . . XIV. The Mollusca and the Brachiopoda. Bull. Mus. Comp. Zool., vol. 43, no. 6, October, 1908, pp. 205-487, pls. 1-22.

[5] Dall, W. H., Report on a collection of Shells from Peru, with a summary of the Littoral Marine Mollusca of the Peruvian Zoological Province. Proc. U. S. Nat. Mus., vol. 37, November 24, 1909, pp. 147-294, pls. 20-28.

[6] Dall, W. H., and Bartsch, P., A Monograph of West American Pyramidellid Mollusks. U. S. Nat. Mus., Bull. 68, December 13, 1909, pp. i-xii, 1-258, 30 pls. For a critical review of this work, see "Some Notes on Pyramidellid Nomenclature," by Tom Iredale. Nautilus, vol. 24, no. 5, September, 1910, pp. 52-58.

[7] Zetek, J., Los Moluscos de la Republica de Panama. Revista Nueva, nos. 1 and 2, July and August, 1918, 69 pp.

[8] Olsson, A. A., Notes on Marine Mollusks from Peru and Ecuador. Nautilus, vol. 37, no. 4, April, 1924, pp. 120-130.

[9] Tomlin, J. R. le B., The Mollusca of the *St. George* Expedition. Jour. Conch., vol. 18, no. 6, December, 1927, pp. 153-170; vol. 18, no. 7, May, 1928, pp. 187-198.

collected during the voyage of the *St. George*. In 1930 Li[10] published a paper in which he described several new species from a mixture of Miocene and Recent shells dredged in Panama Bay. Pilsbry[11] reviewed Li's paper and from a study of the collection concluded that only 8 of the species cited by Li were Miocene forms and the remainder were Recent shells from Panama Bay. In this paper Pilsbry described several new species. The following year Pilsbry and Lowe[12] published a paper dealing chiefly with west Mexican and Central American mollusks. In this paper many species were cited from Panama and several new species were described from there. In a recent paper several new species from the Panamic Province were described by Pilsbry and Olsson.[13] Mollusks from Cocos Island some 300 miles northwest of Panama City have been listed by Biolley,[14] Pilsbry and Vanatta,[15] Dall,[16] and Hertlein.[17] The Recent Pectinidae in the collections secured by the Templeton Crocker Expedition to the Galapagos Islands were described by Hertlein.[18] These included 3 species of *Pecten* collected by Hertlein at Panama during the Allan Hancock Expedition to the Galapagos Islands.

The Gulf of Panama lies well within the tropics in 7° to 8° north latitude and contains a tropical marine fauna. In it dwell such tropical

[10] Li, C. C., The Miocene and Recent Mollusca of Panama Bay. Bull. Geol. Soc. China, vol. 9, no. 3, 1930 [received at the library of the California Academy of Sciences, May 2, 1931], pp. 249-296, pls. 4-8, 1 map.

[11] Pilsbry, H. A., The Miocene and Recent Mollusca of Panama Bay. Proc. Acad. Nat. Sci. Philadelphia, vol. 83, November 13, 1931, pp. 427-440, pl. 41, 5 text figs.

[12] Pilsbry, H. A., and Lowe, H. N., West Mexican and Central American Mollusks collected by H. N. Lowe, 1929-31. Proc. Acad. Nat. Sci. Philadelphia, vol. 84, May 21, 1932, pp. 33-144, pls. 1-17.

[13] Pilsbry, H. A., and Olsson, A. A., New Mollusks from the Panamic Province. Nautilus, vol. 48, no. 4, April, 1935, pp. 116-121, pl. 6; vol. 49, no. 1, July, 1935, pp. 16-19, pl. 1.

[14] Biolley, P., Mollusques de l'Isla del Coco. Mus. Nac. de Costa Rica (San José, Costa Rica), 1907, 30 pp., 2 maps.

[15] Pilsbry, H. A., and Vanatta, E. G., Papers from the Hopkins Stanford Galapagos Expedition, 1898-1899. XIII. Marine Mollusca. (Mollusks collected at Cocos Island.) Proc. Washington Acad. Sci., vol. 4, 1902, p. 559.

[16] Dall, W. H., Reports on the Dredging operations off the west coast of Central America. . . . U. S. Fish Commission Steamer *Albatross*, during 1891. . . . XVII. Reports on the Scientific Results of the Expedition to the eastern tropical Pacific .... XIV. The Mollusca and the Brachiopoda. Bull. Mus. Comp. Zool., vol. 43, no. 6, October, 1908, pp. 436-437.

[17] Hertlein, L. G., Mollusks and Barnacles from Malpelo and Cocos Islands. Nautilus, vol. 46, no. 2, 1932, pp. 44-45.

[18] Hertlein, L. G. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. The Recent Pectinidae. Proc. Calif. Acad. Sci., ser. 4, vol. 21, no. 25, Sept. 26, 1935, pp. 301-328, pls. 18 and 19.

forms as *Arca grandis* Broderip & Sowerby, *Chione gnidia* Sowerby, *Ostrea iridescens* Gray, *Pecten vogdesi* Arnold, *Pitar pollicaris* Carpenter, *Plicatula spondylopsis* Rochebrune, *Pinctada mazatlanica* Hanley, *Tivela byronensis* Gray, *Colubraria aphrogenia* Pilsbry & Lowe, *Conus princeps* Linnaeus, *Conus orion* Broderip, *Fusinus dupetit-thouarsi* Kiener, *Mitra attenuata* Mawe, *Strombus galeatus* Swainson, *Strombus gracilior* Sowerby, *Strombus granulatus* Mawe, *Terebra lingualis* Hinds, *Thais crassa* Blainville, *Thais kiosquiformis* Duclos, *Turritella banksii* Reeve, *Vasum caestus* Broderip. A number of species found in the Recent west Panamanian fauna also occur in the Gulf of California and range south to the Bay of Guayaquil. Certain of the species range farther to the south.

The surface temperature of the ocean near the shores of western Panama from November to March was found by A. Agassiz[19] to be between 80° and 82°F. The western Panamanian marine molluscan fauna includes some species which also occur in the Caribbean Sea. The exact number is not certain at the present time but several authors have mentioned that about 50 species are common to the two areas. C. B. Adams cited 21 species which he considered to be analogous to species collected at Jamaica. It is certain that a much larger number of analogous species than that given by C. B. Adams is present in the two areas. The close relationship of the molluscan inhabitants of the Panamanian and Caribbean regions is readily explained by an open seaway connecting the two areas which is believed to have existed during earlier times. Such a connection is believed to have existed across the Isthmus of Panama or some part of Central America at least during the lower Miocene.[20] This made possible the migration of marine animals between the two areas. *Chione* of the *gnidia* group, large *Dosinia* and *Solenosteira* became elements of the West American fauna at that time. There is no evidence of any oceanic connection between the two regions since the Miocene. Olsson[21] in an excellent discussion of the Tertiary history

[19] Agassiz, A., Reports on the Scientific Results of the Expedition to the Eastern tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer *Albatross,* from October, 1904, to March, 1905. V. General Report of the Expedition. Mem. Mus. Comp. Zool., vol. 33, 1906, pp. 25-26, pl. 3a.

[20] Dickerson, R. D., Ancient Panama Canals. Proc. Calif. Acad. Sci., ser. 4, vol. 7, no. 8, 1917, pp. 197-205.—Smith, J. P., Proc. Calif. Acad. Sci., ser. 4, vol. 9, no. 4, 1919, p. 129.—Hertlein, L. G., and Jordan, E. K., Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 19, 1927, pp. 617-618.

[21] Olsson, A. A., Contributions to the Tertiary Paleontology of Northern Peru: Part 5, The Peruvian Miocene. Bull. Amer. Paleo., vol. 19 (Bull. No. 68), June 30, 1932, pp. 41-43.

of Peru stated that about 17 per cent of the species recorded from the Miocene of Peru occur in Caribbean deposits or have related forms in those beds. He suggested that this relationship of the marine mollusks of the Peruvian and Caribbean Miocene faunas is due to an oceanic connection and that "until near the close of the Miocene, two or more straits along geosynclinal troughs connected Pacific and Atlantic waters and it is through these straits that faunal intermingling took place."

One of the difficulties of determining the exact time and direction of migration of marine mollusks between the two areas is the lack of agreement of authors regarding the exact time units represented by the Mid-Tertiary strata of the Caribbean region. An example of this is the great divergence of views published by workers on the age of the Bowden fauna of Jamaica. The beds containing this fauna were for some time considered by many authors to be Oligocene in age. The results of work within the past few years indicate rather definitely that the fauna of the Bowden beds is at least as late as upper Middle Miocene. Whatever the location and duration of these ancient interoceanic connections in this region, there are a number of species in the present-day molluscan fauna of western Panama that have been considered by several workers to be identical with, and there are certainly quite a considerably greater number of species which are analogous to, those occurring living or fossil in the Caribbean region.

The present collection obtained by shore and shallow water dredging contains 336 species of mollusks. The assemblage consists of the following: 1 brachiopod, 91 pelecypods, 2 scaphopods, 242 gastropods. Five of the species of gastropods are not positively identified but have been compared to known species and in 10 additional ones the genus only is definitely known due to poor preservation. Forty-six species are described as new. All of the new species are small gastropods, and a special effort was made to secure these small forms, due to the fact that heretofore these have been largely neglected for the larger and more brightly colored forms found in the region. In the present collection it is noticed that a rather large number of species represent certain genera, such as *Arca* (11), *Tellina* (7), *Anachis* (10), *Odostomia* (13), *Turbonilla* (21).

Collections were made during the latter part of December, late in January, and early in February. The collecting stations were as follows:

Loc. 27,228 (C.A.S.). Just off Taboga Island, Gulf of Panama, between Taboga Island and Uraba Island, in the channel, in 3 to 9 fms. L. G. Hertlein collector, Feb. 1, 1932.

Loc. 27,229, (C.A.S.). Bahia Honda, Veragua, Panama. Beach, and dredging in about 3 to 9 fms. L. G. Hertlein collector. Dec. 22, 1931.

Loc. 27,243 (C.A.S.). Along the beach from Old Panama (Panama Vieja) to the bridge about 1 to 1½ kilometers east of Old Panama. L. G. Hertlein collector. Dec. 25, 1931.

Loc. 27,257 (C.A.S.). Beach below Delessep's Monument, at Panama City, Panama. L. G. Hertlein collector. Jan. 29, 1932.

List of Species from Western Panama Collected by the Allan Hancock Expedition to the Galapagos Islands, 1931-1932

BRACHIOPODA

Discinisca cumingii Broderip, Loc. 27,228 (C.A.S.)

PELECYPODA

Anomalocardia subrugosa Sowerby, Locs. 27,228; 27,229; 27,243; 27,257 (C.A.S.)
Anomia peruviana d'Orbigny, Loc. 27,228 (C.A.S.)
Apolymetis dombei Hanley, Locs. 27,243; 27,257 (C.A.S.)
Arca aequatorialis d'Orbigny, Loc. 27,243 (C.A.S.)
Arca alternata Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Arca concinna Sowerby, Loc. 27,228 (C.A.S.)
Arca gradata Broderip & Sowerby, Locs. 27,229; 27,257 (C.A.S.)
Arca grandis Broderip & Sowerby, Locs. 27,229; 27,243 (C.A.S.)
Arca mutabilis Sowerby, Loc. 27,229 (C.A.S.)
Arca nux Sowerby, Locs. 27,228;27,229; 27,257 (C.A.S.)
Arca pacifica Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Arca reeviana d'Orbigny, Loc. 27,229 (C.A.S.)
Arca reversa Gray, Loc. 27,243 (C.A.S.)
Arca tuberculosa Sowerby, Loc. 27,229 (C.A.S.)
Cardium biangulatum Broderip & Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Cardium consors Broderip & Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Cardium elenense Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Cardium graniferum Broderip, Locs. 27,228; 27,229 (C.A.S.)
Cardium procerum Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Chama echinata Broderip, Loc. 27,257 (C.A.S.)
Chama imbricata Broderip, Loc. 27,229 (C.A.S.)
Chione asperrima Sowerby, Loc. 27,243 (C.A.S.)
Chione compta Broderip, Locs. 27,228; 27,229 (C.A.S.)
Chione gnidia Broderip & Sowerby, Loc. 27,228 (C.A.S.)
Chione mariae d'Orbigny, Loc. 27,228 (C.A.S.)
Codakia (Jagonia) galapagana Dall, Loc. 27,228 (C.A.S.)
Corbula bicarinata Sowerby, Loc. 27,243 (C.A.S.)
Corbula biradiata Sowerby, Locs. 27,229; 27,243; 27,257 (C.A.S.)
Corbula nasuta Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Corbula ovulata Sowerby, Loc. 27,229 (C.A.S.)

Corbula speciosa Hinds, Loc. 27,228 (C.A.S.)
Corbula tenuis Sowerby, Loc. 27,228 (C.A.S.)
Crassinella pacifica C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Cumingia trigonularis Sowerby, Loc. 27,257 (C.A.S.)
Cuspidaria dulcis Pilsbry & Lowe, Locs. 27,228; 27,229 (C.A.S.)
Cyathodonta undulata Conrad, Loc. 27,229 (C.A.S.)
Cyclinella subquadrata Hanley, Loc. 27,229 (C.A.S.)
Diplodonta subquadrata Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Donax assimilis Hanley, Loc. 27,243 (C.A.S.)
Donax navicula Hanley, Loc. 27,243 (C.A.S.)
Dosinia dunkeri Philippi, Locs. 27,229; 27,257 (C.A.S.)
Gastrochaena ovata Sowerby, Loc. 27,229 (C.A.S.)
Glans affinis Sowerby, Locs. 27,229; 27,257 (C.A.S.)
Glans laticostata Sowerby, Locs. 27,229; 27,243; 27,257 (C.A.S.)
Glycymeris delessertii Reeve, Loc. 27,229 (C.A.S.)
Glycymeris inaequalis Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Glycymeris multicostata Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Iphigenia altior Sowerby, Loc. 27,229 (C.A.S.)
Labiosa undulata Gould, Loc. 27,243 (C.A.S.)
Lima pacifica d'Orbigny, Locs. 27,229; 27,257 (C.A.S.)
Lithophaga aristata Dillwyn, Loc. 27,229 (C.A.S.)
Lucina cancellaris Philippi, Loc. 27,228 (C.A.S.)
Macoma aurora Hanley, Locs. 27,228; 27,229 (C.A.S.)
Macoma undulata Hanley, Locs. 27,228; 27,229 (C.A.S.)
Mactra velata Philippi, Loc. 27,257 (C.A.S.)
Mactrella elegans Sowerby, Loc. 27,243 (C.A.S.)
Megapitaria aurantiaca Sowerby, Loc. 27,229 (C.A.S.)
Megapitaria squalida Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Mulinia pallida Broderip & Sowerby, Loc. 27,243 (C.A.S.)
Nucula declivis Hinds, Locs. 27,228; 27,229 (C.A.S.)
Nuculana elenense Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Nuculana polita Sowerby, Loc. 27,243 (C.A.S.)
Ostrea iridescens Gray, Locs. 27,229; 27,243; 27,257 (C.A.S.)
Ostrea palmula Carpenter, Loc. 27,243 (C.A.S.)
Paphia grata Sowerby, Locs. 27,229; 27,257 (C.A.S.)
Pecten (Plagioctenium) circularis Sowerby, Locs. 27,228; 27,229; 27,243 (C.A.S.)
Pecten (Leptopecten) velero Hertlein, Loc. 27,229 (C.A.S.)
Pecten (Pecten) vogdesi Arnold, Loc. 27,229 (C.A.S.)
Pedalion quadrangularis Reeve, Loc. 27,257 (C.A.S.)
Petricola denticulata Sowerby, Loc. 27,229 (C.A.S.)
Pholas chiloensis Molina, Loc. 27,257 (C.A.S.)
Pinctada mazatlanica Hanley, Loc. 27,229 (C.A.S.)
Pitar concinna Sowerby, Loc. 27,243 (C.A.S.)
Pitar pollicaris Carpenter, Loc. 27,229 (C.A.S.)
Plicatula penicillata Carpenter, Loc. 27,228 (C.A.S.)
Plicatula spondylopsis Rochebrune, Loc. 27,229 (C.A.S.)

Psammobia maxima Deshayes, Loc. 27,228 (C.A.S.)
Pseudochama corrugata Broderip, Loc. 27,229 (C.A.S.)
Semele guaymasensis Pilsbry & Lowe, Loc. 27,228 (C.A.S.)
Semele sparsilineata Dall, Loc. 27,229 (C.A.S.)
Sphenia fragilis Carpenter, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Tagelus affinis C. B. Adams, Loc. 27,243 (C.A.S.)
Tagelus violascens Carpenter, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Tellina cumingii Hanley, Loc. 27,229 (C.A.S.)
Tellina declivis Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Tellina decumbens Carpenter, Loc. 27,228 (C.A.S.)
Tellina felix Hanley, Loc. 27,228 (C.A.S.)
Tellina meropsis Dall, Loc. 27,229 (C.A.S.)
Tellina panamensis Dall, Locs. 27,228; 27,229 (C.A.S.)
Tellina reclusa Dall, Loc. 27,229 (C.A.S.)
Tivela byronensis Gray, Loc. 27,243 (C.A.S.)

SCAPHOPODA

Cadulus panamensis Sharp & Pilsbry, Locs. 27,228; 27,229 (C.A.S.)
Dentalium tetragonum Sowerby, Loc. 27,229 (C.A.S.)

GASTROPODA

Acanthina brevidentata Mawe, Locs. 27,229; 27,257 (C.A.S.)
Acmaea subrotundata Carpenter, Loc. 27,257 (C.A.S.)
Acteocina infrequens C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Alaba interruptelineata Pilsbry & Lowe, Loc. 27,228 (C.A.S.)
Alaba supralirata Carpenter, Loc. 27,229 (C.A.S.)
Alabina veraguaensis Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Alvania tumida Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Alvania veleronis Hertlein & Strong, Loc. 27,228 (C.A.S.)
Amphithalamus trosti Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Anachis boivina Kiener, Loc. 27,257 (C.A.S.)
Anachis coronata Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Anachis diminuta C. B. Adams, Loc. 27,228 (C.A.S.)
Anachis inserta Stearns, Loc. 27,229 (C.A.S.)
Anachis moesta C. B. Adams, Loc. 27,229 (C.A.S.)
Anachis nigricans Sowerby, Loc. 27,257 (C.A.S.)
Anachis pygmaea Sowerby, Locs. 27,229; 27,257 (C.A.S.)
Anachis rugosa Sowerby, Loc. 27,257 (C.A.S.)
Anachis scalarina Sowerby, Loc. 27,229 (C.A.S.)
Anachis varia Sowerby, Loc. 27,257 (C.A.S.)
Architectonica granulata Lamarck, Loc. 27,229 (C.A.S.)
Astraea unguis Mawe, Loc. 27,257 (C.A.S.)
Barleeia zeteki Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Bulla punctulata A. Adams, Loc. 27,229 (C.A.S.)
Caecum bahiahondaense Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Caecum firmatum C. B. Adams, Locs. 27,228; 27,257 (C.A.S.)
Caecum parvum C. B. Adams, Loc. 27,229 (C.A.S.)
Caecum richthofeni Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Calliostoma leanus C. B. Adams, Loc. 27,228 (C.A.S.)

Calyptraea mamillaris Broderip, Locs. 27,228; 27,229 (C.A.S.)
Cantharus lugubris C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Cerithiopsis adamsi Bartsch, Locs. 27,228; 27,229 (C.A.S.)
Cerithiopsis anaitis Bartsch, Loc. 27,228 (C.A.S.)
Cerithiopsis curtata Bartsch, Loc. 27,228 (C.A.S.)
Cerithiopsis eiseni Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Cerithiopsis gissleri Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Cerithiopsis montezumai Strong & Hertlein, n. sp., Locs. 27,228; 27,229; 27,257 (C.A.S.)
Cerithium stercus-muscarum Valenciennes, Loc. 27,257 (C.A.S.)
Cerithium uncinatum Gmelin, Loc. 27,229 (C.A.S.)
Circulus bakeri Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Circulus nicholsoni Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Circulus tricarinatus C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Circulus valvatoides C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Clathrodrillia alcestis Dall, Loc. 27,228 (C.A.S.)
Clathrodrillia pallida Sowerby, Loc. 27,229 (C.A.S.)
Clathurella trichodes Dall, Locs. 27,228; 27,229 (C.A.S.)
Clava gemmata Hinds, Locs. 27,228; 27,229 (C.A.S.)
Colubraria aphrogenia Pilsbry & Lowe, Locs. 27,228; 27,229 (C.A.S.)
Conus brunneus Mawe, Loc. 27,229 (C.A.S.)
Conus gladiator Broderip, Loc. 27,229 (C.A.S.)
Conus mahogani Reeve, Loc. 27,228 (C.A.S.)
Conus nux Broderip, Loc. 27,229 (C.A.S.)
Conus orion Broderip, Loc. 27,229 (C.A.S.)
Conus princeps Linnaeus, Loc. 27,229 (C.A.S.)
Conus purpurascens Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Coralliophila costata Blainville, Loc. 27,229 (C.A.S.)
Cosmioconcha modesta Powys, Loc. 27,229 (C.A.S.)
Crassispira aterrima Sowerby, Loc. 27,257 (C.A.S.)
Crassispira nigerrima Sowerby, Loc. 27,229 (C.A.S.)
Crassispira sowerbyi Reeve, Loc. 27,229 (C.A.S.)
Crepidula aculeata Gmelin, Locs. 27,229; 27,257 (C.A.S.)
Crepidula fimbriata Reeve, Loc. 27,257 (C.A.S.)
Crepidula incurva Broderip,Locs. 27,228; 27,229 (C.A.S.)
Crepidula lingulata Gould, Loc. 27,229 (C.A.S.)
Crepidula nivea C. B. Adams, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Crepidula squama Broderip, Loc. 27,257 (C.A.S.)
Crucibulum imbricatum Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Crucibulum radiatum Broderip, Loc. 27,228 (C.A.S.)
Crucibulum spinosum Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Cyclostrema bartschi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Cyclostrema mccullochae Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Cyclostrema xantusi Bartsch, Locs. 27,229; 27,257 (C.A.S.)
Cylichna defuncta Baker & Hanna, Locs. 27,228; 27,229 (C.A.S.)
Cylichna stephensae Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Cylichna (Cylichnella) tabogaensis Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)

Cylichna veleronis Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Cymatium vestitum Hinds, Loc. 27,229 (C.A.S.)
Cypraea arabicula Lamarck, Loc. 27,229 (C.A.S.)
Cypraeolina margaritula Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Delphinoidea hambachi Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Delphinoidea hannai Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Delphinoidea cf. *ponceliana* De Folin, Loc. 27,228 (C.A.S.)
Diodora panamensis Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Elaeocyma cybele Pilsbry & Lowe, Loc. 27,229 (C.A.S.)
Elaeocyma melea Dall, Loc. 27,229 (C.A.S.)
Elaeocyma rosea Sowerby, Loc. 27,228 (C.A.S.)
Elephantanellum heptagonum Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Elephantulum liratocinctum Carpenter, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Engina jugosa C. B. Adams, Loc. 27,228 (C.A.S.)
Engina maura Sowerby, Loc. 27,229 (C.A.S.)
Engina reeviana C. B. Adams, Loc. 27,229 (C.A.S.)
Epitonium (Nitidiscala) gissleri Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Epitonium (Asperoscala) slevini Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Epitonium (Nitidiscala) wurtsbaughi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Erato columbella Menke, Loc. 27,229 (C.A.S.)
Erato oligocostata Dall, Locs. 27,228; 27,229 (C.A.S.)
Eumete bimarginata C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Eupleura nitida Broderip, Loc. 27,257 (C.A.S.)
Fossarus sp., Loc. 27,228 (C.A.S.)
Fusinus dupetit-thouarsi Kiener, Loc. 27,229 (C.A.S.)
Gadinia peruviana Sowerby, Loc. 27,229 (C.A.S.)
Haminoea angelensis Baker & Hanna, Loc. 27,229 (C.A.S.)
Heliacus planispira Pilsbry & Lowe, Loc. 27,228 (C.A.S.)
Heliacus radiatus Menke, Locs. 27,228; 27,229 (C.A.S.)
Heliacus sp., Loc. 27,228 (C.A.S.)
Hipponix grayanus Menke, Loc. 27,228 (C.A.S.)
Iselica kochi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Lamellaria inflata C. B. Adams, Loc. 27,257 (C.A.S.)
Latirus castaneus Reeve, Loc. 27,228 (C.A.S.)
Leucozonia cingulata Lamarck, Loc. 27,229 (C.A.S.)
Liotia balboai Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Liotia erici Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Liotia heimi Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Liotia sp., Loc. 27,228 (C.A.S.)
Lucapinella aequalis Sowerby, Loc. 27,228 (C.A.S.)
Mangilia antichroa Pilsbry & Lowe, Loc. 27,228 (C.A.S.)
Marginella minor C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Marginella sapotilla Hinds, Loc. 27,229 (C.A.S.)
Megalomphalus hancocki Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)

Melampus trilineatus C. B. Adams, Loc. 27,243 (C.A.S.)
Melanella cf. *gibba* De Folin, Loc. 27,229 (C.A.S.)
Melanella recta C. B. Adams, Loc. 27,228 (C.A.S.)
Melongena patula Broderip & Sowerby, Loc. 27,229 (C.A.S.)
Metaxia convexa Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Micranellum lohri Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Microcitharia uncinata Sowerby, Loc. 27,229 (C.A.S.)
Mitra attenuata Reeve, Locs. 27,228; 27,229 (C.A.S.)
Mitra funiculata Reeve, Locs. 27,228; 27,229 (C.A.S.)
Mitra lens Mawe, Loc. 27,229 (C.A.S.)
Mitra solitaria C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Mitra sp., Loc. 27,229 (C.A.S.)
Mitrella harfordi Strong & Hertlein, Loc. 27,228 (C.A.S.)
Modulus catenulatus Philippi, Locs. 27,228; 27,229 (C.A.S.)
Modulus disculus Philippi, Locs. 27,228; 27,229 (C.A.S.)
Murex incisus Broderip, Loc. 27,229 (C.A.S.)
Murex oxycantha Broderip, Loc. 27,229 (C.A.S.)
Muricopsis squamulata Carpenter, Loc. 27,229 (C.A.S.)
Nassarius complanatus Mawe, Loc. 27,243 (C.A.S.)
Nassarius corpulentus C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Nassarius nucleolus Philippi, Locs. 27,228; 27,229 (C.A.S.)
Nassarius pagodus Reeve, Locs. 27,229; 27,257 (C.A.S.)
Nassarius versicolor C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Natica broderipiana Philippi, Locs. 27,229; 27,243 (C.A.S.)
Natica catenata Philippi, Loc. 27,229 (C.A.S.)
Natica chemnitzii Pfeiffer, Loc. 27,257 (C.A.S.)
Nerita scabricosta ornata Sowerby, Locs. 27,229; 27,257 (C.A.S.)
Neritina latissima Broderip, Loc. 27,229 (C.A.S.)
Neritina usurpatrix Crosse & Fischer, Loc. 27,229 (C.A.S.)
Odostomia (Miralda) azteca Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Odostomia (Belsa) convexa Carpenter, Loc. 27,228 (C.A.S.)
Odostomia (Chrysallida) excelsa Dall & Bartsch, Loc. 27,257 (C.A.S.)
Odostomia (Miralda) galapagensis Dall & Bartsch, Loc. 27,229 (C.A.S.)
Odostomia (Miralda) incantata Hertlein & Strong, Locs. 27,228; 27,229 (C.A.S.)
Odostomia (Evalea?) isthmica Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Odostomia (Pyrgulina) marginata C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Odostomia (Ividella) orariana Dall & Bartsch, Loc. 27,229 (C.A.S.)
Odostomia (Chrysallida) paupercula C. B. Adams, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Odostomia (Menestho) recta De Folin, Loc. 27,229 (C.A.S.)
Odostomia (Chrysallida) rinella Dall & Bartsch, Locs. 27,228; 27,229 (C.A.S.)
Odostomia (Chrysallida) swetti Strong & Hertlein, n. sp., Locs. 27,228; 27,257 (C.A.S.)
Odostomia (Salassia) tropidita Dall & Bartsch, Locs. 27,228; 27,229 (C.A.S.)

Oliva spicata Bolten, Loc. 27,229 (C.A.S.)
Olivella volutella Lamarck, Loc. 27,257 (C.A.S.)
Phyllonotus hippocastanum Philippi, Locs. 27,228; 27,229 (C.A.S.)
Phyllonotus princeps Broderip, Loc. 27,229 (C.A.S.)
Phyllonotus (Muricanthus) radix Gmelin, Loc. 27,228 (C.A.S.)
Planaxis planicostatus Sowerby, Loc. 27,229 (C.A.S.)
Polinices uber Valenciennes, Locs. 27,228; 27,229 (C.A.S.)
Pustularia pustulata Lamarck, Loc. 27,229 (C.A.S.)
Pyramidella (Longchaeus) conica C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Pyramidella (Pyramidella) hancocki Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Rissoina adamsi Bartsch? var., Locs. 27,228; 27,229 (C.A.S.)
Rissoina clandestina C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Rissoina signae Bartsch, Loc. 27,229 (C.A.S.)
Rissoina sp., Loc. 27,229 (C.A.S.)
Seila assimilata C. B. Adams, Locs. 27,228; 27,229; 27,257 (C.A.S.)
Strombiformis healeyi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Strombiformis cf. *varians* Sowerby, Loc. 27,228 (C.A.S.)
Strombiformis sp., Loc. 27,229 (C.A.S.)
Strombina dorsata Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Strombina gibberula Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Strombina maculosa Sowerby, Locs. 27,228; 27,229 (C.A.S.)
Strombina sp., Loc. 27,228 (C.A.S.)
Strombus galeatus Swainson, Loc. 27,229 (C.A.S.)
Strombus gracilior Sowerby, Loc. 27,229 (C.A.S.)
Strombus granulatus Mawe, Locs. 27,228; 27,229 (C.A.S.)
Strombus peruvianus Swainson, Loc. 27,229 (C.A.S.)
Tegula reticulata Wood, Loc. 27,257 (C.A.S.)
Tegula rubroflammulata Koch, Loc. 27,228 (C.A.S.)
Teinostoma cf. *amplectans* Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Teinostoma cf. *carinata* Carpenter, Locs. 27,228; 27,229 (C.A.S.)
Teinostoma hemphilli Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Teinostoma ochsneri Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Terebra elata Hinds, Locs. 27,228; 27,229 (C.A.S.)
Terebra ira Pilsbry & Lowe, Loc. 27,229 (C.A.S.)
Terebra lingualis Hinds, Loc. 27,229 (C.A.S.)
Terebra (Strioterebra) montijoensis Pilsbry & Lowe, Loc. 27,229 (C.A.S.)
Thais biserialis Blainville, Locs. 27,243; 27,257 (C.A.S.)
Thais crassa Blainville, Locs. 27,229; 27,257 (C.A.S.)
Thais kiosquiformis Duclos, Loc. 27,257 (C.A.S.)
Triphora alternata C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Triphora dalli Bartsch, Loc. 27,229 (C.A.S.)
Triphora inconspicua C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Triphora marshi Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Triphora palmeri Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Triphora sp., Loc. 27,228 (C.A.S.)
Tritonalia incisa Broderip, Loc. 27,228 (C.A.S.)
Turbo fluctuosum Wood, Loc. 27,257 (C.A.S.)

Turbo squamiger Reeve, Loc. 27,228 (C.A.S.)
Turbonilla (Cingulina) academica Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Chemnitzia) aculea C. B. Adams, Locs. 27,228; 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) amandi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Bartschella) andrewsi Dall & Bartsch, Locs. 27,228; 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) bartonella Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Strioturbonilla) cowlesi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) craticulata Mörch, Loc. 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) crickmayi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) garthi Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Turbonilla (Strioturbonilla) haleyi Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Turbonilla (Strioturbonilla) imperialis Dall & Bartsch, Loc. 27,229 (C.A.S.)
Turbonilla (Careliopsis) israelskyi Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Pyrgiscus) macbridei Dall & Bartsch, Loc. 27,229 (C.A.S.)
Turbonilla (Mormula) major C. B. Adams, Loc. 27,228 (C.A.S.)
Turbonilla (Strioturbonilla) mcguirei Strong & Hertlein, n. sp., Loc. 27,228 (C.A.S.)
Turbonilla (Pyrgiscus) sealei Strong & Hertlein, n. sp., Loc. 27,229 (C.A.S.)
Turbonilla (Careliopsis) stenogyra Dall & Bartsch, Loc. 27,229 (C.A.S.)
Turbonilla (Strioturbonilla) stephanogyra Dall & Bartsch, Loc. 27,228 (C.A.S.)
Turbonilla (Pyrgiscus) stonei Strong & Hertlein, n. sp., Locs. 27,228; 27,229 (C.A.S.)
Turbonilla (Asmunda) turrita C. B. Adams, Loc. 27,229 (C.A.S.)
Turbonilla sp., Loc. 27,229 (C.A.S.)
Turris funiculata Valenciennes, Loc. 27,229 (C.A.S.)
Turris oxytropis Sowerby, Loc. 27,229 (C.A.S.)
Turritella banksii Reeve, Locs. 27,229; 27,257 (C.A.S.)
Turritella nodulosa King, Locs. 27,228; 27,229 (C.A.S.)
Turritella gonostoma Valenciennes, Loc. 27,229 (C.A.S.)
Vasum caestus Broderip, Locs. 27,228; 27,229 (C.A.S.)
Vermicularia (Aletes) centiquadrus Valenciennes, Loc. 27,229 (C.A.S.)
Vermicularia eburnea Reeve, Loc. 27,229 (C.A.S.)
Vermicularia pellucida Broderip & Sowerby, Loc. 27,229 (C.A.S.)
Vermicularia sp., Loc. 27,229 (C.A.S.)
Volvulella lowei Strong & Hertlein, Loc. 27,229 (C.A.S.)
Volvulella panamica Dall, Loc. 27,228 (C.A.S.)
Williamia galapagana Dall, Loc. 27,229 (C.A.S.)

Notes and Descriptions of New Species

Volvulella lowei Strong & Hertlein

Plate 18, Fig. 1

Volvulella lowei Strong & Hertlein, Proc. Calif. Acad. Sci., ser. 4, vol. 22, no. 6, December 31, 1937, p. 164, pl. 35, fig. 2. "Puerto Escondido, Gulf of California."

Hypotype: No. 759 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Eight additional specimens were dredged at the same locality.

This species differs from the other west coast species of this genus in the much more distinct spiral sculpture.

Cylichna stephensae Strong & Hertlein, new species

Plate 18, Figs. 2, 5

Shell ovate cylindrical, translucent white, shining, with the spire immersed, leaving a minute perforation in the rather deep apical pit; aperture as long as the shell; entire surface sculptured with fine, incised, spiral lines which are rendered slightly wavy by the rather prominent lines of growth; outer lip starting from the apical pit and rising slightly above the apex of the body whorl in a semicircle, then evenly curved along the side of the shell, and rather narrowly rounded at the base; columella partly reflected over the narrow umbilical groove, slightly twisted with a moderate fold at the junction with the basal lip; inner lip erased. The type measures: length, 6.7 mm; diameter, 3.2 mm.

Holotype: No. 717 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-six additional specimens were dredged at the same locality.

The species resembles *Cylichna fantasma* Baker & Hanna[22] more closely than any other west coast species but is smaller, proportionally broader, and has more uniform spiral sculpture.

This species is named for Mrs. Kate Stephens, Curator Emeritus of mollusks at the San Diego Society of Natural History.

[22] *Cylichnella fantasma* Baker & Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 5, 1927, p. 128, pl. 4, fig. 6. "Isthmus Bay, Espiritu Santo Island, Gulf of California."

Cylichna veleronis Strong & Hertlein, new species

Plate 18, Fig. 3

Shell ovately cylindrical, narrower toward the apical end, white, with the spire immersed, leaving a shallow apical pit; aperture as long as the shell; surface smooth except for about 25, slightly irregularly spaced, deeply incised, spiral lines; outer lip starting from the apical pit and rising slightly above the apex of the body whorl in a narrowly rounded point, then slightly curved along the side of the shell, with the basal portion rather effuse; columella, narrow, sharp, not reflected over the deep umbilical groove, nearly straight, with a slight fold at the junction with the basal lip; inner lip erased. The type measures: length, 4.9 mm; diameter, 2.3 mm.

Holotype: No. 719 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Eleven additional specimens were dredged at the same locality.

This species differs from all the other west coast species placed in the genus *Cylichna,* in having wide-spaced, sharp, incised spiral lines over the entire surface.

This species is named for the motor cruiser *Velero III,* belonging to Captain Allan Hancock of Los Angeles, California. It was during an expedition on this cruiser that the junior author collected the specimens described in this paper.

Cylichna (Cylichnella) tabogaensis Strong & Hertlein, new species

Plate 18, Fig. 4

Shell, short cylindrical, white, with the spire immersed leaving a shallow pit in the apex, aperture as long as the shell; surface sculptured with 3 incised spiral lines near the apex, and, on the lower third of the shell, a series of 12 similar incised spiral lines which become stronger and closer spaced toward the umbilical region; outer lip rising slightly above and rounding evenly into the apex of the last whorl without a sinus, nearly straight along the side of the shell, and broadly rounded at the base; columella twisted, with a spiral fold at its insertion and a second fold at the junction with the basal lip. The type measures: length, 3.00 mm; diameter, 1.6 mm.

Holotype: No. 718 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island,

Panama. L. G. Hertlein collector. Six additional specimens were dredged at the same locality, and 7 specimens at Loc. 27,229 (C.A.S.), in Bahia Honda, Panama.

The two distinct folds on the columella are sufficient to separate this form from all other west coast species in the genus. It is the first Recent species in the subgenus *Cylichnella* as defined by Dall,[23] to be described from the west coast of the Americas.

This species is named for Taboga Island, in Panama Bay, the type locality of this species.

Terebra (Strioterebra) montijoensis Pilsbry & Lowe

Terebra (Strioterebra) montijoensis Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, vol. 84, 1932, p. 42, pl. 1, fig. 1. "Montijo Bay."

Two adult and 7 young specimens were dredged at Loc. 27,229 (C.A.S.) in Bahia Honda, Panama. These differ slightly from the type in having 12 axial ribs and finer spiral sculpture but are otherwise very similar.

Mitrella harfordi Strong & Hertlein

Plate 18, Fig. 6

Mitrella harfordi Strong & Hertlein, Proc. Calif. Acad. Sci., ser. 4, vol. 22, no. 6, December 31, 1937, p. 167, pl. 35, fig. 15. "Lat. 16°38′N., Long. 99°27′30″W., to Lat. 16°39′N., Long. 99° 24′30″W., dredged in 20 to 45 fathoms, about 33 miles eastward of Acapulco, Guerrero, Mexico, and 32 miles west of Dulce Bay."

Hypotype: No. 733 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms., off Taboga Island, Panama. L. G. Hertlein collector. Thirteen additional specimens were dredged at the same locality.

Some of the specimens show the outer lip strongly dentate and the columella with a raised edge which is less strongly grooved. One specimen in particular shows a strongly developed varix on the back of the body whorl. Most of them are bleached a dull white. The indications

[23] Dall, W. H., Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 242. "*Cylichnella* Gabb, s.s., type *C. bidentata* Orb. Pillar with two distinct plaits."

of varicose swellings are similar to those on some species of *Strombina* in their younger stages but these specimens seem to be fully mature. The general aspect is more that of *Mitrella*.

Epitonium (Asperoscala) slevini Strong & Hertlein, new species
Plate 18, Fig. 9

Shell small, pure white; nuclear whorls 4, elevated, noticeably smaller than the first postnuclear whorl, smooth; postnuclear whorls 6, well rounded, separated by a deep suture, regularly increasing in size, forming a slender turreted spire; axial sculpture of 14 thin, strongly reflected varices, without angle or spine where they curve into the suture in which they meet and fuse, ascending the spire in a continuous line approximately parallel with the right side of the shell; on the base the varices continue without change to the base of the columellar lip; spiral sculpture of strongly incised spiral lines of which about 12 appear on the spire and 18 on the last whorl; aperture nearly entirely broken away in the type. The type measures: length, 4.3 mm; diameter, 2.0 mm.

Holotype: No. 724 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. It is probably not fully adult. L. G. Hertlein collector. Three additional but younger specimens were dredged at the same locality.

No other species with similar spiral sculpture and approximately this number of unarmed varices seems to have been described from the west coast of the Americas.

This species is named for Mr. Joseph R. Slevin, Curator of Herpetology of the California Academy of Sciences, who has collected numerous specimens for the Department of Paleontology of the same institution.

Epitonium (Nitidiscala) wurtsbaughi Strong & Hertlein, new species
Plate 18, Fig. 14

Shell small, pure white; nuclear whorls a little over 3, elevated, smooth; postnuclear whorls 6, well rounded, separated by a deep suture, rapidly enlarging, forming a broadly turreted spire; axial sculpture of 7, thin, high varices which meet and fuse in the suture and ascend the spire in a continuous line approximately parallel with the right side of

the shell; over the body of the shell the varices are narrowly, sharply reflected and at the shoulder expanded to form broad, nearly vertical spines; on the base they continue without change to the columellar lip; spiral sculpture absent; aperture nearly circular; columellar lip curved, reflected over the ends of the varices and extending posteriorly to the junction with the outer lip which is thickened by the last varix. The type measures: length, 7.2 mm; diameter, 4.4 mm.

Holotype: No. 725 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. One additional very young specimen was dredged at the same locality.

The broad shape and small number of coronating varices will serve to distinguish this species from all known species on the west coast of the Americas.

This species is named for Captain D. H. Wurtsbaugh, U. S. Navy (retired), who accompanied the expedition, during which the present species was collected.

Epitonium (Nitidiscala) gissleri Strong & Hertlein, new species

Plate 18, Fig. 8

Shell small, pure white; nuclear whorls 3, smooth, forming a regular continuation to the turreted spire; postnuclear whorls 6, well rounded, separated by a deep suture, regularly enlarging; axial sculpture of 8 high, rather thick varices which meet and fuse in the sutures and ascend the spire in a continuous line approximately parallel with the right side of the shell; over their entire length these varices are narrowly reflected, and only show a slight angle at the shoulder of the whorls; on the base the varices continue without change to the junction with the columellar lip; spiral sculpture absent; aperture nearly circular; columellar lip curved, broad and much thickened anteriorly, extending posteriorly to the junction with the outer lip which is thickened by the last varix. The type measures: length, 4.8 mm; diameter, 2.3 mm.

Holotype: No. 723 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Six additional specimens were dredged at the same locality.

The small size and small number of high, thick varices will serve to distinguish this species from all known species on the west coast.

This species is named for Captain August Gissler who spent much time on Cocos Island seeking hidden treasure reported to have been left on the island by pirates.

Strombiformis healeyi Strong & Hertlein, new species

Plate 18, Fig. 7

Shell minute, regularly elongate-conic, smooth, polished, uniformly pale brown, with the appearance of a darker subsutural band caused by the basal portion of the preceding whorl shining through the upper portion of the following whorl; whorls 8, early whorls well rounded, later whorls flattened, sutures indistinct; periphery obscurely angulated; base short, well rounded, aperture broadly oval; outer lip slightly thickened at the edge, decidedly protracted or drawn forward in the middle; inner lip short, curved, reflected and appressed to the base posteriorly; parietal callus thin. The type measures: length, 2.1 mm; diameter, 0.6 mm.

Holotype: No. 742 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Seven additional specimens were dredged at the same locality.

This minute species is probably nearer to *Strombiformis burragei* Bartsch[24] from the Gulf of California than to any other west coast species. It differs in the smaller size, more slender form, and in the protracted outer lip.

This species is named for William Healey Dall whose work has added so much to our knowledge of west American mollusks.

Pyramidella (Pyramidella) hancocki Strong & Hertlein, new species

Plate 18, Fig. 12

Shell regularly elongate-conic, dull brown; nuclear whorls having their axis at nearly right angles to and about one half immersed in the first postnuclear whorl, above which the edge appears; postnuclear whorls 12, flat sided, high between the channeled sutures; periphery of the last whorl marked by a distinct sulcus; entire surface marked by

[24] *Strombiformis burragei* Bartsch, Proc. U. S. Nat. Mus., vol. 53, August 13, 1917, p. 345, pl. 47, fig. 5. "Dredged in 3 fathoms at the head of Concepcion bay, Gulf of California."

lines of growth and very fine spiral striations; base inflated, strongly rounded, with a narrow, open umbilicus bounded by a strong, axially striated cord; aperture oval, with a slight anterior canal; outer lip thin, showing 3 faint white spiral lines deep within the aperture; columella slender, with the continuation of the basal cord forming a strong lamellar fold at its insertion, below which are 2 much weaker and more oblique folds. The type measures: length, 8.8 mm; diameter, 2.8 mm.

Holotype: No. 739 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Eight additional specimens were dredged at the same locality.

In general shape this species resembles *Pyramidella conica* C. B. Adams,[25] but the presence of the open umbilicus is a marked difference. The only other umbilicated species described from the west coast, *Pyramidella bairdi* Dall & Bartsch[26] from the Gulf of California, is an entirely differently shaped shell.

This species is named for Captain Allan Hancock, owner of the motor cruiser *Velero III,* through whose generosity the junior author was afforded the opportunity to accompany the expedition and make the collection upon which this report is based.

Turbonilla (Strioturbonilla) cowlesi Strong & Hertlein, new species

Plate 19, Fig. 3

Shell elongate-conic, white; nuclear whorls 2½, forming an elevated helicoid spire, the axis being at right angles to that of the first postnuclear whorl, in which it is slightly immersed, with the apex projecting beyond the outline of the following whorls; postnuclear whorls 10, well rounded, narrowly shouldered, sutures impressed; axial sculpture of slender, nearly vertical ribs, of which 20 appear on the first postnuclear whorl and 16 on the remaining whorls; intercostal spaces shallow, about three times as wide as the ribs, extending from suture to suture but terminating at the periphery; spiral sculpture of very fine, microscopic striations over the entire surface; periphery of the last

[25] *Pyramidella conica* C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 424, 542. "Panama."—Dall & Bartsch, U. S. Nat. Mus., Bull. 68, 1909, p. 23, pl. 1, fig. 9. "Panama Bay."

[26] *Pyramidella (Pyramidella) bairdi* Dall & Bartsch, U. S. Nat. Mus., Bull. 68, 1909, p. 19, pl. 1, figs. 5, 5a. "Gulf of California."

whorl obscurely angulated; base short, well rounded, marked by faint continuations of the axial ribs; aperture subquadrate, outer lip broken in the type; columella strong, almost straight. The type measures: length, 5.0 mm; diameter, 1.4 mm.

Holotype: No. 750 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Thirty-five additional specimens were dredged at the same locality.

In the key given by Dall & Bartsch[27] to the west coast species in the subgenus *Strioturbonilla,* this species would fall between *aresta* from southern California and *pazana* from the Gulf of California. It differs from the first in the smaller number of axial ribs and narrowly tabulated whorls and from the second in the much broader outline.

This species is named for Mr. Thomas Cowles, formerly librarian of the California Academy of Sciences, who assisted the writers many times with the library research necessary for the preparation of this paper.

Turbonilla (Strioturbonilla) mcguirei Strong & Hertlein, new species

Plate 19, Fig. 1

Shell elongate-conic, white; nuclear whorls 2½, forming an elevated helicoid spire, the axis being at right angles to that of the first postnuclear whorl, in which it is slightly immersed, with the apex projecting beyond the outline of the following whorls; postnuclear whorls 11, moderately rounded, sutures impressed; axial sculpture of slender, moderately protractive, slightly undulated ribs, of which 16 appear on the early whorls, gradually increasing to 20 on the body whorl; intercostal spaces about twice as wide as the ribs, extending from suture to suture but terminating at the periphery; spiral sculpture of fine, microscopic striations over the entire surface; periphery of the last whorl obscurely angulated; base short, well rounded, aperture subquadrate, outer lip thin, showing the external sculpture within; columella slender, nearly straight. The type measures: length, 4.7 mm; diameter, 1.1 mm.

Holotype: No. 756 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. A second but much younger specimen was dredged at the same locality.

[27] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 40, 41.

In the key given by Dall & Bartsch[28] to the west coast species in the subgenus *Strioturbonilla,* this would precede the last species from which it differs in the more numerous, protractive ribs and more slender form.

This species is named for Mr. Ignatius McGuire, formerly librarian of the California Academy of Sciences, who assisted the junior author on many occasions in library research necessary during the preparation of several papers.

Turbonilla (Strioturbonilla) haleyi Strong & Hertlein, new species
Plate 19, Fig. 2

Shell elongate-conic, white; nuclear whorls 2½, forming an elevated helicoid spire, the axis being at right angles to that of the first postnuclear whorl, in which it is nearly one half immersed, with the apex projecting slightly beyond the outline of the following whorls; postnuclear whorls 13, well rounded, sutures impressed; axial sculpture of slender, curved, protractive ribs, of which 16 appear on the early whorls, gradually increasing to 20 on the body whorl; intercostal spaces about twice as wide as the ribs; extending from suture to suture on the early whorls but on the later whorls terminating a little above the suture; spiral sculpture of fine, distinct, close-spaced striations over the entire surface; periphery of the last whorl well rounded; base short, well rounded; outer lip broken in the type; columella curved, slender, slightly reflected. The type measures: length, 7.3 mm; diameter, 1.8 mm.

Holotype: No. 753 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector.

This species is unique from any other described from the west coast of North America.

In the key given by Dall & Bartsch[29] to west coast species in the subgenus *Strioturbonilla,* this would follow *nicolsi* from the Gulf of California. It differs in the smaller number of axial ribs, more slender form, as well as in other ways.

This species is named for Dr. George Haley, Professor of Biology and Botany at the University of San Francisco, who has collected many shells for the California Academy of Sciences during his many collecting trips.

[28] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 40, 41.
[29] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 40, 41.

Turbonilla (Pyrgiscus) garthi Strong & Hertlein, new species
Plate 19, Fig. 9

Shell elongate-conic, white; nuclear whorls 2½, forming a depressed, helicoid spire, with the axis at right angles to that of the following whorls, in the first of which they are about one third immersed; postnuclear whorls 10, high between the sutures, with the sides flattened; axial sculpture of low, almost vertical ribs, of which 18 appear on the early whorls and 20 on the last whorl; interspaces shallow, nearly twice as wide as the ribs, marked with about 12, indistinct, irregularly spaced, spiral series of pits; periphery of last whorl rounded, marked by a stronger spiral series of pits, below which the ribs fade out; base moderately long, marked with fine, incised spiral lines; aperture subquadrate, outer lip thin, showing the external sculpture within; columella nearly straight. The type measures: length, 5.5 mm; diameter, 1.4 mm.

Holotype: No. 754 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. A second specimen was dredged at the same locality and two young specimens at Loc. 27,229 (C.A.S.), in Bahia Honda, Panama.

In the key given by Dall & Bartsch to the west coast species in the subgenus *Pyrgiscus*,[30] the new species *garthi* would follow *macbridei* from which it is easily distinguished by its less slender form and fewer axial ribs.

This species is named for Mr. John S. Garth, who accompanied the expedition, as collector of Lepidoptera and as musician.

Turbonilla (Pyrgiscus) stonei Strong & Hertlein, new species
Plate 19, Fig. 5

Shell minute, slender, pale brown; nuclear whorls 2½, comparatively large, helicoid, moderately elevated, with the axis at right angles to that of the following whorls, in the first of which it is about one third immersed; postnuclear whorls 7, moderately rounded, sutures impressed; axial sculpture of narrow, sinuous, nearly vertical ribs of which 18 appear on the second whorl, gradually increasing to 26 on the last whorl, while on the first whorl they are more numerous and quite

[30] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.

irregular; interspaces shallow, about as wide as the ribs, marked with numerous spiral series of fine, narrow pits, of which 2, one near the base of the whorls and the other a little above the middle of the whorls, are wider than the rest; periphery of the last whorl well rounded; base moderately long, the upper part marked by feeble continuations of the axial ribs between which the spiral sculpture is continued as pits, while on the lower part the pits are joined to form incised spiral lines; aperture oval, outer lip thin, showing the external sculpture within; columella curved. The type measures: length, 3.0 mm; diameter, 0.7 mm.

Holotype: No. 758 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-three additional specimens were dredged at the same locality, and 7 specimens from Loc. 27,228 (C.A.S.), off Taboga Island, Panama.

In the key given by Dall and Bartsch to the west coast species in the subgenus *Pyrgiscus,*[31] the new species *stonei* would follow *shimeki,* a species described from the Galapagos Islands which it resembles in general appearance, but from which it differs in the smaller size, lack of color bands, and more numerous axial ribs.

This species is named for Mr. George Stone, who accompanied the expedition as photographer, and who assisted in the collection of many specimens of shells.

Turbonilla (Pyrgiscus) crickmayi Strong & Hertlein, new species

Plate 19, Fig. 10

Shell elongate-conic, white; nuclear whorls 2½, forming a slightly elevated helicoid spire, with the axis at right angles to the following whorls, in the first of which it is about one third immersed; postnuclear whorls 6, moderately rounded, sutures impressed; axial sculpture of 16 lamellar ribs which terminate sharply at the summit, giving the whorls a tabulated appearance; interspaces about three times as wide as the ribs, marked with 8 spiral series of narrow pits; periphery of last whorl rounded, base rather long, marked with continuations of the axial ribs which extend feebly to the umbilical region, and 6 spiral series of pits, of which the one at the periphery is much the strongest; aperture oval, outer lip thin; columella curved. The type measures: length, 3.0 mm; diameter, 1.1 mm.

[31] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.

Holotype: No. 751 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Four additional specimens were dredged at the same locality.

In the key given by Dall & Bartsch to the west coast species in the subgenus *Pyrgiscus,*[32] this would follow *indentata,* a species described from the Gulf of California, which it resembles. It differs from that species in having the tabulation on the ribs only, as well as in other details.

This species is named for Dr. Colin H. Crickmay, formerly Assistant Professor of Paleontology at the University of California at Los Angeles, in recognition of his contributions to the Paleontology of western North America.

Turbonilla (Pyrgiscus) sealei Strong & Hertlein, new species
Plate 19, Fig. 6

Shell elongate-conic, white; nuclear whorls 2½, large, helicoid, with the axis at right angles to that of the following whorls, in the first of which they are about one third immersed; postnuclear whorls 10, rounded, with, on the later whorls, the greatest convexity on the lower third, sutures impressed; axial sculpture of nearly vertical ribs, of which 16 appear on the first 4 whorls, 18 on the fifth and sixth, 20 on the seventh and eighth, and 26 on the penultimate; interspaces shallow, about twice as wide as the ribs, marked with spiral series of shallow pits, of which 3 at the base and 1 a little above the center of the whorls are much wider than the rest which are closely spaced; periphery of last whorl well rounded; base rather short, well rounded, marked with feeble continuations of the axial ribs and about 8 incised spiral lines; aperture oval, outer lip thin; columella slightly curved, the body covered with a strong callus. The type measures: length, 5.2 mm; diameter, 1.4 mm.

Holotype: No. 757 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Eleven additional specimens were dredged at the same locality.

In the key given by Dall & Bartsch to the west coast species in the subgenus *Pyrgiscus,*[33] this would be grouped with *shimeki,* and *stonei*

[32] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.
[33] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.

of this paper, but differs entirely from it in general appearance. It is quite similar to *garthi* of this paper but differs in the presence of stronger series of pits near the middle of the whorls.

This species is named for Mr. Alvin Seale, Superintendent of the Steinhart Aquarium in San Francisco, California, who accompanied the expedition.

Turbonilla (Pyrgiscus) amandi Strong & Hertlein, new species

Plate 19, Fig. 7

Shell elongate-conic, uniformly light brown; nuclear whorls a little more than 2, depressed helicoid, with the axis at right angles to that of the following whorls, in the first of which they are about one fourth immersed; postnuclear whorls 9, moderately rounded, sutures impressed; axial sculpture of strong, narrow, nearly vertical ribs, of which 16 appear on the early whorls, gradually increasing to 24 on the last whorl; interspaces a little wider than the ribs, marked with 6 or 7 broad, shallow, spiral series of pits, on the later whorls the spaces between these pits are cut by 1 or 2 incised spiral lines; periphery of last whorl well rounded; base rather long, well rounded, the upper part marked by continuations of the axial ribs between which are 3 or 4 spiral series of pits, at about the middle of the base the axial ribs fade out and the spiral series of pits are joined to form incised spiral lines which grow gradually weaker toward the umbilical region; aperture oval, outer lip thin, showing the external sculpture within; columella raised, slightly curved, body with a distinct callus. The type measures: length, 4.3 mm; diameter, 1.1 mm.

Holotype: No. 749 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Forty-five additional specimens were dredged at the same locality.

In the key given by Dall & Bartsch to west coast species in the subgenus *Pyrgiscus,*[34] this would follow *almo,* a species described from San Diego, which it much resembles, differing principally in the arrangement of the spiral series of pits in the interspaces between the axial ribs.

[34] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.

This species is named for Dr. Rudolph Amandus Philippi, pioneer in studies of the natural history in Chile, whose works have added much to the knowledge of that region.

Turbonilla (Pyrgiscus) bartonella Strong & Hertlein, new species

Plate 19, Fig. 8

Shell minute, elongate-conic, pale yellowish with a narrow brown spiral band a little below the middle of the whorls; nuclear whorls 2½, relatively large, planorbid, with the axis at right angles to that of the following whorls, in the first of which they are slightly immersed; postnuclear whorls 8, well rounded, sutures impressed; axial sculpture of nearly vertical, slightly sinuous ribs, of which 16 appear on the early whorls, gradually increasing to 24 on the last whorl; interspaces about as wide as the ribs, marked with 2 spiral series of broad pits near the base, above which are about 12, equally spaced, incised, spiral lines; periphery of last whorl well rounded, marked by a narrow, smooth band; base rather long, well rounded, marked by a single spiral series of pits just below the periphery, then a second, narrow, smooth band, followed by 5 fine, incised, spiral lines; aperture oval, outer lip thin, showing the external sculpture within; columella slender, curved. The type measures: length, 2.8 mm; diameter, 0.7 mm.

Holotype: No. 752 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Eight additional specimens were dredged at the same locality.

In the key given by Dall & Bartsch to the west coast species in the subgenus *Pyrgiscus*,[35] this would follow *almo*, and *amandi* of this paper from which it differs in the much smaller size and different arrangement of the spiral series of pits.

This species is named for the late Dr. Barton Warren Evermann, formerly Director of the California Academy of Sciences and of the Steinhart Aquarium.

Turbonilla (Asmunda) turrita C. B. Adams

Chemnitzia turrita C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, July, 1852, pp. 393, 536. "Panama."

Four young specimens which appear to be *Turbonilla turrita* C. B.

[35] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 74, 75, 76.

Adams were dredged at Loc. 27,229 (C.A.S.), in Bahia Honda, Panama. These specimens are much smaller than the type as selected and described by Dall and Bartsch[36] but have only 6 postnuclear whorls, while the type is said to have 10. They agree in other ways with the description. The only other west coast species to be described in this subgenus, *Turbonilla churia* Bartsch[37] from Ecuador, lacks the peripheral keel but is otherwise very similar to our specimens and has about the same measurements.

Turbonilla (Careliopsis) israelskyi Strong & Hertlein, new species

Plate 19, Fig. 13

Shell very slender, translucent, white; nuclear whorls 2½, depressed helicoid, with the axis nearly at right angles to that of the following whorls, in the first of which they are slightly immersed; postnuclear whorls 6, moderately rounded, very narrowly tabulated at the summit, sutures distinct; spiral sculpture of regular incised lines, of which about 15 appear between the sutures; axial sculpture only indicated by a faint row of nodules at the summit of the whorls; periphery of the last whorl rounded; base long, rounded, marked like the spire with about 8 incised spiral lines; aperture oval, outer lip thin; columella strong, twisted. The type measures: length, 2.3 mm; diameter, 0.8 mm.

Holotype: No. 755 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Five additional specimens were dredged at the same locality.

This species differs from *Turbonilla stenogyra* Dall & Bartsch,[38] the only other west coast species described in the subgenus, in the smaller size, fainter axial sculpture, and slightly tabulated whorls.

This species is named for Mr. Merle C. Israelsky of Houston, Texas, formerly Assistant Curator of the Department of Paleontology of the California Academy of Sciences.

[36] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, p. 130, pl. 12, figs. 14, 14a.

[37] *Turbonilla (Asmunda) churia* Bartsch, Proc. U. S. Nat. Mus., vol. 69, art. 20, December 16, 1926, p. 11, pl. 3, fig. 5. "On the coast southeast of Punta Santa Elena, Santa Elena Peninsula, Ecuador."

[38] *Turbonilla (Careliopsis) stenogyra* Dall & Bartsch, U. S. Nat. Mus., Bull. 68, 1909, p. 130, pl. 12, figs. 1, 1a. "San Hipolito Point, Lower California."

Turbonilla (Careliopsis) stenogyra Dall & Bartsch

Turbonilla (Careliopsis) stenogyra Dall & Bartsch, U. S. Nat. Mus., Bull. 68, 1909, p. 130, pl. 12, figs. 1, 1a. "San Hipolito Point, Lower California."

Four specimens dredged at Loc. 27,229 (C.A.S.), in Bahia Honda, Panama. These specimens have only 6 or 7 whorls and are proportionally smaller than the type from San Hipolito Point, Lower California, which has 9 whorls. They agree with the description of the type in shape and details of sculpture, including the axial ribs on the upper part of the early whorls, a character which is mentioned in the description but not shown on the figure. These ribs are distinct in the Panama specimens.

Turbonilla (Cingulina) academica Strong & Hertlein, new species

Plate 19, Fig. 14

Shell elongate-conic, translucent white; nuclear whorls almost entirely, obliquely immersed in the first postnuclear whorl; postnuclear whorls 6, well rounded, sutures distinct; spiral sculpture of rounded keels, of which 1 appears on the first and second, 2 on the third, and 3 on the remaining whorls; the first of these keels is immediately above the suture and appears on all whorls, the second is a little above the middle of the whorl, and the third about half way between the other two, the space between the upper keel and the summit of the whorls is smooth and flattened; axial sculpture of faint riblets appearing in the spaces between the keels; periphery of last whorl marked by a narrow groove; base rather long, well rounded, smooth; aperture oval, somewhat effuse posteriorly, outer lip thin, scalloped by the ends of the spiral keels; columella slender, curved. The type measures: length, 2.7 mm; diameter, 0.9 mm.

Holotype: No. 748 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Five additional specimens were dredged at the same locality.

This species resembles *Turbonilla urdeneta* Bartsch[39] from Lower California, but is smaller and has only 3 instead of 4 spiral keels.

[39] *Turbonilla (Cingulina) urdeneta* Bartsch, Proc. U. S. Nat. Mus., vol. 52, May 29, 1917, p. 660, pl. 45, fig. 1. The type was "dredged in shallow water in Santa Maria Bay, Lower California." Other specimens were dredged in shallow water at Magdalena Bay and in 13½ fms. off Redondo Point, Magdalena Bay, Lower California.

Odostomia (Chrysallida) swetti Strong & Hertlein, new species

Plate 18, Fig. 11

Shell minute, elongate-ovate, white; nuclear whorls deeply obliquely immersed in the first postnuclear whorl; postnuclear whorls 5, slightly rounded, sutures channeled; axial sculpture of nearly vertical ribs of which 16 appear on the second, 22 on the third, and 26 on the penultimate whorl; spiral sculpture of 4 cords of which the upper 3 are rendered nodulous by the intersection with the axial ribs, while the lower cord is smooth or feebly waved at the termination of the axial ribs; the spaces inclosed by the axial ribs and spiral cords form well-impressed squarish pits; periphery of last whorl marked by a strong groove; base rather long, rounded, marked with 6 spiral cords which become weaker and closer spaced toward the umbilical region; aperture oval, outer lip thin, flattened in the middle; columella strong, curved, provided with a slender fold at its intersection; body with a moderate callus. The type measures: length, 2.1 mm; diameter, 1.2 mm.

Holotype: No. 738 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Thirty additional specimens were dredged at the same locality. Seven young specimens collected on the rocks at Loc. 27,257 (C.A.S.), at Panama City, seem to belong to this species.

In the key given by Dall and Bartsch to the west coast species in the subgenus *Chrysallida,*[40] this would be grouped with *vincta* from San Pedro, California, and *fasciata* from Mazatlan, Mexico. It differs from both in the more oval shape and more nearly vertical ribs, as well as in other details.

This species is named for Mr. Charles Swett, chief officer of the motor cruiser *Velero III* during the expedition on which the present collection was made.

Odostomia (Pyrgulina) marginata C. B. Adams

Plate 18, Fig. 13

Chemnitzia marginata C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 391-392, 536. "Panama."

[40] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, pp. 137, 138.

Odostomia (Pyrgulina) marginata C. B. Adams, Dall & Bartsch, U. S. Nat. Mus., Bull. 68, 1909, p. 169, pl. 18, figs. 5, 5a. Adams' specimen from Panama figured.

Hypotype: No. 737 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-five specimens from Loc. 27,229 (C.A.S.), were dredged in Bahia Honda, Panama, and 4 specimens were dredged at Loc. 27,228 (C.A.S.), off Taboga Island, Panama.

Our specimens do not agree in all particulars with the description and figure given by Dall and Bartsch from 1 of the 2 specimens collected by C. B. Adams. Neither does the description by Dall and Bartsch agree entirely with that of Adams. They state that the axis of the nuclear whorls is at right angles to that of the following whorls; Adams states "with the apex oblique," as is the case in our specimens. Dall and Bartsch state 14 axial ribs, Adams 11 or 12, while our specimens show from 16 to 24. However, these specimens come from the type locality of the species and agree in other ways with both descriptions. It would seem reasonable to suppose that they represent the normal form of the species better than the 2 specimens collected by Adams.

Odostomia (Miralda) azteca Strong & Hertlein, new species
Plate 18, Fig. 10

Shell minute, elongate-ovate, translucent white; nuclear whorls deeply obliquely immersed in the first postnuclear whorl; postnuclear whorls 5, sutures channeled; sculptured with 2 strong, elevated, nodulous, spiral cords, one at the summit and the other on the middle of the whorl; of the nodules 18 appear on the second, 20 on the third, and 22 on the penultimate whorl on each cord; the nodules on the lower cord are rounded, while those on the upper cord are axially elongate; the interspaces between the 2 cords and between the lower cord and the suture are marked with feeble axial riblets corresponding in position to the nodules; periphery of the last whorl marked by a smooth cord separated from the lower nodulous cord by a groove a little narrower than that between the 2 nodulous cords; on the base below the peripheral cord are 2 similar but smaller spiral cords; aperture ovate, the edge of the outer lip broken in the type; columella strong, curved, with an obscure fold at its insertion. The type measures: length, 1.3 mm; diameter, 0.8 mm.

Holotype: No. 734 (Calif. Acad. Sci. Paleo. Type Coll.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-five additional specimens were dredged at the same locality and 1 specimen collected on the rocks at Panama City.

In the key to the west coast species of the subgenus *Miralda* given by Dall and Bartsch,[41] *Odostomia azteca* would follow *armata* which was described from Mazatlan, Mexico, by Carpenter. It differs from that species in the smaller size, and in having the upper spiral row of nodules only slightly wider than the lower. These 2 species, together with *Odostomia aepynota* Dall and Bartsch from southern and Lower California, *Odostomia terebellum* C. B. Adams from Panama, and *Odostomia galapagensis* Dall and Bartsch from the Galapagos Islands, form a closely related group, the species of which differ only in the details of the sculpture. Some of them eventually may be found to intergrade through specimens from intermediate localities.

Odostomia (Evalea?) isthmica Strong & Hertlein, new species

Plate 19, Fig. 12

Shell elongate-conic, milk white, polished, shining; nuclear whorls almost completely immersed in the first postnuclear whorl, giving the apex a truncated appearance; postnuclear whorls 8, slightly rounded, narrowly tabulated at the summit, sharply contracted at the base, forming a deeply channeled suture; periphery of the last whorl angulated, with a faint raised thread on the angle (this thread is very faint on the type but quite noticeable on some of the paratypes); base short, well rounded, narrowly umbilicated; entire surface of spire and type marked with curved lines of growth and very fine, microscopic spiral striations; aperture oval, outer lip thin, decidedly drawn forward in the middle; columella slender, curved with a fold at its insertion. The type measures: length, 3.2 mm; diameter, 1.5 mm.

Holotype: No. 736 (Calif. Acad. Sci. Paleo. Type Coll.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Fourteen additional specimens were dredged at the same locality, and 17 specimens were dredged off Taboga Island, Panama.

This species would require a separate subdivision if placed in the key to the west coast species in the subgenus *Evalea*. In many ways it resembles some species of the genus *Pyramidella* but has only the single

[41] Dall, W. H., and Bartsch, P., U. S. Nat. Mus., Bull. 68, 1909, p. 176.

fold on the columella. This character also separates it from the genus *Niso* which contains some species which are quite similar in general appearance. It may belong to some subgenus of *Odostomia* not previously reported from the west coast but seems to fit better in the subgenus *Evalea* than in any of the other subgenera known from the west coast of the Americas.

Triphora palmeri Strong & Hertlein, new species

Plate 20, Fig. 1

Shell sinistral, regularly elongate-conic, light brown; nuclear whorls 6, the first 2 smooth, lighter than the balance of the shell, the 4 following whorls sculptured with 2 spiral cords and fine axial ribs of which about 30 appear on the last whorl; of the 2 spiral cords one is on the middle of the whorl and the other half way between it and the base; postnuclear whorls 7, sutures distinct; spiral sculpture on the early whorls consisting of 2 nodulous cords, of which one is at the summit and the other a little above the suture; beginning at about the third whorl a median, nodulous, spiral cord begins to develop and soon equals the other 2 in strength; axial sculpture of slender ribs connecting the nodules of the spiral cords and extending into the sutures; of these, 20 appear on the early whorls, gradually increasing to 24 on the last whorl; below the median spiral cord these ribs are nearly vertical, while on the upper part of the whorl they are retractive, the degree of angulation at the crossing of the median cord varying at different places on the shell; on the upper spiral cord the nodules are well rounded, while on the median and lower cord they slope more abruptly posteriorly than anteriorly; the space inclosed by the spiral cords and axial ribs form well impressed, square pits; periphery of the last whorl marked by a smooth cord, below which, on the base, are 2 similar and nearly equally strong and equally spaced spiral cords, the interspaces crossed by feeble extensions of the axial ribs; aperture oval, strongly channeled anteriorly; outer lip thin, the edge partly broken in the type; columella short, twisted; body covered with a thin callus. The type measures: length, 3.2 mm; diameter, 1.1 mm.

Holotype: No. 747 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Forty additional specimens were dredged in the same locality and 16 specimens dredged in Bahia Honda, Panama.

PLATE 18

Fig. 1. *Volvulella lowei* Strong & Hertlein, Hypotype, No. 759 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 3.0 mm; diameter, 1.1 mm. (Page 190.)

Fig. 2. *Cylichna stephensae* Strong & Hertlein, new species. Holotype, No. 717 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. Length, 6.7 mm; diameter, 3.2 mm. (Page 190.)

Fig. 3. *Cylichna veleronis* Strong & Hertlein, new species. Holotype, No. 719 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 4.9 mm; diameter, 2.3 mm. (Page 191.)

Fig. 4. *Cylichna (Cylichnella) tabogaensis* Strong & Hertlein, new species. Holotype, No. 718 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 3.0 mm; diameter, 1.6 mm. (Page 191.)

Fig. 5. *Cylichna stephensae* Strong & Hertlein, new species. View of enlarged portion of the shell of the holotype showing the fine incised lines ornamenting the body whorl. Same specimen as illustrated in figure 2. (Page 190.)

Fig. 6. *Mitrella harfordi* Strong and Hertlein. Hypotype, No. 733 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.2 mm; diameter, 1.7 mm. (Page 192.)

Fig. 7. *Strombiformis healeyi* Strong & Hertlein, new species. Holotype, No. 742 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.1 mm; diameter, 0.6 mm. (Page 195.)

Fig. 8. *Epitonium (Nitidiscala) gissleri* Strong & Hertlein, new species. Holotype, No. 723 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.8 mm; diameter, 2.3 mm. (Page 194.)

Fig. 9. *Epitonium (Asperoscala) slevini* Strong & Hertlein, new species. Holotype, No. 724 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.3 mm; diameter, 2.0 mm. (Page 193.)

Fig. 10. *Odostomia (Miralda) azteca* Strong & Hertlein, new species. Holotype, No. 734 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.3 mm; diameter, 0.8 mm. (Page 207.)

Fig. 11. *Odostomia (Chrysallida) swetti* Strong & Hertlein, new species. Holotype, No. 738 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 2.1 mm; diameter, 1.2 mm. (Page 206.)

Fig. 12. *Pyramidella (Pyramidella) hancocki* Strong & Hertlein, new species. Holotype, No. 739 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 8.8 mm; diameter, 2.8 mm. (Page 195.)

Fig. 13. *Odostomia (Pyrgulina) marginata* C. B. Adams. Hypotype, No. 737 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.73 mm; diameter, 0.93 mm. (Page 206.)

Fig. 14. *Epitonium (Nitidiscala) wurtsbaughi* Strong & Hertlein, new species. Holotype, No. 725 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 7.2 mm; diameter, 4.4 mm. (Page 193.)


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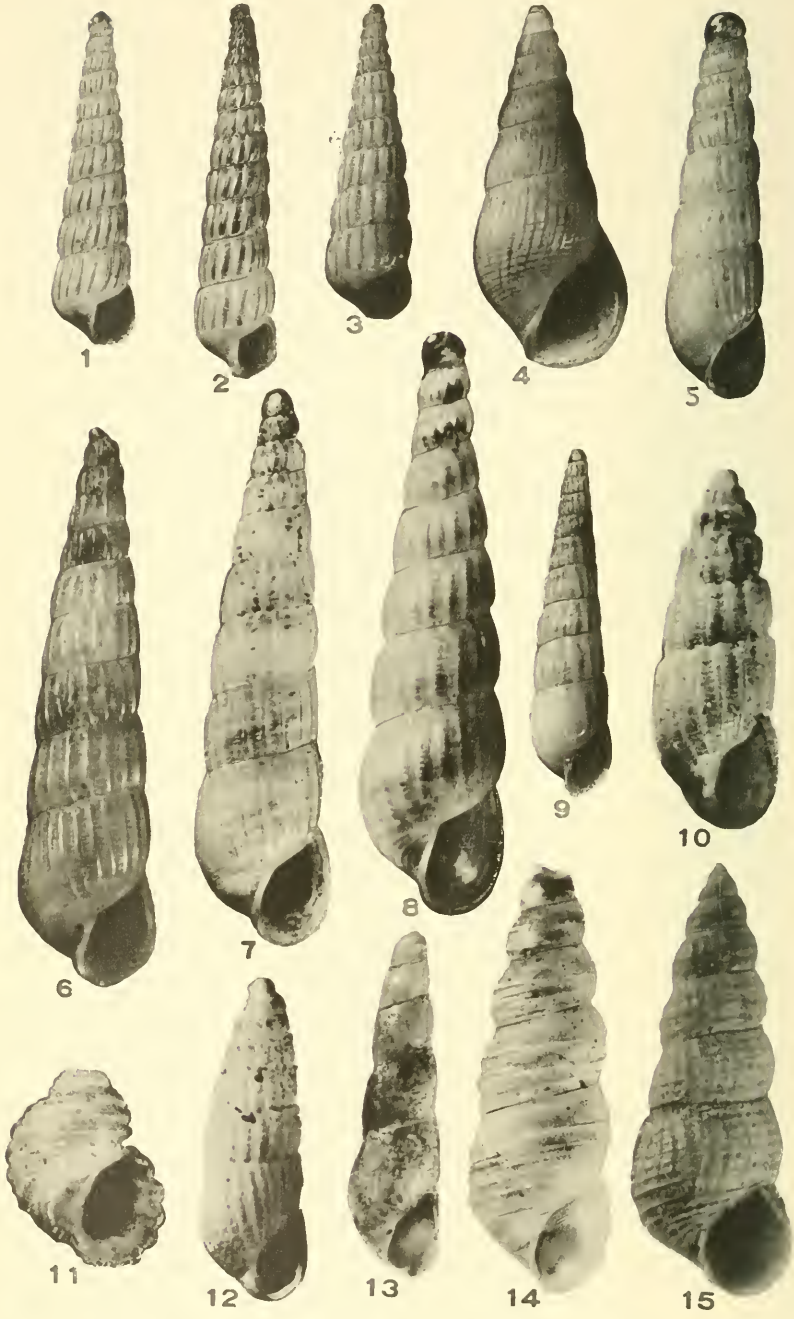
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PLATE 19

Fig. 1. *Turbonilla (Strioturbonilla) mcguirei* Strong & Hertlein, new species. Holotype, No. 756 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.7 mm; diameter 1.1 mm. (Page 197.)

Fig. 2. *Turbonilla (Strioturbonilla) haleyi* Strong & Hertlein, new species. Holotype, No. 753 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 7.3 mm; diameter, 1.8 mm. (Page 198.)

Fig. 3. *Turbonilla (Strioturbonilla) cowlesi* Strong & Hertlein, new species. Holotype, No. 750 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 5.0 mm; diameter, 1.4 mm. (Page 196.)

Fig. 4. *Rissoina adamsi* Bartsch ?var. Hypotype, No. 740 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 3.8 mm; diameter, 1.6 mm. (Page 229.)

Fig. 5. *Turbonilla (Pyrgiscus) stonei* Strong & Hertlein, new species. Holotype, No. 758 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 3.0 mm; diameter, 0.7 mm. (Page 199.)

Fig. 6. *Turbonilla (Pyrgiscus) sealei* Strong & Hertlein, new species. Holotype, No. 757 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 5.2 mm; diameter, 1.4 mm. (Page 201.)

Fig. 7. *Turbonilla (Pyrgiscus) amandi* Strong & Hertlein, new species. Holotype, No. 749 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 4.3 mm; diameter, 1.1 mm. (Page 202.)

Fig. 8. *Turbonilla (Pyrgiscus) bartonella* Strong & Hertlein, new species. Holotype, No. 752 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.8 mm; diameter, 0.7 mm. (Page 203.)

Fig. 9. *Turbonilla (Pyrgiscus) garthi* Strong & Hertlein, new species. Holotype, No. 754 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 5.5 mm; diameter, 1.4 mm. (Page 199.)

Fig. 10. *Turbonilla (Pyrgiscus) crickmayi* Strong & Hertlein, new species. Holotype, No. 751 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 3.0 mm; diameter, 1.1 mm. (Page 200.)

Fig. 11. *Iselica kochi* Strong & Hertlein, new species. Holotype, No. 727 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.5 mm; diameter, 1.2 mm. (Page 227.)

Fig. 12. *Odostomia (Evalea?) isthmica* Strong & Hertlein, new species. Holotype, No. 736 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 3.2 mm; diameter, 1.5 mm. (Page 208.)

Fig. 13. *Turbonilla (Careliopsis) israelskyi* Strong & Hertlein, new species. Holotype, No. 755 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.3 mm; diameter, 0.8 mm. (Page 204.)

Fig. 14. *Turbonilla (Cingulina) academica* Strong & Hertlein, new species. Holotype, No. 748 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.7 mm; diameter, 0.9 mm. (Page 205.)

Fig. 15. *Alabina veraguaensis* Strong & Hertlein, new species. Holotype, No. 699 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.8 mm; diameter, 1.0 mm. (Page 218.)

The sculpture of this species is very similar to that of *Triphora peninsularis* Bartsch,[42] described from Lower California, but the figure of that species shows considerable difference in shape, while the measurements indicate that the Panama shell with an equal number of whorls would be distinctly larger.

This species is named for Dr. Edwin O. Palmer, physician, who accompanied the expedition.

Triphora marshi Strong & Hertlein, new species

Plate 20, Figs. 2, 3

Shell sinistral, regularly elongate-conic, lower portion of the whorls white, upper portion, with the exception of the top of scattering tubercles on the upper spiral cord, brown, the white-topped tubercles being usually arranged in pairs; spiral nuclear whorls 7, the first 2 smooth, darker than the following whorls, which are sculptured with 2 spiral cords and slender axial ribs, of which about 30 appear on the last whorl; of the 2 spiral cords one is situated on the middle of the whorls and the other about half way between it and the base; postnuclear whorls 10, sutures indistinct; spiral sculpture on the early whorls consisting of 2 nodulous cords, of which one is at the summit and the other only a little above the suture; beginning at about the sixth whorl a median spiral cord begins to develop, a little nearer to the posterior than the anterior cord: this gradually increases in strength until on the last whorl it nearly equals the other 2 in strength; axial sculpture of slender, retractive ribs connecting the nodules of the spiral cords: of these, 20 appear on all except the first 2 whorls, where there are a few less; the nodules of the upper spiral cord are well rounded and slightly more prominent than those on the lower spiral cord, on which they are truncated on the posterior face; the nodules on the median cord are also posteriorly truncated; the spaces inclosed by the spiral cords and axial ribs are well-impressed rectangular pits; periphery of the last whorl marked by a nodulous cord which is separated from the suprasutural cord by a narrow channel; below this on the base are 2 spiral cords only a little less strong, of which the upper is feebly nodulous; aperture irregular, outer lip thin, the basal portion expanded and roofing over the anterior canal and columella. The type measures: length, 4.66 mm; diameter, 1.33 mm. It has lost the first 4 nuclear

[42] *Triphoris peninsularis* Bartsch, Proc. U. S. Nat. Mus., vol. 33, December 12, 1907, p. 255, pl. 16, fig. 2. "Point Abreojos, Lower California."

whorls and is bleached until the color pattern is indistinct. The description of the nuclear whorls and color pattern is taken from a paratype of 7 postnuclear whorls.

Holotype: No. 745 and paratype 745A (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty additional specimens were dredged at the same locality and 4 off Taboga Island, Panama.

The sculpture of this species is somewhat similar to that of *Triphora hemphilli* Bartsch,[43] described from Lower California, but it is a smaller and differently colored shell.

This species is named for Mr. Herman Marsh, musician, who accompanied the expedition, during which the present collection was made.

Eumete bimarginata C. B. Adams

Plate 20, Fig. 4

Cerithium bimarginatum C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 375-376, 533. "Panama."

Eumete bimarginata C. B. Adams, Bartsch, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 566, text fig. 2. Dredged in 29.5 fms., in the Bay of Panama; also in 26 fms., on sandy bottom, off La Paz, in the Gulf of California. Adams' original locality record of Panama also cited.

Hypotype: No. 726 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Thirty-six specimens were dredged off Taboga Island, Panama, and 25 specimens were dredged in Bahia Honda, Panama.

The specimens described by Adams and that described by Bartsch are evidently all young. The Academy's collection contains specimens with several more whorls. These show on the lower whorls a slender, smooth, median spiral cord not shown on Bartsch's figure. The specimen figured has 13 postnuclear whorls and measures: length, 7.8 mm; diameter, 2.0 mm. It was dredged in from 3 to 9 fms. off Taboga Island, Panama.

[43] *Triphoris hemphilli* Bartsch, Proc. U. S. Nat. Mus., vol. 33, December 12, 1907, p. 253, pl. 16, fig. 12. The type was collected by Mr. Henry Hemphill "from shell washings at Point Abreojos, Lower California."

Cerithiopsis eiseni Strong & Hertlein, new species

Plate 20, Fig. 6

Shell minute, elongate-ovate, brown; nuclear whorls decollated; postnuclear whorls 6, the early whorls rapidly enlarging, the last contracted toward the base, sutures impressed; spiral sculpture consisting of 3 tuberculate cords, of which one is at the summit, one immediately above the suture, and the third half way between the other two, the spaces between them being a little wider than the cords; axial sculpture of equally strong, nearly vertical ribs connecting the tubercles and extending into the sutures: of these ribs 16 appear on the second, 18 on the third and fourth, and 20 on the penultimate whorl; the tubercles at the junction of the axial cords and spiral ribs are well rounded and the spaces inclosed by them form well impressed, rounded pits; periphery of the last whorl marked by a sulcus about as wide as the spaces between the spiral cords, and like them crossed by the ends of the axial ribs; base well rounded, marked by 3 spiral cords, separated by rounded grooves, the upper of these cords bounds the peripheral sulcus and is slightly nodulous, while the lower is a slender thread encircling the columella; aperture oval, strongly channeled anteriorly, the outer lip broken in the type; columella curved, stout, the body with a thick callus. The type measures: length, 1.8 mm; diameter, 0.8 mm.

Holotype: No. 710 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-seven additional specimens were dredged at the same locality and 3 specimens off Taboga Island, Panama.

In the key to the west coast species in the genus *Cerithiopsis*,[44] this species would follow *pupiformis* which was described from Mazatlan, Mexico. It differs from that species principally in the more ovate form and in the smaller, wider spaced tubercles.

This species is named for Dr. Gustav Eisen, member of the California Academy of Sciences.

Cerithiopsis gissleri Strong & Hertlein, new species

Plate 20, Fig. 7

Shell minute, brown, nuclear whorls white, 4 smooth, well rounded, forming a conical spire; postnuclear whorls 6, the early whorls rapidly

[44] Bartsch, P., Proc. U. S. Nat. Mus., vol. 40, May 8, 1911, pp. 330, 331.

increasing in size, the last 3 cylindrical, sutures impressed; spiral sculpture consisting of 3 tuberculate cords of which one is at the summit, one a little above the suture, and a median cord which is nearer the one at the summit than the suprasutural one on the early whorls but about half way between them on the later whorls; axial sculpture of equally strong, nearly vertical ribs which connect the tubercles and extend into the suture: of these ribs 16 appear on the second, 18 on the third and fourth, 20 on the fifth, and 22 on the penultimate whorl; the tubercles at the junction of the axial ribs and spiral cords are rounded anteriorly and truncated posteriorly; the spaces enclosed between the axial ribs and the upper and median spiral cords form spirally elongated pits and those between the median and suprasutural cords form squarish pits; periphery of the last whorl marked by a sulcus about as wide as that between the median and suprasutural spiral cord and like it is crossed by the ends of the axial ribs; base rather long, marked by 2 strong, rounded spiral cords, of which one bounds the peripheral sulcus and the other is near the middle; in addition to these there is a very slender, raised thread encircling the columella; aperture oval, strongly channeled anteriorly, the edge of the outer lip broken in the type; columella strong, twisted, the body with a strong callus. The type measures: length, 3.0 mm; diameter, 0.9 mm.

Holotype: No. 711 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Seventy additional specimens were dredged at the same locality.

In Bartsch's key to the west coast species in the genus *Cerithiopsis*,[45] this would follow *abreojosensis* which was described from Lower California. It differs principally in the posterior truncation of the tubercles.

This species is named for Captain August Gissler, who resided on Cocos Island for several years and sought for the treasure reported to have been hidden on the island by pirates.

Cerithiopsis montezumai Strong & Hertlein, new species

Plate 20, Fig. 8

Shell dark brown with the nuclear whorls white, regularly elongate-conic; nuclear whorls 4, well rounded, smooth, forming a conical spire; postnuclear whorls 7, sutures impressed; spiral sculpture consisting of

[45] Proc. U. S. Nat. Mus., vol. 40, May 8, 1911, pp. 330, 331.

3 tuberculate cords, of which one is at the summit, one a little above the suture, and the third about half way between the other two; axial sculpture of slightly less strong, moderately protractive ribs which connect the tubercles of the spiral cords and extend into the sutures: of these, 18 appear on the early whorls, gradually increasing to 24 on the penultimate whorl; the tubercles at the junction of the axial ribs and spiral cords more or less truncated on the posterior face, particularly those on the lower spiral cord; the space enclosed by the axial ribs and spiral cords forming well impressed, squarish pits; periphery of the last whorl marked by a sulcus about as wide as that between the spiral cords and like them crossed by the ends of the axial ribs; base short, marked by 2 spiral cords, one of which bounds the peripheral sulcus and the other a slender, raised thread encircling the columella, the space between them being slightly concave; aperture nearly circular, strongly channeled anteriorly, outer lip broken in the type; columella curved, twisted. The type measures: length, 3.2 mm; diameter, 1.2 mm.

Holotype: No. 712 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,257 (C.A.S.), collected on the rocks below the Delessep Monument at Panama City, Panama. L. G. Hertlein collector. A second specimen was collected at the same locality. In addition to these, 31 specimens were dredged in Bahia Honda and 5 specimens were dredged off Taboga Island, Panama.

In Bartsch's key to the west coast species in the genus *Cerithiopsis,*[46] this would follow *infrequens,* also described from Panama. It differs from that species principally in the more numerous axial ribs and different arrangement of basal cords. It is also larger for the same number of whorls.

This species is named for Montezuma, the Chief of the Aztec Indians, in Mexico City, at the time of the arrival of Cortez.

Alabina veraguaensis Strong & Hertlein, new species

Plate 19, Fig. 15

Shell minute, elongate-conic, pale brownish; nuclear whorls 3, yellowish, rounded, smooth; postnuclear whorls 3, with an indistinct, sloping shoulder reaching from a little below the middle to the summit, lower part rounded; major spiral sculpture consisting of 2 spiral cords, one on the middle of the whorl bounding the sloping shoulder, and the other halfway between it and the base of the whorl; on the second

[46] Bartsch, P., Proc. U. S. Nat. Mus., vol. 40, May 8, 1911, pp. 330, 331.

postnuclear whorl a slender spiral cord appears on the middle of the shoulder; on the third whorl still another cord appears at the summit of the whorl; on the fourth whorl there are 4 spiral cords on the shoulder and another between the 2 major spiral cords, while on the penultimate whorl there are 7 nearly equal spiral cords; axial sculpture of slender, more or less curved ribs, of which about 30 appear on the penultimate whorl; periphery of the last whorl marked by a sulcus; base well rounded, marked with 5 equally spaced spiral cords which grow gradually weaker toward the umbilical region; aperture nearly circular, outer lip thin; columella curved, slender, body with a very thin callus. The type measures: length, 2.8 mm; diameter, 1.0 mm. Among the paratypes there is considerable difference in the sculpture on the last whorl, some being almost smooth.

Holotype: No. 699 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. About 400 additional specimens were dredged at the same locality; 17 specimens off Taboga Island, Panama.

The sculpture of this species is quite similar to that of *Alabina diomedeae* Bartsch,[47] described from the Gulf of California, but it is a much smaller and proportionately broader shell.

This species is named for the state of Veragua of the Republic of Panama.

Caecum bahiahondaense Strong & Hertlein, new species

Plate 20, Fig. 10

Shell consisting of a minute, moderately curved, opaque, white tube of nearly uniform diameter; sculptured with 18 strong, rounded elevated rings, separated by rounded grooves a little wider than the rings; aperture sharp edged, circular, separated from the last ring by a narrow, contracted, flat area, which is about twice as wide on the convex as on the concave side of the tube, causing the aperture to be set at a slight angle to the axis of the tube; posterior end of the tube contracted, closed by a plug which is encircled by a narrow, raised rim; from the center of the plug a spur rises toward the convex side of the tube, ending in a rounded point just inside the line of the rim. The type measures: length, 1.9 mm; diameter of tube, 0.5 mm.

[47] *Alabina diomedeae* Bartsch, Proc. U. S. Nat. Mus., vol. 39, January 13, 1911, p. 413, pl. 62, fig. 1. Type dredged "in 26½ fathoms, on broken shell bottom off Cacachitas, Gulf of California."

PLATE 20

Fig. 1. *Triphora palmeri* Strong & Hertlein, new species. Holotype, No. 747 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 3.2 mm; diameter, 1.1 mm. (Page 209.)

Fig. 2. *Triphora marshi* Strong & Hertlein, new species. Holotype, No. 745 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 4.66 mm; diameter, 1.33 mm. (Page 214.)

Fig. 3. *Triphora marshi* Strong & Hertlein, new species. Paratype, No. 745A (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 4 mm; diameter, 1.21 mm. (Page 214.)

Fig. 4. *Eumete bimarginata* C. B. Adams. Hypotype, No. 726 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 7.8 mm; diameter, 2.0 mm. (Page 215.)

Fig. 5. *Rissoina (Folinia) signae* Bartsch. Hypotype, No. 741 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.13 mm; diameter, 1.1 mm. (Page 234.)

Fig. 6. *Cerithiopsis eiseni* Strong & Hertlein, new species. Holotype, No. 710 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.8 mm; diameter, 0.8 mm. (Page 216.)

Fig. 7. *Cerithiopsis gissleri* Strong & Hertlein, new species. Holotype, No. 711 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 3.0 mm; diameter, 0.9 mm. (Page 216.)

Fig. 8. *Cerithiopsis montezumai* Strong & Hertlein, new species. Holotype, No. 712 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,257 (C.A.S.), on rocks on beach below Delessep's Monument at Panama City, Panama. Length, 3.2 mm; diameter, 1.2 mm. (Page 217.)

Fig. 9. *Elephantanellum heptagonum* Carpenter. Hypotype, No. 722 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.8 mm; diameter, 0.4 mm. (Page 226.)

Fig. 10. *Caecum bahiahondaense* Strong & Hertlein, new species. Holotype, No. 708 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.9 mm; diameter, 0.5 mm. (Page 219.)

Fig. 11. *Caecum richthofeni* Strong & Hertlein, new species. Holotype, No. 709 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 2.9 mm; diameter, 0.8 mm. (Page 224.)

Fig. 12. *Micranellum lohri* Strong & Hertlein, new species. Holotype, No. 732 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.4 mm; diameter, 1.2 mm. (Page 225.)

Fig. 13. *Micranellum lohri* Strong & Hertlein, new species. Paratype, No. 732A (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Length, 4.36 mm; diameter, 1.0 mm. (Page 225.)


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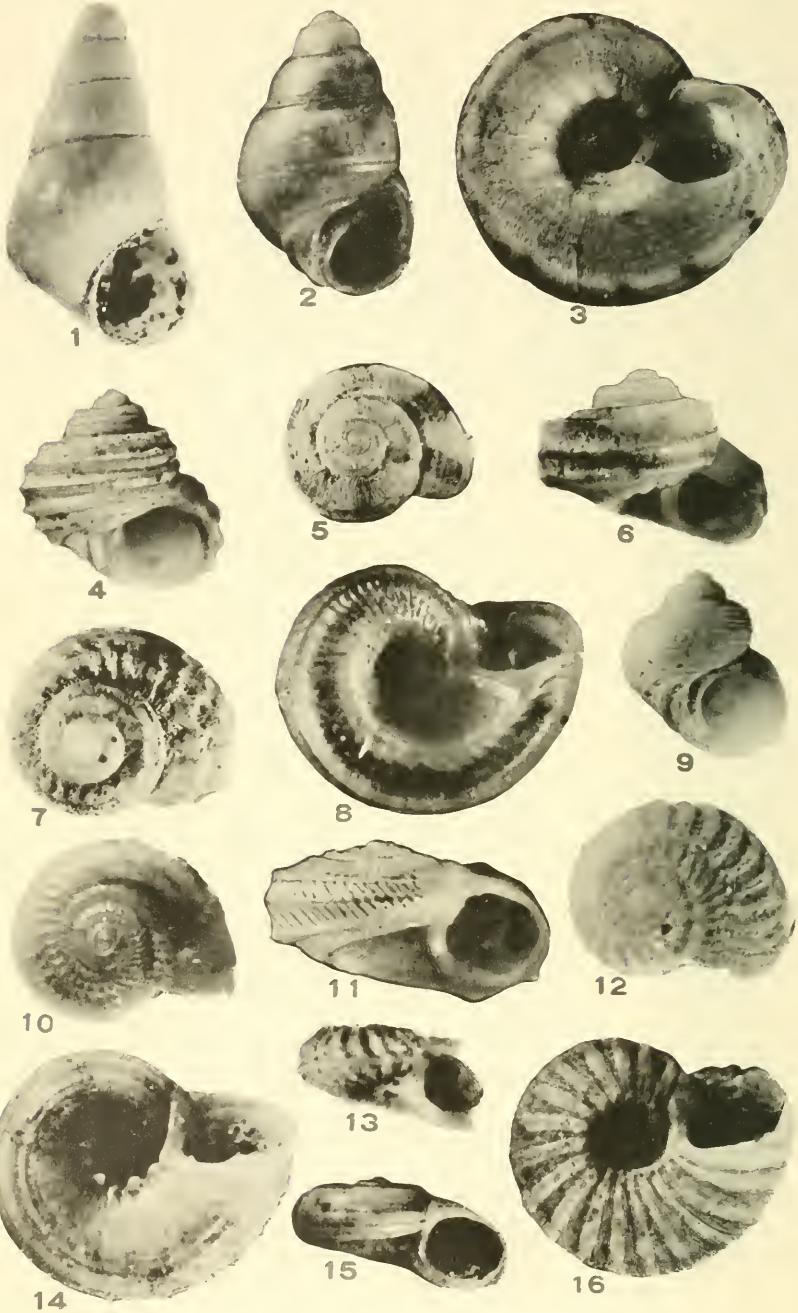
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PLATE 21

Fig. 1. *Barleeia zeteki* Strong & Hertlein, new species. Holotype, No. 707 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 2.2 mm; diameter, 1.3 mm. (Page 228.)

Fig. 2. *Amphithalamus trosti* Strong & Hertlein, new species. Holotype, No. 706 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Length, 1.1 mm; diameter, 0.7 mm. (Page 228.)

Fig. 3. *Liotia balboai* Strong & Hertlein, new species. Holotype, No. 728 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Height, 2.5 mm; diameter, 3.6 mm. View of base. (Page 236.)

Fig. 4. *Liotia heimi* Strong & Hertlein, new species. Holotype, No. 730 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in 3 to 9 fms. off Taboga Island, Panama. Height, 1.4 mm; diameter, 2.0 mm. (Page 238.)

Fig. 5. *Liotia balboai* Strong & Hertlein, new species. View of the top of the specimen shown in figure 3. (Page 236.)

Fig. 6. *Liotia balboai* Strong & Hertlein, new species. Apertural view of the specimen shown in figures 3 and 5. (Page 236.)

Fig. 7. *Liotia heimi* Strong & Hertlein, new species. View of the top of the specimen shown in figure 4. (Page 238.)

Fig. 8. *Cyclostrema mccullochae* Strong & Hertlein, new species. Holotype, No. 716 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.5 mm; greatest diameter, 1.1 mm. Basal view. (Page 239.)

Fig. 9. *Liotia erici* Strong & Hertlein, new species. Holotype, No. 729 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 1.3 mm; diameter, 2.0 mm. (Page 237.)

Fig. 10. *Cyclostrema mccullochae* Strong & Hertlein, new species. View of the top of the specimen shown in figure 8. (Page 239.)

Fig. 11. *Cyclostrema mccullochae* Strong & Hertlein, new species. Apertural view of the specimen shown in figs. 8 and 10. (Page 239.)

Fig. 12. *Cyclostrema bartschi* Strong & Hertlein, new species. Holotype, No. 715 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.5 mm; greatest diameter, 1.0 mm. View of the top of the specimen. (Page 240.)

Fig. 13. *Cyclostrema bartschi* Strong & Hertlein, new species. Apertural view of the specimen shown in figures 12 and 16.

Fig. 14. *Circulus bakeri* Strong & Hertlein, new species. Holotype, No. 713 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.5 mm; greatest diameter, 1.4 mm. (Page 240.)

Fig. 15. *Circulus bakeri* Strong & Hertlein, new species. Apertural view of the specimen shown in figure 14.

Fig. 16. *Cyclostrema bartschi* Strong & Hertlein, new species. Basal view of the specimen shown in figures 12 and 13. (Page 240.)

Holotype: No. 708 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Approximately 600 additional specimens were dredged in the same locality.

The edge of the aperture does not look fully mature, but in the large number of specimens there is nothing to indicate a later stage of growth. The only west coast species approximating this in size and number of rings is *Caecum parvum* C. B. Adams,[48] also from Panama, but it is said to have "acute-edged moderately prominent distant rings." The specimens so identified in this collection are quite distinct from the present species. *Caecum dalli* Bartsch,[49] from California, has much the same appearance but is a larger shell with broader, flat topped rings.

This species is named for Bahia Honda [Deep Bay], Panama, where a collection was made of many species of the smaller mollusks as well as a number of species belonging to the larger forms.

Caecum richthofeni Strong & Hertlein, new species

Plate 20, Fig. 11

Shell consisting of a moderately curved, opaque, white tube of nearly uniform diameter; sculptured with 27 raised rings which are flatly reflected toward the aperture or anterior end of the tube, the edges nearly in contact on the concave side of the tube but separated by open spaces of varying width on the convex side; the flat top of the rings marked with close, microscopic, longitudinal threads; the last 3 rings separated from the balance by a deep, rounded sulcus, showing faint annular striations in the bottom; the last ring contracted to form a broad, sloping face surrounding the aperture; aperture circular, at a slight angle to the curved axis of the tube, the last ring being much narrower on the concave than on the convex side of the tube; posterior end of the tube somewhat contracted, closed by a deep-seated plug encircled by a high rim; a clawlike spur rises from the center of the plug with the point extending beyond the rim on the convex side of the tube. Operculum concave, horn colored, with a central nucleus and about 12 concentric rings. The type measures: length, 2.9 mm; diameter of tube, 0.8 mm.

[48] *Caecum parvum* C. B. Adams, Ann. Lyceum Nat. Hist. New York, 1852, pp. 387, (No. 217), 535. "Panama."

[49] *Caecum dalli* Bartsch, Jour. Washington Acad. Sci., vol. 10, no. 20, December 4, 1920, p. 568. Type locality, "San Diego," California. Also known at many stations from San Diego to Lower California.

Holotype: No. 709 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Fifteen additional specimens were dredged at the same locality.

The sculpture of this species is so different from that given in the description of any other west coast species that any comparison would seem to be of little value.

This species is named for Ferdinand Freiherr von Richthofen, early member of the California Academy of Sciences.

Micranellum lohri Strong & Hertlein, new species

Plate 20, Figs. 12, 13

Shell consisting of a moderately curved, slightly tapering, opaque, white tube; sculptured with about 50 low, flattened rings separated by narrow, squarish grooves; the anterior end of the tube slightly expanded, the expanded area extending over a width of about 8 rings; the last ring contracted, the face marked with 3 fine, incised, annular lines, forming a narrow, rounded edge to the aperture; aperture circular, at a slight angle to the curved axis of the tube, the last ring being narrower on the concave than on the convex side of the tube; posterior end closed by a plug encircled by a very narrow raised rim; the entire surface of the plug rising toward the convex side of the tube and ending in a triangular spur near the edge. Operculum concave, horn colored, with a central nucleus and about 12 concentric rings. The type measures: length, 4.4 mm; diameter of tube, 1.2 mm.

Holotype: No. 732 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. About 130 additional specimens were dredged at the same locality.

The size and shape of this species is quite similar to that of *Micranellum crebricinctum* Carpenter,[50] from California, but that species has about twice as many and much finer rings. In the younger stages, shown on some of the paratypes, the rings are so faint that they are only indicated under the microscope. However, the long, slender form and triangular plug would seem to be sufficient to distinguish this stage from any other description of a west coast species.

[50] *Caecum crebricinctum* Carpenter, Proc. Calif. Acad. Sci., vol. 3, February, 1866, p. 215. "*Hab.* San Diego, 8-10 fms., 12; Monterey, 20 fms., 20, some alive; Santa Barbara, 20 fms., 3, Cooper."

This species is named for Dr. Fred von Lohr, who accompanied Dr. W. M. Gabb on an expedition to Lower California, during the pioneer work on the geology of western North America.

Elephantanellum heptagonum Carpenter

Plate 20, Fig. 9

Caecum heptagonum Carpenter, Mazatlan Catalogue, [1855-] 1857, p. 319. "Mazatlan."

Carpenter's brief description from a fragment collected at Mazatlan, Mexico, "containing a perfect mouth," seems to be unmistakable. A description of the entire shell follows.

Shell consisting of a minute, brownish, moderately curved, slightly tapering, seven-sided tube, concave between the slightly raised longitudinal ridges at the angles; both ridges and interspaces cut by 32 narrow, annular grooves, giving the angles a nodulous appearance; the 3 anterior rings on an expanded area separated from the balance of the tube by a shallow sulcus; the end of the tube beyond the last annular groove contracted, forming a seven-sided face surrounding the aperture; aperture circular, set at a slight angle to the axis of the tube, the expanded area being narrower on the concave than on the convex side of the tube; posterior end of the tube closed by a plug encircled by a narrow rim; from the edge of the plug near the concave side of the tube a sharp, nearly straight, triangular spur rises well above the rim. The specimen figured measures: length, 1.8 mm; diameter of tube, 0.4 mm.

Hypotype: No. 722 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-one additional specimens were dredged at the same locality and 3 specimens were dredged off Taboga Island, Panama.

This species is entirely distinct from any other described from western North America.

In addition to the species in this family listed and described in this paper, the Academy's collection contains 3 lots, one of a single specimen dredged off Taboga Island, a second of 20 specimens from the same place, and the third of 3 specimens dredged in Bahia Honda. The specimens in the first two of these lots are badly worn, while the third probably represents young stages. It is not considered advisable to attempt to identify or describe these.

Fossarus sp.

Three specimens belonging to this genus were dredged off Taboga Island, Panama. This genus is credited with 13 species from the west coast, all briefly described and none figured.

Iselica kochi Strong & Hertlein, new species

Plate 19, Fig. 11

Shell small, ovate, grayish white; nucleus minute, depressed, smooth, polished, of a little more than 1 whorl; postnuclear whorls 2½, rapidly enlarging, well rounded, sutures impressed; spiral sculpture of strong, equal and equally spaced cords, of which 4 appear between the sutures and 8 on the body whorl; axial sculpture of finer, closer spaced, retractive riblets in the interspaces between the spiral cords, which ride up on the sides of the cords but do not cross the summits; umbilicus moderately large, deep, bounded by the lower spiral cord; aperture oval, outer lip scalloped by the ends of the spiral cords; columella slender, curved, with a distinct swelling in the middle; body with a thin callus. The type measures: length, 1.5 mm; diameter, 1.2 mm.

Holotype: No. 727 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Three additional specimens were dredged at the same locality.

While these specimens are probably not fully adult, the species would seem to be even smaller than *Iselica maculosa* Carpenter,[51] described from Mazatlan, Mexico, and much smaller than the other more northern species. They lack the shouldered whorls and colored spots by which Carpenter distinguishes *Iselica maculosa* from the larger *Iselica ovoidea* Gould.[52] None of the 4 specimens retains any epidermis.

This species is named for Mr. Karl Koch, ornithologist of the San Diego Zoological Society, who accompanied the expedition.

[51] *Isapis maculosa* Carpenter, Mazatlan Catalogue, [1855-] 1857, p. 355. "Mazatlan."

[52] *Narica ovoidea* Gould, Boston Jour. Nat. Hist., vol. 6, October, 1853, p. 380, pl. 14, fig. 10. "Purchased at Mazatlan." [According to Dall (U. S. Geol. Survey, Prof. Paper 59, 1909, p. 204) this paper was issued in advance of the Journal, separately, April, 1852.]

Barleeia zeteki Strong & Hertlein, new species

Plate 21, Fig. 1

Shell oval, light yellowish; nuclear whorls 2, well rounded, faintly thimble pitted; postnuclear whorls 5, smooth, moderately rounded, sutures distinct; periphery of last whorl obscurely angulated; base moderately long; aperture large, rather flaring, outer lip thin; inner lip curved, strong, the edge separated from the body whorl for its entire length, and continued as a raised callus over the body to a junction with the outer lip, rendering the peritreme complete. The type measures: length, 2.2 mm; diameter, 1.3 mm.

Holotype: No. 707 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. One hundred sixty additional specimens were dredged at the same locality and 150 off Taboga Island, Panama.

None of these specimens were living and all are probably more or less bleached. The various species in the genus can only be separated by slight differences in size, shape, and color. The present species differs from *Barleeia polychroma* De Folin,[53] the only species to be reported from Panama, in the more elongated shape, less rounded whorls, and angulated periphery. It resembles *Barleeia dalli* Bartsch,[54] dredged off San Diego, California, in shape but is much smaller and lacks the spiral thread on the angulated periphery.

This species is named for Dr. James Zetek, of the Institute for Research in Tropical America, at Barro Colorado Island Biological Laboratory, in the Panama Canal Zone.

Amphithalamus trosti Strong & Hertlein, new species

Plate 21, Fig. 2

Shell minute, ovate, brownish, with nuclear whorls lighter; nuclear whorls nearly 2, well rounded, marked with fine spiral striations and equally fine, retractive axial threads; postnuclear whorls 2½, moderately rounded, narrowly shouldered at the summit, smooth except for retractive lines of growth, sutures distinct; periphery of the last whorl marked

[53] *Rissoa polychroma* De Folin, Fonds de la Mer, vol. 1, 1870, p. 133, pl. 20, fig. 3. Panama Bay.

[54] *Barleeia dalli* Bartsch, Proc. U. S. Nat. Mus., vol. 58, November 9, 1920, p. 168, pl. 13, fig. 10. Dredged "in 71 to 75 fathoms on sand and mud bottom, off Point Loma, California."

by a rounded cord below which the suture is laid, leaving it fully exposed above the suture on the spire; base short, with a broad, rounded spiral cord bounding the wide umbilicus; aperture oval, oblique, outer lip moderately thick; inner lip entirely separated from the body whorl but fusing with the lower portion of the columella and connected with the posterior angle of the outer lip by a shelly bridge; columella strong, curved. The type measures: length, 1.1 mm; diameter, 0.7 mm.

Holotype: No. 706 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. One hundred thirty additional specimens were dredged at the same locality.

This exclusively west coast genus of shells has not previously been reported south of Magdalena Bay, Lower California, from which locality *Amphithalamus stephensae* Bartsch[55] has been recorded. The present species is quite similar to *Amphithalamus inclusus* Carpenter,[56] described from San Diego, California. It differs principally in the slightly smaller size and in having the peripheral cord fully exposed on the spire.

This species is named for Mr. Henry Trost of the M. H. de Young Museum, in Golden Gate Park, San Francisco, California.

Rissoina adamsi Bartsch ?var.

Plate 19, Fig. 4

Rissoina adamsi Bartsch, Proc. U. S. Nat. Mus., vol. 49, 1915, pp. 47-48, pl. 30, fig. 5. "The type, which is in the Amherst collection, comes from Panama."

Hypotype: No. 740 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Forty specimens were dredged off Taboga Island, Panama, and 25 were dredged in Bahia Honda, Panama.

Adams described *Rissoa janus*[57] from 2 specimens found in the sand,

[55] *Amphithalamus stephensae* Bartsch, Proc. Nat. Mus., vol. 70, art. 11, April 8, 1927, p. 28, pl. 4, fig. 5. "Collected by Mrs. C. L. Simons in Magdalena Bay, Lower California." Other specimens collected at Turtle Bay, Lower California.

[56] *Amphithalamus inclusus* Carpenter, Ann. and Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 181. "*Hab.* Sta. Barbara (Jewett); S. Diego (Cooper)."—Bartsch, Proc. U. S. Nat. Mus., vol. 41, 1912, p. 264, text fig. 2. San Diego, California; Santa Catalina Island, California.

[57] *Rissoa janus* C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 403, 538. "Panama."

PLATE 22

Fig. 1. *Circulus bakeri* Strong & Hertlein, new species. View of the top of the specimen shown on plate 21, figures 14 and 15. (Page 240.)

Fig. 2. *Circulus nicholsoni* Strong & Hertlein, new species. Holotype, No. 714 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Height, 0.8 mm; greater diameter, 3.1 mm. (Page 241.)

Fig. 3. *Circulus nicholsoni* Strong & Hertlein, new species. Apertural view of the specimen shown in figures 2 and 4. (Page 241.)

Fig. 4. *Circulus nicholsoni* Strong & Hertlein, new species. Basal view of the specimen shown in figures 2 and 3. (Page 241.)

Fig. 5. *Delphinoidea hannai* Strong & Hertlein, new species. Holotype, No. 721 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.4 mm; greater diameter, 1.0 mm. (Page 242.)

Fig. 6. *Delphinoidea hannai* Strong & Hertlein, new species. View of the top of the specimen shown in figures 5 and 7. (Page 242.)

Fig. 7. *Delphinoidea hannai* Strong & Hertlein, new species. Basal view of the specimen shown in figures 5 and 6. (Page 242.)

Fig. 8. *Delphinoidea hambachi* Strong & Hertlein, new species. Holotype, No. 720 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Height, 0.7 mm; greater diameter, 3.2 mm. (Page 243.)

Fig. 9. *Delphinoidea hambachi* Strong & Hertlein, new species. View of the top of the specimen shown in figures 8 and 10. (Page 243.)

Fig. 10. *Delphinoidea hambachi* Strong & Hertlein, new species. Basal view of the specimen shown in figures 8 and 9. (Page 243.)


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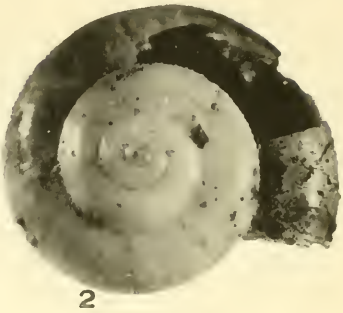
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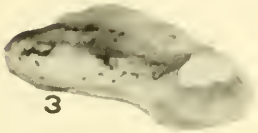
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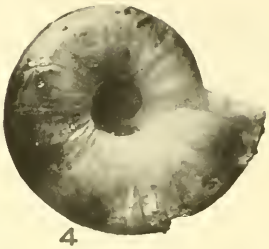
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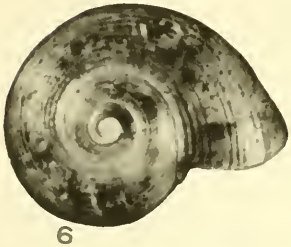
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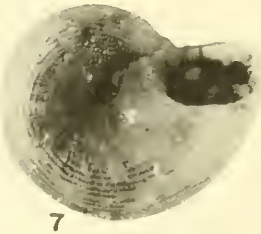
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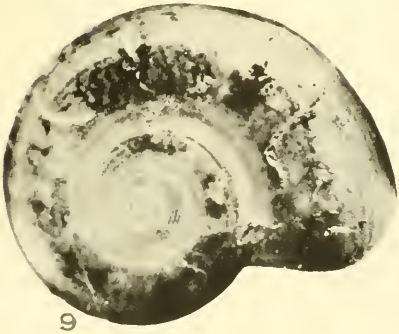
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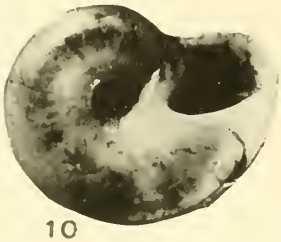
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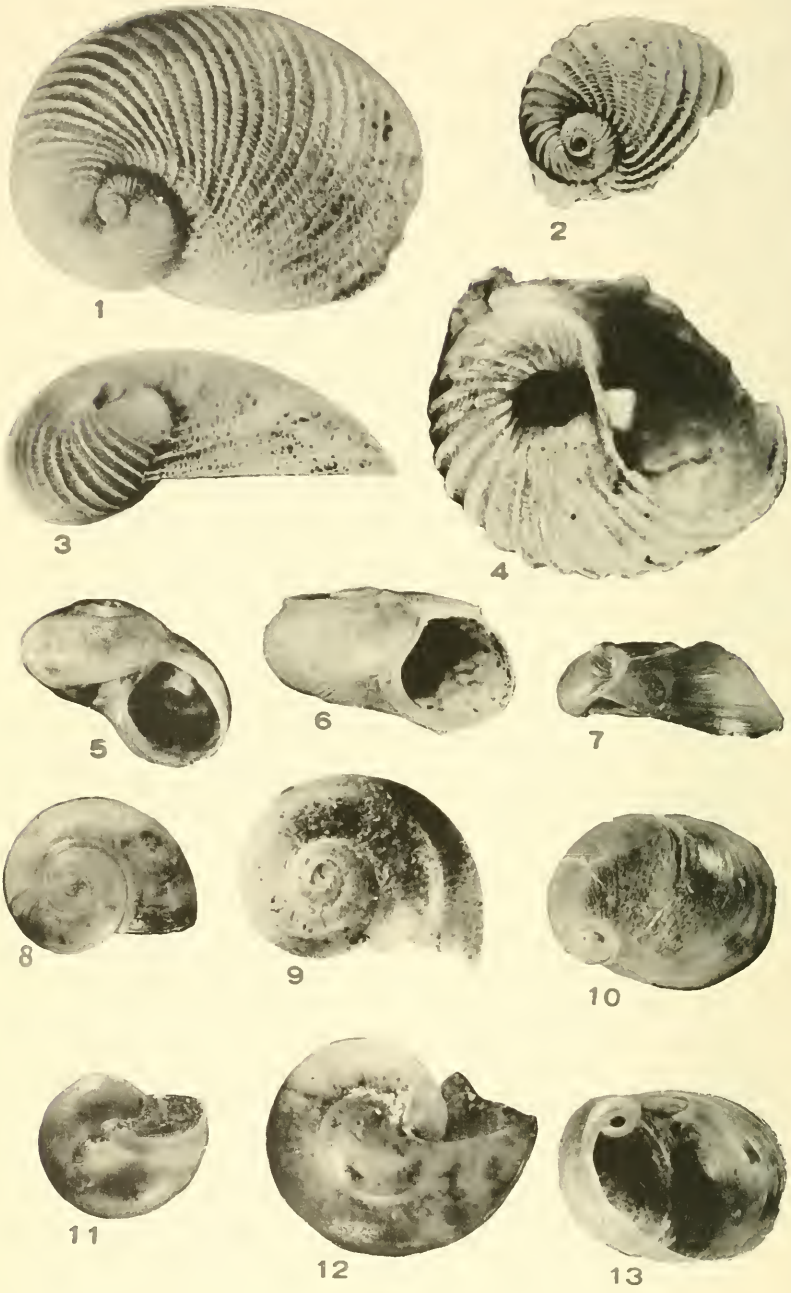
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PLATE 23

Fig. 1. *Megalomphalus hancocki* Strong & Hertlein, new species. Paratype, No. 731A (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Greater diameter, 4.1 mm; lesser diameter, 3.3 mm; height, 1.7 mm. (Page 235.)

Fig. 2. *Megalomphalus hancocki* Strong & Hertlein, new species. Holotype, No. 731 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. Greater diameter, 2.13 mm; lesser diameter, 1.81 mm; height, 1.0 mm. (Page 235.)

Fig. 3. *Megalomphalus hancocki* Strong & Hertlein, new species. Another view of the specimen shown in figure 1.

Fig. 4. *Megalomphalus hancocki* Strong & Hertlein, new species. Basal view of specimen shown in figure 2. (Page 235.)

Fig. 5. *Teinostoma hemphilli* Strong & Hertlein, new species. Holotype, No. 743 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.8 mm; greater diameter, 1.1 mm. (Page 244.)

Fig. 6. *Teinostoma ochsneri* Strong & Hertlein, new species. Holotype, No. 744 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Veragua, Panama. Height, 0.7 mm; greater diameter, 1.5 mm. (Page 244.)

Fig. 7. *Lamellaria inflata* C. B. Adams. Hypotype, No. 773 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,257 (C.A.S.), beach below Delessep's Monument, Panama City, Panama. Height, 2.26 mm; greater diameter (with aperture horizontal), 4.78 mm; lesser diameter, 3.66 mm. (Page 236.)

Fig. 8. *Teinostoma hemphilli* Strong & Hertlein, new species. View of the top of the specimen shown in figures 5 and 11. (Page 244.)

Fig. 9. *Teinostoma ochsneri* Strong & Hertlein, new species. View of the top of the specimen shown in figures 6 and 12. (Page 244.)

Fig. 10. *Lamellaria inflata* C. B. Adams. View of the top of the specimen shown in figures 7 and 13. (Page 236.)

Fig. 11. *Teinostoma hemphilli* Strong & Hertlein, new species. Basal view of the specimen shown in figures 5 and 8. (Page 244.)

Fig. 12. *Teinostoma ochsneri* Strong & Hertlein, new species. Basal view of the specimen shown in figures 6 and 9. (Page 244.)

Fig. 13. *Lamellaria inflata* C. B. Adams. Basal view of the specimen shown in figures 7 and 10. (Page 236.)

of which variety *a* is the larger. Bartsch described *Rissoina adamsi* with this variety *a* as the type, giving the length as 6.0 mm. Concerning the type of *R. janus* he stated[58] that the shell is so worn that it would be impossible to decide whether spiral sculpture may have been present or absent, and that the only thing that will help in the identification is the outline. With but very few exceptions, our specimens, of which 40 were dredged off Taboga Island and 25 in Bahia Honda, Panama, differ from the figure and description of the type of *Rissoina adamsi* in being smaller (with one less whorl) and in having both the axial and spiral sculpture finer. The specimen figured has 3 smooth, well-rounded nuclear whorls and 6 postnuclear whorls. It was dredged off Taboga Island, Panama, and measures: length, 3.8 mm; diameter, 1.6 mm.

These specimens may be *Rissoina janus* but Bartsch's figure of the type indicates fewer axial ribs and a less conical shape. This might be due to the worn condition of the shell. In any case, the differences do not seem to be great enough to warrant the description of a new species.

Rissoina (Folinia) signae Bartsch

Plate 20, Fig. 5

Rissoina (Folinia) signae Bartsch, Proc. U. S. Nat. Mus., vol. 49, July 24, 1915, p. 61, pl. 31, figs. 1 and 4. "The type, which is said to come from Negrito Island (loc.?) or Margarita Island, Bay of Panama"=*Rissoa insignis* De Folin, Les Méléagrinicoles, (Havre), 1867, pp. 48-49, pl. 5, figs. 2 and 3, not *Rissoa insignis* Adams & Reeve, 1850.

Hypotype: No. 741 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector.

A single specimen dredged in Bahia Honda, Panama, seems to agree reasonably well with the figure and description given by Bartsch. This is *Rissoa insignis* De Folin, 1867 (not Adams & Reeve, 1850), and is stated (De Folin, p. 9) to have come from "l'Océan pacifique" . . . "pêchées aux environs des Negritos" or "autour des îles aux Perles, dans la baie de Panama." There has been some question as to whether reference was made to Negritos Island in Panama Bay, or to Negros Island in the Philippines.

[58] *Rissoina janus* C. B. Adams, Bartsch, Proc. U. S. Nat. Mus., vol. 49, 1915, pp. 60, 61, pl. 32, fig. 8. Panama.

Neither the figure nor description shows the 2 strong spiral cords, one forming a bridge connecting the cusps at the posterior end of the axial ribs and the other near the base of the whorls, shown on our specimen.

Megalomphalus hancocki Strong & Hertlein, new species

Plate 23, Figs. 1-4

Shell small, depressed, white; nuclear whorls about 2, very small, smooth, glossy, brownish, forming an elevated, globular apex; post-nuclear whorls nearly 3, rapidly enlarging, inflated, well rounded above, with a distinct suture, below with a wide funicular umbilicus, bounded by an obscure angle; entire surface sculptured with sharp, close-spaced, incremental threads and finer, closer-spaced spiral threads, which are most prominent in the interspaces; aperture semilunate, very oblique; outer lip thin, flaring; columella slender, nearly straight, the upper end expanded into a short, thin callus which renders the peritreme complete. The type measures: greater diameter, 2.13 mm; lesser diameter, 1.81 mm; height, 1.0 mm.

Holotype: No. 731 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Four much smaller, young specimens were dredged off Taboga Island, Panama.

The sculpture of this species is quite similar to that of *Megalomphalus californicus* Dall[59] from the Santa Barbara Islands, California, but that is a much more elevated shell. *Megalomphalus occidentalis* Bartsch,[60] the only other west coast species placed in the genus, is also a more elevated shell with much finer sculpture. *Megalomphalus souverbiei* De Folin[61] has a smaller umbilicus and a groove on the top of the body whorl just below the suture, whereas the new species has a larger umbilicus and lacks the groove in the body whorl.

[59] *Macromphalina californica* Dall, Proc. Biol. Soc. Washington, vol. 16, December 31, 1903, p. 175. Santa Barbara Channel, California.

Megalomphalus californicus Dall, U. S. Nat. Mus., Bull. 112, 1921, p. 166, pl. 14, fig. 7. "Santa Barbara Islands."

[60] *Macromphalina occidentalis* Bartsch, Proc. U. S. Nat. Mus., vol. 32, March 12, 1907, p. 233, text figs. a and b. Type locality, "Point Abreojos, Lower California."

[61] *Sigaretus souverbiei* De Folin, Les Méléagrinicoles (Havre), 1867, p. 68, pl. 6, figs. 8 and 9. On p. 9 it was stated that the shells described in the volume came from "l'Océan pacifique," "aux environs des Negritos" and "autour des îles aux Perles, dans la baie de Panama."

This species is named for Captain Allan Hancock, whose generosity made possible the expedition, during which the collection for this report was made.

Lamellaria inflata C. B. Adams

Plate 23, Figs. 7, 10, 13

Stomatella inflata C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 440, 543. "Panama."—Carpenter, Rept. Brit. Assoc. Adv. Sci., for 1863 (issued 1864), p. 551. Reprint in Smithson. Misc. Coll., No. 252, 1872, p. 37. *"Stomatella inflata* is a *Lamellaria."*—Carpenter, Proc. Zool. Soc. London, 1863, p. 359. Reprint in Smithson. Misc. Coll., No. 252, 1872, p. 194.

An excellent specimen of this species was collected at Loc. 27,257 (C.A.S.), on the beach below Delessep's Monument, at Panama City, Panama. Adams originally described the species from Panama.

Liotia balboai Strong & Hertlein, new species

Plate 21, Figs. 3, 5, 6

Shell small, solid, depressed turbinate, grayish white with broad, brown, axial markings; nuclear whorls nearly 2, small, smooth; postnuclear whorls 3½; axial sculpture on the last whorl of 3 keels, one on the periphery, a second a little above it on the shoulder of the whorl, and the third at an equal distance below the peripheral keel, the 3 being separated by broad grooves; the suture is laid on the lower of the 3 keels leaving the upper 2 exposed in the spire, with the groove between the peripheral and the lower keel forming the channeled suture; in addition to the spiral keels there are 2 fine spiral threads on the flattened space between the upper keel and the suture; axial sculpture of fine, close-spaced riblets over the entire surface; base flattened between the lower keel and the edge of the umbilicus; umbilicus large, the outer edge sharply angulated with 8 nodules on the angle; aperture circular, pearly within, outer lip thickened, greatly so at the posterior angle; inner lip thin where it bounds the umbilicus, spreading above. Operculum concave, with a central nucleus and about 8 granular whorls. The type measures: diameter, 3.6 mm; height, 2.5 mm.

Holotype: No. 728 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. One hundred and seventy-five additional specimens, of all ages, were dredged at the same locality, and 2 adult and 10 young specimens were dredged in Bahia Honda.

In the entire lot there is considerable difference in the color and in the number and strength of the axial riblets and intercalary spiral threads but the shape and major sculpture remain constant. The present species resembles *Liotia rammata* Dall[62] described from Magdalena Bay, Lower California, but the latter is a larger shell with but 2 spiral keels, more rounded whorls, and a smaller umbilicus.

This species is named for the Spanish explorer Vasco Nuñez de Balboa, who crossed the Isthmus of Panama, and who is reported to have been the first European explorer to view the Pacific Ocean from American shores.

Liotia erici Strong & Hertlein, new species
Plate 21, Fig. 9

Shell small, turbinate, solid, grayish white; nuclear whorls 1½, smooth, very small; postnuclear whorls 3½, well rounded, sutures slightly channeled; spiral sculpture of 4 raised threads on the first postnuclear whorl and 8 on the second; on the last whorl there are about 16 fine threads above the shoulder, followed by 12 slightly larger threads on the periphery and upper part of the base, umbilicus bordered by 2 still larger cords with fine intercalary threads; axial sculpture of fine, close-spaced riblets in the interspaces between the spiral threads over the entire surface; periphery of last whorl and base well rounded, umbilicus narrow, with a deep groove between the inner lip and the last spiral cord; aperture circular, the posterior angle falling low on the body whorl; outer lip thick, smooth; inner lip thin where it borders the umbilicus, spreading above. Operculum unknown. The type measures: diameter, 2.0 mm; height, 1.3 mm.

Holotype: No. 729 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Three additional specimens were dredged at the same locality.

In size and shape this species is very similar to the last, but the lack of prominent spiral sculpture makes it entirely different from any other species described from the west coast.

This species is named for a former Assistant Curator of Paleontology of the California Academy of Sciences, Mr. Eric Knight Jordan.

[62] *Liotia rammata* Dall, Proc. Biol. Soc. Washington, vol. 31, February 27, 1918, p. 7. "Magdalena Bay, L. Cal."—Strong, Trans. San Diego Soc. Nat. Hist., vol. 7, no. 37, 1934, p. 436, pl. 29, figs. 4, 5, 6; pl. 30, figs. 1, 2, 3. Tres Marias Islands, Mexico. Also Dall's original locality record cited.

Liotia heimi Strong & Hertlein, new species

Plate 21, Figs. 4, 7

Shell small, turbinate, solid, white; nuclear whorls 2, small, smooth; postnuclear whorls 3, well rounded, sutures channeled; spiral sculpture on the last whorl of 9 nearly equal and equally spaced cords, of which the upper 3 appear on the spire and the last enters the umbilicus; axial sculpture of raised riblets in the interspaces between the spiral cords; on the spire these riblets are fine and closely spaced, while on the last whorl they form wider spaced bars undulating the cords and pitting the interspaces; periphery of the last whorl and base well rounded, the interspaces between the sixth and seventh and eighth spiral cords very deeply pitted; umbilicus rather small, with an entering groove bounded by the last spiral cord, while the upper part is bounded by the next to the last cord; aperture small, circular, outer lip thick, undulated by the ends of the spiral cords; inner lip thin where it bounds the umbilicus, spreading above. Operculum unknown. The type measures: diameter, 2.0 mm; height, 1.4 mm.

Holotype: No. 730 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. Three additional specimens were dredged at the same locality and 4 specimens were dredged in Bahia Honda, Panama.

In common with many species in the genus there is some variation in the character and strength of the axial sculpture while the spiral sculpture remains very constant. The present species belongs in the group with *Liotia acuticostata* Carpenter[63] and its varieties from southern and Lower California. It differs in the greater number of spiral cords and stronger axial riblets.

This species is named for Dr. Arnold Heim, Swiss geologist, in recognition of his contributions to the geology of Lower California.

[63] *Margarita acuticostata* Carpenter, Proc. Calif. Acad. Sci., vol. 3, July, 1864, p. 157. "*Hab.* Santa Barbara, in kelp-root"; "Catalina Island, 8-10 fms."; "Monterey."

Liotia acuticostata Carpenter, Strong, Trans. San Diego Soc. Nat. Hist., vol. 7, no. 37, 1934, p. 437, pl. 29, figs. 7, 8, 9. Isthmus Cove, Santa Catalina Island, California; Guadalupe Island; Magdalena Bay; Cape San Lucas; Tres Marias Islands, Mexico. Also Carpenter's original records of Monterey and Catalina Island cited.

Cyclostrema mcculloch**ae** Strong & Hertlein, new species

Plate 21, Figs. 8, 10, 11

Shell minute, depressed, semitransparent; nuclear whorls nearly 2, smooth, rounded, the apex slightly elevated; postnuclear whorls 2; spiral sculpture of 7 cords, of which the first is situated immediately below the impressed suture, the second is on the middle of the upper surface of the whorls, the third forms a sharply angulated shoulder to the whorls, the fourth is on the periphery, the fifth sharply angulates the base, the sixth bounds the broadly open umbilicus, and the seventh is on the middle of the umbilical wall; of these cords the third and fifth bound a nearly square peripheral area on the first half of the body whorl, but as the second, third, and fourth cords grow successively weaker on the last half of the body whorl and disappear before the lip is reached, this part of the last whorl becomes rounded; the first, fifth, and sixth cords increase rather than diminish with age; axial sculpture of rather close, regularly spaced, retractive riblets which appear on the entire surface except on the latter part of the body whorl where they fade out in the same manner as the spiral cords; the junction of the spiral cords and axial ribs slightly nodulous; aperture nearly circular, outer lip fairly thick, slightly undulated by the ends of the fifth and sixth spiral cords; inner lip strongly curved, with a heavy callus over the body of the shell spanning the third, fourth, and fifth spiral cords. The type measures: greater diameter, 1.1 mm; height, 0.5 mm.

Holotype: No. 716 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Eighty-five additional specimens were dredged at the same locality.

This species comes nearer to *Cyclostrema adamsi* Bartsch[64] than to any other species described from the west coast. It differs in the arrangement of the spiral cords and in the less distinct sculpture. *"Vitrinella" concinna* C. B. Adams[65] would also appear from the description to be quite similar but it is said to be a larger shell with 5 spiral cords.

This species is named for Dr. Irene McCulloch of the Department of Zoology of The University of Southern California.

64 *Cyclostrema adamsi* Bartsch, Proc. U. S. Nat. Mus., vol. 39, January 9, 1911, p. 231, pl. 39, figs. 4, 5, 6. "Panama."

65 *Vitrinella concinna* C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 408 (No. 258), 539. "Panama."

Cyclostrema bartschi Strong & Hertlein, new species

Plate 21, Figs. 12, 13, 16

Shell minute, grayish white, depressed turbinate; nuclear whorls 2, smooth, rounded; postnuclear whorls nearly 2, angulated, sculptured with a compressed spiral keel on the strongly angulated periphery and equally strong, slightly curved axial riblets continuous over both spire and base, 24 appearing on the last whorl; suture strongly appressed with a ridged fold just below it; in addition to the angle at the periphery the upper surface of the whorls is divided into 3 nearly equal areas by 2 angles, the space between the sutural fold and the first angle being concave, while the spaces between the first and second angles and the second angle and the peripheral keel are slightly convex; the axial riblets between the subsutural fold and the first angle are nearly vertical and much narrower than on the balance of the shell, while those on the space between the second angle and the peripheral keel become strongly retractive; base slightly convex between the peripheral keel and the sharply angulated edge to the funnel-shaped umbilicus, into which the axial riblets enter deeply, crossing another angle on the middle of the umbilical wall; aperture nearly circular, the posterior angle falling a little above the peripheral keel, outer lip fairly thick; inner lip curved with a thick callus over the body of the shell. The type measures: greater diameter, 1.0 mm; height, 0.5 mm.

Holotype: No. 715 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Twenty-six additional specimens were dredged at the same locality.

This species is probably nearer to *Cyclostrema miranda* Bartsch,[66] described from San Diego, California, than to any other west coast species. It is only about half the size of that species, lacks the spiral cords on the angles of the whorls, and has relatively stronger axial riblets.

This species is named for Dr. Paul Bartsch, Curator, Division of Mollusks, United States National Museum at Washington, D. C.

Circulus bakeri Strong & Hertlein, new species

Plate 21, Figs. 14, 15; Plate 22, Fig. 1

Shell minute, depressed, semitransparent; nuclear whorls 2, well rounded, smooth; postnuclear whorls 2, upper surface of whorls

[66] *Cyclostrema miranda* Bartsch, Proc. U. S. Nat. Mus., vol. 39, January 9, 1911, p. 230, pl. 39, figs. 1, 2, 3. "San Pedro, California."

rounded, smooth except for fine lines of growth and, on the first whorl, faint indications of spiral striations, sutures appressed; periphery of last whorl marked by a rounded spiral cord; base rounded, marked by 3 spiral cords, the first about as strong as the peripheral cord and separated from it by a groove about as wide as the cords; the second and third cords are about equally spaced but are much more slender, these cords followed by a wider smooth space extending to the edge of the wide, open umbilicus, on the walls of which there are 8 strong, toothlike axial folds; aperture nearly circular, the posterior angle falling just above the peripheral keel, outer lip thickened; inner lip short, straight, with a thick callus over the body of the shell. The type measures: greater diameter, 1.4 mm; height, 0.5 mm.

Holotype: No. 713 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Nine additional specimens were dredged at the same locality.

Similar strong axial ribs on the walls of the umbilicus is the character used by Bartsch to define the subgenus *Docomphala*[67] of the genus *Vitrinella*. The present species combines this character with the spiral sculpture of the genus *Circulus* instead of the smooth or axially marked surface of the genus *Vitrinella*. It may be better to consider *Docomphala* as a genus characterized by this distinctive sculpture in the umbilicus and add the present species to the 2 California species described by Bartsch.

This species is named for the late Dr. Fred Baker, San Diego, California.

Circulus nicholsoni Strong & Hertlein, new species

Plate 22, Figs. 2, 3, 4

Shell small, depressed, opaque white; nuclear whorls about 2, smooth, merging without perceptible change into the following whorls; postnuclear whorls about 3, upper surfaces evenly rounded, smooth except for microscopic lines of growth, sutures appressed; periphery of last whorl with a slender, compressed keel; base evenly rounded between the peripheral keel and the sharply angled edge of the open umbilicus, sculptured with strong, curved lines of growth which rise to sharp, microscopic points or serrations on the peripheral keel; umbilicus large,

[67] *Docomphala* Bartsch, Proc. U. S. Nat. Mus., vol. 32, February 8, 1907, p. 169. "*Type.—Vitrinella (Docomphala) stearnsi.*"

open, the edge of the shell slightly overlapping the vertical walls on the last whorl; aperture oval, the posterior angle falling just below the peripheral keel, leaving it exposed on the later part of the body whorl, outer lip thin; inner lip short, sharply curved, with a thin callus over the body of the shell. The type measures: greater diameter, 3.1 mm; height, 0.8 mm.

Holotype: No. 714 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. A second but much smaller specimen was dredged at Bahia Honda, Panama.

The upper surface of this shell is very similar to that of *Circulus diomedeae* Bartsch[68] also dredged in Panama Bay, but the finely serrated peripheral keel and sharply angled edge to the umbilicus are quite different. A little greater development of the incremental lines would form axial riblets and place the species in the genus *Cyclostrema*. The umbilical characters of this species are quite distinct. Bartsch describes a genus *Scissilabra*,[69] type *S. dalli* Bartsch, which has a very similar umbilicus but the genus is based principally on a notched outer lip, a character not apparent in the present species.

This species is named for Mr. John L. Nicholson, whose work of arranging the collection of land snails of the California Academy of Sciences has been very helpful in facilitating work on that group of mollusks.

Delphinoidea hannai Strong & Hertlein, new species

Plate 22, Figs. 5, 6, 7

Shell minute, depressed, semitransparent; nuclear whorls 2½, smooth, well rounded; postnuclear whorls 2, rounded, sutures appressed; sculpture consisting of fine, close-set spiral threads which are rendered slightly granular by microscopic lines of growth and extend uniformly over the spire and base; of these spiral threads 10 appear on the first whorl between the sutures and about 30 on the last whorl; periphery well rounded; base rounding into the umbilicus, which in the young stages is open but in the adult shell nearly or quite closed over by an expansion of the body whorl back of the base of the inner lip. Aperture

[68] *Circulus diomedeae* Bartsch, Proc. U. S. Nat. Mus., vol. 39, January 9, 1911, p. 232, pl. 40, figs. 1, 2, 3. Dredged "in 62 fathoms, on gray sand and broken shell bottom; bottom temperature 59.6°; in the Bay of Panama."

[69] *Scissilabra* Bartsch, Proc. U. S. Nat. Mus., vol. 32, February 8, 1907, p. 175. *"Type.—Scissilabra dalli."*

nearly circular, very oblique, outer lip fairly thick; inner lip thick, strongly curved, with a strong callus over the body of the shell. The type measures: greater diameter, 1.0 mm; height, 0.4 mm.

Holotype: No. 721 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Nine additional specimens were dredged at the same locality and 8 specimens dredged off Taboga Island, Panama.

This species appears to be quite similar in shape and sculpture to *"Circulus" rossellinus* Dall,[70] described from San Diego, California, but it is only half the size. The closing over of the umbilicus is somewhat like that in the genus *Teinostoma* but there is no defined callus pad or tongue, simply a change in the shape of the last whorl.

This species is named for Dr. G. Dallas Hanna, Curator of the Department of Paleontology of the California Academy of Sciences.

Delphinoidea hambachi Strong & Hertlein, new species

Plate 22, Figs. 8, 9, 10

Shell small, depressed, semitransparent; nuclear whorls 2½, smooth, well rounded, with the apex slightly elevated; postnuclear whorls 2¼, slightly rounded, sutures closely appressed; spiral sculpture on the first whorl of 6 raised threads which gradually increase in number but diminish in strength until on the last whorl they can hardly be distinguished; these are crossed by still finer lines of growth which give the threads a granular and the interspaces a pitted appearance under the microscope; periphery of the last whorl well rounded; base slightly rounded, umbilicus small, deep, more or less constricted by an expansion of the body whorl back of the base of the inner lip; aperture nearly circular, the posterior angle falling at the upper edge of the rounded periphery, outer lip fairly thick; inner lip greatly thickened, strongly curved, with a moderate callus over the body of the shell. The type measures: greater diameter, 3.2 mm; height, 0.7 mm.

Holotype: No. 720 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,228 (C.A.S.), dredged in from 3 to 9 fms. off Taboga Island, Panama. L. G. Hertlein collector. A second adult and 3 young specimens were dredged at the same locality.

[70] *?Circulus rossellinus* Dall, Proc. U. S. Nat. Mus., vol. 56, August 30, 1919, p. 368. "Off South Coronado Island, near San Diego, California, collected by Dr. Fred Baker, in three fathoms."

In general appearance this species is very similar to *Delphinoidea hannai* Strong & Hertlein, but it is much larger and flatter, with fewer, less distinct spiral threads and a more open umbilicus.

This species is named for Dr. Gustav Hambach, whose library and collections, acquired by the California Academy of Sciences after the earthquake and fire of 1906, have been of great use in research work.

Teinostoma hemphilli Strong & Hertlein, new species

Plate 23, Figs. 5, 8, 11

Shell minute, helicoid, smooth except for fine lines of growth, translucent, shining; nuclear whorls about 2, merging imperceptibly into the following whorls; postnuclear whorls about 2½, well rounded, sutures closely impressed, with the basal portion of the preceding whorl shining through the wall of the succeeding whorl, the last whorl only moderately enlarged; periphery and base well rounded; aperture nearly circular, outer lip fairly thick; inner lip strongly curved, thickened, with a spreading callus which forms a pad nearly filling the umbilicus but leaving a narrow open chink. The type measures: greater diameter, 1.1 mm; height, 0.8 mm.

Holotype: No. 743 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Thirteen additional specimens were dredged in the same locality and 2 specimens dredged off Taboga Island, Panama.

This species is evidently quite similar to *"Vitrinella" regularis* C. B. Adams[71] but is smaller and lacks the "impressed spiral line just below the suture." The new species also has a higher spire and the columella is more nearly vertical than in the species described by Adams.

This species is named for Mr. Henry Hemphill, early collector of mollusks on the Pacific coast. Much of his fine collection is now in the California Academy of Sciences.

Teinostoma ochsneri Strong & Hertlein, new species

Plate 23, Figs. 6, 9, 12

Shell minute, depressed, semitransparent; nuclear whorls 2, rounded, smooth; postnuclear whorls 2, everywhere marked with curved lines of

[71] *Vitrinella regularis* C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, pp. 412 (No. 266), 540. "Panama."

Teinostoma regularis C. B. Adams, Baker, Hanna & Strong, Proc. Calif. Acad. Sci., ser. 4, vol. 23, no. 15, 1938, p. 239, pl. 22, figs. 1, 2, 3. Maria Madre Island, Tres Marias Islands, Mexico.

growth; sutures impressed; the last whorl with a strong spiral cord on the shoulder, the area between it and the suture concave; periphery well rounded; base rounded, with a spiral cord on the middle similar to that on the upper surface; umbilicus entirely filled with a concave callus pad; aperture nearly circular, slightly angulated by the basal cord, the posterior angle falling a little below the upper cord, outer lip thin; inner lip thick, strongly curved, with a thin callus over the body of the shell. The type measures: greater diameter, 1.5 mm; height, 0.7 mm.

Holotype: No. 744 (Calif. Acad. Sci. Paleo. Type Coll.), from Loc. 27,229 (C.A.S.), dredged in from 3 to 9 fms. in Bahia Honda, Panama. L. G. Hertlein collector. Six additional specimens were dredged at the same locality.

Among the specimens described from the west coast this seems to be nearest to *Teinostoma supravallata* Carpenter[72] from southern and Lower California. The latter has a similar subsutural cord but lacks the one on the base.

This species is named for Washington Henry Ochsner, who, as geologist, accompanied the expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906. Mr. Ochsner collected many marine and land shells for the Academy's collection during that expedition.

[72] *Ethalia supravallata* Carpenter, Proc. Calif. Acad. Sci., vol. 3, February, 1866, p. 215. "*Hab.* San Diego, Cooper, shell-washings."

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1937, IN 1938, AND IN 1939.

REVISION OF THE NEMERTEAN FAUNA OF THE PACIFIC COASTS OF NORTH, CENTRAL, AND NORTHERN SOUTH AMERICA

(PLATES 24-31)

By W. R. COE

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REVISION OF THE NEMERTEAN FAUNA OF THE PACIFIC COASTS OF NORTH, CENTRAL, AND NORTHERN SOUTH AMERICA

(PLATES 24–31)

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In preparation of this report the collection of nemerteans obtained by the Allan Hancock Expeditions during the cruises of 1933-1939 on the coasts of Mexico, Central America, Ecuador, and Peru has been supplemented by an extensive series obtained by the writer and others during a number of years on the coast of California and northward.

The writer welcomes this opportunity of revising the nomenclature in conformity with modern usage as well as of supplementing the descriptions of a number of species which were not included in the 1905 monograph or which more recent studies have shown to have been inadequately treated in that publication. Moreover, the known geographical distribution of most of the species has been greatly extended by the more recent investigations, and the types of habitat have been found to be more variable for certain species than the earlier accounts would indicate. Opportunity is also offered for the illustration of a number of species of which no figures have been published previously.

The monograph on the ribbon worms of the west and northwest coasts of North America (Coe, 1905) contained descriptions of 85 supposedly valid species, but more extensive collections in the intervening years have included younger stages, intergrading individuals, and color variations, which prove that 7 of these are specifically identical with other species found on the Pacific coast or in other parts of the world. During these years, 4 new species have been described from these regions, and 7 species already known from European or American shores bordering the Atlantic Ocean have been added to the Pacific coast fauna.

The present report includes descriptions of one new genus, *Amphinemertes,* and five additional new species, *Euborlasia hancocki, E. nigro-*

* Contributions from the Scripps Institution of Oceanography, New Series, No. 85.

cincta, Ototyphlonemertes spiralis, Amphiporus peruvianus, and *Tetrastemma sexlineatum,* bringing the number of species found on the Pacific coast of North, Central, and South America between the Arctic Ocean and Ecuador to a total of 94. Two of these are bathypelagic. Several new color varieties are also described.

Of the 98 species included in this report, 4 are not known to occur north of Peru and 8 others, including one bathypelagic species, have been found only in the region from Ecuador to the Gulf of California. The remaining 86 species, including one that is bathypelagic and one that is limited to fresh water, have been reported at various localities from the coast of California and northward. An appended list includes 17 supposed species reported from Peru and southward which were not represented in the Allan Hancock collections and which appear to differ from those found on the Pacific Coast north of the equator.

The geographical distribution as far as at present known of the 111 littoral species recorded from the entire coast from the Arctic Ocean to Patagonia is shown in Table 1. It will be noted that 18 of the species are thought to be identical with well-known European species; 17 of the Pacific Coast species occur also on the Atlantic coasts south of Europe and 13 on the east coast of North America. Some of them appear to have a world-wide distribution.

The changes in nomenclature and more particularly the greater variability which has been found in the appearance and coloration of younger and older individuals of the various species have necessitated the formulation of revised keys to the families, genera, and species.

Since the ecological conditions on the Pacific coast change gradually and without well-marked faunistic barriers from the Bering Strait to the equatorial regions, there is a constant overlapping in the geographical distribution of the various representatives of the nemertean fauna. For convenience, however, the 10,000 or more miles of seacoast comprising the entire region may be considered as representing 5 intergrading zones. In such a classification, the northern zone would extend from the Aleutian Islands to the Arctic Ocean; the north central zone would include the coasts of Alaska and British Columbia from the Aleutian Islands to Puget Sound; the central zone would then extend from Cape Flattery to Cape Arguelos or Point Conception; the south central, or semitropical, zone would cover the coast of southern California and Lower California to Cape San Lucas; and the southern, or tropical, zone the Gulf of California and the entire coast southward to Ecuador.

The Peruvian littoral fauna is evidently more closely similar to that of Chile and Patagonia than to the tropical zone on the northward, presumably because of the colder southern waters which flow northward adjacent to the coast. The entire region south of Ecuador would thus comprise a sixth faunal zone.

The collections of the Allan Hancock Expeditions included the south central and southern of these 5 faunal zones and the coast of Peru. The known southern range of a considerable number of species has been thereby greatly extended. For the reasons stated above, however, the species of all zones will be grouped together into a comprehensive list which will give also the geographical distribution of each species as far as at present known. Table 1 will indicate the numer of species of each of the genera which have been found in each zone up to the year 1939.

In the geographical distribution as given for each species specific localities, if numerous, will be indicated only by the limits of the known range.

Bibliographic references to species described previous to the publication of the monograph of 1905 will not be repeated in the literature list to be found at the end of this report.

In the synoptic keys which are given for the determination of families, genera, and species, only those groups and species are included which are known to be represented on the North Pacific coast from Ecuador to the Arctic Ocean. Hence, such of the Peruvian species obtained by the Allan Hancock Expeditions as are not also known to occur north of the equator are included only in the descriptive lists of species.

TABLE 1

Geographical Distribution of Pacific Coast Species

(Numerals indicate number of species found in each area.)

Genera	*Coasts of Europe*	*Eastern Atlantic, South of Europe*	*Western North Atlantic*	*Bering Sea and Northward*	*Aleutian Islands to Puget Sound*	*Cape Flattery to Point Conception*	*Southern California to Cape San Lucas*	*Gulf of California to Ecuador*	*Peru to Patagonia*	*Total*
PALEONEMERTEA										
Tubulanus	1	1	1	..	3	5	4	1	..	7
Carinomella	..	..	..	..	..	1	1	..	..	1
Carinoma	..	..	..	..	1	1	1	1	..	1
Procephalothrix	..	..	1	..	1	1	2	..	..	2
HETERONEMERTEA										
Baseodiscus	1	1	..	..	1	1	1	3	4	8
Zygeupolia	..	..	1	..	..	1	1	..	..	1
Euborlasia	..	..	..	..	..	1	1	1	..	2
Lineus	5	4	1	..	4	6	6	4	6	12
Micrura	1	1	..	..	3	4	3	..	1	8
Cerebratulus	2	2	1	3	7	6	4	..	2	13
Diplopleura	..	..	..	..	..	..	..	1	..	1

TABLE 1 *(Continued)*

Genera	*Coasts of Europe*	*Eastern Atlantic, South of Europe*	*Western North Atlantic*	*Bering Sea and Northward*	*Aleutian Islands to Puget Sound*	*Cape Flattery to Point Conception*	*Southern California to Cape San Lucas*	*Gulf of California to Ecuador*	*Peru to Patagonia*	*Total*
HOPLONEMERTEA										
Emplectonema	1	1	..	..	3	2	1	..	2	6
Nemertopsis	..	..	..	..	1	1	1	..	..	1
Paranemertes	..	..	..	..	3	2	2	..	..	4
Ototyphlonemertes	..	..	..	..	..	..	1	..	..	1
Dichonemertes	..	..	..	..	..	..	1	..	..	1
Carcinonemertes	..	..	..	..	..	1	..	..	..	1
Prosorhochmus	..	..	..	..	..	1	1	..	..	1
Oerstedia	1	1	1	..	1	1	1	..	..	1
Zygonemertes	..	..	1	..	3	2	2	..	..	3
Amphiporus	2	2	3	5	9	7	8	..	5	22
Amphinemertes	..	..	..	..	1	..	..	..	..	1
Tetrastemma	2	2	2	..	4	3	6	1	1	10
Drepanophorus	1	1	..	..	..	..	1	1	..	2
BDELLONEMERTEA										
Malacobdella	1	1	1	..	1	1	1	..	..	1
Total	18	17	13	8	46	48	50	13	21	111

LIST OF SPECIES

* indicates species not known to occur north of the equator.
** indicates species not known to occur north of the Gulf of California.
All others have been found north of Cape San Lucas.

TUBULANUS

1. albocinctus
2. capistratus
3. cingulatus
4. frenatus
5. pellucidus
6. polymorphus
7. sexlineatus

CARINOMELLA

8. lactea

CARINOMA

9. mutabilis

PROCEPHALOTHRIX

10. major
11. spiralis

BASEODISCUS

12. **delineatus
12a. **delineatus curtus
13. **mexicanus
14. *platei
15. princeps
16. punnetti

ZYGEUPOLIA

17. rubens

EUBORLASIA

18. **hancocki
19. **maxima
20. nigrocincta

LINEUS

21. *atrocaeruleus
22. bilineatus
23. flavescens
24. **geniculatus
25. pictifrons
26. ruber
27. rubescens
28. torquatus
29. vegetus

MICRURA

30. alaskensis
31. impressa
32. nebulosa
33. nigrirostris
34. olivaris
35. pardalis
36. verrilli
37. wilsoni

CEREBRATULUS

38. albifrons
39. californiensis
40. *corrugatus
41. herculeus
42. lineolatus
43. longiceps
44. marginatus
45. montgomeryi
46. occidentalis
47. signatus

DIPLOPLEURA

48. **vivesi

EMPLECTONEMA

49. bürgeri
50. gracile
51. purpuratum

NEMERTOPSIS

52. gracilis
52a. gracilis bullocki

PARANEMERTES

53. californica
54. carnea
55. pallida
56. peregrina

DICHONEMERTES

57. hartmanae

CARCINONEMERTES

58. epialti

OTOTYPHLONEMERTES

59. spiralis

PROSORHOCHMUS

60. albidus

OERSTEDIA

61. dorsalis

ZYGONEMERTES

62. albida
63. thalassina
64. virescens

AMPHIPORUS

65. angulatus
66. bimaculatus
67. californicus
68. cruentatus
69. flavescens
70. formidabilis
71. fulvus
72. gelatinosus
73. imparispinosus
73a. imparispinosus similis
74. macracanthus
75. nebulosus
76. occidentalis
77. pacificus
78. paulinus
79. *peruvianus
80. punctatulus
81. rubellus
82. tigrinus

AMPHINEMERTES

83. caeca

TETRASTEMMA

84. aberrans
85. bicolor
86. bilineatum
87. candidum
88. nigrifrons
89. quadrilineatum
90. reticulatum
91. sexlineatum
92. signifer

PROSTOMA

93. rubrum

DREPANOPHORUS

94. **crassus
95. ritteri

PLANKTONEMERTES

96. **agassizii

NECTONEMERTES

97. pelagica

MALACOBDELLA

98. grossa

Order PALEONEMERTEA

Key to the Families Represented on Pacific Coast

1. Mouth situated immediately behind brain; nephridia with single pair of large collecting tubules and efferent ducts 2
2. Lateral nerves situated at base of body epithelium or external to circular muscles of body walls, at least in anterior portion of body; internal circular musculature relatively thin; lateral sense organs present; rhynchocoel vessels absent . . . . Tubulanidae
2. Lateral nerves situated outside muscular layers in anterior portion of esophageal region but imbedded in longitudinal muscles in nephridial region and posteriorly; internal circular musculature enormously developed in nephridial region; lateral sense organs absent; rhynchocoel vessels present . . . . Carinomidae
1. Mouth situated far behind brain; nephridia with very numerous minute efferent ducts; body filiform; head sharply pointed . . . . . Cephalotrichidae

Family Tubulanidae

Key to Genera

1. Lateral nerve cords at base of body epithelium or external to circular musculature throughout body; cerebral sense organs present . . . . . Tubulanus
1. Lateral nerve cords external to circular musculature anteriorly and imbedded in longitudinal musculature in nephridial region and posteriorly; cerebral sense organs absent . . . Carinomella

Genus TUBULANUS Renier

Seven species belonging to this genus have been found on the North Pacific coast.

Key to Species

1. Body of somewhat homogeneous color, without definite markings 2
1. With distinct longitudinal or transverse markings, or both . . 3
2. Body very soft, attaining a length of nearly 2 m when fully extended; deep red, orange, or bright vermilion . . polymorphus
2. Body minute, very slender; whitish and somewhat translucent . . . . . pellucidus
3. Yellow, rosy, or greenish, with black longitudinal and transverse markings. Body large, rather firm, only moderately slender, attaining a length of 50 cm or more; pale yellowish or rosy, sometimes with greenish tinge, with 3 longitudinal velvety black lines and a series of narrow rings of similar color . . . . . frenatus

3. Red or brown, with white markings 4

4. Deep red, with a series of narrow white rings but without longitudinal lines. Body firm, rather stout, upward of 30 cm long; deep red, with a series of narrow white rings placed at frequent intervals throughout body . . . . . albocinctus

4. Brown, with longitudinal and transverse white markings . . 5

5. With 3 longitudinal white lines. Slender, up to a meter in length; brown, with numerous narrow transverse rings and 3 parallel longitudinal white lines, of which one is in the dorsomedian line and one just below each lateral margin . . capistratus

5. With 4, 5, or 6 longitudinal white lines 6

6. Body slender, subcylindrical, often 15 cm or more in length; deep brown, with a series of white rings and 4 longitudinal white lines, of which 2 are lateral, while the other 2 divide dorsal surface of body into 3 equal parts . . . . . cingulatus

6. Body slender, subcylindrical, often half a meter or more in length when fully extended; brown or chocolate, with numerous narrow white rings and 5 or 6 parallel longitudinal white lines, of which one is in the median dorsal line, 2 on each lateral surface, and the sixth, when present, is usually merely indicated in the ventromedian line . . . . . sexlineatus

1. Tubulanus albocinctus (Coe), 1904

Carinella albocincta Coe, 1904, 1905.

Habitat. Dredged among red algae at depths of 100 to 200 m.

Distribution. Off the coast of southern California.

2. Tubulanus capistratus (Coe), 1901

Carinella capistrata Coe, 1901, 1904, 1905.

Habitat. Lives in delicate, twisted, paperlike tubes beneath stones and among algae and other growths.

Distribution. Alaska, and from Puget Sound to Monterey Bay, California.

3. Tubulanus cingulatus (Coe), 1904

Carinella cingulata Coe, 1904, 1905.

Habitat. Low water to depths of 30 m or more on soft bottom.

Distribution. At present known only from Monterey Bay to San Diego, California.

4. **Tubulanus frenatus** (Coe), 1904

Carinella frenata Coe, 1904, 1905.

Habitat. Among algae, mussels, and other growths, near low-water mark and below on rocks and piers.

Distribution. Southern California.

5. **Tubulanus pellucidus** (Coe), 1895

Carinella pellucida Coe, 1895, 1905.

Habitat. In delicate parchmentlike tubes under stones and among algae and other growths between tides.

Distribution. Coasts of New England; Monterey Bay to San Diego, California.

6. **Tubulanus polymorphus** Renier, 1804

T. polymorphus Bürger, 1895, 1904; *Carinella rubra* Griffin, 1898; Coe, 1904, 1905; *C. speciosa* Coe, 1901.

Habitat. Beneath stones and among mussels and other growths; between tides in muddy situations and below low-water mark at moderate depths.

Distribution. Northern coasts of Europe, Mediterranean; on the Pacific coast from the Aleutian Islands, coast of Alaska, British Columbia, Puget Sound, Oregon, and southward to Monterey, California.

Reproduction. A large individual of this species will supply a vast number of ova for experimental studies during the summer months. The eggs may be teased from body fragments, washed in clean sea water and sperm added if developmental stages are desired. Development of the direct type proceeds rapidly.

7. **Tubulanus sexlineatus** (Griffin), 1898

Carinella sexlineata Griffin, 1898; Coe, 1904, 1905; *C. dinema* Coe, 1901.

Habitat. Lives in delicate tubes among algae, mussels, and other growths on rocks and piling between tides and below.

Distribution. Alaska to southern California.

Genus **CARINOMELLA** Coe

Only a single species of this genus is known at present.

8. **Carinomella lactea** Coe, 1905

Habitat. In sand between tides.

Distribution. At present known only from Monterey, San Pedro, and San Diego, California.

Family **Carinomidae**

Genus **CARINOMA** Oudemans

Only a single species has been found on the Pacific coast.

9. **Carinoma mutabilis** Griffin, 1898

(Plate 25, figs. 21, 22)

C. griffini Coe, 1901; *C. mutabilis* Coe, 1905.

Habitat. In sand, sandy mud, and clay between tides and below.

Distribution. British Columbia, Puget Sound, and southward to Gulf of California. (Angeles Bay, Mexico, Hancock Exped.)

Reproduction. During the summer months eggs are sometimes deposited within a few hours after the worms have been collected and placed in clean sea water. Usually, however, it is necessary to obtain a supply for embryological study by cutting the female lengthwise. Sperm may be added from a ripe male. Development of the direct type proceeds rapidly.

Family **Cephalotrichidae**

Genus **PROCEPHALOTHRIX** Wijnhoff

Two species of this genus are known from the Pacific coast.

Key to Species

1. Body usually twisted, snarled, or knotted into irregular mass, with little tendency to coil in spiral. Pale flesh color, ocher, or straw color, more rosy anteriorly and grayish posteriorly. Length may exceed 1 m; diameter 5 mm or less . . . . major
1. Body usually coiled spirally when contracted. Whitish, gray, or pale yellow, often with pinkish or greenish tinge. Length up to 15 cm, diameter less than 2 mm . . . . . spiralis

10. **Procephalothrix major** (Coe), 1930

(Plate 27, figs. 29, 30)

Cephalothrix major Coe, 1930.

Body. Filiform, usually twisted, snarled, or knotted into irregular mass with 2-3 cm of anterior end exposed; shows little tendency to coil

in spiral; head very slender, mouth far back from anterior extremity (Fig. 29).

Size. Large individuals exceed 1 m in length, with a diameter of only 2-5 mm or less. Body is very strong and not easily ruptured.

Color. Pale flesh color, pale ocher, or straw color, more rosy in anterior portion, grayish posteriorly. Small individuals grayish white or almost colorless.

Ocelli. Absent in mature worm; a single pair present in larval stages.

Nephridia. The peculiar metanephridia (Fig. 30) of this species are large and very numerous (Coe, 1930).

Habitat. Beneath stones in hard sand or clay fully exposed to surf.

Distribution. At present known only from Montara, California, and southward to Ensenada, Mexico.

Regeneration. Individuals of this species are remarkably hardy under laboratory conditions, living for several months in vessels of sea water which is changed occasionally. Posterior regeneration occurs readily, but attempts to obtain anterior regeneration and regulation from body fragments have not thus far proved successful. Such fragments may, however, remain alive for several months, during which time the organ systems present become simplified and much reduced in size.

Reproduction. During the spring and summer months individuals may be found with mature sexual products. If several individuals are placed together in a vessel of clean sea water, a large number of fertilized eggs may be deposited in strings of mucus during the first or second night after the worms have been collected. Otherwise, eggs may be obtained by cutting the body of a ripe female. Sperm may be added after washing the eggs several times in clean sea water. Development of the direct type proceeds rather slowly, several days being required before the young larva leaves the egg membrane. About a month after fertilization the organization of the adult worm becomes fully established if the larva has been suitably fed with mixed cultures of diatoms and other included organisms.

11. **Procephalothrix spiralis** (Coe), 1930

(Plate 28, fig. 37)

Cephalothrix linearis (Rathke) Coe, 1905; *C. spiralis* Coe, 1930.

Body. Filiform in extension, coiled spirally on contraction; head very long, acutely pointed, mouth situated far back of brain (Fig. 37).

Size. Length, 5 to 15 cm when extended; usually only 1-1.5 mm in diameter.

Ocelli. A single pair present in larval stages only.

Color. Whitish, gray, or pale yellow, often with pinkish or greenish tinge.

Nephridia. The numerous metanephridia of this species have been described by Coe (1930).

Habitat. Very common under stones between tides and below in muddy places; often associated with decaying organic matter.

Distribution. North Atlantic coast of America, Alaska, British Columbia, Puget Sound to southern California.

Regeneration. Posterior regeneration of body fragments takes place rapidly but anterior regeneration has been observed only when cut in front of brain. In the latter case the original proboscis is discharged and a new one replaced from the new cephalic tissues after a month or more. Fragments of the body may remain alive for several months, but a new brain has not been restored in any of the cases under observation.

Reproduction. Eggs from ripe females may be obtained during the warmer months of the year. These are usually deposited at night in a string of mucus and are often fertilized at time of deposition or before if both sexes are associated.

Development of the direct type occurs also when the eggs are cut from the body of the worm and fertilized artificially. The larva may be fed with cultures of diatoms associated with other minute organisms. As in the case of the other species which have been studied, development proceeds slowly; the larva has a single pair of ocelli, as described for the preceding species.

Order HETERONEMERTEA

Key to Families

1. Head usually broad and rounded, capable of being withdrawn into body when strongly contracted; with shallow oblique cephalic grooves but without lateral longitudinal grooves. Cutis glands voluminous; connective tissue layer very thick. Proboscis sheath short; proboscis musculature of two layers of which the outer is circular; without muscular crosses. Cephalic glands voluminous . . . . . Baseodiscidae

1. Head variable in shape; pointed or rounded, according to state of contraction; with deep lateral longitudinal grooves (except in Zygeupolia). Proboscis musculature usually of three layers (circular, longitudinal, circular) with muscular crosses. Cephalic glands relatively few . . . . . Lineidae

Family Baseodiscidae

Genus BASEODISCUS Diesing

Four species of this genus have been reported from the North Pacific coast.

Key to Species

1. With narrow transverse rings of white throughout length of body. Body of moderate diameter but may be of great length, sometimes exceeding 2 m; red or brown, with numerous narrow white rings encircling the body . . . . . mexicanus
1. Without white rings 2
2. Longitudinally striated with numerous interrupted and irregularly anastomosing, very narrow black or dark brown lines . . . . . delineatus
2. Without longitudinal striations 3
3. Yellow, thickly sprinkled with small, irregular, dark red spots; body may reach very large size, sometimes 2 m or more in length . . . . . princeps
3. Deep red, orange red, mahogany, or reddish brown, sometimes covered with whitish bloom; anterior portion of head with broad spot of darker color, bordered terminally and laterally by white . . . . . punnetti

12. **Baseodiscus delineatus** (Delle Chiaje), 1823-1829

Polia delineata Delle Chiaje, 1823-1829; *Eupolia delineata* Bürger, 1895; *Baseodiscus delineatus* Bürger, 1904.

Habitat. Beneath stones and among corals and other growths as well as in sand near low-water mark and below.

Distribution. One of the most widely distributed of all species of nemerteans, being reported from both Northern and Southern hemispheres and under widely diverse temperature conditions; Mediterranean to Cape Verde Islands, Mauritius, Fiji Islands, Barbados, Bermuda, Chile, Gulf of California. One specimen, about 30 cm in length and 7 mm in width, was collected by the Allan Hancock Expedition of 1937 on the shore of San Francisco Island and another at Espiritu Santo Island, both in the Gulf of California.

12a. **Baseodiscus delineatus** var. **curtus** (Hubr.)

Polia curta Hubrecht, 1879; *Eupolia curta* Bürger, 1895.

This variety differs from the typical form of *B. delineatus* in having the body less slender and in having the markings composed of small red or brown dots or larger mottlings without definite pattern instead of interlacing longitudinal lines. The two varieties are often associated.

Distribution. Of world-wide occurrence; Mediterranean, East Indies, Polynesia, Mauritius, Bermuda, West Indies, on the Pacific coast in the Gulf of California, and on the coast of Chile.

13. **Baseodiscus mexicanus** (Bürger), 1895

(Plate 26, figs. 24-26)

Eupolia mexicana Bürger, 1895; *Taeniosoma mexicana* Coe, 1905; Joubin, 1905.

Body. Long and slender, moderately flattened even when contracted; usually twisted and knotted into tangled mass; head demarcated by annular constriction; body very firm and not easily ruptured.

Size. Usually about 20-80 cm in length, occasionally up to 2 m or even 4 m; 2-10 mm or more in width; body when contracted about half as long as when living.

Ocelli. Small and numerous, in elongated cluster on each anterolateral surface of head.

Color. Brownish green, maroon, deep red, mahogany, or brownish violet, with numerous white rings encircling body at irregular intervals; head usually bordered anteriorly and laterally by narrow horizontal white band. The number of white rings may exceed 300 in a large individual. In most specimens the white rings are very thin on ventral surface and often incomplete in the midventral line. Some partial rings are usually situated dorsolaterally in the spaces between two complete rings. The thickness of the rings and their distance apart vary with the state of contraction of each region of the body.

This species has been reported previously from the Gulf of California, west coasts of Central America and Panama, and from the Galapagos Islands. It was collected by the Allan Hancock Expeditions at Ballena Bay, Espiritu Santo Island, San Francisco Island, and Agua Verde Bay, Lower California, Mexico; Black Beach Anchorage, Charles Island, Cartago Bay, Albemarle Island, Darwin Bay, Tangales, Bahia Honda, Taboga Island, Panama, and Coconut Beach, Colombia. Several of

these specimens exceeded 1 m in length and were 12 to 18 mm in width when contracted. This is evidently the most abundant as well as the most conspicuous species of nemertean on the tropical Pacific coast.

Habitat. In twisted tubes of tough mucus beneath stones and among shells and corals along the shore near low-water mark and off shore at depths up to 100 m or more.

14. **Baseodiscus platei** Bürger, 1896

Eupolia platei Bürger, 1896; Isler, 1901.

This species, previously known only from the coasts of Chile and Peru, was represented in the collections of the Allan Hancock Expedition of 1935 by a single specimen about 23 cm long and 5 mm wide. It was obtained from the shore of the lee side of Vieja Island, Independencia Bay, Peru.

15. **Baseodiscus princeps** (Coe), 1901

Taeniosoma princeps Coe, 1901, 1904, 1905.

Habitat. In mud and under stones in muddy situations between tides.

Distribution. At present reported only from the coast of Alaska and Puget Sound.

16. **Baseodiscus punnetti** (Coe), 1904

Taeniosoma punnetti Coe, 1904, 1905, 1905a; Joubin, 1905.

Habitat. Common among red algae, corallines, corals, and other growths from near low-water mark to depths of 100 m or more.

Distribution. At present known only from Monterey Bay to San Diego, California, and southward to the Gulf of California, Mexico.

Family **Lineidae**

Key to Genera

1. Lateral edges of body folded back over dorsal surface to form longitudinal groove in dorsomedian line . . . . . Diplopleura
1. Dorsal surface without median longitudinal groove 2
2. Without longitudinal cephalic grooves; caudal cirrus present . . . . . Zygeupolia
2. With longitudinal cephalic grooves 3

3. Caudal cirrus absent; proboscis sheath usually much shorter than body 4

3. Caudal cirrus present; proboscis sheath usually nearly as long as body 5

4. Body remarkably thick and massive, usually nearly cylindrical when fully extended but broad and much flattened in intestinal region when partially contracted; ocelli absent; muscular layers of body wall with reddish tinge . . . . . Euborlasia

4. Body long and slender, filiform in some species, rounded or flattened in others, very contractile; ocelli present in most species . . . . . Lineus

5. Body rather soft, usually flattened; lateral margins not thin; not adapted for swimming; mouth small and round; proboscis sheath often much shorter than body, but proboscis very slender and much longer than body; ocelli usually present . . . Micrura

5. Body firm, long and ribbonlike; much flattened in intestinal region, with very thin lateral margins and well adapted for swimming; body less contractile than in other genera; dorsoventral and diagonal muscles well developed; mouth large and elongated in some species; ocelli very small or absent in most species . . . . . Cerebratulus

Genus **ZYGEUPOLIA** Thompson

Only a single species of this genus is known at present.

17. **Zygeupolia rubens** (Coe), 1895

Valencinia rubens Coe, 1895; *Zygeupolia littoralis* Thompson, 1900, 1902; Coe, 1905.

Habitat. Common between tidemarks on sandy shores of harbors and bays.

Distribution. Southern New England and on the Pacific coast from Monterey Bay, California, to Ensenada, Mexico.

Genus **EUBORLASIA** Vaillant

Three species of this genus have been found on the Pacific coast.

Key to Species

1. Body encircled by conspicuously colored rings usually darker than adjacent surface . . . . . nigrocincta

1. Body without conspicuously colored rings 2

2. Color gray or pale olive green, thickly speckled with dots and flecks of brown or black; head long and narrow . . . hancocki

2. Color in life unknown; head short; body, of relatively great size when fully mature, may exceed 40 mm in width . . . maxima

18. **Euborlasia hancocki,** new species
(Plate 26, figs. 27, 28)

Body. Narrow anteriorly, broad and much flattened in intestinal region. Head sharply pointed, with long cephalic grooves, not demarcated from body.

Size. The incomplete fragments represent individuals of which the largest must have exceeded 30 cm in length during life; width 7-12 mm; thickness 1-3 mm. The smallest was only 4 mm wide.

Color after preservation. Gray or pale olive green, thickly speckled and blotched with dots and flecks of dark brown or black on both dorsal and ventral surfaces. Dots are more widely separated on head and of more intense pigmentation.

Habitat and distribution. At present known only from the collections of the Allan Hancock Expeditions which obtained specimens from Chacahua Bay, Oaxaca, Mexico, at a depth of about 70 m; Bahia Honda, Panama (70 m); 3 miles south of Ladrone Island, Panama (100 m); Sechura Bay, Peru (17 m); and south end of Independencia Bay, Peru.

19. **Euborlasia maxima** Coe, 1905

E. maxima Coe, 1905a.

Distribution. At present known only from one specimen dredged at a depth of 60 m in the Gulf of California.

20. **Euborlasia nigrocincta,** new species
(Plate 24, figs. 1, 2)

Body. Rather thick and rounded but highly variable in shape, according to state of contraction. Body usually twisted and snarled into shapeless mass with only head and esophageal region projecting. Lateral margins of body rounded and often curved ventrally. Surface of body more or less wrinkled with shallow longitudinal rugosities. Generally more slender anteriorly and more or less contracted and thickened in intestinal region, particularly at posterior end. Head pointed, with long cephalic grooves; not demarcated from body.

Size. Up to 50-70 cm in length when mature and 5-12 mm in width.

Color. Two intergrading color varieties may occur in the same locality. The darker variety is rich purplish brown on both dorsal and ventral surfaces, thickly sprinkled with minute white dots. More or less conspicuous darker rings encircle the body at irregular intervals of 2-5 times the body diameter. Head white, speckled with fine red, orange, or brown dots except near tip. The paler variety is rosy flesh color, thickly speckled on dorsal surface with elongated reddish brown or purplish dots; with conspicuous purplish brown or black rings encircling the body; ventral surface rosy flesh color; head white or slightly pink. Many deviations from these two color patterns are found, particularly in younger individuals, which may be reddish brown dorsally and grayish brown ventrally with very inconspicuous rings. Occasionally the rings are somewhat lighter than the intervening body color, in which case they are bordered by darker rings.

Ocelli. Absent.

Habitat. Beneath stones and in hard clay near low-water mark and below both on the open coast and in protected bays.

Distribution. At present known only from Monterey Bay to San Diego, California.

Regeneration. Individuals of this species are very hardy and may live for six months or more in the aquarium. Posterior regeneration occurs readily at all levels in the intestinal region if connected with the head, but anterior regeneration of body fragments has been limited to healing without the formation of new head in all experiments up to the present time.

Genus **LINEUS** Sowerby

Eight species of this genus are known to occur on the North Pacific coast. Only 2 of these have been found in other parts of the world.

Key to Species

1. Tip of head not conspicuously different from body in color; body without distinct markings 2
1. Tip of head of different color from that of body or with distinct markings on body 4
2. Dusky or brownish green, dark brown, or reddish brown, commonly paler beneath; a single row of 4 to 8 ocelli on each side of head 3

2. Yellowish, pale yellow with tinge of orange, dull orange, ocher, buff, or yellowish brown; margins of head pale or colorless; with 3 to 7 irregular red, purple, or black ocelli, of which the most anterior are largest . . . . . flavescens

3. Body contracts by shortening and thickening—not by coiling in spiral; regenerative capacity very slight . . . . . ruber

3. Body contracts by coiling in spiral; regenerative capacity almost unlimited . . . . . vegetus

4. With conspicuous median dorsal stripe, but without transverse markings; dark brown or olive, with median dorsal stripe of white or yellow extending whole length of body and widening out on head to form broad white marking . . . . . bilineatus

4. Without conspicuous median dorsal stripe 5

5. Body with narrow transverse rings of paler color 7

5. Body without transverse rings of paler color 6

6. Pink, rosy, flesh color, or pinkish red, sometimes with tinge of blue; tip of head white both above and below, sharply marked off from rosy color of body; often with bluish tinge after preservation . . . . . rubescens

6. With a single narrow whitish band connecting posterior ends of cephalic furrows on dorsal side of head. Body and head dark reddish brown or purple . . . . . torquatus

7. Green or brown, with numerous narrow white or yellow rings at irregular intervals; head with white ring about midway between brain and tip . . . . . geniculatus

7. Deep brown or black; middle of head without white ring . . 8

8. Deep brown, chestnut, or slaty, sometimes with greenish tinge; with narrow transverse pale yellow rings at intervals along whole length of body; with 7 to 15 very inconspicuous, fine, hairlike longitudinal lines of yellow on dorsal surface; tip of head white, usually with 2 orange-colored spots . . . pictifrons

8. Brown, greenish black, or bluish black; without longitudinal lines . . . . . atrocaeruleus

21. **Lineus atrocaeruleus** (Schmarda), 1859

(Plate 24, fig. 4)

Meckelia atrocaeruleus Schmarda, 1859; *Lineus atrocaeruleus* Bürger, 1896; Isler, 1901.

A common species. Color greenish black or bluish black with numerous white rings at intervals along entire length of body. An inconspicuous white spot surrounds proboscis opening, sometimes extending posteriorly

along cephalic grooves. Color retained after long preservation. Mature individuals may reach 50 cm or more in length and 4-8 mm in width.

Habitat. Beneath stones and in mud and sand between tidemarks and below.

Distribution. Previously reported from several localities in Chile. Collected by the Allan Hancock Expeditions along the shore at San Juan Bay and at Vieja Island, Independencia Bay, Peru.

22. **Lineus bilineatus** (Renier), 1804

L. bilineatus McIntosh (1873); Joubin (1894); Bürger (1895, 1897-1907, 1904); Southern (1913); Wheeler (1934); *L. albolineatus* Coe (1904, 1905).

Habitat. Among algae and other growths and beneath stones near low-water mark and below. Often found among kelp holdfasts.

Distribution. Coasts of Europe, Mediterranean, Madeira, South Africa; coasts of Alaska, and from Puget Sound to San Diego, California.

23. **Lineus flavescens** Coe, 1904

L. flavescens Coe, 1905; Joubin(?), 1905.

Habitat. Among algae and other growths on spiles and rocks near low-water mark and below, particularly among kelp holdfasts and red algae at depths up to 100 m or more.

Distribution. Southern California to Gulf of California and coast of Mexico. The same or a very similar species has been collected at La Paz, Mexico (Joubin, 1905).

Regeneration. Posterior regeneration occurs at all levels behind the brain. Anterior regeneration with restoration of a new brain is occasionally successful in large portions of the body from which the head has been removed, but complete regeneration of fragments from intestinal region failed in all the experiments undertaken.

24. **Lineus geniculatus** (Delle Chiaje), 1828

L. digueti Joubin, 1905; *L. geniculatus* Bürger, 1895; Wheeler, 1934.

The cephalic markings on specimens in the Allan Hancock collections indicate that the peculiarities on which Joubin based the species *digueti* were within the limits of variability of the species *geniculatus*.

Habitat. Beneath stones and in crevices of rocks and corals.

Distribution. Mediterranean and Black seas; west coast of Africa. Collected by the Allan Hancock expeditions at the following localities: La Paz and San Gabriel Bay, Espiritu Santo Island; Puerto Refugio, Angel de la Guardia Island; and at a depth of 30 m off San Francisquito Bay in the Gulf of California; at Ensenada de Francisco, Sonora, and Tenacatita Bay on the west coast of Mexico; and at Secas Islands, Panama.

25. **Lineus pictifrons** Coe, 1904

L. pictifrons Coe, 1905, 1905a, 1932, 1934.

Habitat. In crevices of rocks, beneath stones, among algae and other growths on rocks and piers exposed to surf, also in mud of harbors and bays, as well as among kelp holdfasts.

Distribution. At present known from Puget Sound, Monterey Bay, and southward to the Gulf of California.

Regeneration. This species is of interest physiologically because it shows an intermediate regenerative capacity between such forms as *L. ruber,* in which the organizing center for anterior regeneration is limited to the region adjacent to the cerebral sense organs, and those like *L. vegetus,* in which the organizing center extends the entire length of the nerve cords (Coe, 1932, 1934).

26. **Lineus ruber** (O. F. Müller), 1771

L. sanguineus McIntosh, 1873; *L. sanguineus, L. viridis* Verrill, 1892; *L. ruber* Stephenson, 1911; Southern, 1913; Wheeler, 1934; *L. viridis* Coe, 1901, 1904, 1905.

Habitat. Beneath stones and among shells, grasses, and other growths between tides and below in both sandy and muddy situations. Endures a wide range of ecological conditions in protected bays as well as on the open coast. Survives great changes in salinity.

Distribution. Circumpolar; Siberia, northern coasts of Europe, Mediterranean, Madeira to South Africa; Greenland to southern New England; Alaska to Monterey, California.

Remark. This is a classic species for studies on physiology, embryology and regeneration.

27. **Lineus rubescens** Coe, 1904

(Plate 25, fig. 23)

L. rubescens Coe, 1905.

Habitat. Among algae and other growths on rocks and spiles or beneath stones, near low-water mark and below.

Distribution. At present reported only from Monterey Bay to San Diego, California.

28. **Lineus torquatus** Coe, 1901

L. torquatus Coe, 1904, 1905, 1905a.

Habitat. Beneath stones and in mud between tidemarks.

Distribution. At present known only from coast of Alaska.

29. **Lineus vegetus** Coe, 1931

(Plate 25, fig. 13; plate 28, figs. 32, 33)

L. vegetus Coe, 1931, 1932, 1934.

Body. Very slender in full extension, frequently a hundred times as long as transverse diameter; worm often contracts by coiling in spiral; head narrow, with long cephalic grooves (Fig. 13).

Size. Length, up to 15 cm; diameter, 0.5-1.5 mm.

Ocelli. A single longitudinal row of 2-8 small ocelli is situated on each anterolateral margin of head (Fig. 33).

Color. Usually pale olive brown or reddish brown, darker on dorsal surface, particularly on head; frontal margin and lateral borders of head white or pale gray; brain region rosy; body usually encircled by several to 20 or more very narrow and inconspicuous rings of lighter color, also fine longitudinal line of lighter color often present on each lateral margin of body.

Young worms and small regenerating individuals white to grayish, with rosy brain and a few small brown ocelli.

Habitat. Beneath stones, in crevices of rocks, and among corallines and other growths exposed to the full force of the surf. Abundant in many localities. Often found above the middle of the intertidal zone.

Geographical distribution. At present known only from Monterey Bay, California, and southward to Ensenada, Mexico.

Remarks. This species frequently reproduces asexually by fragmentation (Fig. 32). The new worms from these regenerating fragments may

live for a year or more in closed vessels of sea water without special feeding. Fragments from any part of the body back of the head regenerate about equally well, and they may even be split longitudinally or cut into small sectors, with a minute but fully organized worm resulting from each piece, if not too small, which contains a portion of one of the nerve cords (Coe, 1934). Fragments often encyst during the regenerative processes. Grafting of longitudinally split fragments is sometimes successful if the polarity of the two pieces coincides.

The species is closely similar, both morphologically and physiologically, but not identical with *L. socialis* Leidy and *L. sanguineus* (Rathke) McIntosh, the latter erroneously called *L. ruber,* slender form, by Nusbaum and Oxner (1910, 1911).

Genus **MICRURA** Ehrenberg

Eight species of this genus have been found on the Pacific coast.

Key to Species

1. With narrow white bands or rings encircling body at intervals throughout entire length 2
1. Without conspicuous transverse bands or rings 4
2. Tip of head red or flesh color; ventral surface white 3
2. Tip of head white; both dorsal and ventral surfaces of body brown or blackish, lighter ventrally . . . . . wilsoni
3. Dorsal surface deep purple or reddish brown, ventral surface white; dorsal side of head red, deep orange, or vermilion . . . verrilli
3. Dorsal surface dusky or gray; head flesh colored . . . impressa
4. Dorsal surface with conspicuous spots and blotches 5
4. Without distinct spots, except on tip of head 6
5. Pale yellow; dorsal surface nearly covered with black or dark brown spots and dots, often somewhat elongated and arranged in irregular longitudinal lines; in some individuals spotting pattern is divided into rectangles by narrow transverse lines; 6 to 15 ocelli in single row on each side of head . . . . . pardalis
5. Grayish after preservation (color in life unknown), thickly mottled on both dorsal and ventral surfaces with coarse confluent brownish blotches, which often fuse together posteriorly to form a continuous brownish color . . . . . nebulosa
6. Rosy, flesh color, or red; ocelli absent 7

6. Pale olive brown, grayish ocher, or buff; deeper brown in intestinal region, and with a paler median dorsal stripe in esophageal region; 6 to 12 or more small ocelli in an irregular row on each side of head . . . . . olivaris

7. Deep red; sometimes purplish in esophageal region and brighter red anteriorly; head bright red with a narrow, but very sharp and conspicuous transverse band of white just behind tip, with small, dark brown or black spot on exact tip . . . . nigrirostris

7. Salmon, gray, flesh color, pale red, or light rosy brown, shading into lighter, with tinges of lighter red or yellow or nearly white anteriorly; intestinal lobes more deeply colored, sometimes brown; a cream-colored stripe often situated in median ventral line . . . . . alaskensis

30. **Micrura alaskensis** Coe, 1901

(Plate 24, fig. 12)

M. alaskensis Coe, 1904, 1905; *M. griffini* Coe, 1905.

Habitat. Beneath stones, in crevices of rocks, in sand and sandy mud between tides.

Distribution. Alaska, British Columbia, Puget Sound to southern California and Ensenada, Mexico; common in many localities.

Reproduction. Sexual products mature during the warmer months of the year; the eggs develop rapidly as far as the pilidium stage after artificial fertilization. The blastomeres are sharply defined during the spiral type of cleavage, making the egg very suitable for experimental purposes.

31. **Micrura impressa** (Stimpson), 1857

Cerebratulus impressus Stimpson, 1857; *M. impressa* Coe, 1901, 1904, 1905, 1905a.

Distribution. Known only from Stimpson's original specimen taken in Bering Strait.

32. **Micrura nebulosa** Coe, 1905

M. nebulosa Coe, 1905a.

There is a superficial resemblance between individuals of this species and heavily pigmented specimens of *M. pardalis,* but in the latter the spots or blotches are limited to the dorsal surface.

Habitat and distribution. An abyssal species at present known only from a single specimen dredged from a depth of about 900 m in the Pacific Ocean south of Alaska Peninsula.

33. **Micrura nigrirostris** Coe, 1904

M. nigrirostris Coe, 1905, 1905a.

Habitat. Among kelp holdfasts and other growths on rocks at low-water mark and below.

Distribution. At present known only from southern California.

34. **Micrura olivaris** Coe, 1905

M. olivaris Coe, 1905a.

Habitat. In crevices of rocks near low-water mark.

Distribution. At present known definitely only from Monterey Bay, California. A single specimen of the same or of a similar species was dredged off San Francisco at a depth of 120 m.

35. **Micrura pardalis** Coe, 1905

(Plate 25, figs. 14-19)

M. pardalis Coe, 1905a.

Habitat. Among corallines and other growths on rocks and piers, and especially in tide pools exposed to the full force of the surf. Also beneath stones and in crevices of rocks near low-water mark. In some localities this is one of the most common species of nemerteans.

Distribution. At present known only from Monterey Bay, California, and southward to Ensenada, Mexico.

Reproduction. This species is hardy under aquarium conditions, sometimes living for several months in tubes of secreted mucus. After long captivity most of the pigment disappears. Sexual products mature during the spring and summer on the coast of southern California. The eggs develop rapidly to the pilidium stage after artificial fertilization.

Regeneration. In young individuals posterior regeneration and regulation proceed rapidly at all levels posterior to brain but attempts to obtain anterior regeneration of body fragments have not been successful.

36. **Micrura verrilli** Coe, 1901

Lineus striatus Griffin, 1898 (non *Meckelia striata* Diesing nec *Borlasia striata* Rathke); *M. verrilli* Coe, 1904, 1905, 1905a.

Habitat. Beneath stones, in sandy mud and among roots of eel-grass between tidemarks, among algae and other growths on rocks and in tide pools, and especially among kelp holdfasts in shallow water.

Distribution. Alaska, British Columbia, Puget Sound, and southward to Monterey Bay, California. A somewhat similar species, *Cerebratulus (Micrura) bellus,* was reported by Stimson (1857) from Yezo Island, Japan.

Reproduction and Regeneration. As in preceding species.

37. **Micrura wilsoni** (Coe), 1904

Lineus wilsoni Coe, 1904, 1905, 1905a; Joubin, 1905.

Specimens recently collected were each provided with a minute white caudal cirrus, characteristic of the genus to which the species is now assigned.

Habitat. Beneath stones, in crevices of rocks, on kelp holdfasts, as well as in sandy mud near low-water mark and off the coast to a depth of 35 m or more.

Distribution. Monterey Bay, California, and southward to the Gulf of Mexico.

Genus **CEREBRATULUS** Renier

Nine species of this genus are known from the North Pacific coast, only one of which has been found in other parts of the world.

Key to Species

1. Tip of head whitish both above and below, conspicuously different from deeply colored body 2
1. Tip of head not conspicuously different from body in color . . 3
2. Body very long and ribbonlike, sometimes attaining a length of more than 2 m; deep red, except tip of snout, which is yellowish white above and below . . . . . montgomeryi
2. Body long and ribbonlike, dark brown or reddish purple, except head, which is white on both dorsal and ventral surfaces, back about ¾ the length of the cephalic grooves, or sometimes nearly or quite to the mouth . . . . . albifrons
3. Without distinct longitudinal or transverse markings on body . 4
3. With conspicuous transverse or longitudinal markings on body 8
4. Body long and ribbonlike 5
4. Body comparatively short and broad; brown or reddish brown, darker posteriorly, lighter in ventral median line . . occidentalis

5. Head very long and slender; dark brown or purplish, paler on borders of cephalic furrows and tip of head; cephalic furrows remarkably long and deep . . . . . longiceps
5. Head of moderate proportions, or short 6
6. Body of moderate proportions 7
7. Body very large and stout, sometimes becoming 2 m or more in length and 25 mm in width; head and cephalic furrows short; dark reddish brown . . . . . herculeus
7. Slaty brown to grayish or pale olive, paler beneath, with conspicuously paler or white lateral margins . . . . marginatus
7. Color highly variable; pale yellow, buff, light brown, or chocolate brown; lateral margins thin and often pale; lateral nerve cords red . . . . . californiensis
8. Rather slender; pale gray with numerous fine, irregular, and much interrupted dark olive-brown longitudinal lines extending whole length of body both above and below, but more numerous and larger on dorsal surface than ventrally . . . . lineolatus
8. Rather short; with conspicuous narrow band of dark color in median dorsal line, and a series of narrow transverse markings of dark color placed side by side on dorsolateral aspects of body . . . . . signatus

38. **Cerebratulus albifrons** Coe, 1901

C. albifrons Coe, 1904, 1905, 1905a.

Habitat. In mud or beneath stones at low-water mark and below to a depth of 100 m or more.

Distribution. Coast of Alaska, Puget Sound, Monterey Bay, and southward to San Diego, California. Dredged off central and southern California.

39. **Cerebratulus californiensis** Coe, 1905

(Plate 24, figs. 7-11)

Individuals of this species vary greatly in color according to age, state of sexual maturity, and habitat. Young individuals are pale grayish, pinkish, or yellowish, with a distinctly darker cephalic area (Figs. 8, 12). When living in black mud the color is usually very dark brown or greenish brown, sometimes with distinctly lighter lateral margins (Figs. 9, 10). The nerve cords and, to a less extent, the muscle layers are conspicuous in life, because of a diffusible red coloring matter.

Habitat. In mud, sandy mud, or sand between tides in bays and harbors and to depths of 50 m or more.

Distribution. Previously known from Puget Sound to San Diego, California; the most common species of nemertean in some localities. Collected by the Allan Hancock Expeditions at San Gabriel Bay, Espiritu Santo Island, Gulf of California, and at Mazatlan and Tenacatita, Mexico.

Reproduction. Sexually mature during May and June in southern California and in July at Monterey Bay. Eggs develop readily as far as pilidium stage after artificial fertilization.

40. **Cerebratulus corrugatus** (McIntosh), 1887

C. magelhaensicus Bürger, 1895; *Lineus corrugatus* Wheeler, 1934.

This highly variable and widely distributed species has been reported previously from the vicinity of South Georgia, Falkland and South Shetland islands, and on the South American coast as far north as Chile. It was dredged at a depth of 20-40 m by the Allan Hancock Expedition of 1938 at San Nicolas Bay, and Independencia Bay, Peru, extending the known range considerably northward.

The generic status of the species is somewhat problematical because of the great variability not only in form of body but also in structure of body walls (Wheeler, 1934). The specimens in the Hancock collection are obviously of the *Cerebratulus* type.

41. **Cerebratulus herculeus** Coe, 1901

C. herculeus Coe, 1904, 1905, 1905a; *C. latus* Coe, 1905.

Habitat. Burrows in soft mud near low-water mark and below to depths of 250 m or more.

Distribution. Bering Sea, Alaska Peninsula, coast of Alaska, Puget Sound, and southward to southern California in the off-shore waters.

42. **Cerebratulus lineolatus** Coe, 1905

C. lineolatus Coe, 1905a.

Habitat. In sandy mud near low-water mark and below.

Distribution. Previously known only from San Pedro, Newport, and San Diego harbors, California. Collected by the Allan Hancock Expedition of 1937 at a depth of 70 m at Puerto Refugio, Angel de la Guardia, and at Willards Pt., Gonzaga Bay, Lower California, Mexico.

43. **Cerebratulus longiceps** Coe, 1901

C. longiceps Coe, 1904, 1905, 1905a.

Habitat. Under stones near low-water mark.

Distribution. At present known only from Yakutat Bay, Alaska.

44. **Cerebratulus marginatus** Renier, 1804

C. marginatus Bürger, 1895, 1904; Coe, 1905; *C. fuscus* Verrill, 1892.

Habitat. Lives in mud between tidemarks and below to depths of 50 m or more.

Distribution. This is a typical circumpolar species, its range on the shores bordering the eastern North Atlantic being from Scotland and Norway to the Mediterranean and Madeira; on the shores of the western Atlantic from Greenland and Labrador to Cape Cod and thence southward beneath the off-shore Arctic current; and in the Pacific from Alaska to British Columbia, Puget Sound, Monterey Bay, and south to San Diego, California.

Reproduction. A classical species for experimental studies in embryology.

45. **Cerebratulus montgomeryi** Coe, 1901

C. montgomeryi Coe, 1904, 1905, 1905a.

Habitat. Beneath stones and in mud near low-water mark and below to depths of 160 m or more.

Distribution. Coast of Siberia, Bering Sea, Aleutian Islands, coast of Alaska, British Columbia, Puget Sound to Monterey Bay, California.

Reproduction. Sexually mature during the warmer months of the year. Development proceeds to the pilidium stage after artificial fertilization, but the transformation of the pilidium to the adult form has not yet been described.

46. **Cerebratulus occidentalis** Coe, 1901

C. occidentalis Coe, 1904, 1905, 1905a.

Habitat. Beneath stones and in mud near low-water mark and below.

Distribution. At present known only from coasts of Alaska, British Columbia, and Puget Sound.

47. **Cerebratulus signatus** Coe, 1905

C. signatus Coe, 1905a.

Habitat. Dredged from sandy, shelly bottom at a depth of about 110 m.

Distribution. Known only from a single specimen dredged in the Bering Sea.

Genus **DIPLOPLEURA** Stimpson

48. **Diplopleura vivesi** (Joubin), 1905

Langia vivesi Joubin, 1905.

Habitat. In fine sand at low-water mark.

Distribution. At present known from only a single specimen collected at La Paz, Lower California, Mexico.

Order **HOPLONEMERTEA**

Key to Suborders

1. Armature of proboscis consists of central stylet with truncated conical or pear-shaped basis and usually 2 or more pouches of accessory stylets; mouth and proboscis opening usually united . . . . . Monostylifera
1. Armature of proboscis consists of sickle-shaped basis bearing numerous small stylets and usually several pouches of accessory stylets; mouth and proboscis opening separate or united in short atrium . . . . . Polystylifera

Suborder **MONOSTYLIFERA**

Key to Families

1. Statocysts absent; ocelli usually present 2
1. Statocysts present; ocelli absent . . . . Ototyphlonemertidae
2. Body long and slender; cerebral sense organs small, situated in front of brain 3
2. Body usually relatively short and broad; cerebral sense organs large, situated beside, behind, or in front of brain 4
3. Proboscis sheath not more than ¾ as long as body; proboscis short; ocelli usually numerous, occasionally only one or 2 pairs or none . . . . . Emplectonematidae

3. Proboscis sheath nearly as long as body; proboscis long and slender; usually 2 pairs of large ocelli . . . . . Prosorhochmidae
4. Intestinal diverticula branched; intestinal caecum usually with long anterior branches; gonads irregularly grouped; ocelli usually numerous . . . . . Amphiporidae
4. Intestinal diverticula unbranched; intestinal caecum with short anterior branches or none; gonads alternate regularly with intestinal diverticula; ocelli usually 4 . . . Tetrastemmatidae

Family **Emplectonematidae**

Five genera found on the Pacific coast are included in this family.

Key to Genera

1. Parasitic on crabs; cerebral sense organs absent; proboscis rudimentary and accessory stylet pouches absent . . Carcinonemertes
1. Free living; cerebral sense organs present; proboscis with 2 or more pouches of accessory stylets 2
2. Head with numerous small ocelli or with a small cluster on each side of proboscis opening 3
2. Head with 4 ocelli 4
3. Body very slender; proboscis sheath less than half as long as body; proboscis with only 2 or occasionally 3 pouches of accessory stylets . . . . . Emplectonema
3. Body only moderately slender; proboscis sheath ½ to ¾ as long as body; proboscis with 2, 4, or 6 pouches of accessory stylets . . . . . Paranemertes
4. Body filiform; ocelli large . . . . . Nemertopsis
4. Body firm and only moderately slender; ocelli very small . . . . . Dichonemertes

Genus **EMPLECTONEMA** Stimpson

Key to Species

1. Dorsal surface green; central and accessory stylets curved; stylets long and slender; basis very long; body dark or pale green dorsally; whitish, yellowish, or very pale green ventrally . . . . . gracile
1. Dorsal surface brown or purplish; central and accessory stylets straight 2

2. Stylets short, with swollen heads; basis of central stylet swollen and rounded posteriorly; 11 proboscidial nerves; dark brown above, often with minute purple dots; flesh colored or yellowish white beneath . . . . . bürgeri

2. Stylets without swollen heads, fluted longitudinally; basis of central stylet not swollen posteriorly; 16 proboscidial nerves; purplish or purplish brown from closely placed mottlings on dorsal surface; ventral surface gray or yellowish . . purpuratum

49. **Emplectonema bürgeri** Coe, 1901

E. violaceum Griffin, 1898 (non *E. violaceum* Bürger); *E. bürgeri* Coe, 1904, 1905, 1905a.

Habitat. Among mussels and other growths and beneath stones between tidemarks and below.

Distribution. Pribilof Islands, Bering Sea, coasts of Alaska and British Columbia, Puget Sound to Monterey Bay, California.

50. **Emplectonema gracile** (Johnston)

(Plate 30, fig. 40)

Nemertes gracilis Johnston, 1837; *Emplectonema viride* Stimpson, 1857; Griffin, 1898; *Eunemertes gracilis* Bürger, 1895; *Emplectonema gracile* Coe, 1901, 1904, 1905.

Body. Very long and slender, often twisted and closely knotted, somewhat flattened. Body of firm consistency; does not fragment when roughly handled.

Size. Up to 50 cm or more in length and 2 mm in width; sexually mature when 5-10 cm long.

Color. Yellowish green to dark green on dorsal surface, pale yellowish green or whitish ventrally; tip of head usually pale or colorless; entire body gray, creamy white, or pale yellow with tinge of green or pink when young; often pinkish when ova are mature; intestinal diverticula often dark brown. Pale individuals usually become tinged with green when placed in formalin.

Ocelli. Arranged in 2 groups on each side of head; an anterior, marginal row or elongated cluster with usually 10-15 ocelli of varying sizes and a cerebral cluster with about the same number; much fewer when young (Fig. 40).

Proboscis. Proboscis sheath less than ⅓ as long as body. Basis of central stylet very long and slender, about 2 to 3 times as long as the slender, curved stylet; each of the 2 lateral pouches usually contains 5-7 curved accessory stylets (Fig. 40).

Habitat. Abundant in many localities beneath stones and among mussels and other growths on rocks and piers between tidemarks and below. Often in muddy situations with decomposing organic matter and sometimes in brackish water. Sometimes nearly a dozen may be associated in a single tangled mass.

Distribution. Northern coasts of Europe to Mediterranean and Madeira and from the Aleutian Islands and coast of Alaska to Ensenada, Mexico. Also reported from Chile.

Reproduction. Sexual maturity occurs as early as March on the coast of southern California and in early summer farther north. The very numerous gonads surround the intestinal canal; a dozen or more may occur in a single transverse section of body; gonaducts open ventrally or dorsally, according to position of gonads. Several hundred ova may be included in a single ovulation. Development is of the direct type and occurs readily after artificial fertilization. The newly hatched young worms are abundant among mussels and other growths on rocks and piers during April and May in southern California.

51. **Emplectonema purpuratum** Coe, 1905

E. purpuratum Coe, 1905a.

Habitat and Distribution. At present known from only 2 specimens collected by the U.S.F.C. Steamer *Albatross* at Adakh Island (Aleutian group), Alaska.

Genus **NEMERTOPSIS** Bürger

Only a single species of this genus is at present known from the Pacific coast.

52. **Nemertopsis gracilis** Coe, 1904

(Plate 24, fig. 3*a*)

N. gracilis Coe, 1905, 1905a.

Habitat. Often abundant among corallines, mussels, and other growths on rocks and piers exposed to the full force of the surf; usually near low-water mark and below.


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PLATE 24

FIG. 1. *Euborlasia nigrocincta.* Light-colored variety with conspicuous bands. Regenerating posterior extremity.

FIG. 2. *E. nigrocincta.* Dark variety, with inconspicuous bands.

FIG. 3. (*a*) *Nemertopsis gracilis,* with dorsal stripes separated anteriorly. (*b*) *N. gracilis* var. *bullocki,* with dorsal stripes united anteriorly by broad transverse band.

FIG. 4. *Lineus atrocaeruleus.* Anterior end of body.

FIG. 5. *Tetrastemma sexlineatum.* (To the left of Fig. 6.) Dorsal surface with portion of ventral surface bordered by the narrow marginal stripes.

FIG. 6. *T. sexlineatum.* Anterior end of body; flattened to show the six longitudinal stripes.

FIG. 7. *Cerebratulus californiensis.* Dark red variety.

FIGS. 8-10. *C. californiensis.* Anterior portions of bodies of light and dark varieties and dark variety with pale margins, respectively.

FIG. 11. *C. californiensis.* Very young individual with light-colored body and deeply pigmented head.

FIG. 12. *Micrura alaskensis.* Deeply colored, sexually unripe individual.

Distribution. At present known only from Puget Sound and southward to Ensenada, Mexico.

52a. **Nemertopsis gracilis,** variety **bullocki,** new variety

(Fig. 3*b*)

This variety differs from the typical form in having the longitudinal brown stripes connected at their anterior ends by a broad transverse band of the same color. In some individuals the stripes are inconspicuous in intestinal region or interrupted by paler areas to form 2 rows of small oval brown spots (Fig. 3*b*).

Habitat. Nearly 100 individuals of various sizes representing both young and sexually mature individuals were found by T. H. Bullock and Charles Michener of the University of California in tangled masses in narrow crevices of rock filled with fine mud and detritus near low-water mark.

Distribution. As yet known only from Montara, San Mateo County, California. The typical form has been found at numerous localities from Puget Sound to Todos Santos Bay (Ensenada), Mexico.

Genus **PARANEMERTES** Coe

Four species of this genus are found on the Pacific coast.

Key to Species

1. White, flesh color, pale orange, or light green; stylets without spiral fluting 2
1. Brown or purple, on dorsal surface; stylets with spiral fluting . . . . . peregrina
2. White or flesh color; ocelli numerous 3
2. Pale gray or pale orange anteriorly; flesh color, grayish, or very pale salmon posteriorly, usually much obscured by green color of intestinal tract; ocelli few and inconspicuous . . . . californica
3. With 4 pouches of accessory stylets; 9 or 10 proboscidial nerves; opaque white; nephridia with a single pair of efferent ducts . pallida
3. With 6 (or occasionally 12) pouches of accessory stylets; 11 or 12 proboscidial nerves; whitish, pinkish, or flesh color, nephridia with about 5 pairs of efferent ducts . . . . . carnea

53. Paranemertes californica Coe, 1904

(Plate 28, figs. 34-36)

P. californica Coe, 1905, 1905a.

Body. Moderately slender, usually 10-20 cm in length when sexually mature, occasionally up to 45 cm; width, 2-6 mm.

Color. Rosy or pinkish anteriorly, often tinged with yellow or orange; intestinal region gray or pale salmon, usually much obscured by dark green intestinal tract; rhynchocoel fluid red. In some individuals the entire body, including glandular wreath surrounding stylet apparatus, is tinged with green; this color is often intensified after preservation in formalin.

Ocelli. Usually 2 or 3 small ocelli lie on each side of proboscis opening and a small cluster of about the same number anterior to each brain lobe (Fig. 34).

Proboscis. Proboscis sheath ½ to ⅔ the length of body. Basis slender, about twice as long as central stylet (Figs. 35, 36). There are 2, 4, or 6 pouches of accessory stylets and 10 or 11, occasionally 12 or 13, proboscidial nerves.

Other characteristics. Cephalic glands very voluminous, composing a large part of the tissues of the head as far back as the brain region. Cerebral sense organs elongated and rather large, situated on anteroventral borders of brain and connected with the exterior by large ducts which extend forward to ventrolateral surfaces of terminal portion of head. Longitudinal musculature of the head separated into inner and outer layers by a thick layer of parenchyma. Intestinal caecum very short, since the pylorus opens near the anterior end of a slender part of the mid-gut which extends forward from the main portion of the intestine. Only the latter bears typical paired lateral diverticula of large size. Blood vessels of head and anterior portion of esophageal region provided with many branches extending through the thick layer of parenchyma; more posteriorly they are gathered into the usual 3 longitudinal vessels, which also have lateral branches.

The nephridia consist of branching tubules which follow the blood vessels through the parenchyma in the posterior portion of the pyloric region and a short distance posterior thereto. The thin-walled collecting tubules may become greatly distended or contracted so as to almost close the lumens. One or two pairs of efferent ducts open on the dorsolateral aspects of the body near the posterior end of the pyloric region.

Habitat. In bays and harbors, burrowing in sand and sandy mud between tidemarks.

Distribution. At present reported only from Monterey Bay, California, and southward to Ensenada, Mexico.

54. **Paranemertes carnea** Coe, 1901

P. carnea Coe, 1904, 1905, 1905a.

Habitat. In bays and harbors; burrows in mud and sand between tidemarks.

Distribution. At present known only from Alaska, British Columbia, and Puget Sound.

55. **Paranemertes pallida** Coe, 1901

P. pallida Coe, 1904, 1905, 1905a.

Habitat. Under stones between tidemarks.

Distribution. At present known only from coast of Alaska.

56. **Paranemertes peregrina** Coe, 1901

P. peregrina Coe, 1904, 1905.

Habitat. Occurs in a great variety of situations between tidemarks, especially under stones and among algae, mussels, and other growths on spiles and rocks. The worms are active on cloudy days, often creeping about fully exposed to the air. In some localities this is the most abundant species of nemertean.

Distribution. Commander Islands, Kamchatka, Aleutian Islands, coasts of Alaska and British Columbia, Puget Sound to Ensenada, Mexico. Common and of large size northward (variety *alaskensis*); less abundant and smaller southward (variety *californiensis*).

Reproduction and Regeneration. Gelatinous clusters containing many ova deposited during the warmer months of the year.

Genus **DICHONEMERTES** Coe

Only one species belonging to this genus is known.

57. **Dichonemertes hartmanae** Coe, 1938

(Plate 29, fig. 38)

Body. Rather slender, rounded, and of firm consistency; shaped like long cigar; incapable of extensive contraction.

Size. 10-15 mm long and 0.5 mm in diameter when mature.

Color. Pale red or yellowish, with deep red blood.

Ocelli. 4 very small, crescentic ocelli form the corners of a rectangle immediately in front of brain; the 2 ocelli of the same side are much closer together than the distance between either pair (Fig. 38); situated deep in tissues of head beneath cephalic musculature.

Proboscis. Proboscis sheath limited to anterior third of body (Fig. 38). Proboscis very short and small; muscular layers very thin; anterior chamber only ¼ to ⅙ as long as body, armed with small, pear-shaped basis about the same length as the slender stylet and with two lateral pouches each containing 2-3 stylets. In each of 2 specimens available for study the basis measured only 0.04 mm in length. There are 10 proboscidial nerves.

Vascular system. The 3 longitudinal vessels and the cephalic loop are very conspicuous in the living worm because of the bright red color of the blood. Color present principally in corpuscles, but plasma is also tinged with red. Walls of blood vessels remarkably thick and firm.

Nephridia. Limited to anterior portion of esophageal region. The branching tubules lie close beneath the body musculature both above and below the nerve cords, but the efferent ducts open on the ventrolateral aspects of the body.

Cephalic glands. Voluminous, extending posteriorly to brain region. In addition to pair of main ducts opening at tip of head are very numerous smaller ducts opening directly on all surfaces of the head.

Cerebral sense organs. Small, less than ¼ the diameter of the ventral ganglia. Situated close beneath anterolateral borders of brain; open by large ducts to ventrolateral surfaces of head.

Lateral nerve cords. With single fibrous core.

Alimentary canal. Mouth and proboscis opening united; esophagus-stomach rather long, with correspondingly long intestinal caecum, latter with pair of broad diverticula extending anteriorly to posterior border of dorsal ganglia.

Reproduction. Hermaphroditic and protandric; gonads extend forward almost to brain region; 5-8 anterior gonads function as spermaries, the remaining 20 or more pairs as ovaries.

Habitat. In mud and beneath dead vegetation between tidemarks.

Distribution. At present known only from Mission Bay, San Diego, California.

Genus CARCINONEMERTES Coe

Only one species of this genus has been found on the Pacific coast.

58. Carcinonemertes epialti Coe, 1902

C. epialti Coe, 1904, 1905, 1905a.

Habitat. Adults live among egg clusters of the kelp crab *Epialtus productus* and presumably of other species of crabs.

Distribution. At present known only from Monterey Bay, California.

Family Ototyphlonemertidae

Genus OTOTYPHLONEMERTES Diesing

Only a single species of this highly specialized genus has been found on the Pacific coast.

59. Ototyphlonemertes spiralis, new species

(Plate 31, fig. 41)

This species is closely similar to *O. macintoshi* Bürger but differs in numerous details from the descriptions of the few specimens of the latter species that have been available for study. It can be readily distinguished from all other Pacific coast nemerteans by the pair of statocysts on the dorsal side of the ventral ganglia (Fig. 41).

Body. Minute; filiform in full extension; somewhat thickened and usually drawn into a knot or closely coiled spiral when contracted. Head slender, not demarcated from body. Body of firm consistency and not easily ruptured.

Size. Upward of 3-5 cm in length and only 0.3-0.5 mm in diameter when sexually mature and fully extended; most individuals much smaller.

Color. White, gray, straw color, or yellow; more deeply colored anteriorly; brain region pinkish. Minute brownish granules in surface epithelium sometimes influence the general coloration.

Ocelli. Absent.

Statocysts. A single pair of small, spherical, highly refractive statocysts situated in dorsal surface of ventral ganglia. Each statocyst is about $\frac{1}{6}$ the diameter of ventral ganglion. The statolith is spherical and composed of about 8, 12, or 16 transparent colorless globules united compactly and symmetrically (Fig. 41). The size of the statolith is nearly uniform in all mature individuals, but the size of the component globules is correlated with the number present. In such individuals the statocysts

are approximately 0.027 mm in diameter and the statoliths about 0.012 mm. The statolith usually lies somewhat excentrically in the statocyst and toward the median line of the body, but the position changes when the brain is compressed.

Proboscis. Sheath limited to anterior fourth of body. Proboscis very slender, with long slender canal in place of the usual bulblike middle chamber; posterior chamber remarkably long, with thick glandular walls; with slender retractor at end; armature minute; central stylet very slender, slightly longer than the slender cylindrical basis. In sexually mature individuals the basis is only about 0.03 mm in length and 0.006 mm in diameter. The length is thus about 5 times as great as the width. The central stylet is about 0.04 mm long. There are 2-4 accessory stylets in each of the 2 lateral pouches. Both central and accessory stylets have spiral ridges, giving them a braided appearance because of their transparency (Fig. 41).

Cephalic glands. Voluminous, extending back of brain into foregut region.

Cerebral sense organs. Small, situated near anterolateral border of brain.

Lateral sense organs. A pair of remarkable sense organs extends throughout most of the foregut region on the lateral margins of body in close proximity to the nerve cords. The sensory cells of each sense organ are situated in a longitudinal groove at the base of the surface epithelium and are innervated by an almost continuous row of fibers from the adjacent nerve cord.

Reproduction. Sexes separate; gonads situated laterally, not alternating regularly with intestinal diverticula; spermaries are several times more numerous than ovaries. Sexually mature in spring and summer in southern California.

Habitat. In sand underlying corallines and other growths on rocks and in tide pools on the open coast; locally common.

Distribution. At present known only from San Diego, California.

Family Prosorhochmidae

Key to Genera

1. Body slender; cerebral sense organs beneath or behind ocelli; intestinal diverticula mainly dorsal to intestine . Prosorhochmus
1. Body not very slender; cerebral sense organs anterior to ocelli; intestinal diverticula mainly lateral to intestine . . . Oerstedia

PLATE 25

FIG. 13. *Lineus vegetus.*

FIGS. 14-19. *Micrura pardalis.* Variations in color patterns. Fig. 14. Variety with homogeneous black spotting. Fig. 15. Variety *lineata* with brown spots fused into lines which are interrupted by transverse colorless bands. Ocelli are shown on one side, with one row dorsal and the other ventral to cephalic groove. Fig. 16. Variety with minute black spots in linear arrangement. Fig. 17. Variety with scattered black spots and with indications of transverse colorless bands. Fig. 18. Variety with regularly arranged brown spots and distinct transverse colorless bands. The ocelli on dorsal and ventral borders of cephalic groove are shown. Fig. 19. Very young individual with few ocelli and few grayish spots.

FIG. 20. *Prosorhochmus albidus.* Viviparous individual with 2 young, because of the retention of fertilized eggs within the ovary. Most individuals are oviparous.

FIG. 21. *Carinoma mutabilis.* (To the left of Fig. 22.) Sexually ripe male. Individuals of both sexes when sexually immature are white anteriorly, with pale yellow or brownish intestinal regions.

FIG. 22. *Carinoma mutabilis.* Sexually ripe female. Shape of head changes constantly in living worm. Compare Fig. 21.

FIG. 23. *Lineus rubescens.* Anterior end of body, showing ocelli.


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PLATE 26

FIG. 24. *Baseodiscus mexicanus.* Photograph of living individual taken at Saboga Island, Panama. Note great variation in position and width of transverse bands. Length about 1¼ m. Posterior extremity knotted and obscured by mass of mucus. (Photo: Courtesy, Allan Hancock Expeditions.)

FIG. 25. *B. mexicanus.* Anterior end of preserved individual; ventral surface, showing pattern of markings surrounding mouth.

FIG. 26. *B. mexicanus.* Anterior end of preserved individual strongly contracted.

FIG. 27. *Euborlasia hancocki.* Anterior end of ventral surface, showing mouth and proboscis opening.

FIG. 28. *E. hancocki.* Anterior end of dorsal surface of large individual.

Genus PROSORHOCHMUS Keferstein

Only one species of this genus is known from the region covered by this report.

60. Prosorhochmus albidus (Coe), 1905

(Plate 25, fig. 20)

Tetrastemma albidum Coe, 1905.

Habitat. Among algae, particularly corallines, and other growths on rocks and spiles exposed to the surf.

Distribution. At present known only from Monterey Bay, California, and southward to Ensenada, Mexico. Common in many localities.

Reproduction. Usually oviparous, occasionally viviparous (Fig. 20), because of retention of fertilized eggs within one or more of the ovaries.

Genus OERSTEDIA Quatrefages

Only a single species of this genus has been found on the Pacific coast.

61. Oerstedia dorsalis (Abildgaard)

Tetrastemma dorsalis McIntosh, 1873; Verrill, 1892; *Oerstedia dorsalis* Bürger, 1895; *Tetrastemma (Oerstedia) dorsale* Coe, 1904, 1905; *Oerstedia dorsalis* Stiasny-Wijnhoff, 1930.

Habitat. Among algae and other growths on rocks and spiles near low-water mark and below.

Distribution. Widely distributed in Northern Hemisphere; northern coasts of Europe to Madeira; Nova Scotia to southern New England and southward; Puget Sound, Monterey Bay, California, and southward to Ensenada, Mexico.

Family Amphiporidae

Two genera found on the Pacific coast are members of this family.

Key to Genera

1. Ocelli extend posteriorly along lateral nerve cords beyond brain; basis of central stylet cylindrical and sharply truncated or concave at posterior end . . . . . Zygonemertes

1. Ocelli do not extend posteriorly beyond brain; basis of central stylet truncate conical or pear shaped and usually rounded at posterior end . . . . . Amphiporus

Genus ZYGONEMERTES Montgomery

Three closely similar and possibly intergrading species of this genus have been found on the Pacific coast.

Key to Species

1. Central stylet very short and stubby; basis about 3 times as long as stylet, with serrated posterior edge; 4-5 accessory stylets in each pouch; 12 proboscidial nerves . . . . . thalassina
1. Central stylet moderately slender; basis about twice as long as stylet, without sharply serrated posterior edge; 2-3 accessory stylets in each pouch; 10 or 11 proboscidial nerves 2
2. Color white or pale yellow . . . . . albida
2. Color whitish when young, becoming pale yellow, pink, orange, brown, red, or green when mature . . . . . virescens

62. Zygonemertes albida Coe, 1901

Z. albida Coe, 1904, 1905, 1905a.

Habitat. Among algae and other growths on rocks and piers between tidemarks and below.

Distribution. At present known only from British Columbia and Puget Sound.

63. Zygonemertes thalassina Coe, 1901

Z. thalassina Coe, 1904, 1905.

Habitat. Among algae and other growths on rocks and among broken shells, low-water mark and below.

Distribution. At present known only from the coast of Alaska.

64. Zygonemertes virescens (Verrill), 1879

(Plate 30, fig. 39)

Amphiporus virescens Verrill, 1879, 1892; *Z. virescens* Montgomery, 1897; Coe, 1905, 1905a.

Examination of several hundred individuals representing all ages shows that the species is extraordinarily variable in color, in arrangement of ocelli, and in the relative proportions of central stylet and basis (Fig. 39).

Body. Slender and but slightly flattened; head somewhat wider than adjacent portion of body, with two pairs of oblique grooves of which the posterior pair lies adjacent to brain; crescent-shaped rhabdites present in integument, usually yellow, red, or brown in color.

Size. Individuals of all sizes from very young worms less than 1 mm in length to those mature forms that exceed 40 mm are frequently obtained. Dwarf individuals rarely exceed 20 mm in length when sexually mature, while an occasional individual of the large green variety may reach a length of 80 mm; diameter, 1 to 2 mm.

Proboscis. Sheath extends entire length of body; proboscis armed with slender, sharply pointed stylet and large cylindrical basis about 4 times as long as its diameter and usually 1½-2 times the length of stylet. Basis often, but not invariably, with lobulated posterior end (Fig. 39, *a* and *e*). Each of the 2 lateral pouches usually contains 3 stylets. There are 10 or 11 proboscidial nerves.

Ocelli. The youngest individuals, less than 1 mm in length, have only 4 ocelli, arranged as in *Tetrastemma;* additional ocelli appear later both on the head and along the nerve cords back of the brain until a total of 100 or more may be found on each side of head and body (Fig. 39). More than 30 of these may lie beside each nerve cord. There are 2 irregular double or triple rows anterior to the brain and a single irregular row posteriorly. The eyes of reddish brown individuals are usually red or violet instead of the usual black or brown.

Color. Young individuals are milky white; older individuals are tinged with yellow, pale yellow, pink, orange, pale brown, reddish brown, golden brown, greenish brown or dark olive green, and occasionally brick red. The colors are to some extent correlated with the environment, although the pigmentation becomes intensified with age. Brown individuals often become green when placed in formalin; they also change to white or bluish green after long confinement in the aquarium, because of the disappearance of the more superficial pigment granules and colored rhabdites which in life often mask the underlying green pigment.

Habitat. Beneath stones and among algae, mussels, and other growths on rocks and piers near low-water mark and below. This is the commonest species of nemertean in many situations. The reddish brown variety is most commonly found among corallines exposed to the full force of the surf.

Distribution. Coast of New England; British Columbia, Puget Sound, Monterey Bay, and southward at least as far as Ensenada, Mexico.

Reproduction. Sexual products are mature in summer in northern localities and as early as February and March in southern California. The females ovulate several times during the season, producing relatively few, large, opaque, grayish green ova at each ovulation. The mature ovum is more than ⅓ the diameter of the body in small individuals. Fertilization takes place at time of ovulation. Development is rapid, the free-swimming larva leaving the egg within 24-48 hours. The ciliated ovoid larva is provided with a long anterior flagellum. Two or 3 days later the larva becomes elongated and wormlike and then settles to the bottom. A single pair of ocelli first appears on the anterolateral margins of the brain, followed by a second pair of much smaller ocelli slightly behind the brain.

Genus **AMPHIPORUS** Ehrenberg

This genus appears to be represented on the North Pacific coast by at least 17 species, although the generic status of *A. gelatinosus* is in doubt and there is some question about the specific distinction of *A. pacificus* and *A. rubellus*. Only one of these 17 species has been reported from other parts of the world.

Key to Species

1. Body very gelatinous, with an enormous development of body parenchyma. Body short and broad; ocelli large, 30 or more on each side of head; cerebral sense organs extremely small, situated in front of brain . . . . . A. gelatinosus
1. Body contains only a moderate amount of parenchyma . . . 2
2. Body very slender; white or lightly tinted with red or yellow, without spots 3
2. Body not very slender; color red, brown, purplish, orange, deep yellow, or spotted 5
3. Blood vessels bright red; stylet basis very slender; ocelli in single row on each side of head . . . . . cruentatus
3. Blood vessels not red; stylet basis truncate conical or pear shaped; ocelli in several irregular rows or groups 4
4. With 2 or 3 pouches of accessory stylets . . . . imparispinosus
4. With 6-12 pouches of accessory stylets . . . . . formidabilis
5. Central stylet not more than half as long as basis 6
5. Central stylet nearly as long as basis or longer 7

6. Central stylet about ⅓ as long as massive, elongated, conical basis . . . . . macracanthus
6. Central stylet about half as long as nearly cylindrical basis . tigrinus
7. Central stylet about twice as long as basis 8
7. Central stylet nearly equal to basis in length 9
8. Dorsal surface brown or reddish, with 2 conspicuous spots of darker color on head; 14-16 proboscidial nerves . . bimaculatus
8. Dorsal surface thickly mottled with dark brown dots and blotches; 12 or 13 proboscidial nerves . . . . . punctatulus
9. Dorsal surface mottled with deeply pigmented spots 10
9. Dorsal surface without conspicuous spotting 11
10. Cerebral sense organs anterior to brain . . . . . nebulosus
10. Cerebral sense organs beside brain . . . . . occidentalis
11. Dorsal surface brown, purple, or red 12
11. Dorsal surface yellow . . . . . flavescens
12. Dorsal surface brown or purple 13
12. Dorsal surface red or reddish 15
13. Basis rather slender and conical 14
13. Basis broad and bell shaped . . . . . fulvus
14. With angular white spot on each side of head; ocelli grouped into 2 separate clusters on each side of head; 17-20 proboscidial nerves . . . . . angulatus
14. Without white spots on head; ocelli not separated into distinct clusters; 15 proboscidial nerves . . . . . paulinus
15. With 4-8 ocelli on each side of head; 10-12 proboscidial nerves . . . . . californicus
15. With 10-20 ocelli on each side of head; 14 proboscidial nerves . 16
16. Dorsal surface reddish brown . . . . . pacificus
16. Dorsal surface flesh color, orange, or red . . . . . rubellus

65. **Amphiporus angulatus** (Fabr.), 1774

A. angulatus Verrill, 1892; Coe, 1901, 1904, 1905, 1905a.

Habitat. Lives in sandy situations, particularly beneath stones, between tidemarks and below to depths of 150 m or more.

Distribution. Greenland, Baffin Bay, Labrador, Nova Scotia, New England to Cape Cod and farther south on the Atlantic coast beneath the

offshore Arctic current. On the Pacific coast the species ranges from Arctic Ocean (60 m), Bering Strait, Siberia, Aleutian Islands, Kamchatka, Japan; Alaska, British Columbia, Puget Sound, and off Monterey Bay, California.

66. **Amphiporus bimaculatus** Coe, 1901

A. bimaculatus, Coe, 1904, 1905, 1905a.

Habitat. Lives in crevices of rocks and among algae, mussels, and other growths on rocks and spiles, as well as beneath stones near low-water mark.

Distribution. Coasts of Alaska, British Columbia, Puget Sound, and southward to Ensenada, Mexico. Larger and more common from Monterey Bay, California, northward.

67. **Amphiporus californicus** Coe, 1905

A. californicus Coe, 1905a.

Habitat. In crevices of rocks and beneath stones near low-water mark and below to a depth of 80 m or more.

Distribution. At present known only from southern California.

68. **Amphiporus cruentatus** Verrill, 1879

A. cruentatus Verrill, 1892; Coe, 1904, 1905, 1905a; *A. lepatacanthus* Coe, 1905, 1905a.

Habitat. Lives among algae and other growths on rocks and spiles between tidemarks and below. Common among kelp holdfasts.

Distribution. Coast of New England and southward. Puget Sound and southward to San Diego, California. Has been dredged at a depth of 80 m off southern California.

69. **Amphiporus flavescens** Coe, 1905

A. flavescens Coe, 1905a.

Habitat. Under stones and among algae and other growth on rocks and spiles between tidemarks and below; common in some localities.

Distribution. At present known only from Monterey Bay, California, to Ensenada, Mexico.

70. **Amphiporus formidabilis** Griffin, 1898

A. exilis Coe, 1901; *A. formidabilis* Coe, 1904, 1905, 1905a.

Habitat. Lives beneath stones, in crevices of rocks, and among algae, mussels, and other growths on rocks and spiles between tidemarks. Often seen creeping over stones on foggy days.

Distribution. At present known from Aleutian Islands, coasts of Alaska and British Columbia, Puget Sound, and southward to Monterey Bay, California. Common in many localities.

71. **Amphiporus fulvus** Coe, 1905

A. fulvus Coe, 1905a.

Habitat. Among algae and other growths on rocks and spiles near low-water mark and below to a depth of at least 85 m.

Distribution. At present known only from San Pedro and San Diego, California.

72. **Amphiporus gelatinosus** Coe, 1905

A. gelatinosus Coe, 1905a.

The unfortunate loss of the proboscis at the time of collection and failure to obtain additional specimens make it doubtful whether this species belongs to the genus Amphiporus.

Habitat and Distribution. The single known specimen was dredged at a depth of about 300 m southwest of Kodiak Island, Alaska.

73. **Amphiporus imparispinosus** Griffin, 1898

A. leuciodus Coe, 1901; Punnett, 1901; *A. imparispinosus* Coe, 1904, 1905.

Habitat. Common between tidemarks and below among algae, mussels, and other growths on rocks and spiles; often in situations exposed to the full force of the surf; also found beneath stones on rocky shores and among shells on off-shore bottoms.

Distribution. The writer has personally collected this species on the coast of Siberia, Bering Sea, Alaska, British Columbia, Puget Sound, and southward to Ensenada, Mexico. It has also been represented in almost every collection sent for identification from these localities, so that it is evidently the most populous species of nemertean of the North Pacific coast.

73a. Amphiporus imparispinosus Griffin, 1898; var. similis (Coe), 1905

A. similis Coe, 1905.

Differs from the typical form in having 2, instead of 3, pouches of accessory stylets.

Habitat. Same as in typical form, with which it is often associated.

Distribution. Puget Sound and southward at least as far as Ensenada, Mexico.

74. Amphiporus macracanthus Coe, 1905

A. macracanthus Coe, 1905a.

Distribution. Dredged in shallow water in the Arctic Ocean off Cape Smyth and Wainwright Inlet, Alaska.

75. Amphiporus nebulosus Coe, 1901

A. nebulosus Coe, 1904, 1905, 1905a.

Habitat. Under stones between tidemarks.

Distribution. At present known only from the coast of Alaska.

76. Amphiporus occidentalis Coe, 1905

A. occidentalis Coe, 1905a.

Distribution. Known only from 2 specimens dredged at about 70 and 170 m off the coast of Washington.

77. Amphiporus pacificus Coe, 1905

A. pacificus Coe, 1905a.

Habitat. This species has been obtained only by the dredge at depths of 70-180 m.

Distribution. Bering Sea and off the coasts of Washington and central California.

78. Amphiporus paulinus Punnett, 1901

A. paulinus Coe, 1904, 1905.

Distribution. At present known only from Pribilof Islands, Bering Sea.

79. Amphiporus peruvianus, new species

(Plate 27, figs. 31, 31*a*)

Two well-preserved specimens of a species which appears to differ from any of the many described members of this genus were collected by the Allan Hancock Expedition of 1935.

Body. Very slender, measuring after preservation about 24 cm in length and 4 mm in width.

Color. Color in life unknown; pale grayish yellow after preservation.

Ocelli. A single row of 8-10 rather large ocelli lies on each antero-lateral border of head, followed by an irregular transverse group of 16-20 somewhat smaller ocelli extending nearly to median line on each side of head immediately anterior to brain (Fig. 31).

Proboscis. Sheath extends nearly entire length of body. Proboscis large and long, exceeding body in total length; armed with slender central stylet nearly 1½ times as long as oval basis (Fig. 31*a*). In one of the type specimens, stylet measured 0.14 mm in length and basis 0.1 mm in length and 0.07 mm in diameter. Each of the 2 lateral pouches contained 4-5 accessory stylets. There were 20 proboscidial nerves.

Nephridia. The nephridial system differs from that of any other known species. Such a profuse tangle of intertwining tubules surrounds each of the lateral blood vessels as to constitute a sharply demarcated nephridial gland extending from brain to near end of pyloric region of body. A transverse section of the body may show 30 or more sections of large and small collecting tubules surrounding each of the lateral blood vessels. There are several pairs of very slender efferent ducts.

Cerebral sense organs. Large, situated beside brain. Ducts to exterior extend obliquely forward to open in oblique grooves on ventrolateral surfaces of head.

Habitat. Shore near low-water mark.

Distribution. At present known only from Vieja Island, Independencia Bay, Peru.

80. Amphiporus punctatulus Coe, 1905

A. punctatulus Coe, 1905a.

Habitat. Beneath stones in muddy situation.

Distribution. At present known only from Isthmus Cove, Catalina Island, California.

81. Amphiporus rubellus Coe, 1905

A. rubellus Coe, 1905a.

Habitat. Among mussels and other growths on spiles of wharf and on rocks at low-water mark; more common at depths of 35-200 m off the coast.

Distribution. At present known only from southern California.

82. Amphiporus tigrinus Coe, 1901

A. tigrinus Coe, 1904, 1905, 1905a.

Habitat. Under stones between tidemarks.

Distribution. At present known only from British Columbia and Puget Sound.

Family Tetrastemmatidae

This family is represented on the Pacific coast by 3 genera, of which one is found only in fresh-water lakes and pools.

Key to Genera

1. With 4 or 6 ocelli; lives only in fresh-water lakes and pools . . . . . Prostoma
1. With 4 ocelli or none; marine 2
2. Ocelli absent; hermaphroditic . . . . . Amphinemertes
2. Ocelli 4, occasionally fragmented; sexes separate in most species . . . . . Tetrastemma

Genus AMPHINEMERTES, new genus

Body slender and almost cylindrical; minute; proboscis sheath extends entire length of body; proboscis very large, equal to diameter of body when everted; armature typical for family; intestinal caecum extends forward almost to brain; cerebral sense organs large, situated against anterior and ventral surfaces of brain; ocelli absent; hermaphroditic.

A single species belonging to this genus has been reported from the coast of Alaska.

83. **Amphinemertes caeca** (Coe), 1901

Tetrastemma caecum Coe, 1901, 1904, 1905, 1905a.

Habitat. Dredged with tunicates at a depth of about 5 m; presumably parasitic or commensal in tunicates.

Distribution. At present known only from near Kodiak Island, Alaska.

Genus **TETRASTEMMA** Ehrenberg

Nine species belonging to this genus have been found on the North Pacific coast. Only one of these is known to occur in other parts of the world.

Key to Species

1. With 4 well-developed ocelli 2
1. With 4 fragmented ocelli . . . . . aberrans
2. Dorsal surface with conspicuous brown stripes or rectangular markings or both 3
2. Dorsal surface without brown stripes or rectangular markings 6
3. Dorsal surface with 2, 4, or 6 brown stripes 4
3. Dorsal surface with brown rectangular markings and stripes . . . . . reticulatum
4. Flesh color, creamy, or grayish, with 2 brown longitudinal stripes on dorsal surface . . . . . T. bilineatum
4. Whitish, with 4 or 6 brown longitudinal stripes 5
5. With 4 brown stripes, of which 2 lie on dorsal surface and 2 on lateral margins of body . . . . . quadrilineatum
5. With 6 brown stripes, of which 4 lie on dorsal surface and 2 on or slightly beneath lateral margins of body . . . sexlineatum
6. With large black or brown marking on dorsal side of head . . 7
6. Head without conspicuous marking 8
7. Cephalic marking wreathlike; reddish brown both above and below, except head which is white with a sharply marked dark brown or black wreath on dorsal surface . . . . . T. signifer
7. Cephalic marking triangular or shield shaped; color highly variable except head, which is white with shield-shaped or triangular marking of dark brown color on dorsal surface; dorsal surface of body purple, brown with white dorsal longitudinal band, reddish with brown flecks, pale brownish or buff, sometimes with series of narrow transverse white markings . . T. nigrifrons

8. Orange, yellow, brown, or brownish red, with narrow median white stripe . . . . . T. bicolor
8. Gray, yellow, green, or brownish green . . . . T. candidum

84. Tetrastemma aberrans Coe, 1901

T. aberrans Coe, 1904, 1905, 1905a.

Habitat. Among hydroids and algae between tidemarks and below.

Distribution. At present known only from coast of Alaska.

85. Tetrastemma bicolor Coe, 1901

T. bicolor Coe, 1904, 1905, 1905a.

Habitat and Distribution. At present known only from shallow water near Kodiak Island, Alaska.

86. Tetrastemma bilineatum Coe, 1904

T. bilineatum Coe, 1905, 1905a.

Habitat and Distribution. Among algae and other growths on rocks and piers near low-water mark. At present known only from San Diego, California.

87. Tetrastemma candidum (Müller), 1774

T. candidum McIntosh, 1873; Verrill, 1892; Bürger, 1895, 1904; Stephenson, 1911; Wheeler, 1934.

Habitat. Among algae and other growths on rocks and piers near low-water mark and below.

Distribution. Circumpolar; Norway to Mediterranean to Madeira and South Africa; Labrador to southern New England and southward; Alaska, Puget Sound, Monterey Bay to southern California and Ensenada, Mexico.

88. Tetrastemma nigrifrons Coe, 1904

(Plate 31, fig. 42)

T. nigrifrons Coe, 1905, 1905a.

This species is highly variable both in color pattern and in pigmentation. Four of the most conspicuous color variations are indicated in Fig. 42. Variety *pallidum* (*a* and *d*) is distinguished by triangular dark brown marking on head and pale brown, buff, or flesh-colored body,

sometimes with white longitudinal stripe. Variety *bicolor* (*b*) has broad quadrangular cephalic marking and brown body with white longitudinal stripe. Variety *zonatum* (*c*) is deep brown or reddish brown with from 12 to 20 transversely elongated white spots. Variety *purpuratum* (*e*) is dark reddish brown or purple. There are many intergrading individuals with combinations of these patterns and other variations.

Habitat. Common among algae, bryozoa, and other growths on rocks and piers between tidemarks and below; often found on kelp holdfasts.

Distribution. Previously known from Puget Sound and southward to the coast of Mexico. Collected by the Allan Hancock Expedition of 1935 at Salinas Bay, Costa Rica.

89. **Tetrastemma quadrilineatum** Coe, 1904

T. quadrilineatum Coe, 1905, 1905a.

Habitat. Among algae, ascidians, and other growths on rocks and piers near low-water mark and in tide pools.

Distribution. At present known only from Monterey Bay, California, to Ensenada, Mexico.

90. **Tetrastemma reticulatum** Coe, 1904

T. (Oerstedia) reticulatum Coe, 1904, 1905.

Habitat. Among algae and other growths on spiles and rocks near low-water mark.

Distribution. At present known only from San Pedro and San Diego, California.

91. **Tetrastemma sexlineatum**, new species

(Plate 24, figs. 5, 6)

Individuals of this species resemble those of *T. quadrilineatum* in general appearance but differ in having 6 longitudinal dark stripes.

Body. Rounded; rather short and stout.

Size. Minute; the single specimen available for study was a fully ripe female which measured only 5 mm in length and 0.5 mm in diameter.

Color. General color gray or slightly yellowish, conspicuously marked with 6 longitudinal stripes of dark brown pigment. Of these, 4 are symmetrically placed on dorsal surface of body and one on each lateral margin or slightly ventral to margin (Figs. 5, 6). Pair nearest to median

line wider than the others and extend forward to tip of head, while those situated more laterally reach anteriorly only to brain region. Pigment composing stripes extends into deeper layers of integument and is conspicuous in transverse microscopic sections. Ventral surface gray or yellowish.

Ocelli. Of moderate size, forming the corners of a square when head is moderately extended.

Proboscis. Proboscis large, provided with 10 nerves as in most other members of genus; armed with comparatively large pear-shaped basis. Stylet of about same length as basis. Each of the 2 lateral pouches contains 2-3 accessory stylets. In the sexually mature type specimen the basis measured 0.075 mm in length, 0.024 mm in diameter at anterior end and 0.048 mm near posterior end.

Cerebral sense organs. Large and highly differentiated; situated near anterior margins of brain and opening to ventrolateral surfaces of head by pair of large canals.

Nephridia. A single pair near middle of foregut region.

Reproduction. Ova very large as compared with diameter of body. Only a few are deposited at each ovulation, since the gonads become ripe at different periods and each ovary produces but a single mature ovum at any one time.

Distribution. At present known from only a single specimen, which was dredged at a depth of about 35 m at the northwest anchorage, San Clemente Island, southern California.

92. **Tetrastemma signifer** Coe, 1904

T. signifer Coe, 1905, 1905a.

Habitat. Among algae and other growths on rocks and piers near low-water mark and below; also among kelp holdfasts at depths of 6-10 m.

Distribution. At present known only from Monterey Bay and southward to San Diego, California.

Genus **PROSTOMA** Dugés

Only a single species, which is widely distributed throughout the United States, has been found in fresh-water pools and lakes from Washington to California. This was presumably introduced from the eastern states in association with cultivated water plants.

93. **Prostoma rubrum** (Leidy), 1850

Emea rubra Leidy, 1850; *Stichostemma ascensoriatum* Montgomery, 1896; Child, 1901; *S. rubrum* Coe, 1918.

Habitat. Creeps on living and dead leaves in pools, ponds, and quiet streams; feeds on minute worms, insects, crustacea, and unicellular organisms in great variety. In turn, devoured by larger worms, insects, and crustacea.

Distribution. Widely distributed throughout the United States from New England to Georgia on the Atlantic seaboard and westward to Washington and California.

Reproduction. Hermaphroditic; eggs and spermatozoa develop in each gonad; spermatozoa may mature first but are retained in gonad until ovulation occurs. Hence self-fertilization is the rule, although cross fertilization may ensue when two ovulating individuals are closely associated.

Suborder POLYSTYLIFERA

Key to Tribes

1. Body adapted for burrowing or creeping; not specialized for pelagic life; proboscis sheath provided with caecal appendages . . . . . Errantia
1. Bathypelagic; body adapted for free swimming far beneath the surface of the oceans; proboscis sheath without appendages . Pelagica

Tribe 1. Errantia

Only a single family, Drepanophoridae, has been found on the Pacific coast. This appears to be represented by a single genus.

Genus DREPANOPHORUS Hubrecht

Two species on the Pacific coast have been identified as belonging to this genus.

Key to Pacific Coast Species

1. Body relatively long and ribbonlike; dorsal surface yellowish brown to dark brown, with lighter or whitish lateral borders . crassus
1. Body relatively short and broad; dorsal surface dull red, reddish brown or orange, thickly sprinkled with fine brownish dots . ritteri

94. **Drepanophorus crassus** (Quatr.), 1846

D. crassus Bürger, 1893; *Paradrepanophorus crassus* (?) Wijnhoff, 1926.

Habitat. Dredged in off-shore waters at depths up to 100 m or more.

Distribution. This species has been reported from European waters, from near the shores of tropical Pacific islands as well as from the west coasts of Mexico and Panama. Collected by the Allan Hancock Expeditions in the Gulf of California and at Independencia Bay, Peru.

95. **Drepanophorus ritteri** Coe, 1905

D. ritteri Coe, 1905a.

Habitat and Distribution. At present known only from depths of 50 to 300 m off the coast of southern California.

Tribe 2. Pelagica

Two species of bathypelagic nemerteans have been collected from far beneath the surface of the ocean off the Pacific coast. These are members of separate families.

Key to Families

1. Body broad and very flat; intestinal diverticula with ventral branch; male without tentacles . . . . . Planktonemertidae
1. Body slender, with thin lateral margins; intestinal diverticula without ventral branch; male with tentacles . . Nectonemertidae

Family **Planktonemertidae**

Genus **PLANKTONEMERTES** Woodworth

96. **Planktonemertes agassizii** Woodworth, 1899

P. agassizii Coe, 1905, 1926.

Habitat and Distribution. A bathypelagic species, the individuals of which float freely or swim slowly at depths of nearly 1,000 m or more in the ocean off the coasts of Panama and Ecuador.

Family Nectonemertidae

Genus NECTONEMERTES Verrill

97. Nectonemertes pelagica Cravens and Heath, 1906

N. pelagica Coe, 1926, 1931.

Habitat and Distribution. Bathypelagic; swims or floats sluggishly in a cold-water layer at depths of 50-500 m or more off the coast of California and northward. Also (probably the same species) at depths of nearly 4,000 m off the west coast of South America.

Order BDELLONEMERTEA

Family Malacobdellidae

Genus MALACOBDELLA Blainville

98. Malacobdella grossa (O. F. Müller), 1776

M. grossa Bürger, 1895; Gering, 1911; Guberlet, 1925; *M. obesa, M. mercenaria,* Verrill, 1892.

Habitat. This widely distributed species occurs on the Pacific coast as a commensal in the mantle cavity of *Soliqua patula, Macoma secta,* and presumably other bivalves. On the Atlantic coast it is found in *Venus mercenaria* and *Mya arenaria* and occasionally in *Ostrea virginica;* on the coasts of Europe in *Mya truncata, M. arenaria, Cardium aculeatum, Isocardia cor, Venus exoleta, V. mercenaria, Pholas crispata, Cyprina islandica,* and *Mactra stultorum;* and in Japan the same or a closely related species occurs in *Mactra sachalinensis.* The proportion of infestations in some localities may be as high as 75 to 90 per cent in certain years (Guberlet, 1925).

Distribution. Northern coasts of Europe, Mediterranean; Nova Scotia to Chesapeake Bay; Puget Sound to California; (Japan?).

The following species, not included in the foregoing lists, have been reported by Bürger (1896) and Isler (1901) from Peru, Chile, Juan Fernandez Islands, and southward, but have not been represented in the collections by the Allan Hancock Expeditions from the coasts of Peru and Ecuador or in any of those from more northern localities.

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B. pallida (Isler), 1900, 1901.
B. sulcata (Isler), 1900, 1901.
Lineus molochinus Bürger, 1892.
L. nigricans Bürger, 1892.
L. rubens (Bürger), 1890.
L. vittatus (Quoy et Gaimard), 1833.
L. viviparus Isler, 1900, 1901.
Micrura lactea Hubrecht, 1879.
Cerebratulus joubini Bürger, 1892.
Emplectonema flavens (Bürger), 1896.
E. violaceum (Bürger), 1896.
Amphiporus bürgeri Isler, 1900, 1901.
A. caecus Verrill, 1895.
A. dubius Hubrecht, 1879.
A. pulcher (Johnston), 1837.
Tetrastemma peltatum Bürger, 1896.

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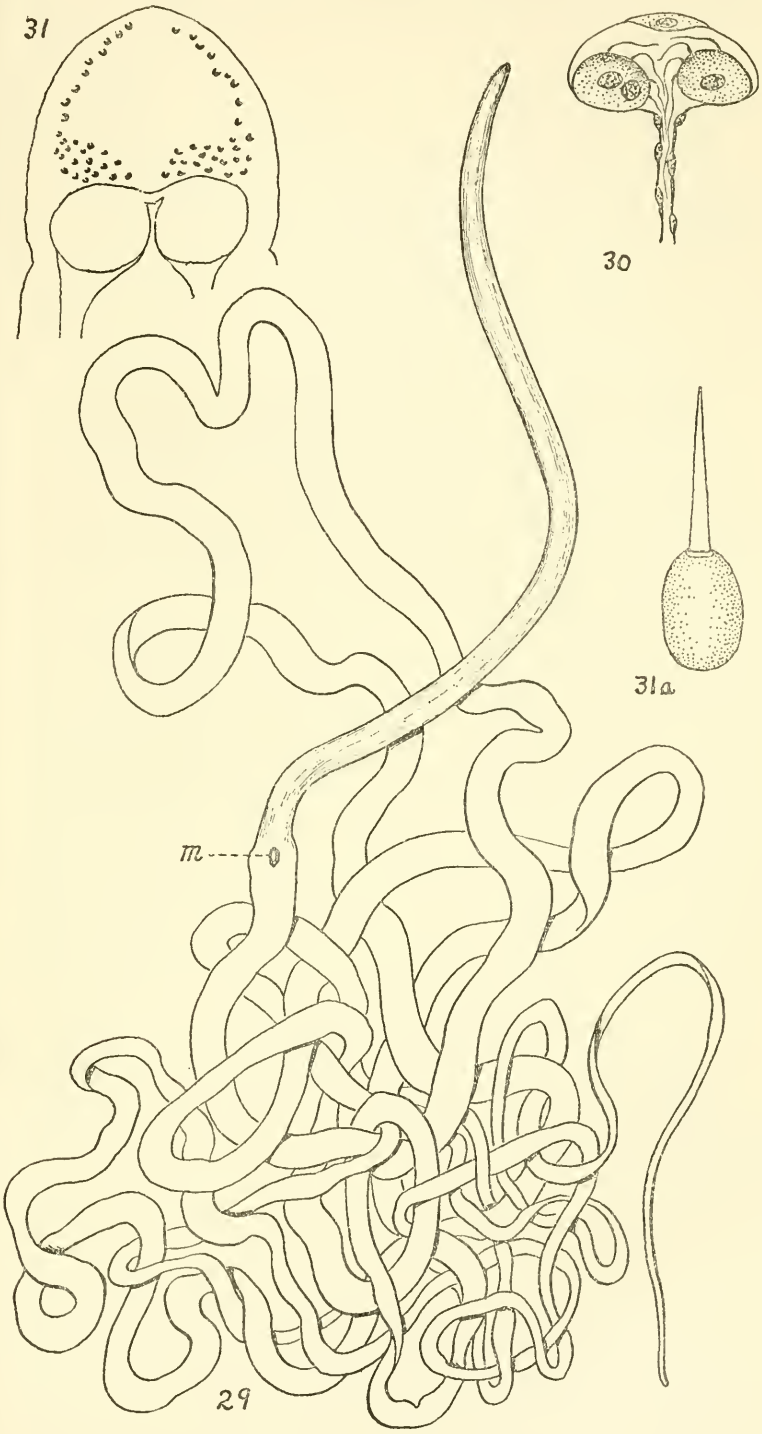
PLATE 27

FIG. 29. *Procephalothrix major.* Outline of individual more than a meter in length, showing position of mouth (*m*).

FIG. 30. *P. major.* Terminal chamber of metanephridium, showing the two ciliated excretory cells and portion of efferent duct.

FIG. 31. *Amphiporus peruvianus,* showing arrangement of ocelli anterior to brain. Fig. 31*a.* Central stylet and basis.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31a
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PLATE 28

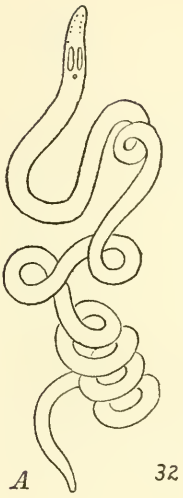
FIG. 32. *Lineus vegetus.* Asexual reproduction by fragmentation. *A,* mature worm; *B,* same, after fragmenting into 21 pieces; *C,* each piece undergoes regeneration and regulation into a minute worm of normal proportions.

FIG. 33. *L. vegetus.* Anterior end of body, showing ocelli and configuration of brain (*br*), cerebral sense organ (*cso*), lateral nerve (*ln*), and mouth (*m*).

FIG. 34. *Paranemertes californica.* Head, showing arrangement of ocelli.

FIGS. 35, 36. *P. californica.* Central stylet and basis from larger and smaller individual, indicating striated head of stylet.

FIG. 37. *Procephalothrix spiralis.* Mature individual with tightly coiled body, showing position of mouth (*m*).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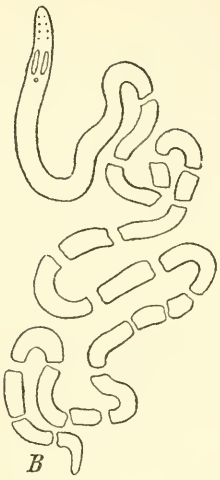
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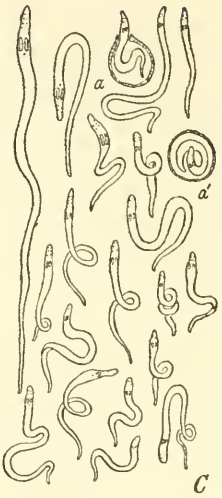

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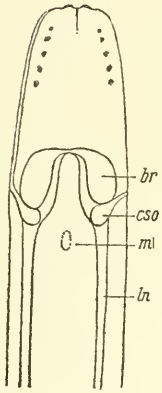

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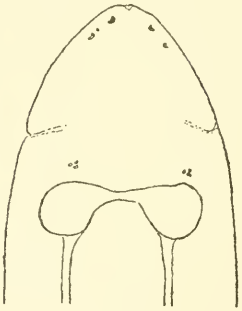
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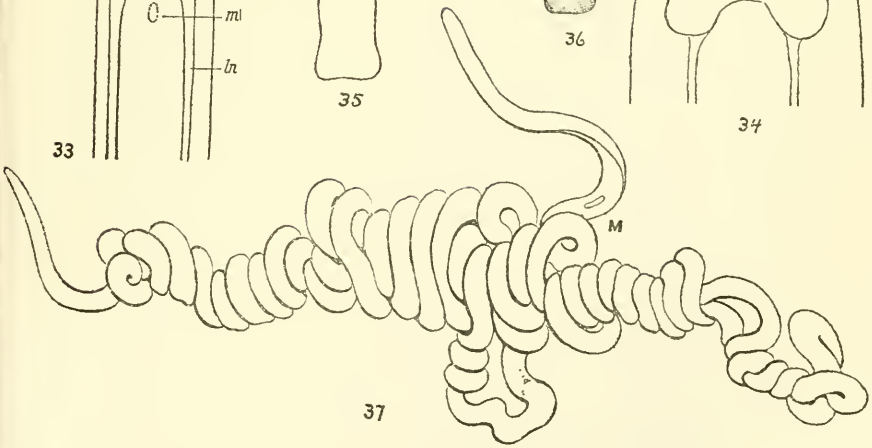
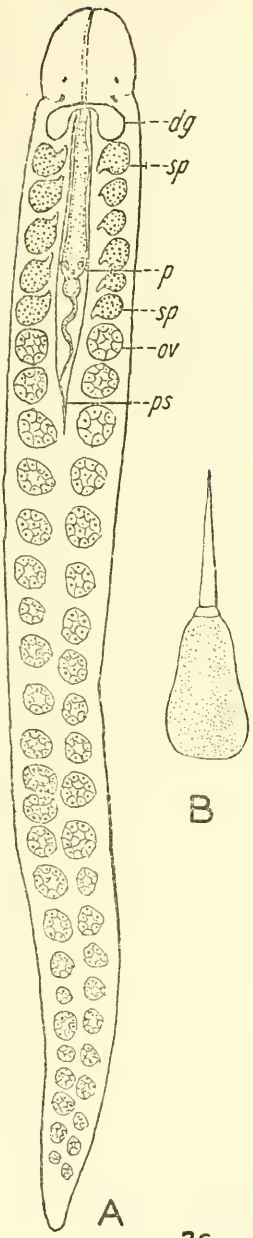
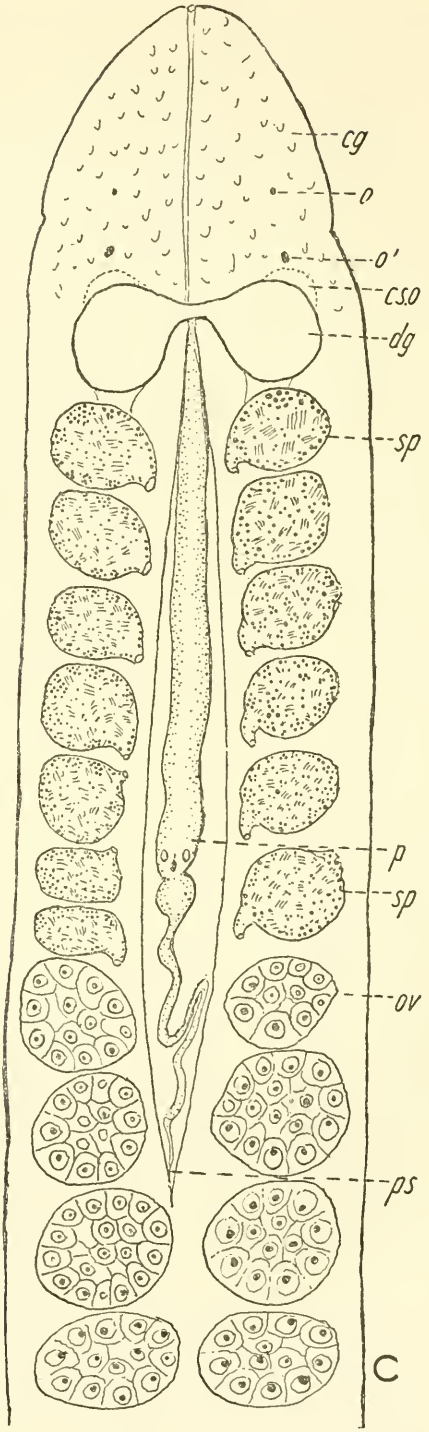


37

PLATE 29

FIG. 38. *Dichonemertes hartmanae. A,* outline of body, showing extent of proboscis sheath and arrangement of ocelli and gonads; *B,* central stylet and basis; *C,* diagram of anterior end of body, showing ocelli (*o, o'*), brain (*dg*), cerebral sense organs (*cso*), proboscis (*p*), proboscis sheath (*ps*), spermaries (*sp*), and anterior pairs of ovaries (*ov*).



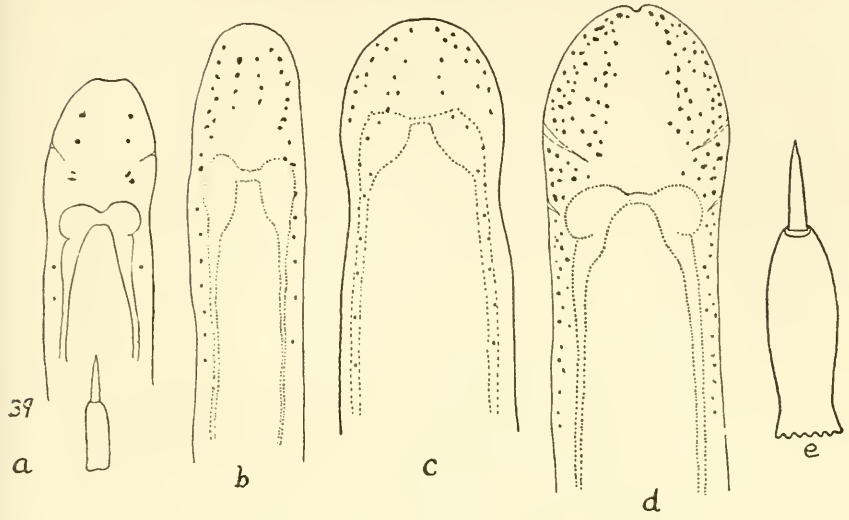


38

PLATE 30

FIG. 39. *Zygonemertes virescens.* Variations in the number and arrangement of ocelli and in size of central stylet and basis in young and older individuals; the stylet and basis in *a* and *e* are drawn at the same scale of magnification.

FIG. 40. *Emplectonema gracile.* Variations in the number and arrangement of ocelli and in size of stylet apparatus in young (*a* and *c*) and older (*b* and *d*) individual. In proboscis of young individual represented in *c* the central stylet and basis have been discarded and replaced by a set of larger size; *d,* stylet apparatus of large individual drawn at the same scale of magnification.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d
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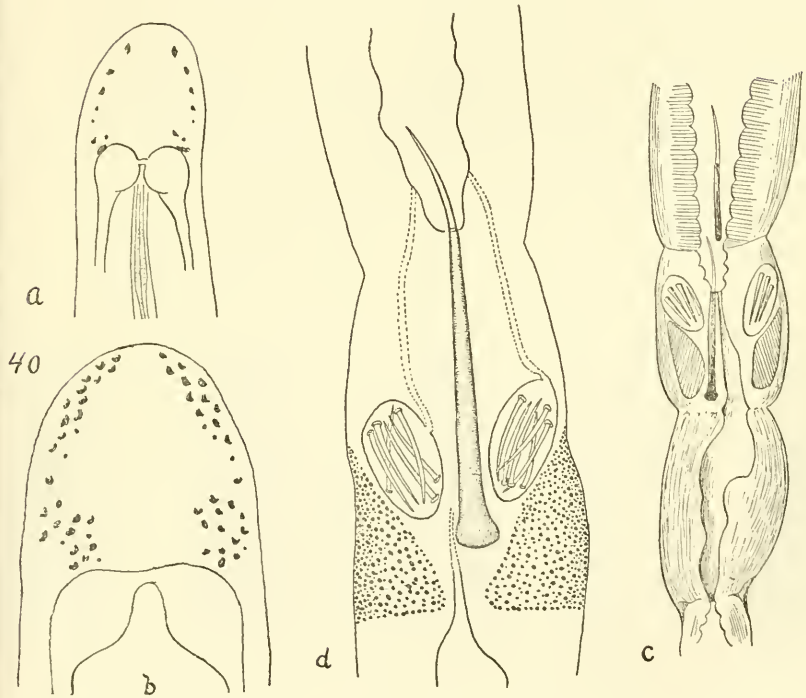
a
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b
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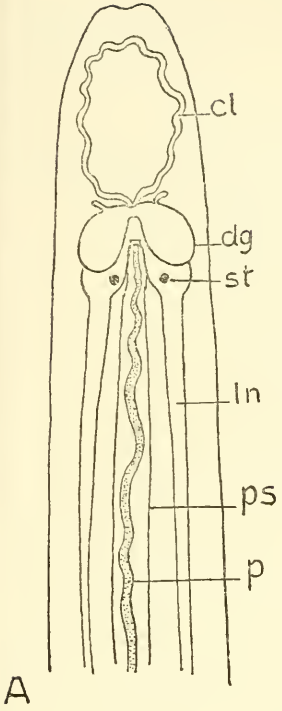
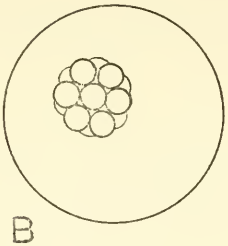
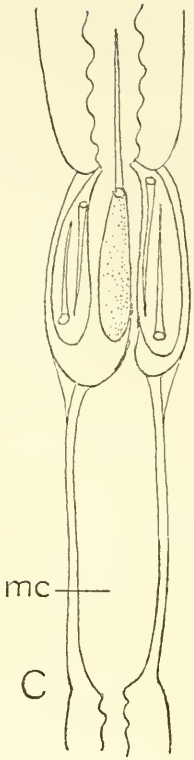
PLATE 31

FIG. 41. *Ototyphlonemertes spiralis. A,* outline of anterior portion of body showing statocysts (*st*) on ventral ganglia; other letters indicate: *cl,* cephalic blood lacunae; *dg,* dorsal ganglion; *ln,* lateral nerve cord; *p,* proboscis; *ps,* proboscis sheath. *B,* statocyst with spherical statolith. *C,* stylet region of proboscis, showing slender stylets and basis and tubular middle chamber (*mc*). *D,* stylet of larger and smaller individuals, indicating spiral ridges.

FIG. 42. *Tetrastemma nigrifrons.* Variations in color patterns, representing 4 color varieties: *pallidum (a* and *d), bicolor (b), zonatum* (*c*), and *purpuratum* (*e*). In some specimens the dark cephalic marking is more or less completely united with the pigmentation of the dorsal surface of body.







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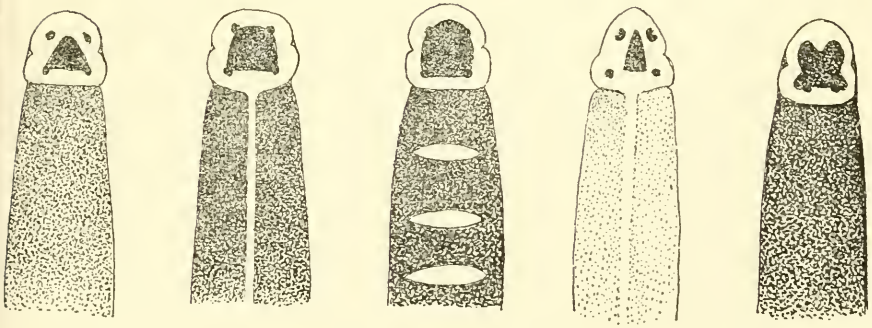

42

REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

DIGENETIC TREMATODES OF FISHES FROM THE GALAPAGOS ISLANDS AND THE NEIGHBORING PACIFIC

(PLATES 32-50)

By HAROLD W. MANTER

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TABLE OF CONTENTS

DIGENETIC TREMATODES OF FISHES FROM THE GALAPAGOS ISLANDS AND THE NEIGHBORING PACIFIC†

(PLATES 32-50)

HAROLD W. MANTER
University of Nebraska

During January, February, and March of 1934 it was the privilege of the writer, aided by the Carnegie Institution of Washington, to accompany the third Allan Hancock Expedition to the Galapagos Islands. A preliminary note concerning the trematode parasites collected has been published (Manter, 1934a). Several papers dealing with various helminths collected have appeared (Manter, 1937; Meserve, 1938; Cuckler, 1938; Gilbert, 1938; Van Cleave, in press). The present paper deals with the digenetic trematodes collected from fishes. Five hundred and thirty-two fishes, including nearly one hundred different species, were examined. Approximately 80 per cent of the species and 43 per cent of the individuals harbored some kind of trematode. Meserve (1938) records 22 species of Monogenea. Eighty-two species of Digenea from 80 different hosts are recorded in this paper. In a number of instances the fish host was unidentified or tentatively identified. A number of fishes were preserved and sent to the United States National Museum, where identifications were made by E. D. Reid and G. S. Myers, to whom the writer is indebted for such assistance. Fishes thus identified are indicated by an asterisk (*) in the host list (p. 445).

Type specimens of all new species described in this paper are deposited in the United States National Museum. Paratypes are deposited in the Allan Hancock Foundation at The University of Southern California.

The trematodes were killed in formol-alcohol-acetic solution, under a cover glass, with application of slight pressure. Most were stained with Delafield's hematoxylin. Serial sections were made of most species.

Descriptions of new genera and species are written in the form of diagnoses that are intended to be sufficiently complete to serve as fairly adequate descriptions. It will be more or less evident that the host distribution and the geographical distribution of these trematodes are of

† Studies from the Zoological Laboratories, University of Nebraska, No. 203.

considerable biological interest especially in comparison with the trematode fauna of the tropical Atlantic. This aspect of the study will be considered in a separate paper.

Practically every digenetic trematode collected is accounted for in this paper with the exception of immature specimens and several species of Didymozoonidae. The latter, usually encysted, were not favorably preserved for specific identification. Numerous specimens (and several species) of immature distomes corresponding to the *Distomum fenestratum* of Linton were collected. Some of these at least are probably identical with the Atlantic forms.

Unless otherwise indicated, measurements are in mm. In most cases, usual terminology descriptive of trematodes is followed. The term "forebody" is used to refer to that portion of the body anterior to the acetabulum. Nicoll's term "ecsoma" is used for the tail appendage of hemiurids. Lloyd's (1938) term "pre-somatic pit" is used for the ventral pit of certain hemiurids. Following the pars prostatica in many trematodes is a swollen region (inside or outside the sinus sac or the cirrus sac) with tall transparent cells. Manter (1934) refers to this structure as a "prostate vesicle." Although Park (1936) has called it a "cirrus vesicle," the term "prostatic vesicle" is used in this paper. Its function is unknown.

The collection and study of these parasites were made possible by the kindness and co-operation of Captain Allan Hancock and the Carnegie Institution of Washington, D.C. Most of the study was made at the University of Nebraska. The manuscript was completed in 1939 at the Rocky Mountain Biological Laboratory. The writer wishes to express appreciation to Dr. Waldo Schmitt for many kindnesses and favors in connection with the work. Considerable technical assistance in preparing specimens and in routine work on the manuscript was rendered by students employed under the National Youth Administration at the University of Nebraska, especially by Miss Rita Giesken.

ASPIDOGASTREA Faust and Tang, 1936

Aspidogastridae Poche, 1907

Lobatostoma pacificum, new species

(Plate 32, figs. 1, 2)

Host: *Trachinotus paloma* Jordan and Starks
Location: Intestine
Locality: Charles Island, Galapagos
Number: Many. 52 specimens were mounted

The genus Lobatostoma was named by Eckmann in 1932. The word Lobatostostoma (Eckmann, 1932, p. 396) is a synonym, the error in spelling being obviously typographical. The genus contains *L. ringens* (Linton) and *L. kemostoma* (MacCallum and MacCallum).

SPECIFIC DIAGNOSIS OF LOBATOSTOMA PACIFICUM

Total body length 2.632 to 4.279. Forebody, which may be more or less retracted dorsal to the disc, 0.352 to 0.862. Anterior end with 2 large ventral lobes and 3 dorsal lobes, the median of which is smaller than the others. Ventral disc 1.552 to 2.160 in length or slightly less to slightly more than ½ total body length. Full width of disc seen in only one specimen where the disc was 1.755 long and 1.215 wide. Number of marginal loculi almost always 32. In one of 12 specimens it was 34, and in another it was possibly 31 (Bychowsky and Bychowsky, 1934, have indicated some variation in number of locules in the disc of Aspidogaster species). Median loculi 15, each divided by a more or less inconspicuous median longitudinal ridge. Total number of loculi, therefore, 62 to 64. Marginal sense organs present between marginal loculi. Hindbody (posterior to disc) 0.810 to 2.562, always more than ½ length of disc, sometimes somewhat longer than disc; posterior end of body tapered almost to a point. Prepharynx 0.247 to 0.465; pharynx cylindrical 0.144 to 0.170 long by 0.100 to 0.127 wide; esophagus short; cecum reaching about to posterior edge of disc or slightly beyond, not reaching posterior end of body by some distance.

Genital pore muscular, slightly to the left, just anterior to disc, opposite esophagus or base of pharynx. Testis single, large, ovoid, longer than wide, dorsal to disc (in one of 52 specimens it was posterior to the disc). Cirrus sac (fig. 2) ovoid with thick wall of loose fibers, containing a few gland cells and surrounded by gland cells; seminal vesicle tubular, free, much coiled, extending backward as far as ovarian level. Ovary pyriform with its narrowed (posterior) portion recurved anteriorly; oviduct extends backward; Laurer's canal long, extending backward, its termination not determined. Vitellaria in 2 lateral rows from near anterior end of disc to end of cecum. Uterus extending to near posterior end of body; uterine seminal receptacle present; metraterm muscular, cylindrical, slightly shorter than cirrus sac, surrounded by gland cells; just posterior to metraterm is a thin-walled, somewhat coiled portion of the uterus, possessing a few gland cells in its wall (fig. 2). Eggs 65 to 76 by 34 to 42 μ, usually 70 to 73 by 37 to 41 μ. The short

unpaired excretory vesicle forks to form two crura which reach to the anterior end of the disc.

The name *pacificum* indicates that this is the first species of the genus known from the Pacific Ocean.

Comparisons. L. pacificum differs from *L. ringens* in number of loculi on the disc (the various descriptions of *L. ringens* give the marginal loculi as 36 to 42 and the transverse loculi as 16 to 18 in number); in a longer portion of the body posterior to the disc, and in that the eggs do not become so large (eggs are commonly 80 μ long in *L. ringens,* and one record gives 103 by 58 μ).

L. pacificum is more similar to *L. kemostoma,* agreeing in number of loculi, in egg size, and in long hindbody. On the basis of the figures and descriptions given for *L. kemostoma, L. pacificum* seems to differ in the following respects: (1) the dorsal median lip is smaller than the others; (2) the disc is relatively longer, at least about ½ total body length and usually over ½ (in *L. kemostoma* it is about ⅓ body length); (3) the ovary and almost always the testis are dorsal to the disc rather than posterior to it; (4) the vitellaria extend from near the anterior end of the disc to the end of the cecum rather than from behind the middle of the disc to near the posterior end of the body.

A 1.417 mm specimen of *L. pacificum* was immature and a 1.830 mm specimen contained but one egg.

All three species of Lobatostoma are found in Trachinotus species, although *L. ringens* also occurs in a variety of other fishes.

Discussion. The muscular septum separating a dorsal portion of the body from the ventral disc is very conspicuous especially in young specimens. The dorsal portion contains the intestinal cecum, the vitellaria, and some of the uterus; but most of the reproductive organs and also the excretory crura lie in the ventral portion. The septum has the same musculature as the body wall, and it seems evident that it represents the body wall of the posterior portion of the larva as the posterior sucker advanced forward to form the ventral disc.

GASTEROSTOMATA Odhner, 1905

Bucephalidae Poche, 1907

Odhner (1905), recognizing the important differences between gasterostomes and other digenetic trematodes, established the suborders Gasterostomata and Prosostomata. He studied *Prosorhynchus squamatus* in

great detail and contrasted the genus Prosorhynchus with Gasterostomum (now Bucephalus) chiefly on the structure of the anterior end which bears in Prosorhynchus a "rostellum-like structure" called the rhynchus. Nicoll later (1914) elevated these differences to subfamily rank, recognizing Prosorhynchinae (with a rhynchus) and Bucephalinae (with an anterior sucker). Although Eckmann (1932) does not recognize subfamilies of the Bucephalidae, the subdivision seems a convenient one and is followed by Nagaty (1937).

In recent years gasterostomes have received considerable attention, and the number of species in the relatively few genera has increased rapidly. There is disagreement among authors as to the validity of a number of species and a few genera, but this confusion normally accompanies the early taxonomic history when a group is being rapidly developed. The following recent authors have contributed materially to our knowledge of the group: Ozaki (1928), Eckmann (1932), Verma (1936), Bhalerao (1937), and Nagaty (1937).

The genus Bucephalus possesses a ventrally directed sucker with definite radial muscles, aperture, and cuplike cavity together with a crown of retractile processes known as fimbriae or tentacles. These curious appendages, conspicuous when extended but very inconspicuous when retracted, have come to be the characteristic feature of the genus, varying in number and form in different species. When extended, they often resemble horns. It is a curious circumstance that the generic name Bucephalus (= ox head), given to the cercaria because of the hornlike appearance of the furcae of the tail, should prove to be appropriate for the adult because of entirely different structures.

Some confusion might arise in recognition of the genus Bucephalus because of failure to note the presence of tentacles when these are completely retracted. Under such conditions the tentacles are evidenced only as small papillae of which the most ventral (on each side of the aperture of the sucker) or the lateral pair is likely to be most conspicuous. Study of these protuberances will reveal a central porelike depression. *Rhipidocotyle kathetostomae* Manter, 1934 shows what is now familiar to the author as characteristic retracted tentacles, and its name is here changed to *Bucephalus kathetostomae* (Manter) n. comb. Although the shape of its tentacles remains unknown, the species can be distinguished from others in the genus Bucephalus. Van Cleave and Mueller (1934) considered the appearance of the tentacles in *Bucephalus elegans* Woodhead an indication of age or senescence. While immature individuals may

lack tentacles, my own experience indicates that even when these structures are fully developed they are often completely retracted and are then all but invisible.

The "hood" surmounting the sucker of Rhipidocotyle assumes various forms. In *R. baculum* it is oval and kidney or bean shaped without papillae or corners; in several species it is pentagonal; or it may bear papillae as in the type species, *R. galeatum* (Rud.). These papillae are sometimes more or less extensible as in *R. longleyi;* they then suggest the tentacles of Bucephalus, to which they are probably homologous.

Eckmann (1932) lists *Prosorhynchus squamatus* Odhner as a synonym of *P. crucibulus (Rud.)* and redescribes what she considered this species collected from Epinephelus sp. from the Suez. Nagaty (1937) accepts this synonymy. Judging, however, from the detailed descriptions of Odhner, 1905, and from specimens of Eckmann's material kindly sent by Dr. Witenberg, the writer cannot agree with this conclusion and is not satisfied that *P. squamatus* is a synonym of *P. crucibulus.* Odhner apparently studied type material of both species. *P. squamatus* differs from *P. crucibulus* primarily in its much weaker rhynchus not evidently cone or wedge shaped, and in a linear rather than a triangular arrangement of gonads. The latter character may vary somewhat (according to Nicoll, 1910). *P. crucibulus* tends to be more elongate. The egg of each species is without a polar process.

The Suez material referred by Eckmann to *P. crucibulus* has such distinctive eggs with very conspicuous polar processes that it seems to represent a new species altogether. The writer has never observed such processes in any species of Prosorhynchus, and they almost certainly could not have been overlooked by Odhner and others in *P. crucibulus.* The name *Prosorhynchus caudovatus* n. nom. is here proposed for the *Prosorhynchus crucibulus* of Eckmann. This name indicates the taillike process on the egg, the distinguishing character of the species.

Nagaty (1937) apparently re-establishes the validity of Alicornis MacCallum. Several other genera of gasterostomes have very uncertain status. Gotonius is generally considered to be a synonym of Prosorhynchus. The writer agrees with Nagaty in the following: Prosorhynchoides Dollfus, 1929 a synonym of Bucephalopsis; Skrjabiniella Issaitschikow, 1928 a synonym of Prosorhynchus. Shen (1930) named *P. vaneyi,* a species peculiar in possessing a triple crown of spines around the "rostrum" or rhynchus. Eckmann (1932) placed *P. vaneyi* in the genus Dollfusina, which name being preoccupied was changed (by Eckmann,

1932) to Dollfustrema. Nagaty considers Dollfustrema a synonym of Prosorhynchus. A gasterostome of this type has been collected by the writer at Tortugas, Florida, and its study leads to the conclusion that the anterior spines might well be considered a generic character. However, the genus Mordvilkovia Pigulewsky, 1931 has "conspicuous cuticula folds" on the rhynchus in such a manner as to suggest the spines of Dollfustrema, and the writer is inclined to consider Mordvilkovia a valid genus with Dollfustrema and Dollfusina as synonyms.

The genus Pseudoprosorhynchus Yamaguti, 1938, with its intertesticular ovary, seems to be a synonym of Neidhartia Nagaty, 1937.

In accordance with the above views, the following genera are recognized: subfamily Bucephalinae—Bucephalus, Bucephalopsis, Rhipidocotyle, Dolichoenterum; subfamily Prosorhynchinae—Prosorhynchus, Alcicornis, Neidhartia, Mordvilkovia.

Bucephalus varicus, new name

(Plate 32, figs. 3-9)

Synonym: *Bucephalus polymorphus* of Nagaty, 1937
Host: A young specimen of an unidentified species of Caranx, or jack
Location: Stomach and intestine
Locality: Bahia Honda, Panama
Number: About 18 from a single host

What is apparently the same species of Bucephalus, which Nagaty records as *B. polymorphus* from several fishes (especially "Trachynotus" and "Caranax" species) from the Red Sea, has been collected by me from both the Atlantic and Pacific. My Atlantic specimens are from *Caranx ruber* (Bloch), *Caranx latus* Agassiz, and *Caranx bartholomaei* Cuv. and Val., all from Tortugas, Florida. The Pacific material is from a "small yellow jack" taken at Bahia Honda, Panama.

Nagaty identified his specimens as *B. polymorphus*. Comparing his description and figures with those given by Eckmann for authentic *B. polymorphus*, it seems to the writer that sufficient differences exist for a separate species, even assuming that seven tentacles are present in *B. polymorphus* (6 are described). *B. polymorphus* is from fresh-water hosts; the mouth is at midbody; the testes are oblique and the ovary more or less lateral to the anterior testis; the cirrus sac is only ⅕ body length; the uterus extends well anterior to the vitellaria but is at the same time very weakly developed posterior to the mouth, where there

are few eggs none of which are posterior to the genital pore. Contrasted with this, Nagaty's material is from marine fishes, the mouth is almost always well posterior to midbody, the testes are tandem; the ovary always anterior to the anterior testis; the cirrus sac is longer than ⅕ body length; the uterus rarely extends anterior to the vitellaria and is better developed posterior to the mouth, while eggs can occur posterior to the genital pore in the Red Sea specimens (see Nagaty's fig. 8) and usually do so in my American specimens. The most constant difference is the anterior position of the ovary which is never lateral to the anterior testis. The next most important difference is probably the length of the cirrus sac. Both the anterior and posterior extent of the uterus is less in young specimens. In the writer's experience gasterostomes either are specific or tend to show host specificity. This tendency indicates that the Bucephalus from the related marine hosts is likely to be distinct from *B. polymorphus*. The marine species is therefore renamed *B. varicus,* a name indicating its variability.

Nagaty, impressed by the variability of the tentacles, considered *B. elegans* Woodhead, 1930 a synonym of *B. polymorphus*. The writer does not agree with this conclusion. The eggs of *B. elegans* are approximately twice the size of those of *B. polymorphus*.

The American specimens of *B. varicus* do show considerable variation, some of which is probably due to degree of contraction, some to degree of maturity, and some perhaps to host influence. Egg size was rather constant within a specimen but varied considerably in different specimens, especially from different hosts. But eggs from the Pacific host were intermediate between extremes found in different Atlantic hosts. Thus, Pacific specimens have eggs somewhat wider than those from *Caranx ruber* at Tortugas, but the difference is not deemed significant considering all variations. All the variations of the tentacles were noted as by Nagaty with the additional occasional occurrence of a third small ventral process near the tip of the tentacle (fig. 6). The writer interprets the threadlike process on the tips of some tentacles as a product of disintegration and believes the slightly elevated bosses to represent completely retracted tentacles.

The following diagnosis is based on specimens from both the Atlantic and the Pacific but does not include Nagaty's data which, however, agree in all essential points. Although the collections from the three hosts are considered to be one and the same species, some of the measurements are separated for purposes of comparison.

SPECIFIC DIAGNOSIS OF BUCEPHALUS VARICUS

A. Panama material from Caranx species

Length	0.892	1.087	1.134	1.269
Width	0.187	0.285	0.210	0.232
Anterior sucker	0.112	0.120	0.120	0.120

Eggs . . . 17 to 20 by 11 to 14 μ

B. Tortugas material from *Caranx ruber*

Length	0.705	0.750	0.862
Width	0.195	0.202	0.180

Anterior sucker.....about 0.060

Eggs.....19 to 20 by 9 to 10 μ

C. Tortugas material from *Caranx latus*

Length	0.999	1.147	1.107	1.458
Width	0.127	0.127	0.150	0.130

Anterior sucker.....0.076 to 0.093

Eggs.....17 to 20 by 11 to 16 μ

Tentacles 7, usually retracted; each tentacle with a large basal and a small distal prong. In two instances (fig. 6) a minute spinelike additional prong was seen on the under side near the tip of the tentacle. The distal half of the tentacle seems to be retractile into the basal portion, telescopelike. Upon disintegration this distal portion of the tentacle seems to disappear early, leaving a finely granular threadlike core. Mouth posterior to midbody, usually considerably so, sometimes posterior to all gonads (fig. 8), sometimes between the testes, sometimes anterior to all gonads (fig. 5). Intestine sac shaped. Excretory vesicle I shaped, extending anterior to vitellaria almost to the anterior sucker. Gonads tandem, testes usually large and close together; posterior testis overlapping cirrus sac. Cirrus sac more than $\frac{1}{5}$ body length but varying considerably in length, with saclike seminal vesicle, long pars prostatica, large genital lobe and atrium, long atrial tube, muscular near the pore; genital pore near posterior end of body. Ovary ovoid, directly anterior to anterior testis. Vitellaria in 2 lateral groups, follicles usually crowded close together, usually 12 to 16 on each side, usually in region of ovary but in extended specimens reaching well anterior to ovary. Yolk ducts extend backward and unite between the testes. From the right descending duct a tube leads anteriorly toward the ovary (fig. 3). Nagaty does not describe this long loop of the yolk ducts. Uterus may or may not extend anterior to vitellaria, usually extending posterior to genital pore (but not in young specimens). Eggs 17 to 20 by 9 to 16 μ, usually about 17 to 20 by 10 to 14 μ.

Bucephalus introversus, new species

(Plate 32, figs. 10-12)

Hosts		*Locality*	*Number*
(Type)	Seriola species	Port Culebra, Colombia	11
	Seriola dorsalis (Gill)	Port Utria, Colombia	15
	Seriola dorsalis	Isabel Island, Mexico	1
	Seriola dumerili (Risso)	White Friar Islands, Mexico	3
	Caranx hippos (Linn.)	Port Culebra, Colombia	1

Location: Stomach. Once on the gills, never in the intestine

SPECIFIC DIAGNOSIS OF BUCEPHALUS INTROVERSUS

Body elongate, cylindrical, blunt at anterior end, rounded and little tapering at posterior end. In almost all specimens the anterior end was introverted into the anterior part of the body for a distance often ⅓ and sometimes almost ½ body length. Four specimens with anterior end everted measured 1.202 to 1.707 in length and 0.225 to 0.285 in thickness. Anterior sucker muscular with ventral aperture. Dorsal wall of sucker rhynchuslike with 5 or 6 distinct longitudinal bands of diagonal muscles (or glands ?). When inverted, the anterior sucker resembles still more a rhynchus, since the aperture of the sucker is not evident. Seven tentacles usually completely retracted. Tentacle long and narrow (fig. 12), with a single large basal process near the base. Diameter of anterior sucker 0.170 to 0.345. Mouth normally posterior to midbody (1.035 from anterior end in a 1.707 specimen; 0.817 in a 1.202 specimen). Even when the anterior end is well inverted, the mouth is usually posterior to midbody but under these conditions may be nearer the apparent anterior end. Pharynx variable, usually longer than wide, 0.037 to 0.061 in width. Intestine dorsal and slightly anterior or posterior to mouth. Gonads tandem, to the right, just posterior to pharynx. Testes large, spherical, tandem, close together. Cirrus sac large, ⅓ body length or often somewhat more; its base overlaps (to the left) at least the posterior testis and may reach to ovary, containing an elongate-oval seminal vesicle, long pars prostatica, and large prostate gland. Genital atrium with a complicated system of lobes and folds (fig. 10); atrial tube variable in shape and length, its circular muscles sometimes conspicuous. Genital pore close to posterior tip of body, very close to excretory pore, which is, however, separate. Ovary spherical, pretesticular, about at pharynx level. Vitellaria in 2 lateral groups, more or less clumped, extending anterior and posterior to pharynx a short distance. Follicles on

left side almost always extending farther back than those on the right, often reaching to anterior testis; number of follicles 11 to 17 on each side. Uterus, chiefly in transverse coils, fills most of body, extending anterior to vitellaria, in extended specimens reaching almost to anterior sucker; inverted sucker pushing against uterus. Uterus not extending posterior to genital pore. Eggs large, yellow brown, rather thick shelled, tapering slightly toward anterior end, 22 to 26 by 12 to 15 μ, most eggs about 24 by 14 μ. Excretory vesicle extending slightly anterior to ovary but not anterior to vitellaria.

The name *introversus* is given to indicate the striking characteristic of inversion of the anterior end.

Comparisons. No other species of Bucephalus exhibits the inversion of the anterior end. The stomach of the host is an unusual location for a gasterostome, most of which occur in the intestine. Manter (1931) has previously recorded a gasterostome from the gills of a fish, and one specimen of *B. introversus* was found on the gills. However, the gills probably are not a normal place for these parasites which more likely wandered up from the stomach after death of the host.

B. uranoscopi is more elongate, with two processes on the tentacle; its uterus does not extend so far anteriorly; and the eggs are smaller. *B. kathetostomae* (Manter) has an anterior sucker of similar structure but has an entirely different shape; the vitellaria, uterus, and mouth have different positions, and the eggs are smaller. *B. polymorphus* seems to be most similar but is less elongate, the vitellaria are more anterior, the cirrus sac shorter. *B. varicus* differs in form of anterior sucker, in egg size, and in genital lobes.

Prosorhynchus ozakii Manter, 1934

(Plate 33, fig. 13)

Hosts and Localities:

1. An unidentified, spotted, grouperlike fish from Isabel Island, Mexico
2. *Mycteroperca olfax* (Jenyns) from Albemarle Island, Galapagos
3. *Mycteroperca xenarcha* Jordan from Albemarle Island, Galapagos

Location: Ceca

Number: One to several specimens in a host

The Mexican material had eggs 26 to 29 by 14 to 19 μ, while the Galapagos specimens (from *Mycteroperca olfax* and *M. xenarcha*) had

eggs measuring 31 to 34 by 15 to 19 μ. This difference is not considered of specific significance.

No differences considered of specific value could be found to distinguish this species from *P. ozakii* Manter, 1934 from *Epinephelus niveatus* from 90 fathoms at Tortugas, Florida. The body form of some of the Pacific material tends to be wider for its length (e.g. 1.026 by 0.450, 1.103 by 0.562). But one specimen (fig. 13) was 1.296 by 0.465, which is more like the proportions of *P. ozakii.* The uterus in the Pacific material reaches to the anterior limit of the vitellaria or slightly beyond, which position is slightly more anterior than in the Atlantic form. But other characters are identical, e.g. distribution of vitellaria, gonads, position of mouth, size of eggs.

The species is much like *P. aculeatus* except that the vitelline follicles are in widely separated, longitudinal, lateral rows.

Prosorhynchus aculeatus Odhner, 1905

(Plate 33, fig. 14)

Host: Gymnothorax species
Location: Intestine
Locality: Charles Island, Galapagos
Number: 2, both in one host

These specimens have the small rhynchus, diagonal testes, arched vitellaria, egg size, and other characteristics of *P. aculeatus.* The writer considers *P. uniporus* Ozaki a synonym of *P. aculeatus. P. magniovatus* Yamaguti differs only in its larger eggs. *P. aculeatus* seems to be a widely distributed species in morays.

Prosorhynchus rotundus, new species

(Plate 33, fig. 15)

Host: *Rypticus safronaceus bicolor* (Val.)
Location: Intestine
Locality: Albemarle Island, Galapagos
Number: 3 specimens from a single host

SPECIFIC DIAGNOSIS OF PROSORHYNCHUS ROTUNDUS

Body relatively small and broad, ovoid, rounded at each end but more broadly rounded posteriorly, 0.712 to 0.825 by 0.360 to 0.367. Body, including the flattened surface of the rhynchus, covered with scalelike spines. Rhynchus fairly large and well developed, the flattened, exposed anterior surface measuring 0.150 to 0.157 in diameter. Internal portion

of rhynchus cone shaped, tapering slightly to a fine point which in all three specimens is recurved at its tip to form a hooklike crook. Mouth almost exactly at midbody; pharynx about 0.075 in diameter; sac-shaped intestine extending forward almost to base of rhynchus. Gonads variable in location. Ovary to the right, slightly anterior to but overlapping pharynx; always overlapping and usually entirely dorsal (or ventral) to anterior testis. Vitellaria in 2 separated lateral groups extending from level of pharynx to base of rhynchus. The 2 groups of follicles converge anteriorly and almost but not quite meet near base of rhynchus. Total number of follicles about 23. Uterus filling most of body, extending forward beyond anterior limit of vitellaria, overlapping basal portion of rhynchus, posteriorly reaching to level of genital pore. Eggs very large in proportion to body size, 39 to 44 by 20 to 23 μ.

Testes close together, tandem, diagonal or lateral to each other; normally probably tandem. Anterior testis overlapping ovary, about at level of pharynx. Both testes wider than long; posterior testis overlapping anterior edge of cirrus sac. Cirrus sac large, 0.300 to 0.390 by 0.110 to 0.136. It may be more than half body length. It contains a coiled tubular seminal vesicle, long pars prostatica, large prostate gland, and has a very thick wall (11 to 12 μ). Genital atrium subspherical, thin walled, with large genital lobes. It is surrounded by a very well-developed mass of gland cells for which the term *atrial gland* is suggested. Such glands have been described in *P. squamatus* by Odhner, who compared their appearance to that of a shell gland and considered that they secreted the capsule for the spermatophore. Genital pore a short distance in front of the anterior end, median or to the left. Excretory pore terminal; excretory vesicle extending to posterior testis.

Comparisons. This species is notable for the small body size together with very large egg size. *P. costai* has even larger eggs but differs in its more elongate body, more posterior uterus, shape and position of testes, and relative size of the cirrus sac. *P. rotundus* differs from *P. aculeatus* in its better-developed rhynchus, more anterior mouth, separated vitellaria, and much larger eggs. *P. magniovatus* Yamaguti, 1938 has eggs almost as large but has a smaller flat rhynchus, confluent vitellaria, and much more posterior mouth. *P. scalpellus* McFarlane, 1936 is probably most similar but differs in more narrow eggs, more elongate body, more posterior mouth, and more rounded testes. It lacks the hooklike curve at the tip of the rhynchus, and the host is different. Additional material may show, however, that *P. rotundus* is a synonym of *P. scalpellus*.

Discussion. The variation in the position of the posterior testis seems to be determined by pressure from the cirrus sac. When the cirrus sac is large and extends very far forward, it pushes the testis forward even until it may be anterior and to the left of the ovary. The fact that in such specimens the testis is misshaped by such pressure indicates that it may have been done by the process of killing the worm under a cover glass.

Prosorhynchus gonoderus, new species

(Plate 33, fig. 16)

Host: a yellow-spotted grouper

Location: Ceca

Locality: James Island, Galapagos

Number: Many. 2 specimens, immature, of what is probably the same species were collected together with *P. ozakii* from what seemed to be the same species of fish from Isabel Island, Mexico.

SPECIFIC DIAGNOSIS OF PROSORHYNCHUS GONODERUS

Body elongate, somewhat flattened, widest posterior to rhynchus where there is a fairly distinct expansion of the body, tapering gradually from this region to a pointed posterior end. Length 1.480 to 2.295; width 0.380 to 0.510. Rhynchus very well developed, muscular, flattened anteriorly, pointed conelike posteriorly, longer than wide, width 0.247 to 0.307. Mouth far anterior, between ⅓ and ¼ body length from anterior end; pharynx 0.562 to 0.076 in diameter; saclike intestine directed forward. Gonads far anterior, well in front of midbody, clumped together overlapping one another. Ovary subspherical, at level of pharynx, to the left, close to intestine, slightly pretesticular, overlapping dorsally the anterior testis. Vitellaria in 2 lateral groups, not much extended longitudinally, tending to be 2 or 3 follicles wide, extending from level of pharynx to the rhynchus, usually overlapping posterior end of the rhynchus. Posterior limit of vitellaria (which is only slightly more or less than that of the pharynx) never more than ⅓ body length from anterior end of body. Uterus does not extend anterior to ovary but does extend posterior to genital pore. Mehlis' gland posterior to ovary, among the three gonads. Eggs golden yellow brown in color, 27 to 31 by 15 to 19 μ, usually about 27 to 28 by 17 μ, shells rather thick. Testes subspherical, diagonally placed; anterior testis to the left, overlapping ovary; posterior testis slightly separated, to the right, overlapping anterior testis. Cirrus sac large but, because of the far anterior location of the gonads, does not usu-

ally reach the posterior testis by some distance (it did so in only one of 16 specimens). Genital atrium large, atrial gland well developed; genital pore some little distance in front of posterior end of body. Several specimens showed recently formed spermatophores. Excretory pore ventral; excretory vesicle conspicuous in most specimens, extending forward to posterior limit of the gonads.

The name *gonoderus* (*gono* = gonads; *derus* = neck) refers to the location of the gonads in the neck region.

Comparisons. This species is notable for the far anterior location of the mouth and of the reproductive organs. The body seems to have elongated posteriorly, leaving these organs anterior, but they are relatively close to the anterior end as well as being very far from the posterior end. The species differs from all others in the genus in this location of the gonads, and from most other species in the fact that the uterus does not extend anterior to the ovary.

Prosorhynchus pacificus, new species

(Plate 33, fig. 17)

This species was collected four times, as follows:

Host	*Locality*
Mycteroperca olfax (Jenyns) (type host)	Albemarle Island, Galapagos (type locality)
Mycteroperca xenarcha Jordan	Albemarle Island, Galapagos
Unidentified grouper	James Island, Galapagos

Location: Ceca

Number: Several to many. In the case of both *M. olfax* and *M. xenarcha, Prosorhynchus ozakii* also occurred in small numbers.

SPECIFIC DIAGNOSIS OF PROSORHYNCHUS PACIFICUS

Body elongate, about equally wide along most of its length, blunt at anterior end, tapering to a rounded, somewhat pointed posterior end. Length 1.206 to 1.444; width 0.300 to 0.397. Rhynchus large, muscular, cone shaped, longer than wide, width 0.172 to 0.232. Mouth between ⅓ and ½ body length from anterior end; sac-shaped intestine extending forward; pharynx 0.054 to 0.061 in diameter. Gonads near midbody. Ovary spherical, at pharynx level, to the right, overlapping anterior testis; vitellaria in two widely separated lateral groups, extending from about the level of the ovary halfway to anterior end of body; follicles

tending to be arranged in a straight, linear row on each side. Posterior limit of vitellaria always (in 54 specimens) more than ⅓ body length from the anterior end and often at midbody level or beyond. Mehlis' gland between testes. Uterus not extending anterior to ovary but does extend posterior to genital pore. Eggs light yellow, fairly thin shelled, 24 to 27 by 12 to 17 μ, usually about 25 by 17 μ.

Testes large, subspherical, chiefly postovarian, diagonal, and not far apart, sometimes almost tandem. Cirrus sac large, typical for genus, usually overlapping posterior testis but not reaching to this testis in 20 of 54 specimens. Genital pore some little distance anterior to posterior end of body. Excretory pore terminal; excretory vesicle extending to anterior testis.

Measurements of the type specimen are: Length 1.350; width 0.352; rhynchus diameter 0.215; mouth to anterior end 0.615; pharynx 0.060; cirrus sac 0.427 by 0.113; eggs 24 to 27 by 12 to 14 μ.

The name, *pacificus,* is for the locality.

Comparisons. P. pacificus differs in its large rhynchus from such species as *P. squamatus, P. grandis, P. aculeatus, P. ozakii,* and *P. magniovatus.* It differs from *P. crucibulus* in separated rows of vitellaria, more anterior mouth, more narrow eggs, and more tandem testes. It differs from *P. scalpellus, P. facilis,* and *P. apertus* in that the uterus does not extend anterior to the ovary. An undescribed species of Prosorhynchus from several species of Mycteroperca at Tortugas, Florida, is very similar to *P. pacificus,* the only important difference being in size and color of the eggs. It is interesting to note that of 3 species of Prosorhynchus from Mycteroperca studied by the writer, this species is much more similar to Atlantic collections than to its neighbor, *P. gonoderus,* from the Pacific.

PROSOSTOMATA Odhner, 1905

Gyliauchenidae Ozaki, 1933

Megasoleninae Manter, 1935

The new genus described below is related to Apocreadium Manter, 1937 and is another allocreadid-like distome with lymphatic vessels. Ozaki (1934) reported the first distome, *Petalocotyle nipponica,* with a lymphatic system. At that time, Ozaki considered Petalocotyle in the family Allocreadiidae. Manter (1935) discovered that Megasolena Linton and Hapladena Linton both have well-developed lymphatic vessels and her-

maphroditic sacs. He considered them nearer the amphistomes than the distomes and tentatively classified them in the family Opistholebetidae, subfamily Megasoleninae. The same author (Manter, 1937) described the genus Apocreadium which, while possessing lymphatic vessels, lacks all trace of a cirrus sac and shows many similarities to the Anallocreadiinae. Ozaki (1937, 1937a) held that Gyliauchenidae (with lymphatic vessels) could be separated from Opistholebetidae (without lymphatic vessels). He then considered Petalocotyle in the Gyliauchenidae but did not definitely allocate Megasolena or Hapladena to any family, although implying relationship to Gyliauchenidae. Park (1938) complicated this tendency toward amphistome relationship by describing the genus Carassotrema, which has a hermaphroditic sac (and single testis) as does Hapladena, but lacks lymphatic vessels. The single testis is not of more than generic significance. Park's comparison to Deradena is based on an error by Linton of confusing specimens of Hapladena with specimens of Haplosplanchnus, as explained by Manter (1937a). The genus Deradena is a synonym of Hapladena, and most of the species described by Linton belong in the genus Haplosplanchnus. Carassotrema is indeed very similar to Hapladena, differing only in lacking lymphatic vessels. The peculiar hermaphroditic sac is so unique that there seems little doubt that Carassotrema is to be classified along with Hapladena in the subfamily Megasoleninae. Park's work thus indicates that the presence or absence of lymphatic vessels may not be of such great significance as to warrant the placing of the Megasoleninae among the amphistomes. Furthermore, there appear to be lymphatic vessels in a species of Opechona and in a species of Pseudolepidapedon described below. The writer's view (Manter, 1937) that the Allocreadiidae show evident relationship to the Paramphistomidae is further supported by these recent findings. Sooner or later, more information will determine the placing of the subfamilies and families involved. For the present, the family Gyliauchenidae should probably be considered in the superfamily Allocreadioidea.

Choanodera caulolatili, new genus, new species
(Plate 33, fig. 18)

Hosts: *Caulolatilus anomalus* (Cooper) (type host)
Caulolatilus sp.

Location: Intestine

Localities: Cerros Island, Mexico (type locality)
James Island, Galapagos

Number: Many in each host

SPECIFIC DIAGNOSIS OF CHOANODERA CAULOLATILI

The body is elongate, fairly thick, almost equally wide along most of its length, only slightly tapering and rounded or subtruncate at each end. In life, orange yellow in color. Size 2.565 to 3.307 by 0.945 to 1.282 (a specimen 1.40 long contained but one egg). The thick cuticula covered with scales or spines which are close together in the anterior part of the body but gradually becoming fewer until rather sparse near posterior end of body. Edges of the forebody folding in ventrally, separated anteriorly but converging posteriorly to meet just posterior to acetabulum. (This conspicuous and peculiar character gives the forebody the shape of a funnel flaring anteriorly but with its ventral side open. Sometimes the folds almost meet ventrally, forming a longitudinal slit along the length of the forebody. Under pressure the folds may be flattened out laterally to form an expansion of the forebody.) Oral sucker subterminal, round, 0.165 to 0.225 in diameter; acetabulum subcircular, often slightly wider than long, 0.262 to 0.337 in diameter, its aperture usually wider than long. Forebody ¼ to ⅕ body length. Prepharynx short, often extending down over anterior part of pharynx; pharynx unmodified, usually somewhat longer than wide but of variable proportions, 0.104 to 0.127 in length by 0.078 to 0.141 in width; esophagus very short and surrounded by gland cells; intestinal bifurcation approximately midway between suckers; ceca extending to near posterior end of the body where each ends blindly. Genital pore median at anterior edge of acetabulum. Testes tandem, close together, smooth or with slightly crenulated border, extending between the ceca; anterior testis about at midbody level. Testes somewhat variable, especially the anterior testis, usually wider than long. They are sometimes subequal in size, but either one may be considerably larger than the other. Posttesticular space from slightly to considerably longer than forebody length. Seminal vesicle an ovoid sac just posterior to and partly overlapping the acetabulum, narrowing (dorsal to acetabulum) to a tubular pars prostatica surrounded by a well-developed prostate gland. Just anterior to the middle of the acetabulum the tube bends ventrally and is joined by the uterus to form a tubular genital sinus or ductus hermaphroditicus. Cirrus and cirrus sac lacking.

Ovary a short distance anterior to the anterior testis and to the right of midline, just median to the right cecum, about halfway between anterior testis and acetabulum, without distinct lobes and almost always somewhat extended in a diagonal direction. Since it is somewhat broader at

one end, it assumes a heartlike shape tipped at varying angles. Mehlis' gland large, between ovary and anterior testis. Laurer's canal very large with thick walls, opening dorsally and medianly opposite the ovary. Uterus pretesticular but chiefly to the left of the ovary, becoming a straight, narrow tube dorsal to acetabulum where it joins the male duct. Large flask-shaped seminal receptacle to left of ovary or, more often, between ovary and acetabulum. Vitelline follicles large, extending from near posterior edge of the acetabulum to posterior end of body. (Anteriorly they may almost reach mid-acetabular level.) They are lateral, dorsal, and ventral to ceca and are confluent posterior to the testes. Eggs thin shelled, variable in size, 87 to 102 by 48 to 65 μ, usually 92 to 100 by 50 to 60 μ.

Excretory pore terminal; excretory vesicle extending to posterior testis where it forks into 2 tubules. The tubule on each side soon becomes double. A single pair of smaller tubules extends to near the posterior end of the body. Lymphatic vessels present. Four longitudinal vessels close to intestinal ceca can be seen at most body levels. One pair of these vessels extends dorsal to oral sucker. Anterior to the middle of the body the vessels are inconspicuous and often cannot be seen probably because in a collapsed state. The lymph vessels show no sign of branching.

GENERIC DIAGNOSIS OF CHOANODERA

Body thick, elongate, little tapering, spined, yellow orange. Forebody with edges folded ventrally and converging to meet at posterior edge of acetabulum. Acetabulum $\frac{1}{4}$ to $\frac{1}{5}$ from anterior end, larger than oral sucker. Prepharynx, pharynx, esophagus present; ani lacking. Genital pore median. Testes tandem, close together. Seminal vesicle and prostate gland free in parenchyma; cirrus sac and cirrus lacking; tubular genital sinus present. Ovary pretesticular, to the right, ovoid, tapering toward one end; seminal receptacle, Mehlis' gland, and Laurer's canal all well developed. Uterus largely to left of ovary. Vitellaria well developed. Eggs large, thin shelled. Excretory vesicle to posterior testis with 2 pairs of anterior and one pair of posterior tubules. Four longitudinal, unbranched lymph vessels. Type species: *Choanodera caulolatili.*

The name *choanodera* is from *choan* (= funnel) and *dera* (= neck), and refers to the characteristic form of the forebody.

Comparisons. Choanodera is closely related to Apocreadium Manter, 1937. The ventrolateral folds of the forebody give a superficial resemblance to Bianium, which genus, however, is fundamentally different in possessing ani and a cirrus sac, and in lacking lymph vessels. Choanodera

differs from Apocreadium in the characteristic folds of the forebody and in the unbranched lymph vessels. Body spines are better developed in Choanodera. The details of the reproductive system are practically identical in the two genera, differing only in specific characters.

The discovery of still another Allocreadid-like distome with lymphatic vessels increases the known number of such genera to five: namely, Petalocotyle, Megasolena, Hapladena, Apocreadium, and Choanodera. Carassotrema must be considered a related genus. This group of trematodes shows relationship to the amphistomes, on one hand, and to the Anallocreadiinae and Lepocreadiinae, on the other.

Apocreadium mexicanum Manter, 1937

Host: *Labrisomus xanti* Gill
Location: Intestine
Locality: Tangola Tangola, Mexico
Number: 18 specimens from a single host

Apocreadium longisinosum Manter, 1937

Hosts: *Cheilichthys annulatus* (Jenyns)
Spheroides angusticeps (Jenyns)
Location: Rectum
Locality: Galapagos Islands
Number: 2 to 10 in a host, total of 15 collected from 3 hosts

Allocreadiidae Stoss., 1904

Lepocreadium bimarinum, new species

(Plate 34, figs. 19-21)

Hosts: *Pimelometopon pulcher* (Ayres) (type host)
Bodianus diplotaenia (Gill)
Location: Intestine
Locality: Cerros Island, Mexico (type locality)
Socorro Island, Mexico
Number: 5 specimens from a single *P. pulcher;* 2 to several collected from each of 3 *B. diplotaenia*

The following diagnosis is based chiefly on 4 specimens from *P. pulcher* and one from *Lachnolaimus maximus* (Walbaum) from Tortugas, Florida. The specimens from Bodianus were dead when collected and partly macerated, although they agreed in every significant detail with the forms from Pimelometron.

SPECIFIC DIAGNOSIS OF LEPOCREADIUM BIMARINUM

Body ovate to elongate according to contraction state, usually widest near posterior end which is broadly rounded; spined almost to posterior end; without definite eye spots; length 1.200 to 1.900; greatest width 0.412 to 0.552; forebody 0.305 to 0.555 or about ⅓ to ⅕ total body length. Oral sucker 0.143 to 0.210; acetabulum 0.195 to 0.266, somewhat larger than oral sucker, sucker ratio about 4:5 to 3:4, or in a few cases the acetabulum is only slightly larger than oral sucker. Short, wide prepharynx; pharynx usually longer than wide, 0.099 to 0.130 long by 0.061 to 0.110 wide; esophagus short and wide; intestinal bifurcation not far anterior to acetabulum or (if forebody is extended) about midway between suckers; ceca extending to near posterior end. Genital pore slightly to the left a short distance anterior to acetabulum, near intestinal bifurcation.

Testes smooth, rounded or ovoid, tandem, close together, in posterior half of body. Posttesticular space 0.285 to 0.442, rather variable, may be ⅓ body length or only about ⅙. Cirrus sac longer than wide, of almost equal width except narrowing near posterior end, not extending posterior to acetabulum, sometimes not reaching middle of acetabulum, sometimes reaching past the middle, containing a short muscular tube near its base, a wider pars prostatica in its middle half and a cirrus (straight or slightly sinuous); external vesicle a somewhat coiled tube extending almost to the ovary. Ovary spherical or ovoid, smooth, immediately pretesticular, slightly to the right; seminal receptacle largely dorsal to posterior half of ovary; vitelline follicles large, sometimes not reaching acetabulum by a short distance, sometimes just reaching the acetabulum, in a few cases reaching almost to mid-acetabular level; dorsal, lateral, and ventral to ceca. Uterus to left and anterior to ovary; metraterm a little shorter than cirrus sac. Spines in cirrus or metraterm not seen. Eggs usually collapsed, 51 to 70 by 25 to 32 μ, usually 53 to 64 by 27 to 32 μ. Excretory vesicle not well seen but apparently reaching to the anterior testis.

The name *bimarinum* indicates the occurrence of this species in both the Atlantic and Pacific Ocean.

Comparisons. L. bimarinum differs distinctly from *L. pegorchis* (Stoss.), *L. ovale* Manter, *L. trulla* (Linton), and *L. clavatum* (Ozaki) in that the vitellaria do not extend anterior to the acetabulum. It is most similar to *L. album* (Stoss.) but differs in that the acetabulum is larger than the oral sucker and the cirrus sac does not extend posterior to the acetabulum. The eggs of *L. album* become larger or at least wider, and

the vitellaria extend to the middle of the acetabulum or even anterior to the acetabulum.

The elongated specimen from the Atlantic (fig. 21) agreed almost perfectly with one elongated specimen from Pimelometron (not figured) from the Pacific. Variations in the anterior extent of the vitellaria and posterior extent of the cirrus sac in other specimens led to the conclusion that these more elongate specimens did not represent another species. Decision that specimens from the 3 hosts represented one species was arrived at before relationships of the hosts were considered. It is interesting to note that the 3 host genera are related fishes.

Opechona pharyngodactyla, new species

(Plate 34, figs. 22, 23)

Host: *Trachinotus rhodopus* (Gill) (type host)
Zalocys stilbe Jordan and McGregor

Location: Intestine

Localities: Tenacatita Bay, Mexico (type locality)
Port Utria, Colombia
Clarion Island, Mexico

Number: Several to many

SPECIFIC DIAGNOSIS OF OPECHONA PHARYNGODACTYLA

Body flattened, widest near acetabular level but almost equally wide along middle half, anterior end tapering, posterior end broadly rounded. Cuticula with spines which become sparser and scattered posteriorly. Body size 1.714 to 2.903 by 0.397 to 0.487. Oral sucker somewhat longer than wide, 0.102 to 0.126 in transverse diameter. Acetabulum subcircular, about ¼ body length from anterior end, 0.146 to 0.187 in diameter; sucker ratio approximately 2:3. Forebody 0.405 to 0.750. Posterior end of oral sucker cupped (calyxlike) in a thin layer of circular muscles. Prepharynx long but retractile so that measurements vary from 0.034 to 0.300, flaring at base which often extends down along the side of the pharynx (fig. 23). Pharynx elongate, 0.136 to 0.153 by 0.068 to 0.093, approximately twice as long as wide. Four anteriorly directed, fingerlike, almost transparent, thin-walled processes on anterior end of pharynx (fig. 23). These four processes varied considerably in length and might even extend into the oral cavity. The two lateral processes are the largest, and the right seemed always larger than the left. Esophagus and pseudoesophagus short, approximately equal, combined length less than pharynx; in-

testinal bifurcation a short distance anterior to acetabulum; ceca extending to near posterior end of body.

Genital pore a long, diagonal slit near left anterior edge of acetabulum, its aperture approximately same length as aperture of acetabulum. Testes smooth, tandem, intercecal, posterior to midbody, longer than wide, close together. Postesticular space 0.337 to 0.570, or about 1/6 body length. Cirrus sac curved, claviform, extending to or usually slightly beyond posterior edge of acetabulum; external and internal seminal vesicles present, the latter usually inconspicuous; pars prostatica large; cirrus thick walled. Genital atrium large with thick more or less folded walls continuous with a short, thick-walled metraterm. Ovary globular, median, separated from anterior testis by the large spherical seminal receptacle; Laurer's canal present; gland cells around uterus at base of metraterm; vitellaria from posterior edge of acetabulum backward, surrounding ceca, confluent posterior to testes; eggs 60 to 68 by 34 to 54 μ, usually about 66 by 36 μ.

Excretory vesicle a narrow sinuous tube extending forward to posterior end of pharynx, receiving near its posterior end 2 pairs of small collecting tubules.

Discussion. The peculiar pharyngeal processes of this trematode seem to be unique. Specimens of *Opechona gracilis* (Manter) show very slight elevations of the anterior edge of the pharynx which suggest rudiments of such structures. These pharyngeal processes are very distinctly from the tissues of the pharynx but are not comparable to the lobed border of the pharynx in some trematodes (Megapera, Thysanopharynx).

Not mentioned in the above diagnosis are thin-walled tubes in the forebody similar to or possibly lymph vessels. Their number was not determined because of their winding, convoluted nature. One pair seems to extend near the lateral sides of the body, another pair along the sides of the prepharynx. None were seen posterior to the acetabulum.

Opechona pharyngodactyla differs from all other species in the genus in its pharyngeal processes. In extent of vitellaria it is like *Pharyngora retractilis* Lebour [considered by Nicoll to be a synonym of *O. bacillaris* (Molin)], *O. scombri* Yamaguti, and *O. orientalis* (Layman). It differs from all species, except possibly *O. scombri,* in the fact that the pharynx is always longer than the esophagus and pseudoesophagus combined. Its eggs are larger than those of *O. scombri* or *O. orientalis.* Its ovary is not trilobed as in *O. orientalis.*

Variable characters of *O. pharyngodactyla* include the length of the prepharynx, length of the pharyngeal processes, and the sizes of the internal and external seminal vesicles.

Opechona orientalis (Layman, 1930) Ward and Fillingham, 1934
(Plate 34, figs. 24, 25)

Synonym: *Pharyngora orientalis* Layman, 1930

Hosts and Localities: Angelichthys sp., angelfish, from unknown locality (taken from ship's tanks)
Paranthias furcifer (Cuv. and Val.) from Clarion Island, Mexico
Small mackerel, Tagus Cove, Albemarle Island, Galapagos

Location: Intestine

Number: 8 specimens from a single Angelichthys
10 specimens from 2 of 13 Paranthias

The angelfish host was a fish which died in the tanks. These trematodes had lost body spines but otherwise were in fairly good condition, although they were dead when collected. Their characters seem to agree specifically with those of *O. orientalis,* a trematode previously reported by Layman (1930) and by Yamaguti (1934) from *Scomber japonicus, Spheroides rubripes,* and *Engraulis japonicus* from Peter the Great Bay and Toyama Bay. The specimens from Angelichthys (fig. 24) give the following measurements, all of which fall within the limits of *O. orientalis:* length 1.363 to 2.214; width 0.307 to 0.375; forebody about 1/3 body length; oral sucker often elongate; prepharynx 0.165 to 0.285; pseudoesophagus shorter than esophagus, the 2 together being subequal to the prepharynx in length; sucker sizes and ratios as in *O. orientalis;* eggs 51 to 61 by 27 to 34 μ. The extent of the cirrus sac, of the vitellaria, size and shape of the genital atrium correspond exactly with *O. orientalis.* The excretory vesicle, undescribed for *O. orientalis,* extends to the pharynx, crossing the intestinal bifurcation ventrally. A second smaller and shorter branch of the vesicle extends in the left half of the body to the region of the base of the cirrus.

The ten specimens from *Paranthias furcifer* (fig. 25) were smaller (0.712 to 0.972 by 0.270 to 0.367 mm), the forebody shorter and wider, the prepharynx and esophagus only about the length of the pharynx, the vitellaria in each specimen reaching to the posterior edge of the acetabulum, the ovary more compact, the testes wider than long. But the speci-

mens from Angelichthys (fig. 24) were all greatly extended. The excessive extension of the forebody probably explains differences of these trematodes. A striking similarity between the trematodes from the 2 hosts is seen in the peculiar excretory system with the long vesicle extending median to the right intestinal cecum, bending ventrally anterior to the genital sinus to cross the intestinal bifurcation ventrally and reaching to the pharynx or even to midpharynx level. The excretory vesicle of all species of Opechona is supposedly a simple tube. The occurrence of another small longitudinal branch just median to the left cecum is thus unexpected. Its connection to the main vesicle is not clear.

Lepidapedon hancocki, new species
(Plate 35, fig. 26)

Hosts: *Mycteroperca olfax* (Jenyns) (type host)
Mycteroperca xenarcha Jordan
A large, spotted grouper; unidentified

Location: Intestine

Locality: All hosts were from the Galapagos Islands (Albemarle and James islands)

Number: From one to 15 in a host

SPECIFIC DIAGNOSIS OF LEPIDAPEDON HANCOCKI

Body flattened, spined, elongated, widest in its middle third, tapering anteriorly, more bluntly rounded posteriorly; length 1.458 to 3.997; width 0.553 to 0.948. Oral sucker 0.157 to 0.255 in diameter; acetabulum 0.127 to 0.187 in diameter; sucker ratio about 4:3; forebody ⅓ to ¼ body length. Prepharynx short; pharynx 0.090 to 0.136 long by 0.052 to 0.082 wide; esophagus muscular, slightly longer than pharynx; intestinal bifurcation about midway between the suckers; ceca narrow, ending blindly near posterior end of body. Genital pore sinistral, some distance anterior to acetabulum, not far from left cecum. Testes smooth, tandem, close together, wider than long, in posterior third of body. Posttesticular space 0.157 to 0.300. Cirrus sac clavate, extending almost halfway to ovary, with elongate seminal vesicle extending about half its length, large ovoid prostatic vesicle, a short and wide pars prostatica, few prostatic cells, and a muscular cirrus. External seminal vesicle a large, wide sinuous tube surrounded by a mass of gland cells, extending almost to ovary. Ovary ovoid, wider than long, smooth, a short distance anterior to testes; Mehlis' gland just anterior to ovary; flask-shaped seminal receptacle originating just anterior to ovary, extending along

side of ovary or even posterior to it. Uterus preovarian; metraterm long, sinuous, dorsal to acetabulum and to anterior half of cirrus sac. Vitellaria from mid-acetabular level to posterior end of body; dorsal, ventral, lateral, and partly median to ceca. Eggs thin shelled, 60 to 75 by 32 to 42 μ. Excretory vesicle extending to intestinal bifurcation.

Type host: *Mycteroperca xenarcha*

Comparisons. This species differs from all others in the genus, except *L. nicolli* Manter, 1935, in its very short esophagus. It is very similar in most other respects to *L. nicolli,* e.g. extent of vitellaria, size of eggs, position of testes, sucker ratio. It is not thought to be *L. nicolli* chiefly because in every specimen the external seminal vesicle reached to or nearly to the ovary, whereas in all 3 specimens of *L. nicolli* this organ only reached about halfway between acetabulum and ovary. Other differences shown by *L. hancocki* are: more anterior genital pore; longer, more sinuous metraterm; narrower forebody; and a constantly different shape of the internal seminal vesicle, which is small and spherical in *L. nicolli.*

The species is named in honor of Captain Allan Hancock.

L. hancocki occurred in each case with *Prosorhynchus pacificus,* and each collection of the latter was from a host infected with the former.

Lepidapedon nicolli Manter, 1934

Host: Unidentified, spotted grouper
Location: Ceca
Locality: Isabel Island, Mexico
Number: One specimen

Although but one specimen was collected, comparison with the description and with paratype specimens of *L. nicolli* makes its identification definite. It agrees in every detail of structure and size except for slight variation in that the seminal vesicle extends more than halfway to the ovary and the eggs reach only a size of 58 by 36 μ. However, the former character is more or less variable in the 3 specimens of *L. nicolli,* and additional egg measurements of *L. nicolli* show that its eggs may be as small as 56 by 35 μ. The most characteristic feature of the species is the position of the genital pore posterior to the anterior border of the acetabulum. The original description states the genital pore to be "at level of anterior border of ventral sucker or slightly posterior to this level." In the Pacific specimen and in one Atlantic specimen the pore is actually about opposite the middle of the acetabulum.

L. hancocki is a very similar species, but the genital pore is definitely anterior to the acetabulum.

Pseudolepidapedon balistis, new species
(Plate 35, fig. 27)

Host: *Balistes verres* (Gilbert and Starks)
Location: Intestine
Locality: James Island, Galapagos
Number: 2 specimens in one host

Yamaguti named the genus Pseudolepidapedon for a lepocreadid-like trematode, *P. paralichthydis,* from an unnamed Japanese fish. He included in it the Lepodora sp. of Kobayashi (1921), which he named *Pseudolepidapedon kobayashii.* Yamaguti distinguished the genus from Lepidapedon by its median genital pore, absence of a seminal receptacle, and the structure of the terminal genitalia. Absence of an external seminal vesicle and a modified anterior portion of the pharynx are other important differences from Lepidapedon.

The following species is placed in the genus Pseudolepidapedon, even although it seems to have a seminal receptacle, because it has a median genital pore, lacks an external seminal vesicle, has a similar pharynx and similar terminal genital ducts. An interesting character is the presence of what seem to be lymphatic vessels, here associated again with a modified pharynx as in Apocreadium, Megasolena, Hapladena, and other genera. The affinities of the genus are probably Lepocreadid, but there is considerable resemblance to Acanthopsolus Odhner.

SPECIFIC DIAGNOSIS OF PSEUDOLEPIDAPEDON BALISTIS

Body completely spined; with eye spots. Length 1.957 to 2.794; width 0.945 to 1.093; greatest width near posterior end; posterior end broadly rounded, anterior end more tapering; forebody 0.712 to 1.161 (extended); oral sucker 0.275 to 0.307; acetabulum 0.300 to 0.360 (only slightly larger than oral sucker); prepharynx 0.142 to 0.315; pharynx pyriform, anterior third modified with circular muscles forming a prepharyngeal ring; pharynx 0.232 to 0.277 long by 0.225 to 0.262 wide; esophagus very short; ceca wide, diverging laterally, then extending to near posterior end of body.

Genital pore median, immediately anterior to acetabulum. Testes ovoid, smooth or with slightly irregular contour, longest in a diagonal direction, subtandem or slightly diagonal, close together, intercecal, in posterior half of body. Posttesticular space 0.285 to 0.465. Cirrus sac elongate, more or less divided by a narrowed region into a fairly wide anterior portion lying along the left anterior border of acetabulum and

a claviform posterior portion extending to the ovary and overlapping that organ slightly dorsally. The basal portion contains a wide convoluted seminal vesicle, the narrow portion a smaller less convoluted tube, and the anterior portion a sinuous ejaculatory duct. Tall cells of a prostatic vesicle are lacking; prostatic cells are present but few. The unspined, muscular ejaculatory duct opens into a spacious genital atrium at the tip of a large blunt papilla.

Ovary ovoid, unlobed, pretesticular, slightly to the right, just median to right cecum; Laurer's canal probably present; uterus to the left of ovary and preovarian, extending to left of acetabulum; a saclike seminal receptacle apparently present but sperm cells also in uterus. Metraterm narrow, straight, unspined, opening into atrium at base of male papilla; vitelline follicles large, from intestinal bifurcation to posterior end of body, dorsal, ventral, and lateral to ceca, confluent posterior to testes and dorsally between acetabulum and pharynx. Eggs thin shelled, almost colorless, 60 to 70 by 31 to 37 μ. Excretory vesicle extending to ovary. Sinuous lymphatic vessels present (probably four longitudinal vessels).

The name *balistis* is for the host.

Comparisons. This species differs from both the other two species in more anterior extent of the vitellaria, in diagonal testes, in dextral ovary, in more posterior extent of the cirrus sac, and in presence of a seminal receptacle. There is some question as to the exact nature of the seminal receptacle in *P. balistis;* in the specimen sectioned it seemed to contain one or two eggs, and in the total mount its connections could not be made out. It may be a saclike outpocketing of the uterus.

Until more is known of the lymphatic system in the 3 forms, this species should be considered only tentatively in the genus. The taxonomic status of the genus will be of some interest if all species are found to possess a lymphatic system. At present, the family connections appear to be with the Allocreadiidae (subfamily Lepocreadiinae). However, as has been stated, resemblance to Acanthopsolus should be noted. The chief conspicuous difference seems to be the unspined cirrus and metraterm, while in addition the body is stouter, the eggs smaller, and the pharynx probably different.

Pseudocreadium scaphosomum, new species

(Plate 35, figs. 28, 29)

Hosts: *Balistes polylepis* Steindachner (type host)
B. verres Gilbert and Starks

Location: Intestine

Localities: Socorro and Clarion islands, Mexico, (type locality)—in *B. polylepis*
Charles Island, Galapagos
Isabel Island, Mexico,—in *B. verres*
Number: Few to many present in 2 specimens of each host

SPECIFIC DIAGNOSIS OF PSEUDOCREADIUM SCAPHOSOMUM

Body flat and thin, subcircular, with very thin inrolled edges giving it a bowllike appearance; edges (when flattened by pressure) more or less frilled; cuticula smooth except for a few spines seen near the anterior end of some specimens. Probably a few easily lost spines are normally present. The body may be somewhat longer than wide or wider than long; length 1.552 to 2.268; width (at midbody level) 1.620 to 2.078 (specimens from *B. verres* somewhat smaller). Oral sucker subterminal, subcircular, 0.112 to 0.165 in diameter; acetabulum just anterior to midbody, only slightly larger than oral sucker, 0.165 to 0.195 in diameter. Forebody 0.675 to 0.937. Pharynx 0.068 to 0.102 long by 0.058 to 0.097 wide; esophagus long and narrow, almost as long as pharynx; ceca conspicuous, undulating, diagonally diverging backward, then bowed, some distance from edges of body, tips converging and almost meeting before ending blindly well anterior to posterior end of body. The ceca thus arch around a central area containing most of the reproductive organs. Excretory pore dorsal, median, between tips of ceca; excretory vesicle extending, dorsal to uterus, to near acetabulum where it gives off an anterior and a posterior pair of tubules.

Genital pore slightly to the left, opposite posterior end of esophagus. Testes symmetrical, immediately posterior to acetabulum, smooth or slightly irregular in outline, intercecal, separated by ovary. Cirrus sac (fig. 29) large, claviform, extending from genital pore diagonally backward, overlapping anterior half of acetabulum. In its base is a small, transversely extended, ovoid seminal vesicle followed by a large bipartite prostatic vesicle. Posterior portion of prostatic vesicle larger and more elongate, connected by a posteriorly directed, narrow duct with the more spherical anterior portion. Basal portion of cirrus papillated, filling most of the anterior half of the sac, making one backward loop, anterior portion smooth, muscular. Genital atrium short. External seminal vesicle present, short, tubular, little coiled. Prostate gland large, entirely external, surrounding most of cirrus sac. Ovary more or less lobed, median, intertesticular, immediately postacetabular. Vitellaria of small follicles

copiously distributed on both sides of ceca but not covering them dorsally or ventrally, not extending to edges of body by some distance. Seminal receptacle elongate, along left side of acetabulum. Uterus extending backward in narrow, median coils to level of excretory pore, then forward to metraterm; metraterm large, muscular, overlapping acetabulum. Eggs thin shelled, usually 51 to 56 by 32 to 44 μ, but in one specimen up to 66 μ in length, and in another as narrow as 26 μ.

The name *scaphosomum* is from scapho (=bowl) and *somum* (= body), and refers to the shape of the body.

Discussion. The specimens collected from *Balistes verres* are thought to represent the same species, although they are smaller (0.937 to 1.36 in length, as compared with 1.552 to 2.268 in the other collections). In them, too, more variation was found in the quantity of vitelline follicles which seemed partly exhausted in some specimens. Some of these specimens showed the uterus not reaching the posterior border of the testes, and in one case it was almost wholly anterior to the ovary. However, sucker ratio, egg size, and the internal structure of the cirrus sac agree with material from *B. polylepis*.

A consideration of the above species together with the following species leads the writer to conclude that Hypocreadium Ozaki, 1936 should be considered a synonym of Pseudocreadium Layman, 1930. Yamaguti (1938) has already shown that Leptocreadium Ozaki, 1936 is a synonym of Pseudocreadium. The possible generic distinction between Pseudocreadium and Hypocreadium would be based on the following characters of Hypocreadium (which apparently differs in Pseudocreadium) : smooth cuticula, unlobed ovary, and uterus reaching posterior to the testes. The variable nature of these characters is revealed by (1) the fact that some specimens of *P. scaphosomum* show a few spines in the cuticula; (2) the fact that in the following species the ovary may be smooth or considerably lobed; and (3) that in certain specimens of *P. scaphosomum* the uterus may not reach beyond the testes.

The following species are known: *P. monocanthi* Layman, 1930 (synonym: *Leptocreadium skrjabini* Ozaki, 1936); *P. vitellosum* (Ozaki, 1936) Yamaguti, 1938; *P. symmetrorchis* (Ozaki, 1936) n. comb.; *P. patellare* (Yamaguti, 1938) n. comb.; and the 2 species described in the present paper.

P. scaphosomum is most similar to *P. patellare.* In *P. patellare,* however, the eggs are larger (63 to 81 by 33 to 43 μ), the ovary smooth, the ceca less undulating, and the prostatic vesicle is undivided and the cirrus

straight. *P. symmetrorchis* is different in body shape, sucker ratio, more posterior testes, and unlobed ovary. *P. monocanthi* has a more lobed ovary, more anterior uterus, and smoother testes.

Pseudocreadium spinosum, new species

(Plate 35, figs. 30, 31)

Host: Caulolatilus sp. (whitefish)
Location: Intestine
Locality: James Island, Galapagos
Number: Large numbers were collected from a single host. In the same fish were *Lecithochirium microstomum* and *Choanodera caulolatili.*

SPECIFIC DIAGNOSIS OF PSEUDOCREADIUM SPINOSUM

Sides of the thin, flattened body are curled over ventrally especially along the lateral edges and sometimes to a lesser degree along the posterior edge. If flattened out, the body would be as wide as long or even wider, but this condition is rarely seen. Length 0.592 to 1.053. A specimen 0.510 long contained no eggs. Body width measurements (0.562 to 1.053) are usually not precise because of the ventral folding of the lateral edges. Both ends are broadly rounded; anterior end likely to be more truncate. Spines conspicuous in anterior half of body and extend posteriorly almost to the end of the body. Suckers weakly muscular. Oral sucker circular, subterminal, a short distance from anterior end, 0.071 to 0.116 in diameter; acetabulum near middle of body or slightly anterior to middle, circular or subcircular, 0.107 to 0.168. Sucker ratio approximately 3:4. Forebody slightly more than ⅓ body length. Prepharynx wide; pharynx globular (0.042 to 0.068 in diameter); esophagus short. Ceca unbranched, not undulating, curving backward distant from sides of body, passing closely outside testes and curving a short distance medianly just posterior to testes, ending blindly. Ceca very inconspicuous and partly covered by vitellaria. Genital pore to left of midline about midway between suckers, opposite or just median to left cecum. Testes symmetrical, just posterior to acetabulum, intercecal, separated by ovary and uterus, longer than wide with the long axis extending diagonally backward, outline smooth to definitely lobed. Cirrus sac elongate, clavate, large, extending from genital pore diagonally backward to overlap the right half of acetabulum. In a 1.012 specimen the cirrus sac was 0.310 by 0.088. It contains a subtriangular seminal vesicle, a bipartite prostatic

vesicle the posterior ⅔ of which is usually recurved, the anterior ⅓ globular; cirrus large, straight, wide, inflated, filling approximately ½ cirrus sac, with papillated inner surface, tapering to a short smooth muscular portion near genital pore. The few prostatic cells are external to cirrus sac near its base. Tubular external seminal vesicle extends to left of base of cirrus sac usually overlapping the acetabulum.

Ovary variable in shape, usually irregularly lobed and elongate; it may be smooth and almost globular. A roughly triangular form is not uncommon. Seminal receptacle an elongate tube extending anterior to ovary along left side of acetabulum. The uterus may extend as far posterior as the posterior edge of the testes. Eggs few, yellow, thin shelled, 60 to 75 by 32 to 41 μ, usually 60 to 65 by 34 to 37 μ. Metraterm strongly muscular, slender, slightly curved, overlapping acetabulum. Vitelline follicles profuse, filling most of body from pharynx to posterior end, contiguous anteriorly and dorsally at level of esophagus and, if body is contracted, as far forward as the oral sucker. They are dorsal to the ceca as well as inter- and extracecal. They usually are not contiguous posteriorly but separated by a region around the excretory pore. They do not extend to the lateral edges of the body. Excretory pore conspicuous, dorsal, some distance anterior to posterior end, between the tips of the ceca; excretory vesicle extending straight forward to the ovary.

Comparisons. P. monocanthi and *P. vitellosum* differ from *P. spinosum* in larger size, in multilobed ovaries, and in smooth rounded testes. *P. monocanthi* also differs in that its suckers are of equal size and the vitelline lobes are separated anteriorly. *P. vitellosum* has more profuse vitellaria, diagonal testes close together and postovarian, suckers of equal size, and smaller eggs. *P. scaphosomum* has the vitellaria interrupted anteriorly, more undulating ceca, and a curved or coiled cirrus. *P. symmetrorchis* is larger, has more rounded seminal receptacle, vitellaria interrupted anteriorly, and more posterior extent of the uterus. *P. patellare* has a different distribution of the vitellaria, more anterior genital pore, longer cirrus, and more posterior extent of the uterus.

Anisoporus eucinostomi, new species

(Plate 36, figs. 32, 33)

Hosts: *Eucinostomus californiensis* (Gill) (type host)
Polynemus approximans Lay and Bennett
Location: Intestine

Localities: Port Utria, Colombia (type locality)
Bahia Honda, Panama
Number: 5 specimens from *E. californiensis*
One specimen from *P. approximans*

SPECIFIC DIAGNOSIS OF ANISOPORUS EUCINOSTOMI

Body smooth, tapering at each end but almost equally wide along most of its length, widest posterior to acetabulum; length 1.222 to 2.497; width 0.345 to 0.465. Forebody narrow, from 1/5 to 1/7 total body length. Oral sucker longer than wide, 0.109 to 0.144 in transverse diameter; acetabulum protuberant, each lip with 3 prominent lobelike papillae, length of acetabulum 0.144 to 0.210; sucker ratio probably about 2:3. A conspicuous accessory sucker, ventral, median or submedian, directly anterior to acetabular stalk, between acetabulum and genital pore. Accessory sucker with distinct pore and radiating muscles but lacking an outer membrane. Genital pore slightly to the left opposite base of pharynx.

Short prepharynx; pharynx 0.064 to 0.110 in length by 0.049 to 0.085 wide; esophagus muscular, 0.119 to 0.136 long, bifurcating dorsal to acetabulum; ceca unite near posterior end of body; anus near posterior tip of body.

Testes tandem, close together, in posterior half of hindbody, transversely extended, reaching almost to sides of body; posttesticular space sometimes longer, sometimes shorter than forebody. Cirrus sac lacking; cirrus short; prostatic cells few; seminal vesicle sinuous, extending to intestinal bifurcation or rarely as far as posterior edge of acetabulum. Ovary subtriangular, transversely extended, median, immediately pretesticular. Uterus largely intercecal, entirely preovarian; eggs 41 to 48 by 25 to 29 μ; no seminal receptacle. Vitelline follicles large, from near base of acetabular stalk to posterior end of body except for a short interruption opposite posterior testis and sometimes opposite anterior testis; ventral, dorsal, and lateral to ceca; filling posttesticular area. Excretory pore terminal or dorsoterminal, close to anus; anterior extent of excretory vesicle not determined.

Discussion. The genus Anisoporus was named by Ozaki in 1928 (Ozaki, 1928a). *A. cobraeformis,* the type, is the only other species described to date.

Anisoporus is very closely related to Opecoeloides Odhner, 1928. Opecoeloides was based on *Distomum furcatum* Brems. It possesses an accessory sucker between the acetabulum and the genital pore, and has 6

tentacles on the acetabulum. It agrees with Anisoporus except that the ceca open into the excretory vesicle rather than to the outside. Genitocotyle Park, 1937 is also a related genus. Genitocotyle has the accessory sucker but no tentacles on the acetabulum, and apparently its ceca end blindly. There is considerable doubt if either of these characters should be of generic rank (for example, the acetabular processes are not considered generic in Opecoelus, and the uroproct is not emphasized in the genus Stephanostomum). Anisoporus, Opecoeloides, and Genitocotyle should all be considered to be in the subfamily Opecoelinae.

A. eucinostomi is very different from *A. cobraeformis* in shape of the forebody, in location of the accessory sucker which is median rather than lateral, in lacking a genital sucker, in more anterior extent of the vitellaria, and in longer esophagus.

Anisoporus thyrinopsi, new species

(Plate 36, fig. 34)

Host: *Thyrinops pachylepis* (Günther)
Location: Intestine
Locality: Port Utria, Colombia
Number: One specimen in one of 10 hosts

SPECIFIC DIAGNOSIS OF ANISOPORUS THYRINOPSI

Body slender, widest at acetabular level, 1.538 by 0.307; forebody 0.412. Oral sucker longer than wide, 0.120 in transverse diameter; acetabulum 0.195 in diameter, with three pairs of papillae. Genital pore to the left, opposite base of pharynx. Accessory sucker to the left, midway between genital pore and acetabulum. Short prepharynx; pharynx 0.097 long by 0.048 wide; esophagus 0.135 long; intestinal bifurcation at anterior edge of acetabulum. Testes small, smooth, longer than wide, tandem, separated by a short distance; posttesticular space about $\frac{1}{3}$ body length. Cirrus short; pars prostatica long but with few cells; seminal vesicle sinuous, extending almost halfway between acetabulum and ovary. Ovary subspherical; vitellaria from posterior edge of acetabulum to posterior end of body; eggs 41 to 46 by 28 to 29 μ.

The name *thyrinopsi* is for the host. Being based on a single specimen, this species is named more or less tentatively.

Comparisons. This species is most like *A. eucinostomi.* It differs in more slender body, more tapering hindbody, shape of testes, and much longer seminal vesicle.

Dactylostomum vitellosum, new species

(Plate 36, fig. 35)

Host: Small, silver tide-pool fish
Location: Intestine
Locality: Gorgona Island, Colombia
Number: One specimen

SPECIFIC DIAGNOSIS OF DACTYLOSTOMUM VITELLOSUM

Body elongate, smooth, 1.755 by 0.352, widest at about midbody, bluntly rounded posteriorly. Forebody 0.285. Oral sucker 0.119 long; acetabulum 0.180 long, with transverse aperture, each lip of aperture (fig. 35) with 3 large rounded median lobes and 6 small papillalike elevations, 3 on each side. Prepharynx very short; pharynx 0.060 long, 0.076 thick; esophagus shorter than pharynx; ceca uniting near posterior end of body, but an anus is apparently lacking. Genital pore median, about midway between suckers. Testes tandem, approximately in midbody, somewhat separated by vitellaria, unlobed but slightly irregular in outline, somewhat extended transversely; posttesticular space 0.607. Cirrus sac very weak (possibly absent), enclosing only the short cirrus; seminal vesicle tubular, almost straight, free in parenchyma, extending backward to near posterior end of acetabulum. Ovary roughly three lobed or heart shaped, median, immediately anterior to testes. Vitelline follicles from anterior border of acetabulum to posterior end of body, chiefly lateral, confluent between and behind testes; yolk reservoir at dorsoanterior border of ovary; seminal receptacle lacking; uterus preovarian; eggs 53 to 54 by 27 to 30 μ.

Discussion. The genus Dactylostomum was named by Woolcock in 1935 and considered to be in the subfamily Coitocoecinae. The type species is *D. gracile* from *Myxus elongatus,* Port Philip Bay, Victoria. Considering the difference in host and locality, the present species is remarkably similar to *D. gracile.* It is smaller (1.755 as compared with 2.5 to 5.0), there is less difference in the sizes of the 2 suckers, the vitellaria are more profusely developed but have about the same distribution, the pharynx is larger, the eggs are smaller (53 to 54 μ as compared with 70 to 80 μ), the posttesticular space is longer. The smaller papillae of the acetabulum were not evident in *D. gracile,* but the extended condition of the sucker may have resulted in their reduction.

Woolcock compared Dactylostomum with Coitocaecum. The form of the acetabulum suggests Opecoelus and Opegaster. Actually, the genus

Dactylostomum differs from the so-called "Opecoelinae" only in the absence of an anus. The character of the terminal sex ducts and the character of the acetabulum are exactly as in some species of Opegaster and Opecoelus.

The presence or absence of an anus is sometimes difficult to determine. In fact, it can be said for *D. vitellosum* that an anus is almost present. Study of the toto-mount could not determine this character with certainty. It was thought probable that an inconspicuous anus was present. The posterior end of the worm was cut into serial cross sections 7.5 μ thick. These sections show that the posterior part of the united ceca approaches very close to the ventral surface of the body and comes in direct contact with the cuticula. The cuticula even seems to be thin at this spot, but no connection to the outside could be seen. It was finally decided that an anus was lacking. If an anus should be present in this species, it would become a member of the genus Opegaster and very similar to *O. parapristipomatis*.

After studying examples of all the following genera the writer is convinced that Opecoelus, Opegaster, Dactylostomum, Coitocaecum, and Opecoelina are rather closely related genera and should be classified in the same subfamily, Opecoelinae.

OPECOELUS and OPEGASTER

The genera Opecoelus Ozaki, 1925 and Opegaster Ozaki, 1928 are very similar. In Opegaster the vitellaria, or at least "rudimentary vitellaria," extend anterior to the acetabulum, while in Opecoelus the vitellaria are postacetabular. In Opegaster, the seminal vesicle does not extend appreciably beyond the acetabulum as it does in Opecoelus. The acetabulum is often stalked in Opecoelus, but not in Opegaster. The presence or absence of papillae on the acetabulum has not been considered a generic character, and both conditions are to be found in different species of each genus.

Actually some species seem close to the border line between the 2 genera. Thus, *Opegaster tamori* has vitellaria barely anterior to the acetabulum and a seminal vesicle reaching halfway to the ovary. Furthermore, the "rudimentary vitellaria" might not be considered by some as vitellaria, in which case some species exhibit the vitellarian condition of Opecoelus and the cirrus-sac extent of Opegaster.

Opecoelus mexicanus, new species

(Plate 36, figs. 36, 37)

Hosts: *Paranthias furcifer* (Cuv. and Val.)
Lutianus viridis (Val.)

Location: Ceca and intestine, once from the stomach

Locality: Clarion Island, Mexico. Here the trematodes were found in 3 of 4 Paranthias and in 2 of 3 Lutianus. They were not found in 9 *Paranthias furcifer* or in 3 *Lutianus viridis* from the Galapagos Islands.

Number: Present in small numbers in the above-mentioned infected hosts

SPECIFIC DIAGNOSIS OF OPECOELUS MEXICANUS

Body flattened, elongate, tapering at each end, 0.935 to 1.957 in length by 0.345 to 0.562 in greatest width. Oral sucker subcircular, 0.102 to 0.153 in diameter. Acetabulum about ⅕ body length from anterior end, slightly wider than long, 0.189 to 0.255 in transverse diameter. Sucker ratio approximately 3:5. Aperture of acetabulum transverse, each lip bearing 3 fairly long, pointed, median, fingerlike papillae and 2 lateral rudimentary papillae, one on each side. Pharynx large, pyriform, elongate, often widest in its anterior half, measuring 0.071 to 0.110 in length by 0.053 to 0.085 in greatest width; esophagus varying according to contraction (from 0.020 to 0.068), when extended it is more than half pharynx length; intestinal bifurcation a short distance anterior to acetabulum; the narrow ceca extend to near posterior end of body where they unite to form a short rectum; anus ventral, a little in front of posterior end of body. Genital pore slightly to left of midline, opposite middle or the base of pharynx. The small cirrus sac surrounds only the cylindrical cirrus and a few gland cells. It reaches approximately to intestinal bifurcation. From it a narrow male tube leads backward, gradually enlarging to form the elongate, almost straight, seminal vesicle extending dorsal to the right half of acetabulum and posterior to acetabulum a short distance. Testes just posterior to midbody, tandem, close together, wider than long, smooth, or slightly lobed; posttesticular space approximately ⅓ body length.

Ovary immediately pretesticular, wider than long, somewhat heart shaped (sometimes of irregular outline). Vitellaria extending lateral to ceca from posterior edge of acetabulum to posterior end of body, not meeting posterior to anus; 2 longitudinal fields of follicles in posttesticular space. In one specimen the anterior extent was almost to mid-acetabular

level. Eggs thin shelled, 48 to 61 by 26 to 34 μ, averaging 53 by 27 μ. Excretory vesicle extending dorsal to testes to level of ovary. Type host: *Paranthias furcifer*.

Comparisons. This species differs from *O. inimici* Yamaguti, 1934 in its rudimentary lateral acetabular papillae, its more anterior genital pore, smaller eggs, wider testes, arrangement of posttesticular vitellaria, and sucker ratio. *O. goniistii* Yamaguti, 1938 also has 5 pairs of papillae but differs in many respects such as location of genital pore, shape of testes, extent of vitellaria, and seminal vesicle.

Opecoelus xenistii, new species

(Plates 36 and 37, figs. 38, 39)

Host: *Xenistius californiensis* (Steindachner)
Location: Intestine
Locality: Tagus Cove, Albemarle Island, Galapagos
Number: 7

SPECIFIC DIAGNOSIS OF OPECOELUS XENISTII

Size 1.552 to 2.356 by 0.675 to 0.780. Widest posterior to midbody; posterior end broadly rounded. Forebody 1/5 to 1/7 body length. Oral sucker 0.157 to 0.193 in transverse diameter; acetabulum 0.292 to 0.330 in diameter or slightly less than twice size of oral sucker; acetabulum with transverse aperture and 5 pairs of papillae. The 3 median papillae more prominent, lateral papillae very inconspicuous (fig. 39). Short prepharynx; pharynx 0.076 to 0.100 by 0.076 to 0.100; esophagus as long as pharynx or shorter; rectum short; anus conspicuous, a short distance anterior to posterior end of body. Genital pore conspicuous, with radiating muscles, slightly to the left, opposite base of pharynx. Testes large, tandem, just posterior to midbody, transversely extended, close together, with lateral edges bent dorsally and posterior borders deeply indented. Posttesticular space about 1/3 body length. Seminal vesicle almost straight, extending slightly posterior to acetabulum. Cirrus sac enclosing only the cirrus and a few gland cells. Ovary immediately pretesticular, extended transversely, 3-lobed. Vitellaria close together, from near anterior border of acetabulum to near posterior end of body, filling posttesticular space, not meeting posterior to anus. Metraterm muscular, extending to acetabulum. Eggs 50 to 59 by 29 to 34 μ, usually about 54 by 32 μ. Excretory pore terminal or slightly dorsal. Excretory vesicle extending, dorsal to testes, as far forward as ovary.

Comparisons. The constant deep median cleft of the posterior margin of each testis is one of the most distinguishing characters of this species. Most species of Opecoelus have 3 pairs of labial processes. *Opecoelus mexicanus* is very similar in form of acetabulum, body form and size, and egg size, but differs in that the 3 pairs of median labial processes are longer; the vitellaria do not extend quite so far anterior; the genital pore is opposite the middle of the pharynx; the testes rather than being indented medianly are extended at that point; the ovary is not so deeply lobed, and the pharynx is longer in comparison with its width. *Opegaster tamori* has similar testes but no acetabular papillae and a more posterior genital pore.

Opecoelus inimici Yamaguti, 1934

(Plate 37, fig. 40)

Host: *Paralabrax nebulifer* (Girard)
Location: Intestine
Locality: Cerros Island, Mexico
Number: Several

These specimens seem to agree in all important specific characters with Yamaguti's description of *O. inimici,* e.g. location of gonads, vitellaria, genital pore. Most measurements overlap those of the Japanese species, although the eggs (54 to 63 by 27 to 34 μ) are slightly smaller.

It seems to the writer that *O. sebastodis* Yamaguti, 1934 is a synonym of *O. minor* Yamaguti, 1934. Measurements of the two overlap. Yamaguti separated the two on the character of the acetabular processes which were 0.075 long in *O. sebastodis* as compared with 0.118 in *O. minor.* But Yamaguti states (p. 347) that the 0.118 is the length when extended and that "these appendages are variable in length according to contraction." Individual variation in the location of the opening of Laurer's canal is unknown. The vitellaria seem to reach somewhat more forward in *O. sebastodis,* but this character is somewhat variable in my own collections of Opecoelus species. *O. sebastodis* is here considered a synonym of *O. minor.*

Opegaster acuta, new species

(Plate 37, fig. 41)

Host: *Abudefduf saxatalis* (Linn.)
Location: Intestine
Locality: Socorro Island, Mexico
Number: 12 specimens in one host, 9 in 3 others

SPECIFIC DIAGNOSIS OF OPEGASTER ACUTA

Body elongate, little flattened, almost cylindrical, widest at acetabular level, tapering toward each end, usually rather sharply pointed at posterior end; 0.950 to 1.633 in length, 0.307 to 0.427 in width. Forebody 0.187 to 0.382 or about ¼ body length. Oral sucker usually longer than wide, 0.120 to 0.150 in width by 0.135 to 0.150 in length. Acetabulum wider than long, with transverse aperture; nonpedunculated; 0.210 to 0.232 in diameter; sucker ratio approximately 3:5. Acetabulum with 5 pairs of small, simple, interlocking papillae. Prepharynx short and wide; pharynx 0.085 to 0.110 long by 0.060 to 0.102 wide; esophagus short and wide; intestinal bifurcation about midway between suckers; ceca unite near posterior end to form a short rectum (of somewhat variable length up to 0.102); anus ventral, subterminal, close to excretory pore. Genital pore median, opposite posterior edge of oral sucker. Testes subglobular (may be wider than long or longer than wide, the posterior testis being usually more elongate), tandem, close together, immediately posterior to midbody, intercecal, smooth. Cirrus sac very small, inconspicuous, surrounding only the cirrus, not extending posterior to pharynx. Seminal vesicle a sinuous tube lying free in parenchyma from level of intestinal bifurcation to about middle of acetabulum, connected with the cirrus sac by a thin-walled uncoiled tube. Prostate gland apparently lacking but perhaps represented by large nuclei in region of seminal vesicle. Ovary median, immediately pretesticular, either subtriangular and unlobed or distinctly trilobed; yolk reservoir to left of ovary; seminal receptacle lacking, sperm cells in uterus; Laurer's canal present; uterus preovarian; eggs yellow, thin shelled, blunter at one end, 44 to 49 by 24 to 27 μ (in balsam mounts). Vitelline follicles filling sides of hindbody; confluent posterior to testes; dorsal, ventral, and lateral to ceca; may overlap testes dorsally; extending anterior to acetabulum almost to intestinal bifurcation on one or both sides. In one specimen (fig. 41) only rudimentary follicles could be seen anterior to acetabulum. Excretory vesicle extending forward to ovary.

Comparisons. Opegaster acuta differs from all other species in the genus in the location of the genital pore, which is much more anterior. Most species do not have as many as 5 pairs of acetabular papillae. *O. acuta* differs from *O. tamori* in extent of the seminal vesicle, in shape of testes, in egg size, and in length of esophagus.

Opegaster pentedactyla, new species
(Plate 37, fig. 42)

Host: *Balistes verres* Gilbert and Starks
Location: Intestine
Locality: Charles Island, Galapagos
Number: 4 to numerous specimens in each of 2 hosts

SPECIFIC DIAGNOSIS OF OPEGASTER PENTEDACTYLA

A contracted specimen measured 0.918 by 0.450; 3 more extended specimens measured 1.360 to 1.424 by 0.337 to 0.450. Body widest at acetabular level, tapering toward each end but more pointed at posterior end. Forebody about ¼ total body length. Oral sucker 0.119 to 0.144 in diameter; acetabulum not markedly protuberant, wider than long, 0.178 to 0.247 in transverse diameter, with transverse aperture. Sucker ratio approximately 2:3. Acetabular lips each with 5 short papillalike interlocking tentacles. (In the type specimen there seem to be only 4 tentacles on the posterior lip, but the fifth might have been compressed by its anterior mate.) Prepharynx short; pharynx large, 0.087 to 0.110 in length by 0.085 to 0.105 in width. It may be wider than long, longer than wide, or of about equal dimensions. Esophagus shorter than pharynx in all 4 specimens. Possibly, when fully extended it might be as long as or even slightly longer than the pharynx. Rectum short; anus a short distance anterior to posterior end of body. Genital pore submedian, to the left, at level of posterior end of pharynx. Cirrus extending to or almost to the end of the esophagus; cirrus sac, if present at all, very delicate and enclosing only the cirrus; seminal vesicle with 2 curves, widening as it extends posteriorly, reaching to posterior edge of acetabulum; definite prostate gland lacking but probably represented by a few isolated gland cells near seminal vesicle opposite anterior edge of acetabulum. Testes ovoid, smooth or with slightly irregular contour, tandem, intercecal, close together or, at least, not far apart, in posterior half of body. A vas efferens arises dorsally from near anterior end of each testis and unites with its mate to form a short vas deferens near the seminal vesicle. The posttesticular space varies from only 0.187 in the contracted specimen to 0.425. Ovary indistinctly 3-lobed, heart shaped, the anterolateral lobes being more evident; shell gland dorsal at anterior border of ovary; seminal receptacle lacking; Laurer's canal present; uterus preovarian, extending along the medial side of the narrowed seminal vesicle, opening at the common genital pore from the anterior side; eggs 46 to 50 by 26 to 29 μ; vitellaria extending

from posterior edge of acetabulum to posterior end, not confluent between testes, often overlapping the ceca ventrally but not dorsally. Colorless cellular structures the same size and shape of vitellaria in forebody ("rudimentary vitellaria"). Excretory pore subterminal, slightly dorsal; excretory vesicle a straight tube extending to level of ovary.

Comparisons. This species is probably most similar to *Opegaster acuta.* Two constant differences are: more posterior genital pore in *O. pentedactyla* and more anterior anus in *O. acuta. Opecoelus xenistii* has very similar acetabular papillae and terminal genital organs. Actually, although named in a different genus, *O. xenistii* is possibly identical with *Opegaster pentedactyla.* The difficulties in separating the genera have been mentioned above. *Opegaster pentedactyla* is considered distinct from *Opecoelus xenistii* because of more constant "rudimentary vitellaria," smaller size, considerably larger pharynx, slightly smaller eggs, and smooth testes.

A number of specimens secured from a fish *(B. verres),* which died in the ship's tanks, showed some variations probably due to their macerated condition. They are slightly longer, more slender, with longer prepharynx and esophagus, less conspicuous acetabular processes. One specimen seemed to have but 3 acetabular processes. Because of agreement with *O. pentedactyla* in other respects, the specimens were identified as that species.

Opegaster parapristipomatis Yamaguti, 1934

(Plate 37, fig. 43)

Hosts: *Trachinotus rhodopus* (Gill)
Selar crumenophthalmus (Bloch)
Location: Intestine
Locality: Chatham Island, Galapagos
Number: 6 in one, 15 in another of 2 hosts

The differences between these trematodes and *O. parapristipomatis* are considered too small to justify a new species. These differences are as follows: my specimens (1.200 to 1.790 in length) are somewhat smaller than the Japanese species which is 2.5 to 2.8 in length. The vitelline follicles are somewhat larger and in the forebody extend farther median than is shown in Yamaguti's figure. Eggs are somewhat smaller, 48 to 54 by 26 to 30 μ as compared with 57 to 70 by 31 to 42 μ. Most details are in agreement, e.g. the sucker ratio, the large pharynx, the length of the esophagus, the position of the genital pore, the extent of the vitellaria, ex-

tent of the seminal vesicle, and location of intestinal bifurcation. In most of my specimens the testes were considerably extended transversely, but this character was variable and some specimens were much like Yamaguti's in this character. Although most specimens showed 3 large and 2 small lateral papillae on each lip of the acetabulum, a few showed these structures inconspicuously, thus agreeing with Yamaguti's description of "inconspicuous papillae." The seminal vesicle may barely overreach the acetabulum, or it may extend to the posterior edge. The anus is practically terminal and opens with the excretory vesicle into a common terminal depression.

Two specimens of a trematode from *Selar crumenophthalmus* from Bahia Honda are almost certainly the same species or at least the same species as that from the Galapagos. They accidentally became dried but were mounted and agreed in all characters above except for more rounded testes.

Coitocaecum tropicum, new species

(Plate 37, figs. 44, 45)

Host	*Locality*	*Number*
Halichoeres dispilus (Günther) (type host)	Charles Island, Galapagos (type locality)	2
Bathygobius soporator (Cuv. and Val.)	Socorro Island, Mexico	1
Bathygobius soporator	Charles Island, Galapagos	6
Malacoctenus zonifer (Jordan and Gilbert)	Corrientes Bay, Colombia	2
Blenny	Charles Island	3
Opisthognathus scops (Jenkins and Everman) Location: Intestine	Galapagos Islands	4

SPECIFIC DIAGNOSIS OF COITOCAECUM TROPICUM

Body smooth, elongate, flattened, rather abruptly pointed at posterior end, forebody more gradually narrowing. Length 0.780 to 1.140; greatest width (just posterior to acetabulum) 0.277 to 0.465; forebody usually about ⅓ body length, 0.227 to 0.427 in length. Oral sucker slightly longer than wide, 0.088 to 0.135 wide; acetabulum wider than long, 0.165 to 0.277 in width, with transverse aperture. Sucker ratio approximately 1:2 (more often the acetabulum is a little less than twice the diameter of oral sucker). Prepharynx short and wide; pharynx globular or

subglobular, 0.059 to 0.087 long by 0.056 to 0.071 wide; esophagus about same length as pharynx, its anterior portion muscular and thick walled; intestinal bifurcation about midway between suckers; ceca uniting not far from posterior end; anus lacking. Genital pore to the left, opposite anterior half of esophagus. Testes tandem, or very slightly oblique, close together, smooth, wider than long, in posterior half of body. Testes were lacking in both specimens from *Malacoctenus zonifer*. Seminal vesicle tubular, coiled between acetabulum and intestinal bifurcation, only slightly overlapping acetabulum. (In one specimen from Bathygobius what seemed to be the seminal vesicle extended slightly posterior to the acetabulum.) Cirrus sac thin walled, between pore and left cecum which it overlaps but does not overreach, containing a sinuous ductus ejaculatorius and delicate cirrus (fig. 45). The narrowing seminal vesicle apparently not constricted as it enters the cirrus sac. Ovary small, ovoid, wider than long, to the right (sometimes median), close in front of anterior testis; seminal receptacle lacking; uterus pretesticular, may overlap left cecum slightly; metraterm thin walled, not quite so long as cirrus sac; eggs 48 to 51 by 26 to 32 μ. Vitellaria from intestinal bifurcation or esophagus region in sides of body to posterior end, lateral to ceca in anterior half of body, then, beginning at level of ovary, ventral and lateral to ceca, contiguous behind testes and behind cecal union. Excretory vesicle to level of ovary.

The name *tropicum* refers to the tropical distribution of this species.

Comparisons. Of the 10 species named in the genus Coitocaecum, the following 8 have vitellaria anterior to acetabulum; *C. anaspidis* Hickman, 1934; *C. diplobulbosum* Ozaki, 1929; *C. latum* Ozaki, 1929; *C. macrostomum* Pigulewski, 1931; *C. orthorchis* Ozaki, 1926; *C. ovatum* Pigulewski, 1931; *C. plagiorchis* Ozaki, 1926; *C. unibulbosum* Ozaki, 1929. In Ozaki's 1929 key to species, *C. tropicum* keys to *C. orthorchis,* while in Hickman's 1934 key it keys to *C. anaspidis. C. orthorchis* is redescribed and figured by Yamaguti, 1938. *C. tropicum* differs from it in much smaller size, much smaller eggs, somewhat more anterior genital pore, somewhat smaller cirrus sac, and entirely lateral vitellaria in the forebody. It differs from *C. anaspidis* in smaller size, much smaller eggs, more tandem testes (perhaps a variable character), relatively larger pharynx, and entirely lateral vitellaria in the forebody. All 3 species are remarkably alike when one considers the differences in hosts and localities.

Discussion. Reference should be made here to the collections from blennies at Charles Island and from *Opisthognathus scops* from the same

region. These are tentatively considered as *C. tropicum*. Agreement is fairly complete (even to the exact distribution of the vitellaria), but whether an anus was lacking or not was not certain. Apparently there was no anus, and these specimens fit the above description in all essentials. The posttesticular portion of the body seemed longer and more flat.

Opecoelina pacifica, new species

(Plate 38, figs. 46, 47)

Host: Paralabrax species (?)
Location: Intestine and ceca
Locality: Albemarle Island, Galapagos
Number: 15 from a single host

SPECIFIC DIAGNOSIS OF OPECOELINA PACIFICA

Body smooth, flattened, elongated, tapering to a rounded point at each end, 1.404 to 2.130 in length, 0.607 to 0.945 in width, widest near acetabulum. Oral sucker 0.157 to 0.217 in transverse diameter; acetabulum 0.330 to 0.465 in transverse diameter, without papillae; sucker ratio approximately 1:2. Pharynx 0.082 to 0.112 by 0.067 to 0.087; esophagus about same length as pharynx; intestinal bifurcation about midway between suckers; rectum short; anus terminal or subterminal, immediately ventral to excretory pore. Genital pore well to the left (halfway or more toward the left side of the body), varying from a level opposite base of esophagus to opposite base of pharynx. Testes tandem, close together, in posterior half of body, ovoid, slightly wider than long, smooth or (more often) slightly lobed, a median indentation being common. Cirrus sac well developed with a long slender cirrus portion which widens abruptly to form a swollen posterior portion containing a sinuous, narrow, tubular internal seminal vesicle and prostatic cells (fig. 47). Cirrus often protruded. Posterior portion of cirrus sac overlapping acetabulum at least slightly, usually about to its middle, sometimes to its posterior edge. External seminal vesicle a wide tube, bent once near its middle; its anterior part extending diagonally to the left, its posterior part extending diagonally to the right; extending posteriorly to level of ovary or perhaps only halfway from acetabulum to ovary; connected to cirrus sac by a slender, almost straight, somewhat sinuous tube.

Ovary 3- or 4-lobed, immediately pretesticular. Uterus, Mehlis' gland, yolk reservoir, Laurer's canal, and seminal receptacle preovarian.

Seminal receptacle a large, elongate sac, the posterior end of which may overlap ovary. Vitellaria from posterior end of pharynx to posterior end of body, interrupted opposite acetabulum, confluent or almost so dorsally anterior to acetabulum; in hindbody follicles are chiefly lateral, median, and ventral to ceca with very few dorsal follicles. Eggs yellow, thin-shelled, 54 to 68 by 31 to 36 μ. Excretory pore terminal immediately dorsal to anus; excretory vesicle extending dorsal to testes to level of ovary.

Comparisons. This species differs from all others in the genus (*O. scorpaenae* Manter, *O. helicoleni* Manter, *O. theragrae* Lloyd) in much more anterior extent of vitellaria. Other specific characters could be noted. The genus Opecoelina is to be separated from Opecoelus and Opegaster by the presence of a seminal receptacle.

Cymbephallus carangi Yamaguti, 1938

(Plate 38, figs. 48-50)

Host: *Selar crumenophthalmus* (Bloch)
Location: Intestine
Locality: La Plata Island, Ecuador
Number: 7 specimens in one host

These specimens agree with Yamaguti's description of *C. carangi* in all details except egg size, which was 42 to 54 by 26 to 31 μ rather than 60 to 72 by 33 to 35 μ. The acetabulum was not extended but a retracted peduncle is apparently present. Sometimes the acetabulum is pulled back into the body. There is agreement with Yamaguti's material in such details as sucker ratio, location of genital pore, size of pharynx and esophagus, shape of gonads, and distribution of vitellaria. The hosts are related.

Measurements on my material are: length 1.575 to 2.632; width 0.292 to 0.405; forebody about $\frac{1}{6}$ body length; oral sucker 0.142 to 0.195; acetabulum 0.150 to 0.195; ratio about 1:1. Eggs 42 to 54 by 26 to 31 μ, blunter at one end, without knob.

Parvacreadium bifidum, new genus, new species

(Plate 38, figs. 51-55)

Host: Identified only as a goby
Location: Intestine
Locality: James Island, Galapagos
Number: 5 specimens from a single host

SPECIFIC DIAGNOSIS OF PARVACREADIUM BIFIDUM

Body smooth, widest at posterior end, tapering from posterior to anterior end, more rapidly so anterior to acetabulum; posterior end truncated and deeply indented medianly to form 2 rounded lobes, right and left. These lobes may bear peculiar papillalike or fingerlike processes (seen on 2 specimens) (figs. 54 and 55). Body 0.817 to 0.953 in length by 0.360 to 0.450 in greatest width. Forebody narrow and thinner than remainder of body. Oral sucker subterminal, elongated, 0.076 to 0.099 in transverse diameter by 0.085 to 0.110 in length; acetabulum proper nearly circular, 0.127 to 0.178 in diameter, possessing a single large anterior lobe and a single large posterior lobe overlapping each other to cover the acetabular aperture (fig. 52). Edges of lobes with very thick cuticula; free edge of posterior lobe extending diagonally backward and outward beyond acetabulum (fig. 52). These large, peculiar acetabular lobes seem to have a grasping function.

Prepharynx possessing an inner circular fold forming a circular ridge, almost or quite meeting in the center (fig. 53); pharynx 0.060 to 0.071 long, 0.048 to 0.066 wide; esophagus somewhat shorter than pharynx; intestinal bifurcation about ⅔ from anterior end of body to acetabulum; ceca reaching almost to posterior end, ending blindly. Genital pore slightly to the left, opposite base of pharynx or as far forward as mid-pharynx level. Testes tandem, close together, in posterior half of body, wider than long, slightly irregular in outline. Seminal vesicle slightly coiled, free in parenchyma, at anterior border of acetabulum which it may overlap a short distance; ejaculatory tube nonmuscular, almost straight, uniting with uterus near genital pore; genital sinus very short, thick walled; few prostatic cells scattered in region of ejaculatory tube and also near end of uterus. A delicate, rudimentary cirrus sac, continuous with the wall of the sinus, extends a very short distance backward enclosing a few gland cells and a weakly developed cirrus (cirrus sac observed only in sections).

Ovary transversely ovoid, pretesticular, to the right, close to anterior testis; seminal receptacle lacking; Laurer's canal present but apparently not opening to outside; vitellaria from intestinal bifurcation to posterior end of body, surrounding ceca in hindbody; uterus preovarian; eggs large and thin shelled, 51 to 59 by 30 to 34 μ. Excretory pore median, terminal, between posterior lobes of body; excretory vesicle narrow, extending to posterior testis.

GENERIC DIAGNOSIS OF PARVACREADIUM

Allocreadiinae of small size, with smooth skin. Acetabulum with a single large anterior and a similar posterior lobe. Posterior end broad and truncated, usually bilobed, or of very irregular contour. Prepharynx with internal thickening. Genital pore near pharynx. Seminal vesicle coiled, not reaching posterior to acetabulum. Genital sinus very short. Cirrus sac rudimentary. Cirrus weak. Seminal receptacle lacking. Type species: *Parvacreadium bifidum.*

The generic name is from *parva* (= small) and *creadium* and indicates a small, creadium-like trematode. The specific name *bifidum* indicates the bifid posterior end.

Discussion. Because the cirrus sac of this trematode is so inconspicuous, the genus might be thought related to the Anallocreadiinae. Actually, it differs from that subfamily in lacking body spines and a seminal receptacle as well as in the presence of a delicate but definite cirrus sac. Parvacreadium is probably most closely related to Cymbephallus Linton, 1934. Cymbephallus also has a very weak and small cirrus sac, a smooth cuticula, and, like Parvacreadium, a uterine seminal receptacle. Furthermore, certain Cymbephallus species possess acetabular processes. Parvacreadium differs from Cymbephallus in shape of the body, small size, the large acetabular lobes, the far anterior seminal vesicle, and reduced cirrus.

Bianium adplicatum, new species

(Plate 39, figs. 56, 57)

Hosts and Localities:

Cheilichthys annulatus (Jenyns) from Albemarle and Charles islands, Galapagos, and San Francisco, Ecuador

Spheroides angusticeps (Jenyns) from Charles Island, Galapagos

Location: Intestine

Number: One to several in 5 hosts

SPECIFIC DIAGNOSIS OF BIANIUM ADPLICATUM

Length 1.58 to 2.43; greatest width 0.73 to 1.08; anterior half of body flattened with inrolled edges making it scoop shaped; ventrolateral folds extending a short distance posterior to acetabulum where they may turn medianly but do not unite; posterior half of body more or less cylindrical; body spined anteriorly, spines disappearing on hindbody; both ends of body broadly rounded, anterior end subtruncate. Oral sucker circular

or subcircular, 0.187 to 0.315 in diameter; acetabulum a short distance anterior to midbody, circular, 0.195 to 0.300 in diameter. Suckers subequal, oral sucker usually slightly larger. Short prepharynx present; pharynx 0.142 to 0.225 in length, 0.135 to 0.270 in width, with anterior border of eight lobes (fig. 57). These pharyngeal lobes are more marked ventrally and internally, the dorsal lobes being broader and not so clearly demarked. Esophagus short; ceca broad; 2 ani present. Genital pore to the left immediately anterior to acetabulum. Testes usually smooth, rarely slightly lobed, tandem or oblique, near hind end of body. Cirrus sac pyriform, extending from genital pore well past posterior edge of acetabulum; 0.390 to 0.555 long by 0.127 to 0.180 greatest width; containing a cirrus (extending approximately to posterior edge of acetabulum), a wide pars prostatica, an ovoid internal seminal vesicle. External seminal vesicle present. Ovary multilobed, median, immediately anterior to anterior testis; seminal receptacle elongate, extending along left side of anterior testis; uterus chiefly or wholly preovarian, wholly pretesticular; metraterm extending somewhat posterior to acetabulum. Vitellaria from near posterior edge of acetabulum to posterior end of body, lateral, dorsal, and ventral to ceca. Eggs 56 to 61 by 29 to 36 μ. Excretory pore at posterior end of body; excretory vesicle extending at least to ovary.

The name *adplicatum* indicates similarity to *B. plicatum.*

Comparisons. B. adplicatum is very similar to *B. plicatum* (Linton) except for the following differences: the oral sucker is larger, the pharynx is larger and possesses a lobed anterior border, the eggs are smaller, and the genital pore tends to be slightly more anterior. The lobed anterior border of the pharynx suggests the Megaperidae Manter, 1934, which also possesses anal pores.

B. cryptostoma (Ozaki) is very similar to *B. plicatum,* apparently differing only in the union of the body folds and absence of a prepharynx. Egg sizes were not given for *B. cryptostoma,* which may be a synonym of *B. plicatum.*

All species of Bianium to date occur in puffers.

Myzotus vitellosus, new genus, new species
(Plate 39, figs. 58-60)

Host: Caulolatilus sp. probably *princeps* (Jenyns)
Location: Intestine
Locality: Tagus Cove, Albemarle Island, Galapagos
Number: Many from a single host

SPECIFIC DIAGNOSIS OF MYZOTUS VITELLOSUS

Body rather thick, elongated, rounded at each end, almost equally wide, 3.172 to 5.130 in length, 0.958 to 1.755 in greatest width. Cuticula smooth, very thick, and often thrown into folds, striated perpendicularly. Oral sucker subcircular, slightly wider than long, near anterior end, 0.277 to 0.435 in transverse diameter. Acetabulum about ⅓ body length from anterior end, apparently circular, 0.562 to 1.040 in diameter; sucker ratio about 1:2. Body wall on each side of acetabulum prolonged to form 2 pairs of flaplike muscular lobes or flaps (fig. 59) of very irregular outline. Each anterior flap more or less tapering to a free, rounded point. Each posterior lobe more or less separated from the anterior lobe by an indentation. Size and shape of posterior lobe variable. Acetabulum deeply embedded in body, typical except near its small aperture where there occurs a group of circular muscles (fig. 60) more conspicuous in the posterior lip. A peculiar group of longitudinal muscles (fig. 60) in ventral posterior wall of acetabulum near the aperture.

Prepharynx very short; pharynx of about equal length and width, 0.180 to 0.337 in diameter; esophagus lacking; ceca broad, extending to posterior end of body, often slightly sinuous, ending blindly.

Testes tandem, smooth, close together, intercecal, wider than long, about in middle of hindbody, posterior testis often subtriangular, posttesticular space variable. Cirrus and cirrus sac lacking. Seminal vesicle an uncoiled tube, free in parenchyma, entirely dorsal to acetabulum, claviform and almost straight except for its curve around acetabulum. A short pars prostatica joins uterus at middle of anterior surface of acetabulum to form a fairly long genital sinus. Genital pore median at anterior edge of acetabulum, well buried within body folds. Prostatic cells around male tube and sinus.

Ovary smooth, ovoid, wider than long, median, not far anterior to anterior testis. Mehlis' gland very large, immediately preovarian. Seminal receptacle flask shaped, chiefly between ovary and anterior testis. Laurer's canal large and muscular. (In one sectioned specimen this canal was distended with sperm cells with heads directed toward the oötype indicating that Laurer's canal functions in copulation.) Uterus between ovary and acetabulum. Vitelline follicles large, filling most of body from middle of oral sucker to posterior end, confluent in forebody and also posterior to testes, dorsal, ventral, lateral, and median to ceca. Eggs thin shelled and variable in size. In four specimens, eggs were 61 to 68 by 31 to 39 μ, but in one 5.130 specimen they measured 95 by 42 μ.

Excretory pore terminal; excretory vesicle extending dorsal to hind testis, then ventral to anterior testis to end at level of ovary. A pair of anterior tubules on each side extends to anterior end of body and a pair of posterior tubules extends to near posterior end of body. No lymphatic vessels seen.

GENERIC DIAGNOSIS OF MYZOTUS

Anallocreadiinae. Body robust, cuticula thick, smooth, with two conspicuous bilobed flaps, one on each side of acetabulum. Gonads tandem, unlobed. Cirrus and cirrus sac lacking; genital sinus long; seminal vesicle simple, tubular, uncoiled. Mehlis' gland, Laurer's canal, and seminal receptacle large; vitellaria extensive. Lymph vessels lacking. Type species: *M. vitellosus.*

Discussion. This allocreadid genus can be referred to the Anallocreadiinae because of its lack of cirrus and cirrus sac and its possession of a tubular genital sinus. It is, however, very different from other genera not only in its peculiar acetabular lobes but in its smooth cuticula, thick body, and extensive vitellaria. Crassicutis Manter, 1936 with its practically smooth skin is perhaps a related genus, but its general appearance is very different, its body flattened and wide, its gonads of different location, its ceca narrow, and its acetabulum unmodified. The muscular modification of the acetabular lips of Myzotus is suggestive of Myzoxenus Manter, 1934 (see p. 299), but Myzoxenus lacks a genital sinus, has a cirrus sac, and is without acetabular flaps. Myzotus shows considerable resemblance to Apocreadium Manter, 1937 and Choanodera Manter (see p. 345), notably in the terminal genital tubes which are practically identical, in the histology of the oötype region with its huge Mehlis' gland and large Laurer's canal, and in its excretory system. Furthermore, Choanodera does possess ventral body folds which, however, involve the entire forebody. The similarity to Choanodera was so pronounced, especially in the reproductive systems, that one could expect to discover lymph vessels in Myzotus. Careful search reveals no trace of such vessels. Thus again it is indicated (see p. 348) that lymph vessels may be present or absent in related genera. In this paper, Myzotus is considered in the subfamily Anallocreadiinae.

The name Myzotus is from *myzo* (= sucker) and *otus* (= ear) and refers to the earlike flaps of the acetabulum. The name *vitellosus* refers to the extensive vitellaria.

Plagioporus gastrocotylus, new species
(Plate 39, figs. 61-63)

Host: *Calamus brachysomus* (Lockington)
Location: Intestine
Locality: Charles Island, Galapagos
Number: 7 specimens in one host

SPECIFIC DIAGNOSIS OF PLAGIOPORUS GASTROCOTYLUS

Body plump, smooth, fusiform, tapering toward each end from the wide acetabular region, greatest width more than half body length. Size 1.485 to 2.686 in length by 0.862 to 1.377 in greatest width. Oral sucker slightly extended at posterior end, slightly longer than wide, 0.232 to 0.352 in transverse diameter; acetabulum, located at about midbody, somewhat wider than long, with transverse aperture, 0.412 to 0.585 in transverse diameter. Sucker ratio almost 1:2. Ventral surface of widest portion of body almost wholly enclosed by a large circular fold of body wall which leaves an aperture opposite acetabulum of about the size of the acetabulum (figs. 62 and 63). Lateral portions of this fold not separated from body surface but anterior edge and often the posterior edge clearly demarked. (This curious overlapping sheet of the body wall is the most unique characteristic of the species.)

Prepharynx lacking; pharynx large, either wider than long or longer than wide, 0.165 to 0.292 in length, 0.150 to 0.285 in width; esophagus lacking or very short; intestinal bifurcation about midway between suckers; ceca wide, extending to near posterior end of body. Genital pore median or submedian, usually opposite middle of pharynx, sometimes opposite base of pharynx. Testes smooth, subspherical, close together, diagonal, intercecal, in middle of hindbody, anterior testis slightly sinistral, posttesticular space 0.090 to 0.270. Cirrus sac claviform, elongate, from genital pore to about midacetabular level; cirrus long and slightly sinuous; seminal vesicle internal, coiled, surrounded by prostatic cells. Ovary spherical, to the right, immediately posterior to acetabulum, overlapped by body fold; Mehlis' gland at anteroleft border of ovary; seminal receptacle large, partly dorsal and partly posterior to ovary; Laurer's canal present; uterus chiefly to left of ovary, extending backward to overlap anterior testis, reaching almost to anterior border of posterior testis. Eggs thin shelled, 63 to 68 by 32 to 37 μ. Vitellaria from mid-pharynx level to posterior end of body, surrounding ceca except on inner sides, confluent posterior to testes, not extending into ventral fold of body wall. Excretory vesicle extending forward to ovary.

The name *gastrocotylus* is from *gastro* (= ventral) and *cotyle* (= cup), and refers to the cuplike formation of the ventral body fold.

Comparisons. P. gastrocotylus differs from all other species in the genus in the circular body fold enclosing the region near the acetabulum. The median genital pore is not common in the genus. The fusiform shape and the diagonal testes occur also in *P. branchiostegi* Yamaguti, 1937, *P. alacris* (Looss), and *P. crassigula* (Linton). The two former species differ from *P. gastrocotylus* in position of genital pore, length of esophagus, and smaller size, as well as in other minor characters. *P. gastrocotylus* is without doubt most similar to *P. crassigula* collected from related hosts at Tortugas, Florida. Specimens of *P. crassigula* collected by the writer show the acetabulum somewhat sunk in the body and a muscular development of the peripheral region of the body wall suggesting the body fold of *P. gastrocotylus*. Both species have large pharynges and a very short or no esophagus. *P. gastrocotylus* is somewhat wider and more fusiform. Although Linton states that the genital pore of *P. crassigula* is near the acetabulum, in my specimens it may be as far forward as the base of the pharynx, thus corresponding to its possible position in *P. gastrocotylus*. It is, however, slightly more to the left in *P. crassigula*. The two species are enough alike so that they were thought for some time to represent the same species. They seem to form an example of a pair of "twin species."

Hamacreadium mutabile Linton, 1910

(Plate 40, fig. 64)

Hosts: *Lutianus viridis* (Val.)
Mycteroperca xenarcha Jordan (?)
Location: Intestine
Locality: Charles and Albemarle islands, Galapagos
Number: 3 from one Lutianus, 6 from Mycteroperca (?)

These specimens agree with *H. mutabile* Linton when the common but rather marked variations occurring within this species are considered. *H. mutabile* has been collected many times by the author at Tortugas, Florida, where it occurs in Lutianus and related hosts. The extent of the vitellaria is fairly constant. The follicles are confluent at the level of the intestinal bifurcation, especially dorsally, and extend approximately to mid-esophagus level. The lobing of the testes is highly variable and in a single collection of specimens may vary through all degrees from smooth to deeply lobed. The position of the genital pore is also variable. Usually

well to the left, opposite the edge of the left cecum, it is apparently median in some specimens, otherwise in perfect agreement with *H. mutabile.* Both of these variations are unusual within a species of trematode. In fact, one of the 3 specimens in the present lot shows a genital pore almost median in position. The cirrus sac extends to the left but bends back medianly near its tip. When the cirrus sac is straight, the genital pore is to the left.

These variations arouse some question as to the validity of *H. epinepheli* Yamaguti, 1934 and *H. lethrini* Yamaguti, 1934. Specimens of *H. epinepheli* kindly sent to me by Yamaguti show the dorsal preacetabular confluency of the vitellaria. But the genital pore is constantly median and *H. epinepheli* may be a valid species. *H. lethrini* differs in the anterior extent of the vitellaria.

The specimens from *Mycteroperca xenarcha* (?) (the identification of the host is somewhat uncertain) all agreed in showing a short, narrow, and pointed posterior region of the body; but, since other details agreed with *H. mutabile,* the pointed posterior end is interpreted as an individual variation.

The genus Hamacreadium is so similar to Plagioporus (= Lebouria) and to Podocotyle that its validity might be questioned. Yamaguti emphasizes the anterior extent of the excretory vesicle. The median genital pore, although not constant in Hamacreadium, is usual, whereas it is never median in Plagioporus. The ovary is always lobed in Hamacreadium and rarely so in Plagioporus. In Podocotyle the testes are tandem (possible exception—*P. atherinae* Nicoll), the excretory bladder not anterior to the acetabulum, the vitellaria not anterior to the acetabulum, the genital pore to the left.

Hamacreadium oscitans Linton, 1910

Host: *Anisotremus interruptus* (Gill)
Location: Intestine
Locality: Sulivan Bay, James Island, Galapagos
Frequency: One specimen collected

Hamacreadium oscitans was described by Linton (1910) from Tortugas, Florida, from the following hosts: *Haemulon plumieri, H. sciurus,* and *Anisotremus virginicus.* The writer has collected it at Tortugas from *Anisotremus virginicus* and *A. carbonarium* (the latter a new host record).

Although only a single specimen was collected from the Galapagos Islands, it is in good condition and shows all the specific characters to be identical with the Atlantic species. For example, not only are all the organs identical in position, shape, and size, but the eggs are identical in size and shape and possess the characteristic tubercle at one pole. There seems no doubt as to the identification of the parasite.

There may be some doubt whether *H. oscitans* should be retained in the genus Hamacreadium. The median genital pore and the form and position of the testes and ovary would so indicate, but the vitellaria do not extend anterior to the acetabulum, and the excretory vesicle reaches only to the posterior fourth of the acetabulum. While Yamaguti (1934) considers the extension of the excretory vesicle anterior to the acetabulum a generic character, McCoy (1930) found it did not reach beyond the acetabulum in *H. gullela*. For the present, *H. oscitans* is retained in the genus Hamacreadium.

Podocotyle mecopera, new species

(Plate 40, fig. 65)

Host: Unidentified, spotted grouper
Location: Intestine
Locality: James Island, Galapagos
Number: 9 specimens from one host

This trematode fits the rather broad generic diagnosis of Podocotyle as given by Park (1937) except that the vitellaria do not reach to the region of the acetabulum. Another uncommon Podocotyle feature is the unlobed ovary. The species is, however, considered in the genus Podocotyle.

SPECIFIC DIAGNOSIS OF PODOCOTYLE MECOPERA

Body elongate, little flattened, subcylindrical, tapering toward each end, widest opposite acetabulum; length 1.849 to 2.538; width 0.517 to 0.600. Forebody short but usually contracted, 0.262 to 0.375 or $\frac{1}{6}$ to almost $\frac{1}{10}$ body length. Diameter oral sucker 0.157 to 0.188; acetabulum wider than long; transverse diameter 0.375 to 0.420, slightly more than twice diameter of oral sucker. Pharynx 0.102 to 0.144 long by 0.070 to 0.083; esophagus shorter than pharynx; bifurcation just anterior to acetabulum; ceca ending blindly near posterior end of body. Genital pore well to the left, opposite intestinal bifurcation. Testes large, rounded, smooth, tandem, close together but not quite touching, anterior testis

about in midbody. Posttesticular space 0.600 to 0.900. Cirrus sac with a long, slender, anterior portion extending from the pore diagonally backward to acetabulum then almost directly backward to posterior border of acetabulum where it may make a short coil or loop and joins a large, swollen, posterior portion. Seminal vesicle large and much coiled within the posterior portion of the sac, sinuous in the narrow portion; prostatic cells large and fairly numerous in the basal region of the sac. The cirrus sac reaches entirely or almost to the anterior edge of the ovary. Ovary globular, smooth, wider than long, slightly to the right, directly anterior to the anterior testis. Shell gland at the left posterior edge of ovary; seminal vesicle pyriform, dorsal to ovary. Vitelline follicles large, from anterior border of ovary to posterior end of body, dorsal, ventral, and lateral to ceca, uninterrupted, a few follicles dorsal to testes and ovary. Uterus preovarian; eggs thin shelled, variable, 70 to 83 by 32 to 48 μ, usually 73 to 82 by 36 to 46 μ. Excretory vesicle extending forward to the ovary; a pair of collecting tubules median to ceca between ovary and posterior end of body.

The specific name is from *meco* (= long) and *pera* (= pouch) and refers to the very long cirrus sac.

Comparisons. No other species of Podocotyle has the vitellaria terminating at the ovary. The peculiar shape and the far posterior extent of the cirrus sac are also unique. Although *P. pearsei* Manter, 1934 and *P. petalophallus* (Yamaguti, 1934) have only indistinctly lobed ovaries, *P. mecopera* is the only species with entirely smooth ovary.

Podocotyle breviformis, new species

(Plate 40, figs. 66-68)

Host: Anisotremus (?) species
Location: Intestine
Locality: Tagus Cove, Albemarle Island, Galapagos
Number: 7 specimens from one host

SPECIFIC DIAGNOSIS OF PODOCOTYLE BREVIFORMIS

Body thick, subcylindrical, about 3 times longer than wide, 1.44 to 2.025 long by 0.510 to 0.675 in greatest width; forebody (in preserved specimens) ¼ to ⅕ body length, tapering to oral sucker; hindbody tapering gradually to a rounded posterior end. Oral sucker circular, 0.210 to 0.270 in diameter; acetabulum wider than long, 0.382 to 0.520 in transverse diameter, with transverse aperture; sucker ratio approximately

1:2. Prepharynx very short; pharynx large, muscular, 0.130 to 0.170 long by 0.088 to 0.094 wide; esophagus short; intestinal bifurcation a short distance anterior to acetabulum; ceca wide, extending to near posterior end of body. Genital pore only slightly to left of midline, a short distance anterior to acetabulum, opposite left cecum, close to intestinal bifurcation. Testes smooth, rounded, diagonal, immediately posterior to midbody; posttesticular space 0.270 to 0.487. Cirrus sac clavate, extending diagonally in space between intestinal bifurcation and acetabulum, sometimes overlapping anterior border of acetabulum slightly or only reaching to acetabulum, containing a large, tubular, sinuous seminal vesicle, fairly well-developed prostatic cells, and a muscular, sinuous cirrus which extends approximately ¼ length of cirrus sac. Ovary very distinctly divided into rounded lobes which seem to be almost completely separated. Usually 3 lobes can be seen, but in one specimen there were 4, one of which perhaps represented the central body of the ovary; the other 3 lobes were chiefly posterior to it. Ovary located to right of anterior testis and may even overlap posterior testis; seminal receptacle spherical or ovoid, immediately anterior to ovary; vitellaria begin abruptly at level of posterior edge of acetabulum and extend, close together, dorsal, ventral, and lateral to ceca to posterior end of body; uterus preovarian but usually overlapping anterior testis; metraterm extending from genital pore to anterior edge of acetabulum; eggs thin shelled, almost rounded, almost colorless, without constant ribs or folds, sometimes truncate at one end, 36 to 43 by 26 to 32 μ. Excretory vesicle extending to slightly in front of ovary.

The name *breviformis* refers to the rather short body.

Comparisons. The Podocotyle species most similar to *P. breviformis* are *P. atherinae* Nicoll, *P. pearsei* Manter, *P. levinseni* Issaitschikov and *P. blennicottusi* Park. *P. breviformis* differs from *P. pearsei* in the shape and position of the ovary, in its much shorter esophagus, in location of the intestinal bifurcation, in its much shorter and wider eggs, and in posterior extent of cirrus sac. *P. levinseni* differs in shape and location of the ovary, the tandem position of the testes, the longer esophagus, and very much larger eggs (80 to 95 μ as compared with 36 to 43 μ). *P. breviformis* keys to *P. blennicottusi* in the key offered by Park (1937), but *P. blennicottusi* differs in shape and location of the ovary, in shape and location of the testes, in different posterior extent of the cirrus sac, in anterior extent of vitellaria, and in egg size. *P. breviformis* is most similar to *P. atherinae,* named by Nicoll (1914) as a species inquirenda. The two agree in body form, diagonal testes, and position of ovary but differ in

that *P. breviformis* has a much shorter cirrus sac not much more than reaching the acetabulum, a shorter esophagus, smaller and wider eggs, more tapering hindbody, and longer posttesticular space.

Discussion. Park (1937) has recently reviewed the genus Podocotyle. In view of his emphasis on the form of the seminal vesicle it might be stated here that in *P. pearsei* Manter, 1934 the seminal vesicle is largely a straight wide tube filling most of the cirrus sac but which after narrowing loops back a short distance and then becomes slightly sinuous. Thus, the species is correctly placed in Park's key under the head of "seminal vesicle sinuous." The distinction, however, between a "sinuous" and a "coiled" seminal vesicle might be difficult to determine. Park questioned the specific value of the length of the esophagus, extent of vitellaria, and size of eggs within this genus. Obviously, such characters should be carefully evaluated with some consideration given to degree of body contraction or extension. Single specimens may exhibit abnormal or unusual conditions which should not influence specific criteria too much. In general, the writer feels that length of esophagus, extent of vitellaria, and size of eggs are fairly reliable specific characters in this genus.

Park (1937a, p. 411) states that "size of eggs is the only reliable difference between *P. levinseni* (= the *P. levenseni* of Park, 1937) and *P. pearsei,* and then concludes that *P. pearsei* can scarcely be established as distinct from *P. levinseni.* While this conclusion may be correct, differences between the 2 forms include not only the size of the eggs but also the shape of the eggs and the anterior extent of the vitellaria (as used by Park in his key).

P. pacifica Park, 1937 seems to be very similar to the *P. atomon* of McFarlane, 1936 which was collected from a similar host from a neighboring region. The esophagus of the specimen drawn by McFarlane is short for *P. atomon;* yet the vitellaria are too continuous for *P. olssoni.* Collections of these 2 Pacific forms should be compared more fully.

Helicometra torta Linton, 1910

Host: *Epinephelus labriformis* (Jenyns)
Location: Intestine
Locality: Cape Elena, Ecuador
Number: 5 specimens in one host

These trematodes agree fully with *H. torta* in all fundamentals such as size, thin hindbody, sucker ratio, position of genital pore, aperture of

acetabulum, shape of gonads, extent of vitellaria, and size of eggs. There was a tendency for the vitellaria to reach slightly more than halfway from the ovary to the acetabulum, but in no case did they reach the acetabulum and in no case farther than has been observed in *H. torta*. It is of interest to note that the host is Epinephelus, the same genus as the hosts of this trematode at Tortugas, Florida.

Helicometra sinuata (Rud., 1819)

Host: Moray
Location: Intestine
Locality: Port Culebra, Costa Rica
Number: One specimen from one host

This species is previously known only from Europe, where it occurs in *Trachinus draco* and *Ophidium imberbe* (= *Fierasfer imberbis*). Its occurrence in the Pacific is unexpected. Although only one specimen was collected, there can be little doubt as to its specific agreement with *H. sinuata*. The measurements are: length 2.29, width 0.75, forebody 0.49, oral sucker 0.18, acetabulum 0.26, eggs 46 to 53 by 19 μ. The body is elongate, broadly rounded posteriorly. The testes are not lobed, although not perfectly spherical. The posterior testis is subtriangular; the anterior testis is transversely extended. The vitellaria are distributed exactly as in *H. sinuata* and are interrupted opposite the acetabulum. Palombi (1929) has given a list of synonyms and a discussion of *H. sinuata*.

Helicometra fasciata (Rud., 1819)

Hosts and Localities: Flounder from Tenacatita Bay, Mexico
Unidentified stargazer from Santa Maria, Mexico
Location: Intestine
Number: One specimen from each of the above hosts

These specimens agree well with the characteristics of *H. fasciata* as limited by Palombi (1929). The specimen from the flounder is almost typical, but the one from the stargazer possessed somewhat oblique testes and rather large eggs.

Helicometrina nimia Linton, 1910

(Plate 40, fig. 69)

Host: *Paralabrax nebulifer* (Girard)?, kelp bass
Location: Intestine

Locality: Cerros Island, Mexico
Number: 5 specimens

This species is a common trematode at Tortugas, Florida, where Manter (1933) has reported it from 14 different hosts. It has not been recorded elsewhere. Thus, this extension of a Gulf of Mexico form to the Pacific is of special interest. Until recently, only two Helicometrina species (*H. nimia* and *H. parva*) have been known, but Srivastava (1936) has described *H. septorchis* and *H. orientalis* from the Bay of Bengal.

Manter (1933) considered *Helicometrina azumae* Layman, 1930 in the genus Rhagorchis Manter, 1931; Yamaguti (1934) considered *H. azumae* in his new genus Decemtestis. The chief difference between Rhagorchis and Decemtestis seems to be the presence of an external seminal vesicle in the former. Since no external seminal vesicle was described for *H. azumae,* Yamaguti's disposition seems to be correct, and *Rhagorchis azumae* (Layman, 1930) Manter, 1933 becomes a synonym of *Decemtestis azumae* (Layman, 1930) Yamaguti, 1934.

Labrifer secundus, new species
(Plate 40, fig. 70)

Host: *Pimelometopon pulcher* (Ayres)
Location: Intestine
Locality: Cerros Island, Mexico
Number: One from a single host

This single specimen occurred with another trematode (*Lepocreadium bimarinum*). The posterior end was torn away or macerated but all other organs were clearly discernible. The unique structure of the acetabulum and the peculiar male genital organs very clearly indicate the genus Labrifer in which, to date, but one other species is known. Therefore, since generic and specific identification is easily possible, the species is described in spite of the small quantity of material.

SPECIFIC DIAGNOSIS OF LABRIFER SECUNDUS

Body smooth, with rapidly tapering forebody and rounded anterior end, pigment spots in forebody. Body fragment (probably nearly complete) 1.35 by 0.690 with greatest width at acetabular level. Oral sucker subterminal 0.150 in transverse diameter, with transverse aperture; acetabulum 0.412 in diameter, weak, deeply embedded in body, its aperture small, transverse, guarded by an anterior and posterior lip of homogeneous structure and by larger lips (anterior and posterior) with parallel

muscular bands (fig. 70). Anterior muscular lip 0.153 in diameter, posterior muscular lip 0.110 in diameter. Prepharynx lacking; pharynx 0.940 long by 0.110 wide; esophagus short; very wide ceca. Genital pore slightly to the left at posterior end of pharynx. Testes subspherical, smooth, tandem, close together, in posterior half of body. Cirrus sac muscular, thick walled; spindle shaped with anterior narrow portion bent ventrally, posterior portion (dorsal to acetabulum) narrowing almost to a point, containing in basal portion a broad, tubular, internal seminal vesicle, in middle portion a spherical prostatic vesicle, and terminally a muscular cirrus. A narrow seminal tube widens opposite posterior fourth of acetabulum to form a broad, tubular, external seminal vesicle ending at anterior border of ovary. Just posterior to acetabulum, dorsally on each side occurs a group of gland cells interpreted by Yamaguti in *L. semicossyphi* as prostatic cells. Male system almost exactly as in *L. semicossyphi* except for greater coiling of external seminal vesicle. Ovary subspherical, smooth, at right anterior border of anterior testis not far posterior to acetabulum; seminal receptacle flask shaped, lying transversely and dorsally across posterior half of ovary; yolk reservoir to left of ovary; uterus preovarian; eggs 58 to 60 by 26 to 31 μ; vitelline follicles from level of intestinal bifurcation backwards, lateral to and anterior to acetabulum they are ventral to ceca, but posterior to that level they surround the ceca. Excretory system not seen.

The name *secundus* indicates the second-named species in the genus.

Comparisons. This species differs from *L. semicossyphi* chiefly in the more anterior extent of the vitellaria. Since Yamaguti had numerous specimens of *L. semicossyphi* in which the vitellaria usually did not reach the acetabulum and never beyond its posterior border, this character can be considered specific. Other minor differences seen in *L. secundus* seem to be: less conspicuous acetabulum, shorter uterus, coiled external seminal vesicle, and wider ceca.

Discussion. The very close resemblance of this species to *L. semicossyphi* at once suggested a comparison of the hosts involved. These fishes do prove to be related, both being in the family Labridae. The trematodes, however, are more similar than the hosts, presumably, since the parasites can scarcely be distinguished specifically while the fishes are in different genera. The indicated interhost connections, therefore, are Pacific rather than Atlantic. *L. semicossyphi* is from the Inland Sea, Japan.

There can be no doubt that Labrifer is related to the genus Myzoxenus Manter, 1934. Both possess similar muscular lips on the acetab-

ulum and both possess a very muscular cirrus sac and a tubular external seminal vesicle. In Myzoxenus, however, the acetabular lips are lateral in position rather than anterior and posterior. It might be noted that the two species of Myzoxenus are both from related fishes in the Atlantic. *M. vitellosus* Manter, 1934 is from *Decodon puellaris* and (in 2 of 14) *Calamus calamus*. The other species of Myzoxenus (as yet undescribed) is from *Lachnolaimus maximus*. All of these genera of fishes with the exception of Calamus are Labridae.

ACANTHOCOLPIDAE Lühe, 1909

Stephanostomum megacephalum, new species

(Plate 41, figs. 71-74)

Host: *Caranx hippos* (Linnaeus)

Location: 6 specimens from the gills, one specimen from the intestine

Localities: Bahia Honda, Panama (type locality)
San Francisco, Ecuador
White Friars, Mexico

Number: 7 specimens from one host, one each from 2 others

SPECIFIC DIAGNOSIS OF STEPHANOSTOMUM MEGACEPHALUM

(Based on 7 specimens)

Length 1.431 to 2.212; greatest width 0.375 to 0.465. Forebody ⅓ to ¼ total body length; posttesticular space ⅛ to 1/10 total body length. Oral sucker 0.165 to 0.206 in diameter; acetabulum 0.165 to 0.195 in diameter; sucker ratio varying from about equal to 5:4. Oral spines in two rows, interrupted by a short space in midventral line; 30 to 32 in number, almost always 32. The two pairs of spines immediately adjacent to the midline space are smaller than the others, measuring 0.051 to 0.068 in length by 0.012 to 0.014 in width. The spines reach maximum size laterally and dorsally, measuring 0.085 to 0.100 by 0.015 to 0.019. Immediately posterior to the oral ring and opposite the oral sucker the skin is free of spines. Body spines very large on forebody; spination disappearing a short distance posterior to acetabulum, the posterior half of body apparently smooth. Prepharynx long; pharynx 0.187 to 0.262 in length by 0.088 to 0.114 in width, subcylindrical rather than markedly pyriform; esophagus short. Prepharynx may be less than, equal to, or more than pharynx length, according to state of contraction. Ceca ending close to excretory vesicle with which they may connect (this point not deter-

mined). Genital pore median, immediately preacetabular. Testes subglobular, not markedly longer than wide, of slightly irregular contour, close together, intercecal, in posterior fourth of body. Cirrus sac almost straight or bent at level of anterior end of seminal vesicle, extending from ⅓ to ½ the distance from acetabulum to ovary; cirrus spined, extending only slightly posterior to acetabulum; tubular genital atrium from pore to near midacetabular level. Ovary globular, median, closely anterior to anterior testis. Vitellaria from posterior end of cirrus sac to posterior end of body; continuous; dorsal, ventral, and lateral to ceca (follicles may not quite reach cirrus sac or may reach very slightly posterior to its posterior edge); no follicles directly between gonads; metraterm spined, considerably shorter than cirrus sac; eggs 60 to 71 by 32 to 42 μ.

Comparisons. Only two other species of Stephanostomum show the ventral interruption of the oral spines. These are *S. bicoronatum* (Stossich) and *S. cesticillum* (Molin). *S. megacephalum* differs from both in its much smaller size, less extensive anterior extent of the vitellaria, shape of testes, smaller eggs, and shape of pharynx.

The name *megacephalum* refers to the large oral sucker.

Two specimens (figs. 71 and 74) of Stephanostomum from the same host, one from San Francisco, Ecuador, the other from White Friars, Mexico, were thought for a time to represent another species but are included as *S. megacephalum.* They are only slightly larger (up to 3.307); they have a sucker ratio of about 3:2 rather than 5:4; the testes are ovoid and rather definitely longer than wide; the genital atrium is short; the eggs 70 to 76 by 37 to 46 μ; and the oral spines are somewhat larger. Other features such as number and arrangement of oral spines, location of gonads, extent of vitellaria, and extent of cirrus sac are the same. Since the degree of differences is small, it was decided that these specimens could be considered as *S. megacephalum.*

In a collection of Stephanostomum specimens from *Caranx latus* Agassiz at Tortugas, Florida, one specimen, somewhat macerated and not quite complete posteriorly, is identified as *S. megacephalum.* It agrees with the Pacific material in sucker ratio, oral spines (there seem to be only 30, but the count might be uncertain to that extent of difference, or the median pair may have been lost), extent of vitellaria, extent and shape of cirrus sac, egg size, and shape and position of the gonads. Other Stephanostomum in the same collection belong to other species, one of which is similar if not identical with the following species. These could not be identified, however, with any certainty because of loss of spines, unusual body extension, et cetera.

Discussion. The genus Stephanostomum was named by Looss in 1899. In accordance with the then accepted interpretation of the rules of nomenclature, Looss came to consider the name Stephanostomum unavailable because of the generic name Stephanostoma Danielsen, 1880, and in 1901 he renamed the trematode genus to Stephanochasmus. Stephanochasmus Looss, 1901 became the recognized name for the genus and has been and still is the most commonly used term.

However, a Recommendation under Article 36 of the International Rules of Zoological Nomenclature reads: "It is well to avoid the introduction of new generic names which differ from generic names already in use only in termination or in a slight variation in spelling which might lead to confusion. But when once introduced, such names are not to be rejected on this account." The first example cited is "Picus, Pica." In Opinion 25 of the International Commission it was voted 11 to 1 (3 not voting) that Damesella, 1905 should not be rejected because of the existence of Damesiella, 1898.

Following this Recommendation, the writer (Manter, 1934, p. 286) considered that Stephanostomum Looss, 1899 was "not to be rejected" on account of its similarity to Stephanostoma. However, recommendations of the International Commission are not mandatory, and some authorities might prefer to continue with the use of the name Stephanochasmus.

Stephanostomum longisomum, new species

(Plate 41, figs. 75, 76)

Host: *Caranx hippos* (Linnaeus)
Location: Intestine
Localities: San Francisco, Ecuador
White Friars, Mexico (type locality)
Number: One specimen in each of 2 hosts examined. In both cases, *Stephanostomum megacephalum* was also present.

The following diagnosis is based on one complete specimen and one incomplete specimen lacking the forebody. The measurements (except egg size) are on the complete specimen, although the fragment showed similar proportions so far as could be seen.

SPECIFIC DIAGNOSIS OF STEPHANOSTOMUM LONGISOMUM

Length 7.627; width 0.540, most of hindbody about equally wide. Forebody 0.937 or about 1/8 total body length; posttesticular space 0.802.

Body spination to about level of ovary with traces as far back as testes. Oral sucker 0.262 in diameter; acetabulum 0.397 in diameter; sucker ratio about 3:4.5; acetabulum with narrow transverse aperture. Oral spines 38 or 40 (probably 38—count uncertain), with 2 pairs of smaller spines in the midventral area. Smallest (midventral pair) 0.048 by 0.010; adjacent pair 0.051 by 0.012; largest spines (lateral and dorsal) 0.110 by 0.017. Prepharynx longer than pharynx; pharynx more or less pyriform, 0.300 long by 0.165 wide; short esophagus; ceca to near posterior end, probably uniting with excretory vesicle. Testes narrow and elongate, tandem, intercecal, in posterior third of body, close together and almost touching but separated by a very few vitelline follicles. Cirrus sac slender, slightly sinuous, extending about ¼ distance between acetabulum and ovary; cirrus short, spiny, opposite posterior half of acetabulum; genital atrium opposite anterior half of acetabulum; genital pore median at anterior edge of acetabulum. Ovary subtriangular and elongate, median, well anterior to testes from which it is separated by many vitellaria; uterus long but with narrow intercecal coils, uterine area (to metraterm) more than ⅓ total body length. Metraterm considerably shorter than cirrus sac, ending at anterior level of seminal vesicle. Vitellaria abundant, dorsal, ventral, and lateral to ceca; ventral to uterus; continuous from posterior end of cirrus sac to posterior end of body, filling space between ovary and testes but barely meeting between testes. Eggs 60 to 65 by 31 to 37 μ.

The name *longisomum* refers to the very long hindbody which is 8 times the length of the forebody.

Comparisons. The presence of smaller oral spines in the midventral region groups this species with *S. bicoronatum, S. cesticillum,* and *S. megacephalum,* which are the only other species with ventrally interrupted rows of oral spines. It is distinctly different from *S. megacephalum* (collected from the same host) in body size and proportions, in sucker ratio, in number of oral spines, in shape of testes, and in position of the ovary in relation to the testes. It is more like *S. bicoronatum* and *S. cesticillum* in body size and body proportions, although its hindbody is relatively longer. It differs from both in the anterior extent of the vitellaria (which do not extend beyond the base of the cirrus sac), in posterior extent of the cirrus sac (which does not reach nearly so far toward the ovary), in smaller eggs, and in a slightly larger number of oral spines. The testes are closer together than in *S. cesticillum;* the ovary is more distant from the testes than in *S. bicoronatum.*

Stephanostomum casum (Linton, 1910)

Hosts and Localities: *Lutianus viridis* (Val.) from Albemarle Island, Galapagos
Lutianus jordani (Gilbert) ? from Secas Islands, Mexico
Lutianus novemfasciatus (Gill) ? from Tangola Tangola, Mexico
Location: Intestine
Number: One specimen from each of the above hosts

These specimens agreed in all details with *S. casum*. Identification is based on body form, sucker ratio, 36 oral spines, anterior extent of the vitellaria, location of gonads, extent of cirrus sac, and egg size.

This species is common at Tortugas, Florida, in *Lutianus analis* and *L. griseus* as well as occurring in other hosts. It has been reported from Sebastodes sp. from British Columbia by McFarlane (1936). The writer (Manter, 1931) has reported it from *Micropogon undulatus* at Beaufort, North Carolina, but this record is incorrect. The Beaufort specimens are not *S. casum*. Yamaguti reports *S. casum* from *Pagrosomus auratus*, but, since he states that 46 oral spines occur, his form may be another species.

Stephanostomum multispinosum, new species

(Plate 41, figs. 77, 78)

Hosts: *Mycteroperca olfax* (Jenyns) (type host)
Mycteroperca sp. (perhaps *olfax*)
Location: Intestine
Locality: Albemarle Island, Galapagos (type locality)
Clarion Island, Mexico
Number: 2 specimens only were collected, one from Albemarle Island (in *M. olfax*), one from Clarion Island (in Mycteroperca sp.)

The following specific diagnosis is based on these two specimens.

SPECIFIC DIAGNOSIS OF STEPHANOSTOMUM MULTISPINOSUM

Length 2.754 to 2.929; width 0.615 to 0.787; forebody 0.570 to 0.675 or a little less than $\frac{1}{5}$ body length. Posttesticular distance 0.412 to 0.427 or about $\frac{1}{7}$ total body length. Oral sucker 0.180 to 0.187 in diameter; acetabulum 0.247 to 0.250 in diameter; sucker ratio about 3:4. Oral spines small, very numerous, in two rows, not sharply pointed; 38 to 40 pairs or a total of approximately 80 (the number may be the same in

both specimens, but accuracy in counting cannot be certain along the sides where the spines overlap several times); largest spines about 0.027 by 0.012; smallest spines about 0.017 by 0.007. Body spination extending to posterior end but denser anteriorly. Prepharynx not much longer than pharynx (shorter when forebody contracted); pharynx 0.195 to 0.228 long by 0.180 to 0.187 wide; distinctly pyriform; esophagus short; ceca obviously opening into excretory vesicle. Genital pore median close in front of acetabulum. Testes rounded, tandem, in posterior ½ to ⅓ of body; not markedly longer than wide, largely intercecal but partly overlapping the ceca ventrally; separated by a short distance which is not occupied by vitellaria except dorsally; cirrus sac sinuous, very long, reaching more than halfway between acetabulum and ovary, cirrus very long, reaching almost halfway to ovary; seminal vesicle in basal fourth or fifth of sac; genital atrium tubular, opposite anterior half of acetabulum. Ovary globular to subtriangular, not elongated, separated from anterior testis by a short space not occupied by vitellaria; vitellaria from posterior fourth or posterior edge of acetabulum to posterior end of body; continuous; not covering uterus; dorsal, ventral, and lateral to ceca but not entering between gonads except dorsally; eggs 68 to 82 by 38 to 44 μ, usually about 71 to 73 by 41 to 42 μ; metraterm narrow, sinuous, almost as long as cirrus sac, and extending more than halfway to the ovary.

The name *multispinosum* refers to the large number of oral spines.

Comparisons. No other species of Stephanostomum has nearly so many oral spines as *S. multispinosum* with the exception of *S. microstephanum* and *S. tristephanum,* both of which have 3 rows instead of 2. The oral spines, furthermore, are smaller than in other species.

Stephanostomum hispidum (Yamaguti, 1934) n. comb.

(Plate 42, figs. 79, 80)

Synonym: *Echinostephanus hispidus* Yamaguti, 1934

Hosts and Localities: *Seriola dorsalis* (Gill) at Tangola Tangola, Mexico, and Secas Islands, Panama
Seriola species (not *dorsalis*) at White Friars, Mexico
Elagatis bipinnulatus (Quoy and Gaimard) at Bahia Honda, Panama

Location: Intestine

Number: 4 from *S. dorsalis;* 6 from S. species; 4 from *E. bipinnulatus*

Echinostephanus hispidus was collected by Yamaguti from *Seriola quinqueradiata* from Japan (Pacific Coast). Ward (1937, p. 517) pointed out that the genus Echinostephanus should be considered a synonym of Stephanochasmus (= Stephanostomum). There can be no doubt as to this synonymy.

An interesting but perplexing condition exists among the specimens from the 3 species of Seriola mentioned above. Specimens from any one of these species are remarkably similar but differ in small details from specimens collected from any of the other species of Seriola. One rather obvious solution, if the differences are not sufficient to warrant different species, is to consider that 3 subspecies or varieties exist. Certainly on the basis of available specimens (which include 4 specimens collected by Yamaguti and kindly sent to the writer), certain fairly constant but slight differences exist among the 3 collections. It was decided, however, not to give specific rank to each collection.

Figs. 79 and 80 show the form from *S. dorsalis*. In this form the suckers are usually subequal, but in one specimen the ratio was almost 3:4 (0.225 as compared with 0.277). The number of oral spines was 42 to 44 (possibly 46 in one specimen). The oral spines are noticeably smaller ventrally, and about 7 lateral spines on each side lie in a single row (fig. 80). This unusual arrangement was described by Yamaguti for *S. hispidum*. He states, "There are 42 spindle-shaped spines arranged dorsally and ventrally in two alternate rows, but laterally in a single row." His figures do not show this condition clearly, and specimens I have are somewhat macerated and without spines. Other characters of interest shown by the form from *S. dorsalis* are: long genital atrium extending posterior to the acetabulum, anterior limit of the vitellaria either at the base of the cirrus sac or as far forward as the anterior level of the seminal vesicle (about ⅓ the length of the cirrus sac), and conspicuous metraterm almost as long as the cirrus sac.

Specimens from Seriola species agree in most respects. The oral spines are the same number (about 44), but the single lateral row is less evident and apparently not present in some if in any of the 6 specimens. The oral sucker is not equal to the acetabulum, the ratio being about 3:4 or even 2:3. This sucker ratio, however, is not much different from that shown by one specimen from *S. dorsalis*. The only other difference is that the ovary is separated from the testes by at least a few vitelline follicles. In this respect, the form resembles Yamaguti's specimens.

Yamaguti's form agrees well with the above except in two respects. The vitellaria extend slightly farther forward, reaching a level about opposite the middle of the cirrus sac; and the metraterm is inconspicuous and evidently thin walled. My specimens of Yamaguti's forms show the cirrus sac joining the metraterm posterior to the acetabulum so that the genital atrium is actually as long as in my material. The position of the ovary is like that in the form from Seriola species but unlike that in the form from *S. dorsalis*. The number and probably the arrangement of the oral spines, the sucker ratio, and the egg size probably differ only within the range of individual variation. All forms have a uroproct. The position of the ovary is usually constant, but, since one specimen showed it separated from the anterior testis by only a few vitelline follicles, it is not urged as a significant character here. The character which might most validly distinguish the Japanese form is the slightly more anterior extent of the vitellaria.

The specimens from Elagatis (a genus closely related to Seriola) are like those from Seriola species, although only 38 oral spines could be counted in one specimen.

Stephanostomum anisotremi, new species

(Plate 42, figs. 81, 82)

Host: *Anisotremus scapularis* (Tschudi)
Location: Intestine
Locality: Tagus Cove, Albemarle Island, Galapagos
Number: 16 specimens from a single host

The following diagnosis is based chiefly on 4 specimens favorable for measurement. The other specimens were also studied and found to agree in all characters which could be determined. The cylindrical nature of the body often resulted in lateral views of total mounts. The oral spines had been partly lost in a few specimens. Two specimens (one broken) of another (undetermined) species with 32 oral spines and with vitellaria almost to the acetabulum occurred in the same collection.

SPECIFIC DIAGNOSIS OF STEPHANOSTOMUM ANISOTREMI

Length 2.808 to 3.874; width 0.450 to 0.532; body elongate and cylindrical. Body spination to level of posterior testis becoming sparse posteriorly. Forebody 0.652 to 0.810, about $\frac{1}{4}$ to $\frac{1}{5}$ total body length except when greatly extended, when it may be almost $\frac{1}{3}$ body length.

Posttesticular space 0.270 to 0.390. Oral sucker 0.142 to 0.165 in diameter; acetabulum 0.258 to 0.315 in diameter; sucker ratio almost 1:2 (about 4:7). Oral spines 40 (20 rows), possibly 38 in a few cases; all spines approximately the same size, anterior row slightly larger, posterior row extending beyond anterior row; largest spines 0.060 to 0.065 by 0.014 to 0.017; smallest spine 0.043 to 0.060 by 0.010 to 0.015. Prepharynx long; pharynx pyriform, 0.210 to 0.240 long by 0.102 to 0.145 wide; esophagus very short; intestinal bifurcation just anterior to acetabulum; uroproct probably present. Testes large, tandem, intercecal, close together, almost always in contact, rarely with a very few vitelline follicles between them; anterior testis globular or subglobular, almost as wide as long; posterior testis longer than wide. Cirrus sac slightly sinuous, extending about ⅓ the distance from acetabulum to ovary, never as far as ½; cirrus very long, often protruded from genital pore; genital atrium opposite anterior half of acetabulum. Ovary ovoid, wider than long, immediately anterior to anterior testis from which it is almost always separated by a very few vitelline follicles. Vitellaria from base of cirrus sac continuous to posterior end of body; dorsal, ventral, and lateral to ceca but not covering the uterus; eggs 60 to 68 by 27 to 41 μ; metraterm weak, usually so filled with eggs as to be invisible.

Comparisons. This species is to be compared with those having complete rows of oral spines and with the vitellaria ending at or near the base of the cirrus sac. Of these, it is most like *S. sentum* (Linton) which is common in related hosts at Tortugas, Florida. Only three differences can be recognized: *S. anisotremi* has 40 oral spines rather than 36; it has a sucker ratio of 1:2 (or nearly 2) rather than 1½; and the eggs are somewhat smaller (up to 68 μ rather than 75 to 85 μ or even more). These differences are not great, but after studying specimens of *S. sentum* from Florida, the writer believes they are sufficiently constant. *S. caducum* (Looss) has 48 oral spines, a sucker ratio of 1:1, and (at least usually) interrupted vitellaria. *S. minutum* (Looss) has 36 spines and smaller eggs.

In comparing species of Stephanostomum, the writer can find no significant differences between the descriptions of *S. imparspine* (Linton, 1905) n. comb. described from Beaufort, North Carolina, fishes and *S. sentum* (Linton, 1910) from Tortugas, Florida. Linton doubtless was dealing with more than one species in his records of *"Dist. imparspine,"* one of which is probably identical with *S. sentum.*

Dihemistephanus brachyderus, new species

(Plate 43, figs. 83-86)

Hosts: *Oligoplites saurus* (Bloch and Schneider)
Caranx hippos (Linn.) ?

Location: Intestine

Locality: San Francisco, Ecuador

Number: 8 specimens from 2 *O. saurus;* one specimen from *C. hippos.* In *C. hippos* it occurred with *Stephanostomum longisomum* and *S. megacephalum*

The genus Dihemistephanus was named by Looss in 1901. It is distinguished from the genus Stephanostomum chiefly because the oral spines are interrupted by a wide ventral space. The genus was more completely described by Little in 1930. Only 2 species are known to date: *S. lydiae* (Stoss.) Looss, the type, and *S. sturionis* Little.

There is some doubt that the present species belongs in Dihemistephanus rather than in a new genus. Divergences shown are the tendency for a dorsal as well as a ventral break in the rows of oral spines, the complicated folds of the oral sucker, and the thick-walled, convoluted excretory tubules. However, it seems evident that the dorsal break in the oral spines and also the shape of the oral sucker are variable characters.

SPECIFIC DIAGNOSIS OF DIHEMISTEPHANUS BRACHYDERUS

Length 2.632 to 6.480; width 0.315 to 0.652. Forebody 0.217 to 0.292, usually about $\frac{1}{20}$ body length but in one case about $\frac{1}{10}$ body length. Pigment flecks in forebody. Fine scalelike spines cover body as far back as ovary but are lacking on ventral surface of forebody. Oral sucker 0.120 to 0.262 in transverse diameter; acetabulum 0.150 to 0.285 in transverse diameter. The transverse diameters of the suckers may be equal, or the acetabulum may be slightly larger. Acetabulum always longer than wide, usually considerably so, ratio of width to length about 3:4. Acetabulum usually tapering posteriorly; somewhat protuberant and overlapping forebody. Oral sucker with crown of narrow spines alternating so closely that the shorter posterior row often seems to lie directly beneath anterior row; separated by a wide ventral space and usually by a shorter dorsal space. Spines, however, rather easily lost; number of spines about 50 to 60; smallest spines (ventral) about 20 to 27 by 5 to 6 μ; largest spines (lateral) about 60 by 7 to 8 μ. Oral sucker with small longitudinal aperture, an anterior sometimes protuberant cone-shaped lobe, ventrolateral lobes, and two wider and thicker dorsolateral lobes (figs. 84 and 85). The appearance is usually that of an inner portion more or less pulled down into an outer portion (fig. 86 shows sections cut

through the aperture). Very short prepharynx; pharynx large, cylindrical, 0.109 to 0.178 in length by 0.076 to 0.093 in width, overlapping acetabulum. Esophagus very short or lacking; ceca extending to posterior end of body; uroproct present.

Genital pore in groove of forebody covered by acetabulum, hence inconspicuous. Testes smooth, ovoid, longer than wide, tandem in posterior half of body; separated by vitelline follicles. Cirrus sac very elongate, extending a little over halfway between acetabulum and ovary; containing a swollen, tubular, slightly sinuous, seminal vesicle occupying a little less than ⅓ total length of cirrus sac, a slender glandular portion occupying a little more than the middle third, and a slender spiny cirrus occupying about the terminal third. Cirrus joins metraterm a short distance posterior to acetabulum. Ovary ovoid, wider than long, separated from anterior testis by a few vitelline follicles. Seminal receptacle present. Vitellaria from shortly anterior to seminal vesicle; dorsal, ventral, and lateral to ceca to posterior end of body; interrupted opposite ovary and testes; confluent between and behind gonads. Metraterm straight, spined, a little over half length of cirrus sac. Eggs yellow, 58 to 65 by 31 to 36 μ. Genital atrium a narrow muscular tube posterior to acetabulum, a wide muscular tube dorsal to acetabulum, becoming a very thin-walled narrow tube near the genital pore.

Unpaired excretory vesicle extending to level of anterior testis whence two small inconspicuous lateral tubes extend forward. These soon become paired (2 on each side of the body) but remain inconspicuous until about opposite the anterior end of the seminal vesicle. Here they become much coiled and with very thick, convoluted walls and are conspicuous even in total mounts. The outer (more lateral) pair becomes smaller and gradually disappears opposite the spiny portion of the cirrus; the median pair extends to the acetabulum and becomes thin walled and inconspicuous in the forebody, apparently ending near the oral sucker.

Discussion. Although some of the unusual characters of this species (e.g. the form of the oral sucker, the dorsal break in the oral spines) are variable, many distinctive features are very constant. It is very different from the other 2 species in the genus in its very short forebody, short prepharynx, number and relative sizes of the oral spines, distribution of the vitellaria, and length and shape of the genital atrium. The 2 pairs of anterior excretory tubes seem to be unlike the single-paired condition described for other species, and the thick convoluted walls of these vessels are also distinctive. A uroproct is not described for either of the other 2 species, but this character is very inconspicuous.

Haplosplanchnidae Poche, 1926

Haplosplanchnus acutus (Linton, 1910)

Hosts: *Tylosurus fodiator* Jordan and Gilbert
Kyphosus elegans (Peters) ?
Location: Intestine
Localities: Port Utria, Colombia
Charles Island, Galapagos
Number: 4 in Tylosurus; one in Kyphosus

This species has been recorded hitherto (by Linton, 1910 and Manter, 1937a) from *Tylosurus acus, T. marinus,* and *T. raphidoma* at Tortugas, Florida, and at Bermuda.

Haplosplanchnus pomacentri Manter, 1937

Host: *Pomacentrus rectifraenum* Gill
Location: Intestine
Locality: Charles Island, Galapagos
Number: 2

This species is recorded by Manter, 1937a from *Pomacentrus leucostictus* and *P. xanthurus* at Tortugas, Florida. Its occurrence in a related yet shallow-water reef fish in the Galapagos is of some interest.

Monorchidae Odhner, 1911

Proctotrema longicaecum, new species

(Plate 44, figs. 87-89)

Host: *Anisotremus interruptus* (Gill)
Location: Intestine
Locality: James Island, Galapagos
Number: 2 specimens in one of 3 hosts examined

The following specific diagnosis is based on 2 specimens from the above locality and one specimen from *Anisotremus virginicus* (Linn.) from Tortugas, Florida. Specimens from both regions are figured (figs. 87 and 89), and differences are discussed below.

SPECIFIC DIAGNOSIS OF PROCTOTREMA LONGICAECUM

Body spined, elongate, 1.5 to 1.781 by 0.292 to 0.357, anterior end truncate, posterior end tapering slightly and rounded. Oral sucker termi-

nal, funnel shaped, longer than wide, length 0.240 to 0.314, width 0.202 to 0.272. Acetabulum about ⅓ body length from anterior end, 0.107 to 0.126 in diameter or about half the transverse diameter of oral sucker. Prepharynx present, almost as long as pharynx, pharynx well developed, 0.117 to 0.130 long by 0.080 to 0.118 wide; esophagus not quite so long as pharynx; ceca extending to near posterior end of body. Genital pore median or submedian, a very short distance anterior to acetabulum. Testis large, ovoid, intercecal, directly posterior to midbody. (Two vasa efferentia could be seen arising from the anterior end of the testis in one specimen.) Cirrus sac elongate, curving around the right side of acetabulum or overlapping the right half of acetabulum, extending to the anterior edge of the ovary or even past the ovary to the anterior edge of the testis; containing a long-spined cirrus, pars prostatica, prostate gland, and, in its basal third, the ovoid seminal vesicle. Spines in the cirrus are of one type. Ovary ovoid, unlobed, immediately anterior to testis, to the right. Seminal receptacle, if present, rudimentary. Vitellaria of 9 large, distinct follicles on each side, lateral, just posterior to midbody at ovariotesticular level. Uterus chiefly intercecal, filling most of hindbody, entering the middle region of the metraterm sac. Metraterm sac elongate oval, to the left, extending a short distance posterior to the acetabulum, containing a large spherical vesicle in its base and an anterior spiny region. What seems to be a muscular terminal region is probably the genital atrium but is not demarked from the metraterm. Eggs 18 to 20 by 9 to 11 μ. The excretory system could not be made out.

Comparisons. This species is probably most closely related to *Proctotrema truncata* (Linton, 1910) n. comb.[1] (Synonym: *Genolopa truncata* Linton), but is clearly distinct in the following characters: more elongate body, much longer ceca, more slender cirrus sac, smaller ovary, more posterior vitellaria, larger acetabulum, and slightly larger eggs. *P. longicaecum* differs from *P. bacilliovatum* Odhner, 1911 in shape of eggs as well as in other characters; from *P. lintoni* Manter, 1931 in body form, size of oral sucker, extent of ceca, more posterior vitellaria, more slender cirrus sac, and shorter eggs. It differs from *P. plectorhynchi* Yamaguti, 1934 in shape of ovary, length of ceca, more slender cirrus sac, and smaller eggs. It differs from *P. macrorchis* Yamaguti, 1934 in longer ceca, shape and position of ovary, and smaller eggs.

[1] The removal of *Genolopa truncata* from the genus Genolopa leaves *Genolopa ampullacea,* the type species, still in the genus which is at least for the present recognized as distinct from Proctotrema.

Discussion. The specimens from the Pacific were so similar to the specimen from *Anisotremus virginicus* that an earlier description for the latter fitted the former in almost all details. Figures of both (figs. 87 and 89) reveal the differences. The Atlantic form (fig. 89) is somewhat more contracted, a condition probably explaining the folded prepharynx. The chief difference is the larger size of the cirrus sac in the Atlantic form where it reaches beyond the ovary. Since the body contraction might be involved here and since individual variation might also be a factor, that difference alone is not considered sufficient to warrant a species. The spines of the cirrus sac seem longer in the Pacific form, but the entire cirrus apparently varies greatly with contraction. In the Atlantic form it was inserted into the genital atrium (without extension through the genital pore) and back as far as the spiny region of the metraterm. In the Pacific form it was retracted seemingly by inversion, much like a proboscis.

It is of interest to note that another specimen of *Anisotremus interruptus* from James Island contained *Hamacreadium oscitans* Linton, which is likewise found in *A. virginicus* at Tortugas, Florida.

Specimens of what seems to be this same species were collected by Dr. A. O. Foster from *Anisotremus pacifici* (Günther) from Miraflores Locks in the Panama Canal in 1937. These specimens varied considerably in size and were somewhat contracted. Most of them were smaller than the other collections. A 0.397 mm specimen was immature, but one, 0.435 long, contained eggs. The Panama Canal material agrees with *P. longicaecum* in sucker ratio, egg size, length of ceca, and terminal genital organs.

Proctotrema costaricae, new species

(Plate 44, fig. 90)

Host: A yellow-striped grunt or porgy, possibly of the genus Medialuna, taken in nearly fresh condition from the stomach of Seriola species

Location: Ceca and intestine

Locality: Port Culebra, Costa Rica

Number: 4 specimens

SPECIFIC DIAGNOSIS OF PROCTOTREMA COSTARICAE

Body oval to elongate, 0.786 to 0.995 by 0.397 to 0.450, rounded at each end, anterior end somewhat truncated; spined except near posterior end (in two specimens spines were lost). Oral sucker terminal, funnel

shaped, longer than wide, 0.144 to 0.165 in width. Acetabulum about ⅓ body length from anterior end (at moderate body extension), 0.085 to 0.097 in diameter or a little over half the diameter of oral sucker. Genital pore median, posterior to intestinal bifurcation, varying from about midway between suckers to considerably nearer acetabulum. Prepharynx short; pharynx usually displaced to lie beside posterior portion of oral sucker, about twice as long as wide (0.068 by 0.032 in the type specimen); fairly short esophagus; ceca not reaching posterior end of body and apparently ending in region of testis. Testis approximately in midbody, not far posterior to acetabulum, ovoid; cirrus sac large, curved claviform in shape, extending diagonally backward and to the left, 0.262 to 0.285 long, 0.087 to 0.116 wide; large ovoid seminal vesicle in basal third of cirrus sac; middle third of sac containing a pars prostatica with large, tall, thin-walled cells and prostatic cells; distal third of sac containing a spined cirrus. Ovary to the right, immediately postacetabular and pretesticular, overlapping both testis and acetabulum, ovoid, smooth, longer than wide. Vitellaria consisting of 8 or 9 follicles in each of 2 widely separated lateral groups at the acetabular and ovarian level, the right group overlapping the ovary dorsally. Uterus filling almost the entire hindbody, partly overlapping testis; sperm cells present in early coils of uterus. Metraterm sac 0.202 to 0.262 long by 0.076 to 0.082 greatest width (almost as large as cirrus sac), extending along left side of and parallel to cirrus sac, containing a large metraterm vesicle (filling its basal half) and a spined metraterm. Uterus entering metraterm sac laterally just anterior to vesicle. Eggs elongate, 25 to 28 by 8 to 9 μ. Excretory vesicle not clearly seen, but in one specimen it seemed to be a very short sac.

Comparisons. Proctotrema costaricae differs from all previously named species, except *P. bacilliovatum* Odhner, 1911, in its long narrow eggs. It differs from *P. bacilliovatum* in shape of ovary and testis, in development of the thin-walled prostatic vesicle cells, structure of the metraterm sac, and in that the egg length is about 3 times the egg width instead of 4 times as in *P. bacilliovatum*. In both species the eggs are 8 to 9 μ in width, but in *P. bacilliovatum* they are 31 to 33 μ instead of 25 to 28 μ.

Paramonorcheides bivitellosus, new species

(Plate 44, fig. 91)

Host: *Symphurus atramentatus* Jordan and Bollman

Location: Intestine

Locality: James Island, Galapagos
Number: One specimen

The genus Paramonorcheides Yamaguti, 1938 apparently differs from Monorcheides Odhner, 1905 chiefly in its lobed ovary. The long ceca and the posterior group of vitelline follicles of the present species might almost be of generic value, but the species is included in Yamaguti's genus.

SPECIFIC DIAGNOSIS OF PARAMONORCHEIDES BIVITELLOSUS

Length 0.675; greatest width (just posterior to midbody) 0.280; both ends tapering slightly and rounded; body spined except posterior to testes. Oral sucker 0.102 in diameter; acetabulum 0.095 in diameter; ratio almost equal, oral sucker slightly larger. Forebody 0.220 or about ⅓ body length, rich in gland cells. Prepharynx very short or lacking; pharynx 0.049 long by 0.042 wide; esophagus very short or lacking; intestinal bifurcation about midway between suckers or slightly nearer oral sucker; ceca extending to near posterior end of body, curving inward opposite testes. Genital pore midway between acetabulum and intestinal bifurcation, submedian or slightly to the right (cirrus protruded). Testes 2, about twice longer than wide, at level of beginning of posterior third of body, symmetrical, far apart, near sides of body, largely or wholly extracecal. Cirrus sac (with cirrus protruded) claviform, from pore to posterior edge of acetabulum, largely to right of acetabulum, with ovoid seminal vesicle, 2 types of spines; cirrus with thorn-shaped spines. Ovary lobed, to the right, close to right testis to which it is partly median, partly anterior, ventral to right cecum; seminal receptacle not seen; metraterm claviform, spiny, from genital pore to posterior edge of acetabulum, lying to left of cirrus sac, largely dorsal to acetabulum, about same length as cirrus sac; vitelline follicles arranged in two lateral groups on each side divided by testes; anterior group from mid-acetabular level to testes, chiefly lateral to ceca; posterior group of few follicles extending a short distance posterior to testes, largely ventral to ceca. Eggs thick shelled, sometimes almost spherical, 19 to 20 by 15 to 16 μ. Uterus filling most of middle of body but not reaching posterior end by a short distance. Extent of excretory vesicle not determined.

The name *bivitellosus* refers to the double grouping of vitellaria on each side of the body.

Discussion. This species is placed in the genus Paramonorcheides because of the 2 testes and the lobed ovary. It differs from both *P. awa-*

tati Yamaguti, 1938 and *P. siremboni* Yamaguti, 1938 in several respects, notably: the posterior group of vitellaria, the anterior group of vitellaria not reaching anterior to the acetabulum, the longer ceca, shorter esophagus, and wider eggs. The testes are more posterior and less elongate.

Telolecithus tropicus, new species

(Plate 44, figs. 92-94)

Host: *Selar crumenophthalmus* (Bloch)
Location: Intestine
Locality: Bahia Honda, Panama
Number: 2 specimens in one of 2 hosts examined

SPECIFIC DIAGNOSIS OF TELOLECITHUS TROPICUS

Body flat, elongate, more or less tapering at each end, forebody thickly spined but spines soon disappear posterior to acetabulum. Type specimen 1.074 long, 0.217 wide. Suckers weakly muscular; oral sucker slightly wider than long, not funnel shaped, 0.060 in transverse diameter; acetabulum 0.060 to 0.065 in diameter or about equal to oral sucker; forebody 0.375 in length.

Very short prepharynx, fairly large pharynx, 0.058 long by 0.033 wide; very long, narrow esophagus, 0.175 in length or more than 3 times length of pharynx; ceca inconspicuous, extending almost but not quite to posterior end of body.

Genital pore a median, transverse slit immediately in front of acetabulum. Testis single, large, elongate, slightly irregular in outline, in posterior third of body, extending almost to posterior end of body. Cirrus sac (fig. 93) clavate, bowing around right side of acetabulum, size 0.177 (length) by 0.054 (greatest width, near base); containing a large ovoid seminal vesicle in its basal third, in its middle third a narrow tube surrounded by large transparent cells, in its distal third a spined cirrus; prostatic cells chiefly around base of cirrus; gland cells also present around seminal vesicle. Genital atrium short but spacious, unspined. Ovary elongated, very irregularly lobed, to the left partly covering left cecum, immediately anterior to testis; uterine seminal receptacle; uterus extending posteriorly to overlap testis or (in one specimen) even posterior to the testis, entering base of metraterm, without bulb; metraterm (fig. 93) clavate, almost as large as cirrus sac, bowing around left side of acetabulum, its basal portion largely vesicular with a few large spines (fig. 93) and with a central fibrous mass; anterior third of metraterm with short

triangular spines; eggs tapering abruptly at one end, more rounded at the other, 24 to 26 by 12 to 15 μ. Vitellaria in the form of indefinite follicles usually more or less fused together, from about the anterior end of the ovary to the tips of the ceca, not quite reaching posterior end of the body and not reaching acetabulum by some distance, largely lateral, partly median, overlapping testis and uterus. Excretory vesicle very short, Y shaped.

The name *tropicus* is for the region of collection.

Comparisons. This trematode is placed in the genus Telolecithus chiefly because of the posterior location of the vitellaria. It bears some resemblance to Paraproctotrema Yamaguti, 1934 but differs in the location of the vitellaria, in lacking the uterine bulb, in shorter ceca, and in other details. It differs from *Telolecithus pugetensis* Lloyd and Guberlet, 1932 in body shape, length of esophagus, extent of vitellaria, shape of ovary and testis, in the terminal entrance of the uterus into the metraterm, in shape of eggs. It resembles *Genolopa trifolifer* Nicoll, 1915 in many respects, although the vitellaria extend more posteriorly, the gonads are of different shape, the prepharynx is shorter, and the esophagus is longer. It is probable that the genus Genolopa should be restricted to monorchids with a median cluster of much longer spines in the cirrus sac, a character of *G. ampullacea* Linton, the type species. Such a view, however, would remove most of the species now contained in the genus.

Proctoeces magnorus, new species

(Plate 45, fig. 95)

Host: *Caulolatilus anomalus* (Cooper) ?
Location: Intestine
Locality: Cerros Island, Mexico
Number: One specimen

SPECIFIC DIAGNOSIS OF PROCTOECES MAGNORUS

Body smooth, subcylindrical, equally wide along most of its length, posterior end pointed, anterior end blunt. Length 2.862, width 0.412; forebody 0.825; posttesticular space 0.640. Oral sucker 0.375 deep, 0.435 long; acetabulum on body stalk, 0.322 wide, 0.310 long, with transverse aperture; within its cavity is a longitudinal groove with muscular edges (fig. 95). Prepharynx very short; pharynx large, 0.307 long by 0.217 wide; esophagus very short; ceca thin walled, inconspicuous, reaching to near posterior end of body. Genital pore slightly to the left, at base of

acetabular stalk, posterior to intestinal bifurcation. Testes spherical, diagonal, not far apart but separated by a few eggs in the uterus, in posterior half of body. Cirrus sac claviform, slightly curved, extending only slightly posterior to acetabulum; 0.502 long by 0.130 in greatest width (near its base), containing a coiled tubular seminal vesicle in its basal third; a long pars prostatica and a short cirrus. Genital atrium large. Cirrus may be inserted in terminal portion of uterus. Ovary spherical or subspherical, a short distance pretesticular, separated from testes by uterine coils; vitelline follicles few, in 2 lateral groups from anterior end of ovary to anterior end of anterior testis; extending medianly dorsal to uterus between ovary and testis; eggs 32 to 37 by 15 to 19 μ. Excretory vesicle not traced.

The name *magnorus* refers to the relatively large oral sucker.

Comparisons. Two species of Proctoeces have been described, *P. maculatus* (Looss) Odhner, 1911 from *Labrus merula* and *Crenilabrus pavo* from the Mediterranean (also reported by Yamaguti from several fishes of Japan) and *P. erythraeus* Odhner, 1911 from *Chrysophrys bifasciata* from the Red Sea. *P. magnorus* is very different from *P. maculatus* in sucker ratio, in extent of vitellaria, and in egg size. It is more similar to *P. erythraeus.* Odhner gives a very brief description and no figure of *P. erythraeus.* Compared with *P. maculatus,* the acetabulum is "at least ⅓ smaller," eggs about 45 μ long, and the vitellaria shorter. These differences are all in the direction of *P. magnorus,* which, however, seems to have a larger oral sucker, making the sucker ratio even greater than in *P. erythraeus,* and also to have smaller eggs (the largest of which is 37 μ long). It is probable the vitellaria are even shorter in *P. magnorus* than in *P. erythraeus.* Assuming the other 2 species are alike in other respects, *P. magnorus* shows slight differences in possessing an acetabular stalk, shorter esophagus, cirrus sac not reaching ovary, and a longitudinal groove within the acetabular cavity.

Tergestia laticollis (Rud., 1819)

Host: *Caranx caballus* Günther
Location: Intestine
Locality: Port Culebra, Costa Rica
Number: 5 specimens from one host

The genus Tergestia was named by Stossich in 1899 with *T. laticollis* (Rud.) as type species. Odhner in 1911 redescribes the genus and the

species *T. laticollis* and associates the genus along with Proctoeces Odhner with the family Fellodistomidae (= Steringophoridae Odhner). Tergestia can probably be considered in the subfamily Haplocladinae. Its fellodistomid relationship can be clearly seen in the terminal male organs.

The genus Theledera Linton, 1910, established for *Distomum pectinatum* Linton, 1905, is an evident synonym of Tergestia. The genus Cithara, named by MacCallum in 1917 with *C. priacanthi* as type, is likewise an evident synonym of Tergestia.

Five species of Tergestia have been named: *T. laticollis* (Rud.); *T. acanthocephala* (Stoss.); *T. pectinata* (Linton) n. comb.; *T. priacanthi* (MacCallum) n. comb.; and *T. acanthogobii* Yamaguti, 1938. *T. pectinata* and *T. priacanthi* are poorly described, being based on poor material. *T. priacanthi* in particular, since egg measurements are not given, cannot be identified as to species from its description.

Linton's (1905, p. 389) *Distomum pectinatum* from *Bairdiella chrysura* and *Trachinotus carolinus* at Beaufort, North Carolina, was reported by Linton (1910) from *Auxis thazard* at Tortugas, Florida, and renamed *Theledera pectinata* (Linton). For the Tortugas material, Linton gives but a few measurements, which differ from the Beaufort description in that the suckers are almost equal in size (0.14 and 0.18) whereas in the specimens from Beaufort the acetabulum was over twice the diameter of the oral sucker (oral sucker 0.10, acetabulum 0.25). I have collected specimens from *Bairdiella chrysura* at Beaufort and can confirm the sucker ratio stated by Linton. Furthermore, there occur at least 2 species of Tergestia at Tortugas, one of which [collected by the writer from *Trachurops crumenophthalmus* (Bloch) and *Priacanthus arenatus* Cuv. and Val.] has a sucker ratio of approximately 1:2 or a little over 2 and probably corresponds to the original *D. pectinatum* from Beaufort; the other [collected from *Gymnosarda pelamis* (Linn.) and *G. alletterata* (Raf.)] possesses subequal suckers with the acetabulum usually very slightly larger than the oral sucker. This latter form is probably the *Theledera pectinata* of Linton, 1910.

The Pacific material agrees very well with that form from the Atlantic possessing subequal suckers. In 2 of 5 specimens the ratio was about 3:4, but in the other 3 the acetabulum was only very slightly larger than the oral sucker. This material is to be compared with *T. laticollis*. There is agreement in shape of pharynx, in distribution of vitellaria, in sucker ratio, and fair agreement in egg size. My Pacific material has eggs 22 to 26 by 12 to 17 μ; my Atlantic material has eggs 25 to 29 by 17 to 20 μ;

and Odhner reports 22 to 23 by 15 μ for *T. laticollis*. In view of individual variation and the fact that these measurements overlap one another, it does not seem possible to separate these forms on egg size, and they are all considered to be *T. laticollis*.

These new hosts and localities for the species extend its already wide distribution. It is now reported from the following hosts and regions: *Caranx trachurus* from the Mediterranean (reported by Odhner, 1911); *Trachurus trachurus* from the North Sea (reported by Nicoll, 1913); *T. trachurus* from the Black Sea (reported by Wlassenko, 1931); *Scomber japonicus* and *T. trachurus* from Japan (reported by Yamaguti, 1934, 1938); *Auxis thazard, Gymnosarda pelamis,* and *G. alletterata* from Tortugas, Florida; and *Caranx caballus* from Port Culebra, Costa Rica.

Tergestia pectinata (Linton) occurring at Beaufort, North Carolina, and Tortugas, Florida, is to be considered a different species differing chiefly in sucker ratio.

Family **Accacoeliidae** Looss, 1912

Tetrochetus proctocolus, new species

(Plate 45, figs. 96, 97)

Host: *Cheilichthys annulatus* (Jenyns)
Probably also (rarely) in *Trachinotus rhodopus* (Gill) and Angelichthys sp.

Location: Rectum

Locality: Galapagos Islands

Number: One in each of 2 hosts, 3 in another of a total of 8 examined

The genus Tetrochetus was named by Looss in 1912 with *T. rayneriius* (Nardo) as type. Dollfus (1935, p. 205-206) in a review of the Accacoeliidae points out that only 2 valid differences seem to separate Tetrochetus from Orophocotyle Looss, 1902. These are the lack of the anterior duplication of the acetabulum and the more continuous and branching vitellaria in Tetrochetus. Three species of Tetrochetus are known: *T. raynerius* (Nardo); *T. coryphaenae* Yamaguti, 1934; and *T. hamadai* Fukui and Ogata, 1935.

SPECIFIC DIAGNOSIS OF TETROCHETUS PROCTOCOLUS

Body smooth, cylindrical, 2. to 5.4 in length by 0.442 to 1. in width; forebody 0.442 to 1.012 or almost exactly the same as greatest body

width. Color in life, red. Oral sucker subspherical, 0.187 to 0.277 in transverse diameter, with internal conelike elevation at its base; acetabulum longer than wide, protuberant on a short stalk, with longitudinal aperture, 0.210 to 0.270 in depth (only one specimen in a position for transverse measurement which was 0.345), 0.277 to 0.472 in length. The ratio of transverse diameters about 3:4. Depth of acetabulum only slightly greater than width of oral sucker. Short prepharynx; pharynx cylindrical, 0.102 to 0.178 long by 0.076 to 0.136 wide; esophagus fairly long, joining ceca dorsal to acetabular stalk; intestine H shaped; anterior ceca reaching to midpharynx level or beyond to the base of oral sucker. Nine dorsal diverticula of varying length at the intestinal bifurcation (fig. 97). Posterior ceca wide, extending to posterior end of body, uniting with excretory vesicle.

Genital pore median, opposite base of oral sucker. Testes diagonal, smooth, rounded, slightly longer than wide, in middle of body (midline lies between the testes), anterior testis dorsal, posterior testis ventral, separated by coils of the uterus and by vitellaria. Seminal vesicle a much convoluted tube extending a short distance posterior and a short distance anterior to acetabulum; pars prostatica a straight tube extending almost to the genital pore; prostatic gland free; no copulatory organs. Ovary ovoid or bean shaped, smooth, wider than long, median, about ⅓ from posterior end of body; Mehlis' gland spherical; yolk reservoir ventral to Mehlis' gland; vitellaria consisting of coiled tubes with numerous branches (not of isolated fragments), extending from just posterior to acetabular stalk to ovary (not posterior to ovary); uterus with ascending (ventral) coil to near acetabulum, winding descending posterior coils becoming ventral posterior to testes reaching to near posterior end of body, a dorsal ascending little coiled limb which passes ventral to anterior testis then almost straight to near genital pore where it joins the male duct. Eggs thin shelled, light yellow, ovoid, 22 to 25 by 14 to 17 μ (one specimen with many abnormal eggs had a few up to 32 by 25 μ, but egg size seemed rather constant in normal specimens). Excretory vesicle short; excretory tubes much coiled in anterior region of body, extending to oral sucker. These tubes come close together, but whether or not they unite was not determined.

The name *proctocolus* is from *procto* (= anus) and *-colus* (= inhabiting) and refers to the location of the parasite in the rectum.

Discussion. In the 2 mm specimen the eggs had not reached the portion of the uterus posterior to the ovary; hence, it was but recently sexually mature. The number of dorsal diverticula of the intestinal bifurca-

tion may vary. They could be counted in but 2 specimens in both of which the number was 9.

Although *T. hamadai* is from a related host in Japan, *T. proctocolus* is more similar to *T. coryphaenae*. I have collected what I consider to be *T. coryphaenae* from *Coryphaena hippurus* at Tortugas, Florida. On the basis of this material the questions raised by Dollfus (1935) can be answered by saying that no copulatory organ is present and the vitellaria are tubular and continuous, thus confirming the location of the species in the genus Tetrochetus.

T. proctocolus and *T. coryphaenae* are almost identical. The most pronounced difference is egg size. My material of *T. coryphaenae* has constantly larger eggs (32 to 35 by 16 to 19 μ). Yamaguti records 26 to 33 by 16 to 19 μ for *T. coryphaenae*. Except for a specimen having both abnormally small and abnormally large eggs, *T. proctocolus* eggs were consistently 22 to 25 by 14 to 15 μ. Another difference between the 2 species is a relatively somewhat larger oral sucker in *T. coryphaenae*. Because of the usual lateral view of specimens the most available dimensions to compare are the lengths (anterior-posterior) of these suckers. The following proportions represent in hundredths of millimeters these ratios (oral sucker above acetabulum):

T. proctocolus.....	$\frac{16}{27}$	$\frac{17}{30}$	$\frac{23}{47}$	$\frac{24}{35}$	$\frac{24}{39}$			
T. coryphaenae.....	$\frac{18}{25}$	$\frac{27}{39}$	$\frac{28}{36}$	$\frac{36}{44}$	$\frac{36}{46}$	$\frac{37}{42}$	—	$\frac{20}{29}$ (Yamaguti's record)

T. coryphaenae seems to have thicker vitelline tubes with fewer coils between anterior testis and acetabulum. The anterior extent of the uterus and vitellaria is probably too variable to separate the two species. *T. coryphaenae* is from the intestine of its host rather than from the rectum.

T. proctocolus is distinctly different from *T. raynerius* in sucker ratio and location of the gonads. It differs from *T. hamadai* in sucker ratio, in shape of pharynx, and in more posterior extent of vitellaria.

A single specimen of Tetrochetus from the intestine of *Trachinotus rhodopus* at Chatham Island is probably *T. proctocolus*. The sucker ratio would so indicate, as well as most of the eggs, but a very few eggs were abnormally large as compared with others. Another single specimen, probably *T. proctocolus,* was collected from the intestine of an angelfish (Angelichthys sp.) from the Galapagos. In this specimen, a peculiar abnormality was the entire absence of egg shells. The uterus was fully developed and filled with naked embryos. The vitellaria were normal.

Family Heterophyidae Odhner, 1914

Paracryptogonimus americanus, new species

(Plate 45, figs. 98-100)

Hosts and Localities: *Lutianus novemfasciatus* (Gill) or *cyanopterus* (Cuv. and Val.)
Tangola Tangola, Mexico
Lutianus jordani (Gilbert) ?
Secas Islands, Panama

Location: Ceca and intestine

Numbers: Large number collected, especially from the former host and locality

SPECIFIC DIAGNOSIS OF PARACRYPTOGONIMUS AMERICANUS

Body thick and plump with thick, somewhat wrinkled cuticula covered with fine spines; spines easily lost in posterior region of body; anterior end broadly rounded; posterior half of body tapering slightly and bluntly rounded. Most specimens 2.308 to 2.376 long by 1.147 to 1.555 in greatest width (anterior to midbody), but one mature specimen only 0.985 by 0.690. Oral sucker subterminal, almost circular, 0.300 to 0.307 in diameter (0.144 in the 0.985 specimen); single row of 52 to 57 oral spines. Preoral cavity present (fig. 99), formed by body surface enclosing oral sucker; oral spines covered by this circular fold. Oral spines about 26 μ long, tapering but not sharply pointed, sometimes slightly forked at base. Acetabulum 0.187 to 0.225 in diameter (about $\frac{2}{3}$ diameter of oral sucker), deeply embedded in body, with transverse aperture. Forebody short, varying with contraction, usually about 0.540 but sometimes as short as 0.300 or practically the diameter of the oral sucker; with many gland cells.

Genital pore median near aperture of acetabular cavity at anterior edge of acetabulum, a short distance posterior to intestinal bifurcation. Pseudosucker lacking.

Prepharynx present (fig. 99) but evident only in sections; pharynx partly dorsal to oral sucker, slightly wider than long (0.120 to 0.142 in length by 0.150 to 0.165 in width); esophagus apparently lacking; ceca large, diverging laterally to bow backward, extending in sides of body to near posterior end.

Testes 2, ovoid, slightly wider than long, smooth, symmetrical, far apart near lateral edges of body, ventral to ceca, separated by uterus, at about midbody level. Seminal vesicle an elongated, irregularly lobed

sac, beginning just anterior to ovary, curving around left side of acetabulum to genital pore. Near the pore, the vesicle narrows to a fine tube; cirrus and cirrus sac lacking; prostate gland not evident, probably lacking.

Ovary large, median, multilobed, immediately anterior to level of testes. Seminal receptacle large, dorsal, and slightly anterior to ovary. Laurer's canal present. Uterus extending backward in lateral coils in right half of body to near ends of ceca (about ¾ distance between ovary and posterior end of body), then coiling forward in left half of body to genital pore. Eggs brown, elongated, tapering toward one pole, 20 to 25 by 9 to 10 μ. Vitellaria in 2 groups, extending from posterior edge of acetabulum to posterior edges of testes; some follicles extracecal; a few are ventral to ceca and to testes; most are dorsal, extending medianly to or almost to ovary which separates the 2 groups. Excretory vesicle large, much inflated, Y shaped, forking near ovary, with crura reaching to anterior end of body. Excretory pore terminal or ventrosubterminal, with conspicuous radial muscle bands.

Discussion. P. americanus differs in several respects from *P. acanthostomus* Yamaguti, 1934, the only other species in the genus. The body is broader in its anterior half, the oral sucker is more posterior in position, the ovary and testes are more anterior, the ceca are farther apart, and the eggs more elongate. There are more oral spines in *P. americanus* (52 to 57 as compared with 49), and the preoral chamber seems to be unique. The acetabulum is relatively larger in *P. americanus.*

It is of interest to note that *P. acanthostomus* is from a related host, *Lutianus vitta.*

Yamaguti classified Paracryptogonimus in the Acanthostomidae Poche, 1926, although noting that Fuhrmann considered the related genus Cryptogonimus in the Heterophyidae. Yamaguti lists as related genera: Cryptogonimus Osborn, Biovarium Yamaguti, Allacanthochasmus Van Cleave, and Caecincola Marshall and Gilbert. Siphoderina Manter, 1934 was named at about the same time that Yamaguti's paper appeared. It is a closely related genus, differing chiefly in the lack of oral spines, and brings together the genera Siphodera, Siphoderina, and Paracryptogonimus.

Mueller and Van Cleave (1932, pp. 114-132) have discussed the family Heterophyidae with special reference to forms occurring in fishes. They state (p. 119): "Likewise the Cryptogoniminae of Osborn (1903), though never previously assigned as a subfamily under the Heterophyidae, is based upon a concept which falls wholly within the Heterophyinae

except for the fact that its members are from fishes." They consider Cryptogoniminae a synonym of Heterophyinae. The writer agrees with this conclusion.

These opinions suggest a similarity between the Acanthostomidae and the Heterophyidae. Such a similarity does seem to exist, and a realignment of the two families in relationship to each other is needed. Acanthostomidae is perhaps a heterogeneous group, some of the genera in it (e.g. Maesnia Chatterji, 1933 and Anoiktostoma Stossich, 1899) apparently possessing a cirrus sac. Most of the genera listed in the Acanthostomidae could be logically placed in the Heterophyidae. It seems probable that too much emphasis has been placed on an oral crown of spines and not enough consideration given to the terminal genital structures and posterior extent of the uterus. Perhaps knowledge of life cycles will be necessary to elucidate the status of the two families.

Mueller and Van Cleave recognized six subfamilies of the Heterophyidae. Manter (1934, p. 325) considered Siphodera and Siphoderina in a new subfamily Siphoderinae. It seems apparent, however, that Siphodera, Siphoderina, Cryptogonimus, Paracryptogonimus, Centrovarium, Biovarium, and Caecincola are similar enough to be classified in one subfamily. Paracryptogonimus, in particular, shows relationship to Neochasmus and Allacanthochasmus in its oral spines, deeply lobed ovary, and posterior uterus, differing in lacking a gonotyl. But the presence or absence of a gonotyl has not been considered a subfamily character. The plate of heterophyid genera given by Mueller and Van Cleave (1932, pl. 25, p. 129) shows a series in which Paracryptogonimus and Siphodera might well fit. Mueller and Van Cleave consider the oral spines a subfamily distinction between Heterophyinae and Neochasminae. Since these spines are absent or present in marine trematodes as closely related to each other as Siphoderina and Paracryptogonimus, they do not seem to constitute more than a generic difference.

Yamaguti (1938) has recently discussed certain Japanese trematodes in the genera Exorchis Kobayashi, 1921 and Pseudexorchis Yamaguti, 1938. His subfamily Exorchiinae is essentially similar to Siphoderinae and hence should also be considered a synonym of Heterophyinae. In this connection it might be noted that the cercaria of *Pseudexorchis major* (Hasegawa, 1935) "resembles the cercaria of *Metagonimus yokogawai* so closely that even an experienced trematologist might be unable to distinguish the two without experimental evidence."

It is the present view of the writer that Siphoderinae Manter, 1934, Neochasminae Van Cleave and Mueller, 1932, Cryptogoniminae Osborn, 1903, and Exorchiinae Yamaguti, 1938 are all synonyms of Heterophyinae Ciurea, 1924.

Siphoderoides vancleavei, new genus, new species
(Plate 45, figs. 101, 102)

Host: *Orthostoechus maculicauda* Gill
Location: Intestine
Locality: Port Utria, Colombia
Number: One specimen

The status of this trematode should be qualified by the limitations of a single specimen. This specimen is, however, favorable to show most of the significant features with the exception of the exact length of the ceca. The trematode is evidently a heterophyid similar to Siphodera and Siphoderina but is distinctive in possessing a conspicuous, muscular gonotyl posterior to the acetabulum.

SPECIFIC DIAGNOSIS OF SIPHODEROIDES VANCLEAVEI

Body more or less flattened, entirely spined, broadly rounded at each end, posterior end broad and scarcely tapering at all, anterior end only slightly tapering; length 1.485; width 0.585. Forebody 0.427 or between ⅓ and ¼ total body length; pigment granules in forebody. Oral sucker 0.180 in transverse diameter, without oral spines; acetabulum 0.075, embedded in body; sucker ratio about 5:2. Gonotyl (fig. 102) with transverse aperture, immediately posterior to acetabulum, with semicircular muscles. Acetabulum with 2 lateroposterior muscles extending diagonally backward into the body. Prepharynx short; pharynx 0.102 long by 0.087 wide; esophagus short; bifurcation midway between pharynx and genital pore; ceca extending posterior to testes but not reaching posterior end of body, probably ending shortly behind the testes. Genital pore (fig. 102) median, immediately anterior to acetabular aperture, not on surface of body but within the body fold which enfolds acetabulum. Testes 2, lateral, far apart, in posterior half of body about midway between acetabulum and posterior end of body, elongated, unlobed, extracecal, partly covered ventrally by uterus. Seminal vesicle large, saclike, apparently undivided, from anterior edge of acetabulum almost to ovary; prostatic vesicle short, at anterior edge of acetabulum; cirrus and cirrus sac lacking; genital atrium tubular, muscular.

Ovary multilobed, median, chiefly intercecal, immediately pretesticular; seminal receptacle anterior to ovary, posterior to seminal vesicle; Laurer's canal dextral, preovarian; uterus largely filling body posterior to ovary, descending coils to the right, ascending coils to the left, crossing to extreme left at testicular level, then across the body anterior to ovary to loop over the right testis, then almost straight to atrium. Vitellaria of numerous follicles from level of genital pore to midovarian level, largely lateral and ventral to ceca, tending to be more median just anterior to ovary. Eggs brown, 19 to 20 by 7 to 9 μ. Colorless glandular masses filling forebody. Excretory vesicle Y shaped.

The name Siphoderoides indicates relationship to Siphodera. The specific name is in honor of Dr. H. J. Van Cleave.

GENERIC DIAGNOSIS OF SIPHODEROIDES

Heterophyinae of fairly large size, elongate with rounded ends; oral sucker much larger than acetabulum, without special spines; acetabulum embedded in body; muscular gonotyl with aperture present posterior to acetabulum; testes 2, lateral, extracecal; seminal vesicle large, saclike, undivided; ovary median, multilobed; vitellaria follicular, anterior to testes.

Comparisons. The presence of a gonotyl posterior to the acetabulum distinguishes this genus from Siphodera Linton, 1910; Siphoderina Manter, 1934; Exorchis Kobayashi, 1921; Pseudexorchis Yamaguti, 1938; Centrovarium Stafford, 1904; and Metadena Linton, 1910. Neochasmus has a gonotyl but also oral spines and a fragmented ovary.

Hemiuridae Lühe, 1901

Parahemiurus merus (Linton, 1910) Woolcock, 1935

(Plate 46, fig. 103)

Hosts: *Opisthonema libertate* (Günther)
Anchovia arenicola Meek and Hildebrand
Location: Stomach
Locality: La Plata Island, Ecuador
Number: 3 specimens in one host, one specimen in another

Discussion. Hemiurus merus was named by Linton in 1910 from *Clupanodon pseudohispanicus* at Tortugas, Florida. He noted the muscular undivided seminal vesicle as distinguishing the species from *H. appen-*

diculatus. Linton (1910, p. 60) also suggested that this character might be of generic value. Vaz and Pereira in 1930 named the genus Parahemiurus with *P. parahemiurus* from *Sardinella aurita* in Brazil as type. This genus is distinguished from Hemiurus by the muscular undivided seminal vesicle. As suggested by Manter (1934, p. 304) and accepted by Woolcock (1935), *H. merus* is a member of the genus Parahemiurus.

P. merus has been collected by the writer from 9 different species of hosts at Tortugas, Florida. Twenty-six specimens have been studied. No differences between *P. merus* and the description of *P. parahemiurus* can be detected except in the extent of the cuticular denticulations or rings. Since their distribution on the 2 surfaces of the body is not indicated by Vaz and Pereira, the "anterior fourth of the body" extent described might apply only to the complete rings on the dorsal surface. I consider that *P. parahemiurus* is a synonym of *P. merus*.

Eight other species of Parahemiurus have been named. Differences between some of these are slight and indicate that variations within a single species should be better known. Specimens of *H. merus* from Tortugas indicate that egg size is variable in the species, at least in different individuals. For example, eggs in three specimens measured 18 to 22 by 8 to 10 μ, 23 to 24 by 10 μ, and 30 by 10 μ; and Linton records 27 by 10 μ. The limits seem to be 18 to 30 by 8 to 10 μ in preserved specimens, while Vaz and Pereira's measurements would extend the width to 14 μ. Another variable character is seen in the form of the vitellaria which may be unlobed or slightly lobed. The uterus may or may not enter the ecsoma. The cuticular denticulation seems fairly constant. The body folds or rings extend entirely across the dorsal surface only as far back as the acetabular region, whereas on the ventral surface they continue to the level of the ovary or in some specimens to the posterior edge of the vitellaria or, in a few specimens, slightly beyond (fig. 103). Near their termination they become inconspicuous. There may be some variation as to how far dorsally the plicae reach, but in both the Atlantic and the Pacific material favorable to show this character they extend well around the edges of the body as far back as the testes but do not meet dorsally posterior to the acetabulum. The unringed dorsal area gradually widens posteriorly (fig. 103). This denticulation is similar to that of most of the described species but different from that of *P. australis,* probably *P. anchoviae,* and the new species following.

From these observations, I believe that *P. platichthyi* Lloyd, 1938 from Puget Sound is a synonym of *P. merus*. *P. atherinae* Yamaguti,

1938 and *P. harengulae* Yamaguti, 1938 seem to me to be synonyms, also. The short distance between the ovary and testes I have observed in young individuals. *P. atherinae* is characterized by a wall of the seminal vesicle which is "not very thick." The thickness of the wall of the seminal vesicle varies greatly according to the volume of sperm cells within it. One specimen from Florida had a completely empty vesicle and was rounded (43 by 43 μ) with very thick walls (17 μ). *P. harengulae* has eggs from 29 to 34 μ long, which is a little larger than the largest I have seen in *P. merus,* but the smaller size is within the limits of the latter species. Perhaps the chief difference shown by *P. harengulae* is in the dorsal denticulations reaching to the testes, but it is not made clear whether they extend entirely across the dorsal surface at this level.

P. sardinae and *P. seriolae* are also possibly synonyms of *P. merus* but may be justified by the more posterior position of the ovary and the larger ecsoma. In none of my specimens is the ovary so far posterior.

There is thus indicated for *P. merus* a wide distribution from the Gulf of Mexico into the South American Atlantic, in the American Pacific, and probably in Japanese waters. Proposed synonyms are: *P. parahemiurus, P. platichthyi, P. atherinae, P. harengulae.* Other species are: *P. australis, P. anchoviae, P. sardinae, P. seriolae,* and a new species described below.

SPECIFIC DIAGNOSIS OF PARAHEMIURUS MERUS (LINTON)

Length 1.14 to 3, ecsoma usually extended. Body rings extending to level of ovary or vitellaria on ventral side, but the middle of the dorsal surface is not ringed posterior to the acetabulum. Acetabulum 2 to 2.5 times oral sucker. Ceca may or may not enter ecsoma. Genital pore opposite posterior portion of oral sucker. Sinus sac extending beyond anterior border of acetabulum sometimes to middle of this sucker; pars prostatica long, slightly coiled, extending some distance posterior to acetabulum; seminal vesicle subspherical to ovoid, undivided, with muscular wall; testes diagonal or tandem. Ovary transversely ovoid, separated by some distance from posterior edge of body; vitellaria unlobed or slightly 3- or 4-lobed; uterus may or may not enter ecsoma; eggs 18 to 34 by 8 to 14 μ, usually 20 to 27 by 9 to 12 μ.

Parahemiurus ecuadori, new species

(Plate 46, fig. 104)

Host: Anchoviella sp.

Location: Stomach

Locality: San Francisco, Ecuador
Number: 4 or 5 specimens from a single host

The following diagnosis is based on 2 specimens. The smaller was not quite mature.

SPECIFIC DIAGNOSIS OF PARAHEMIURUS ECUADORI

Body cylindrical, ecsoma well developed, partially or wholly extended, denticulations or rings extend along entire length of body; total length 1.012 to 1.147; body length 0.825 to 0.862; tail on 0.862 body extended (fully) 0.322. Greatest width 0.150 to 0.200. Oral sucker 0.090 to 0.102; acetabulum 0.083 to 0.087; sucker ratio about 5:4; forebody $\frac{1}{5}$ to $\frac{1}{6}$ body length. Pharynx elongate and cylindrical, length almost 3 times width, 0.085 to 0.102 by 0.034 to 0.042; esophagus a short thin-walled sac; ceca extend anteriorly then backward into the ecsoma to near its posterior tip. Genital pore ventral to oral sucker. Testes rounded, diagonal, almost tandem; anterior testis about in middle of hindbody; seminal vesicle postacetabular, a large elongate sac, undivided, thick walled, 0.178 by 0.065 in the mature specimen; pars prostatica S shaped, somewhat shorter than seminal vesicle; sinus sac a slender elongate muscular tube, 0.170 in length (in mature specimen), extending to midacetabular level. Ovary in posterior half of hindbody; vitellaria two large, compact, unlobed masses, side by side, immediately postovarian, near posterior end of body; seminal receptacle small; uterus extends into ecsoma; eggs 14 to 15 by 7 μ.

Discussion. The rapid growth of the genus Parahemiurus dispels any doubt as to its validity once questioned by the writer (Manter, 1934, p. 304). *P. ecuadori* is easily distinguished from all the other species by the fact that the oral sucker is larger than the acetabulum and by its very elongate pharynx. These two characters are so distinct that no further comparisons are necessary.

Dinurus barbatus (Cohn, 1902)

Host: *Coryphaena hippurus* Linn.
Location: Stomach
Locality: Secas Islands, Panama
Number: Several

These common trematodes of Coryphaena occurred in a host only 10 cm in length.

Dinurus longisinus Looss, 1907

Host: *Coryphaena hippurus* Linn.
Location: Stomach
Locality: Secas Islands, Panama
Number: Several

This species was in the same host with *D. barbatus*. Other immature specimens of Dinurus were present but were not sufficiently developed for specific identification.

Elytrophallus mexicanus, new genus, new species

(Plate 46, figs. 105-107)

Hosts: *Lutianus viridis* (Val.) ? (type host)
Paranthias furcifer (Cuv. and Val.)
Epinephelus sp.
Epinephelus labriformis (Jenyns)
Caranx lugubris Poey ?
Zalocys stilbe Jordan and McGregor
Mycteroperca sp.

Location: Stomach

Locality: All collections were from Socorro or Clarion Island, Mexico, except for a few specimens from 2 *Paranthias furcifer* from James Island, Galapagos. The trematode is very common at Socorro and Clarion. Three of 4 specimens of *P. furcifer* contained it in that region, but only 2 of 6 specimens of this same host were infected in the Galapagos region.

Number: Common in the above hosts at Clarion and Socorro islands. Collected there 8 times.

SPECIFIC DIAGNOSIS OF ELYTROPHALLUS MEXICANUS

Body smooth, elongate, cylindrical, with protrusible ecsoma; body itself 1.125 to 2.025 in length, tail may be extended up to 0.487 to make a total length up to 2.323; greatest width 0.292 to 0.487, usually at acetabular level, sometimes near posterior end of body. Forebody 0.232 to 0.435 (about ⅕ body length). Oral sucker subterminal, 0.090 to 0.127 in diameter. Acetabulum circular, 0.244 to 0.397 in diameter. Sucker ratio close to 1:3. Genital pore far anterior, median or submedian, ventral to oral sucker, only a short distance posterior to mouth. Pharynx usually slightly wider than long, 0.039 to 0.053 in length, 0.044 to 0.053 in width; esophagus spherical, saclike, sharply defined, ventral, rather distinct from intestinal ceca which arise from its dorsal side; ceca diverging

then turning posteriorly, sometimes entering ecsoma, sometimes not. Testes subspherical, diagonal, close together, a short distance posterior to acetabulum. Seminal vesicle a thick-walled, elongate or ovoid sac lying close to and overlapping anterior testis; an indistinct tripartite appearance (fig. 106), sometimes evident within the vesicle [a condition similar to that described by Woolcock (1935, p. 321) for *Erilepturus tiegsi*]. Pars prostatica sinuous, usually forming a posterior loop and always overlapping anterior end of vesicle, entirely postacetabular, not reaching appreciably anterior to seminal vesicle; prostatic cells present but not profusely developed. Pars prostatica and a short narrow portion of uterus uniting posterior to acetabulum to form a very long tubular ductus hermaphroditicus or genital sinus enclosed in a sinus sac. Sinus tube almost or quite ⅓ body length, divided into 4 regions as follows: a narrow, almost straight region slightly wider at its base, extending past acetabulum, sinus sometimes with somewhat convoluted inner wall in anterior part of this region, but tube is uncoiled. Just anterior to acetabulum occurs a thin-walled, usually expanded region of the sac within which the muscular sinus tube often becomes greatly coiled (fig. 107). This region is more or less separated by a constriction at its posterior end and sometimes appears to be partially divided near its middle. The penislike sinus tube is very evidently flexible and capable of protrusion; its tip end can usually be seen in this saclike portion of the sac; in a few specimens it is extended into the next anterior and more muscular region. This muscular region of the sac is long and straight, extending almost to the genital pore. It measures 0.127 to 0.170 in length. The fourth region is a short, thin-walled, tubular genital atrium leading to the genital pore.

Ovary ovoid, transversely extended, not far posterior to testes, about in middle of hindbody. Vitelline lobes fairly thick and of medium length, thickened at tips with some slight indication of branching (fig. 105). Seminal receptacle very small, embedded in Mehlis' gland. Laurer's canal lacking. Uterus may or may not send a loop into ecsoma. Eggs thin shelled, elongate, 14 to 17 by 6 to 8 μ. Eggs were seen within the ductus hermaphroditicus and even in the sinus sac outside the ductus. Excretory vesicle forking at base of seminal vesicle; branches uniting dorsal to pharynx.

GENERIC DIAGNOSIS OF ELYTROPHALLUS

Smooth-bodied, tailed Hemiuridae. Subfamily Dinurinae. Acetabulum large, in anterior half of body. Genital pore ventral to oral sucker.

Seminal vesicle ovoid, thick walled, not distinctly divided. Pars prostatica fairly short, sinuous, with prostatic cells moderately developed. Ductus hermaphroditicus exceedingly long with 4 regions more or less evident: a long, straight posterior portion; a thinner-walled distensible portion within which the sinus tube is usually coiled; a straight, very muscular portion within which the sinus tube may be extended; and a thin-walled genital atrium. Vitellaria of 7 rather thick tubes, thicker terminally. Small seminal receptacle present; Laurer's canal absent. Branches of excretory vesicle uniting dorsal to pharynx. Type species: *E. mexicanus*.

The name Elytrophallus is from *elytro* (= sheath) and *phallus* (= penis). It refers to the sheathlike manner in which the sinus sac encloses the sinus tube. The name *mexicanus* is for the locality.

Discussion. This trematode reveals a combination of characters known in several genera. The smooth body, the rather small tail appendage, and the form of the vitellaria all suggest the genus Sterrhurus. But the seminal vesicle, the tubular pars prostatica, and especially the long tubular form of the sinus sac are very different from Sterrhurus. Tubovesicula Yamaguti, 1934 has a smooth body but a larger tail, a very long pars prostatica, and a short pyriform sinus sac. These differences also hold for Culpenurus Srivastava, 1935, a genus which probably should be considered a synonym of Tubovesicula. Lecithocladium Lühe has a long slender sinus sac and a genital pore near the mouth, but it has a ringed body, long tubular vitellaria, and usually a very long pars prostatica. Dinurus Looss has a ringed body, long tubular vitellaria, distinctly tripartite seminal vesicle, and lacks the ventral spherical swelling of the esophagus. Elytrophallus is similar to Erilepturus Woolcock, 1935 in some respects, especially in the seminal vesicle and in that the ringed condition is practically lacking in Erilepturus. Erilepturus, however, has a more posterior acetabulum, a more posterior genital pore, a different pars prostatica which is preacetabular and separated from the seminal vesicle, and a shorter sinus sac. The sphincters of the sinus sac figured by Woolcock seem to divide the common genital tube into somewhat similar but less evident regions, as have been noted in Elytrophallus.

Elytrophallus is perhaps most like Erilepturus. Woolcock correctly minimizes the subfamily significance of cuticular plications or rings. As a consequence it becomes increasingly difficult to separate the Sterrhurinae from the Dinurinae. Elytrophallus is considered in the subfamily Dinurinae chiefly because of the length of the sinus tube, the tubular pars prostatica, and the shape and position of the seminal vesicle.

Mecoderus oligoplitis, new genus, new species

(Plates 46 and 47, figs. 108-110)

Host: *Oligoplites saurus* (Bloch and Schneider)
Location: Stomach and gills
Locality: San Francisco, Ecuador
Number: 10 specimens were collected, 8 from the stomach of one fish, 2 from the gills of another

SPECIFIC DIAGNOSIS OF MECODERUS OLIGOPLITIS

Smooth-skinned, tailed hemiurids with much narrowed, elongated anterior region and short, wide, plump posterior region containing most of reproductive organs. Total length of body including extended portion of ecsoma 5.872 to 7.425; greatest width 0.600 to 1.309. Forebody very short; equally wide, 0.622 to 0.877 in length or somewhat less than $\frac{1}{10}$ total body length. Anterior portion of body slender, flexible, very long, 3.105 to 4.455 in length, always more than half total body length, about equally wide, widening abruptly to form body proper; distance from acetabulum to wide portion of body 2.025 to 3.240. Wide portion of body 1.087 to 2.025. Ecsoma partially extended in most specimens (from 0.810 to 1.433) but always at least partially retracted (wholly so in one specimen). Oral sucker subterminal, large, somewhat longer than wide; 0.277 to 0.420 in transverse diameter. Several pairs of papillae around oral aperture. Posterior edge of mouth with conspicuous lobes, 3 median lobes evident, a smaller lobe on each side sometimes evident; total: 5 lobes. Acetabulum 0.337 to 0.450 in diameter; at least slightly larger than oral sucker; ratio may be up to 3:4.

Pharynx 0.202 to 0.225 in length by 0.165 to 0.195 in width; lateral thickenings of pharynx wall at anterior edge; esophagus subcircular, capable of inflation into a saclike outpocketing or esophageal diverticulum so varying in appearance as to suggest it is an inconstant structure (it is probably an elastic bulb capable of expansion); ceca bow forward slightly, then extend, rather close together, to extreme posterior end of ecsoma, considerably wrinkled and folded in the partially extended ecsoma.

Genital pore an inconspicuous transverse slit opposite middle of pharynx. Testes smooth, subtriangular to ellipsoidal, close together, oblique, at anterior end of widened portion of body. Seminal vesicle a thin-walled sac, immediately anterior to and overlapping anterior testis, at anterior border of widened portion of body. Pars prostatica, surrounded by prostatic cells, coiled or sinuous, rather short, extending only a short distance

into narrow part of body. Vas deferens, without gland cells, very long and straight, extending entire length of narrow part of body (1.2 to 3) to near sinus sac; near its anterior end it is again surrounded by gland cells forming a second pars prostatica. Or, expressed differently, the pars prostatica and prostate gland are divided into two parts by a very long vas deferens. Sinus sac muscular but thin walled, subcylindrical, preacetabular; genital atrium lacking or very small.

Ovary median, kidney shaped, transversely extended, immediately posterior to testes. Mehlis' gland at its posterior border. Seminal receptacle large, dorsal and posterior to Mehlis' gland. Laurer's canal lacking. Vitelline glands in the form of long coiled tubes, 4 on one side, 3 on the other; chiefly lateral but partly ventral; extending in middle half of widened part of body. Uterus coiling backward into ecsoma, then forward; coils in widened body chiefly lateral, extending between vitellaria; coils gradually straighten along left side of seminal vesicle; uterus narrow and straight throughout the long narrow part of body, entering base of sinus sac; metraterm not differentiated. Eggs thin shelled, ovoid, 17 by 8.5 to 10 μ. Excretory vesicle forking anterior to testes; branches uniting dorsal to pharynx.

The name *mecoderus* is from *meco* (= long) and *derus* (= neck). The name *oligoplitis* is for the host.

GENERIC DIAGNOSIS OF MECODERUS

Fairly large Hemiuridae with ecsoma, without cuticular denticulations. Body much elongated with narrow, flattened anterior necklike region and a shorter, widened, plump posterior region containing reproductive organs and ecsoma. Suckers large, close together, distant from reproductive organs. Seminal vesicle a simple thin-walled sac. Prostatic portion of duct divided into a rather short, coiled pars prostatica near the testes and a shorter pars prostatica near the sinus sac, these two regions separated by a very long vas deferens. Vitelline glands tubular and coiled. Seminal receptacle large; Laurer's canal lacking. Sinus sac preacetabular, simple, rather small and weak. Crura of excretory vesicle uniting dorsal to pharynx. Type species: *Mecoderus oligoplitis*.

Comparisons. This hemiurid is unusual in its peculiar body form and in the long stretch of the vas deferens between the testes and the sinus sac. The lobed posterior border of the mouth is also peculiar. The trematode is to be compared to other smooth, tailed forms with tubular vitellaria (i.e., Stomachicola Yamaguti, 1934; Erilepturus Woolcock, 1935; and

Tubovesicula Yamaguti, 1934). Yamaguti has described a species of Lecithocladium without denticulations, but even so the genus differs from Mecoderus in body form, male duct, location of genital pore, and form of sinus sac. Erilepturus has suckers distant from one another and a tripartite seminal vesicle as well as a different body shape. Tubovesicula has a different body shape, a long continuous prostatic gland, tubular seminal vesicle, separated testes, and shorter vitelline lobes. It is, however, probably the most closely related genus. Stomachicola is very different in body form, development of ecsoma, and location of the gonads in relation to the acetabulum.

Sterrhurus fusiformis (Lühe, 1901)

Host: *Muraena clepsydra* Gilbert
Location: Stomach
Locality: Cape Elena, Ecuador
Number: Several specimens in both of 2 hosts examined

These rather large sterrhurids (3.051 to 4.434 in length by 0.864 to 1.067 in width) agree almost perfectly with specimens from *Gymnothorax funefris* Ranzani and *Gymnothorax morinza* (Cuv.) at Tortugas. Linton (1910) reported them from Tortugas. Both the Atlantic and Pacific forms agree in detail with Looss' (1907) description of *S. fusiformis* from *Conger conger* in the Mediterranean except that the eggs are slightly smaller and more narrow. Specimens from both Tortugas and Ecuador have eggs measuring 14 to 18 by 9 to 12 μ as compared with 20 to 25 by 17 to 19 μ reported by Looss.

Lecithochirium microstomum Chandler, 1935

(Plate 47, figs. 111-113)

Hosts: *Calamus brachysomus* (Lockington)
Caulolatilus sp.
Euthynnus alletterata (Raf.)
Paralabrax humeralis (Cuv. and Val.)
Paranthias furcifer (Cuv. and Val.)
Location: Stomach
Localities: Charles Island, Albemarle Island, James Island, Galapagos
Number: This parasite was collected in small numbers from 6 specimens of *P. humeralis,* from 4 specimens of *P. furcifer,* from 1 specimen of *C. brachysomus,* from 1 specimen of *E. alletterata,* and from one specimen of Caulolatilus sp.

Discussion. These specimens were all assigned to a single species in spite of some differences noted in shape and size of the eggs. However, all gradations between the short plump eggs and the narrow bowed eggs could be found in different specimens (fig. 113). Sample measurements (in μ) from different specimens including extremes are: 17 by 14, 19 by 12, 22 by 15, 23 by 13, 22 by 12, 24 by 14, 25 by 11, 25 by 12, 26 by 14, 26 by 13. In the absence of other constant or significant differences these trematodes were considered a single species, *L. microstomum.* This species is easily distinguished from 2 other Lecithochirium species collected, viz., *L. magnaporum* and *L. muraenae.*

While my specimens are somewhat smaller than those described for *L. microstomum* and the egg size somewhat larger, because of the variation in these characters the differences were not considered specific. The details of the sinus sac, the bipartite prostatic vesicle, and the vitelline lobes are as in *L. microstomum.* The United States National Museum kindly loaned the type and paratype specimens of *L. microstomum.* Chandler (1935) states the egg size as 16 by 12 μ, but this seems to vary up to 19 by 10 to 12 μ.

The question of sucker ratio does not help much in distinguishing *L. microstomum, L. synodi* Manter, 1931, and my specimens. Chandler gives 1:2.5 to 1:2.8 for *L. microstomum* and in the type specimen it is 1:2.5. Over a dozen specimens of *L. synodi* show a ratio usually about 1:1.33 but ranging from only about 1:2 up to 1:2.5. In other words, the ratio in *L. synodi* ranges from 1:2.5 somewhat downward, while in *L. microstomum* it is 1:2.5 to somewhat above. My Galapagos material is more like *L. synodi,* the sucker ratio being usually about 1:1.33, but it may be fully 1:2.5 or slightly above. Thus, all three species may meet at a sucker ratio of 1:2.5. *L. magnaporum* has a fairly distinctly smaller ratio varying on either side of 1:2, while *L. japonicum* is distinctly different in its 1:3 or 1:4 ratio. *L. exodicum* is like *L. microstomum* in this ratio.

A restudy of specimens of *L. synodi* reveals an error in the description in that a bipartite prostatic vesicle is present. It is, however, usually very indistinct. The anterior portion is very small and cylindrical, usually appearing rudimentary and sometimes appearing absent. The posterior portion is larger and cylindrical but smaller than in *L. microstomum.* In spite of the removal of these supposed differences between *L. synodi* and *L. microstomum,* I believe that *L. synodi* is specifically distinct. It has a sinus sac that is almost cylindrical and not enlarged at its base. Its ductus

hermaphroditicus is very wide and more muscular. Its eggs are smaller and wider, and the cell pad around the presomatic pit is much better developed. *L. synodi* does not seem to possess the sphincter of the metraterm described for *L. microstomum* and *L. japonicum*.

Lecithochirium magnaporum, new species

(Plate 47, figs. 114-116)

Hosts: *Paralabrax humeralis* (Cuv. and Val.)
Euthynnus alletterata (Raf.)
Seriola dorsalis (Gill)
Epinephelus sp. ?

Location: Stomach

Locality: Galapagos Islands (Charles Island, Albemarle Island, Hood Island)

Number: 20 specimens were collected from 5 hosts. A single specimen in *Seriola dorsalis,* in Epinephelus (?), and in one *Paralabrax humeralis.* In the other 2 collections the trematode occurred with *Lecithochirium microstomum.* 6 specimens were collected from one *Paralabrax humeralis* and 11 specimens from *Euthynnus alletterata.*

SPECIFIC DIAGNOSIS OF LECITHOCHIRIUM MAGNAPORUM

Length 1.404 to 1.728; greatest width 0.337 to 0.450. Oral sucker 0.135 to 0.150 in diameter; acetabulum 0.262 to 0.292 in diameter; sucker ratio approximately 1:2, or acetabulum may be slightly less than twice diameter of oral sucker. Forebody 0.240 to 0.420. Ecsoma almost always completely retracted. Pharynx usually slightly wider than long; 0.054 to 0.075 in length, 0.063 to 0.073 in width; esophagus very short; ceca usually not entering ecsoma. Presomatic pit muscular, its aperture a transverse slit. Genital pore opposite base of pharynx, large, conspicuous; with a narrow transverse slit similar to aperture of pit; provided with conspicuous radial muscles. Testes diagonally oblique, just posterior to acetabulum. Seminal vesicle tripartite, overlapping acetabulum. Prostatic cells surrounding male tube (pars prostatica) just before it enters sinus sac. Sinus sac thin walled, very large, wider than long, 0.060 to 0.102 in length, 0.094 to 0.153 in width. Prostatic vesicle pyriform, entirely inside sinus sac. Ovary transversely extended. Vitelline lobes digitiform. Uterus may, but usually does not, enter ecsoma. Eggs tapering somewhat toward each end but more abruptly toward one end so that they are widest toward one end of the middle; size 15 to 19 by 8 to 9 μ.

The name *magnaporum* refers to the large, conspicuous genital pore.

Comparisons. Although the same size as *Lecithochirium microstomum* with which it frequently occurs, *L. magnaporum* can be identified by its large genital pore, very large sinus sac, and smaller eggs with pointed ends. The ventral sucker is slightly smaller and the prostatic vesicle is not bipartite. It differs from *L. exodicum* in longer vitelline lobes and smaller body size. It differs from *L. japonicum* in genital pore, size and shape of the sinus sac, absence of external prostatic vesicle, and much smaller ventral sucker.

Lecithochirium muraenae, new species

(Plate 48, figs. 117, 118)

Host: *Muraena clepsydra* Gilbert

Location: Stomach

Locality: Cape Elena, Ecuador

Number: 2 specimens of this moray were examined. Several specimens of what seemed to be the same hemiurid occurred in each host. The parasites were placed in the same vial. Upon study 3 specimens proved to be *L. muraenae,* the others *Sterrhurus fusiformis.* The 2 species of parasites probably can occur together in this host.

SPECIFIC DIAGNOSIS OF LECITHOCHIRIUM MURAENAE

Body rather thick and robust, 3.684 to 5.359 in length by 0.958 to 1.120 in greatest width (near middle). Ecsoma glandular, much folded, retracted in every specimen, much as in *Sterrhurus fusiformis.* Oral sucker subterminal, surmounted by fleshy lip, somewhat wider than long, 0.300 to 0.375 in transverse diameter; acetabulum large, circular, 0.715 to 0.883 in diameter; sucker ratio approximately 3:7. Forebody 0.756 to 1.188. Presomatic pit about midway between suckers, suckerlike, 0.225 to 0.255 in diameter, with radial and circular muscles, nonglandular, with small irregularly shaped pore. Genital pore median, a short distance anterior to presomatic pit. Pharynx 0.120 to 0.170 in length by 0.075 to 0.120 in width; esophagus apparently lacking; ceca slightly sinuous, extending to level of base of ecsoma but not entering ecsoma. Testes oblique (almost symmetrical), immediately posterior to acetabulum, separated by uterus. Seminal vesicle thin walled, not distinctly divided into 3 parts, making 3 more or less distinct loops before straightening to enter sinus sac, thus being approximately S shaped; posterior end of seminal vesicle

overlapping acetabulum. Prostate gland conspicuous, fan shaped, at base of sinus sac. External prostatic vesicle lacking. Sinus sac thin walled, very broad, filling most of the intercecal space anterior to acetabulum, tapering very little anteriorly and still less posteriorly, both ends broadly rounded, 0.270 to 0.300 in length by 0.225 to 0.255 in width. Spherical, internal, prostatic vesicle, near base of sinus sac. Genital sinus very wide; its wall thrown into peculiar longitudinal folds (fig. 118); when contracted, almost as wide as long. Most of sinus sac filled with very thin-walled, transparent cells. Anterior end of sinus may be protruded lobelike from genital pore.

Ovary smooth, ovoid, to the left, about midway between acetabulum and base of ecsoma. Vitelline lobes short and thick, almost spherical, each narrowed at its base; group of 3 facing laterally; group of 4 facing ventrally. Uterus not extending beyond base of ceca, not entering ecsoma; surrounded by gland cells opposite posterior half of acetabulum; metraterm opposite anterior half of acetabulum, joining sinus sac just anterior to prostatic vesicle. Eggs thin shelled, 15 to 19 by 10 to 12 μ. Excretory vesicle sinuous, forking between testes just posterior to acetabulum, branches uniting dorsal to pharynx.

The name *muraenae* is for the host.

Comparisons. The sharply defined, muscular, nonglandular presomatic pit is different from such organ found in other species of the genus. Other distinctive characters are the large size and great width of the sinus sac and the peculiar longitudinal folds or rugae in the walls of the sinus. The vitelline lobes are shorter than in *L. synodi* or *L. microstomum*.

Derogenes varicus (O. F. Müller, 1784)

Hosts: *Paralabrax humeralis* (Cuv. and Val.)
Cratinus agassizii Steindachner
Location: Stomach
Locality: Tagus Cove, Albemarle Island, Galapagos
Number: One specimen in each of the above hosts

These 2 new host records for this cosmopolitan trematode bring its total known hosts to at least 59. Although the distribution of *D. varicus* is wide, the species has not yet been reported from tropical waters except at some depth. Manter (1934, p. 318) suggests that temperature is an important factor in its distribution, since he found it rather common at Tortugas at depths of 190 fathoms and more, but did not find it in

shallow water. The above records do not constitute clear evidence against such a view, since the temperature of the water at Tagus Cove is approximately 68° F.

A specimen of a Derogenes species which may be *D. varicus* was collected from an unidentified flounder dredged at Bahia Honda, Panama. The exact depth from which this fish was secured is not available, but no very deep hauls were made. If this specimen actually is *D. varicus,* it occurs in rather warm water. However, eggs in this specimen were 68 to 69 by 27 to 29 μ, which is markedly larger than the 51 to 56 by 29 to 31 size of specimens from Tagus Cove. Egg size in *D. varicus* is evidently variable, records varying from 51 to 66 by 28 to 40 μ. Since the Panama specimens (2) exceed even these limits, it is identified merely as Derogenes species.

Theletrum lissosomum, new species

(Plate 48, figs. 119-121)

Host: Unidentified angelfish
Location: Stomach
Locality: Socorro Island, Mexico
Number: 7 from one fish, one from another

SPECIFIC DIAGNOSIS OF THELETRUM LISSOSOMUM

Body smooth, elongate, cylindrical, without ecsoma, with ventral papillae. Length 2.916 to 3.699; greatest width 0.216 to 0.499. Forebody 0.607 to 0.712 (about $\frac{1}{5}$ body length), tapering slightly to a rounded end. Hindbody almost equally wide, posterior end bluntly rounded, almost truncate. Oral sucker subspherical, 0.180 to 0.195 in transverse diameter. Acetabulum 0.255 to 0.300 in transverse diameter, somewhat longer than wide, with longitudinal aperture. Sucker ratio approximately 2:3. Pharynx 0.085 to 0.111 in length by 0.080 to 0.099 in width; esophagus short, with small ventrally directed esophageal diverticulum; intestinal bifurcation nearer oral sucker; ceca rather wide, extending to extreme posterior end of body beyond uterine coils. Genital pore median, varying from opposite middle of pharynx to opposite intestinal bifurcation. Testes globular, oblique, ventral to ceca, about halfway between acetabulum and ovary, separated by uterus. Seminal vesicle inconspicuous, tubular, sinuous; its posterior end near anterior edge of acetabulum. Prostatic gland well developed; pars prostatica almost straight, shorter than seminal vesicle, near intestinal bifurcation. Sinus

sac small, cylindrical to pyriform in shape; its tip can be projected as a small genital papilla into a very shallow genital atrium (fig. 120). Male duct and uterus entering sac separately, uniting near middle of sac to form the short, tubular genital sinus (fig. 120).

Ovary transversely extended, more or less median, about in middle of hindbody. Seminal receptacle chiefly anterior to ovary. Three compact vitellaria immediately posterior to ovary; anterior pair side by side, connected by a narrow isthmus; single, larger, bilobed posterior vitellarium directly posterior to anterior pair and more or less median. Uterus coiling backward some distance but not reaching posterior end of body; nearly straight in region of acetabulum. Eggs thin shelled, elongate, 26 to 34 by 9 to 15 μ. Excretory pore ventral, a short distance in front of posterior end of body; branches of vesicle unite dorsal to oral sucker.

The name *lissosomum* is from *lisso* (= smooth) and *somum* (= body) and refers to the absence of the ventral papillae.

Discussion. The genus Theletrum was named by Linton in 1910 for a single specimen of a trematode collected from the black angelfish, *Pomacanthus arcuatus,* from Tortugas, Florida. A few specimens have been collected there by the writer. The genus was named for the peculiar cutaneous papillae posterior to the acetabulum. These are lacking in *T. lissosomum* and are considered here as being a specific rather than a generic character. *T. lissosomum* is fundamentally similar to *T. fustiforme* especially in the reproductive systems. Linton's description and figure are incorrect in the so-called "cirrus sac," which is actually a typically hemiurid sinus sac. The 3 vitellaria and their arrangement are probably prime generic characters, although in my Florida material these vitellaria are sometimes so crowded together as to appear like one.

The following generic diagnosis is proposed.

GENERIC DIAGNOSIS OF THELETRUM LINTON, 1910

Elongate, cylindrical hemiurids, without ecsoma; body smooth or with ventral papillae, without denticulations, posterior end broadly rounded or truncate. Acetabulum anterior to midbody. Intestinal ceca extending to posterior end of body. Genital pore near intestinal bifurcation. Sinus sac cylindrical or pyriform; seminal vesicle tubular, preacetabular; testes diagonal, separated from one another and from the ovary by the uterus. Ovary posttesticular; seminal receptacle present; vitellaria postovarian, 3 in number, 2 side by side and one median and posterior.

Eggs without filaments. Excretory pore ventral, excretory crura uniting near oral sucker. Type species: *T. fustiforme* Linton, 1910.

This genus is to be classified in the subfamily Derogeninae.

T. lissosomum is very clearly distinct from *T. fustiforme*. Among the differences are: sucker ratio 2:3 rather than 1:2, more anterior ovary, smaller sinus sac, larger prostatic gland, less coiled and smaller seminal vesicle.

Although the two species occur in different oceans, both occur in angelfishes.

Theletrum gravidum, new species

(Plate 49, figs. 122, 123)

Host: *Abudefduf saxatilis* (Linn.)
Location: Usually in the stomach, sometimes in the intestine
Localities: Socorro and Clarion islands, Mexico
Number: Collected from 4 hosts; 2 to 5 specimens in each host

SPECIFIC DIAGNOSIS OF THELETRUM GRAVIDUM

Body smooth, cylindrical, rounded at each end, somewhat more tapering at anterior end, posterior end usually broadly rounded, 1.566 to 2.443 in length by 0.465 to 0.667 in greatest width. Forebody 0.405 to 0.547 or about ¼ to ⅕ body length. Oral sucker subspherical, 0.150 to 0.202 in diameter. Acetabulum 0.262 to 0.375 in transverse diameter, slightly longer than wide, slightly less than twice diameter of oral sucker, with longitudinal aperture. Pharynx subspherical, 0.068 to 0.076 long by 0.066 to 0.082 wide; esophagus represented by a spherical ventral diverticulum; intestinal diverticulum nearer oral sucker; ceca wide, extending to near posterior end of body but not posterior to uterus. Genital pore median, opposite esophagus. Testes rounded, diagonal, just anterior to middle of hindbody, separated by and largely covered by uterus. Seminal vesicle tubular, sharply bent once, not quite reaching acetabulum. Prostatic gland compact, subspherical, about same length as sinus sac. Short prostatic vesicle just outside sinus sac. Sinus sac more or less cylindrical, inconspicuous, opposite intestinal bifurcation. Ovary just posterior to middle of hindbody, ovoid, transversely extended. Seminal receptacle large, subspherical, partly anterior and partly dorsal to ovary. Three compact vitellaria as in other species of the genus; posterior vitellarium unlobed. Uterus voluminous with saclike coils too wide and irregular to be traced, covering most organs and reaching to tips of ceca or beyond. Eggs

elongate, 24 to 29 by 10 to 12 μ, usually about 25 by 10 μ. Excretory pore subterminal and ventral; branches of vesicle uniting dorsal to esophagus.

The name *gravidum* refers to the extensive development of the uterus.

Comparisons. This species is the third to be named in the genus. It is more like *T. lissosomum* than like *T. fustiforme*. It differs from *T. lissosomum* in smaller size, in extent of the uterus, in more compact prostate gland, in unlobed posterior vitellarium, in shape of the seminal vesicle, and in slightly smaller eggs.

T. lissosomum and *T. gravidum* are both from Socorro Island, Mexico, while *T. fustiforme* is from Florida. *T. gravidum* was not collected from the Galapagos Islands.

Aponurus trachinoti, new species

(Plate 49, figs. 124, 125)

Host: *Trachinotus rhodopus* (Gill)
Location: Stomach
Locality: Tenacatita Bay, Mexico
Frequency: One specimen collected from one of hosts examined

The single specimen is a typical member of the genus Aponurus, and only a diagnosis is necessary for its characterization.

DIAGNOSIS OF APONURUS TRACHINOTI

The body is elongate, subcylindrical, 1.120 by 0.262; both ends rounded and somewhat tapered, but forebody more tapered than hindbody. Oral sucker 0.088; acetabulum 0.155; ratio not quite 1:2. Forebody (extended) 0.352 or almost ⅓ body length. Genital pore opposite posterior half of pharynx. Pharynx 0.042 long, 0.051 wide. Esophagus short; ceca extending only slightly beyond the vitellaria. Testes oblique almost tandem a short distance posterior to acetabulum. Seminal vesicle an elongate, almost straight tube, 0.102 in length; pars prostatica curved dorsally in a bow; sinus sac pyriform, 0.093 long, 0.051 wide. Ovary about in middle of hindbody; vitellaria in a group of 4 and a group of 3 rounded masses; seminal receptacle medium sized, anterior to ovary, between ovary and posterior testis; uterus filling most of hindbody; eggs pyriform, widest at or near one end, tapering almost to a point at the other end, 25 μ long, 10 μ greatest width.

The specific name is for the host.

Comparisons. This species of Aponurus is unique in the size and especially in the shape of the eggs. The eggs of *A. sphaerolecithus* are more

than twice as big. *A. trachinoti* seems to be most similar to *A. laguncula,* but the eggs are not nearly so wide and have a different shape, and the pars prostatica is somewhat longer and curved. *A. rhinoplagusiae* has a larger seminal receptacle, 1:3 sucker ratio, larger eggs, and longer ceca. *A. brevicaudatus* remains distinct in posterior ovary and vitellaria and in position of genital pore. *A. intermedius* has different eggs, more spherical sinus sac, and more symmetrically placed testes.

A. vitellograndis Layman, 1930 needs a more complete description. Because an ecsoma was figured and described, the species was considered in the genus Sterrhurus by Manter (1934). Yamaguti has collected it and reports an ecsoma lacking. He states it belongs in the genus Aponurus. *A. trachinoti* differs from it in the same way as from *A. laguncula.* Layman figures the vitellaria of *A. vitellograndis* as pointed medianly, more as in Lecithaster. The shape and size of the vitellaria seem to be the only differences between *A. laguncula* and *A. vitellograndis.* The two species should be compared more fully.

Leurodera pacifica, new species

(Plate 49, figs. 126, 127)

Hosts: *Anisotremus interruptus* (Gill)
Anisotremus scapularis (Tschudi)

Location: Stomach

Locality: Galapagos Islands (Albemarle, James, Charles islands)

Number: From one to 5 specimens in each of 4 hosts

SPECIFIC DIAGNOSIS OF LEURODERA PACIFICA

Body tongue shaped, somewhat flattened, broadest near posterior end, length 1.215 to 2.632, greatest width 0.513 to 1.012. Forebody tapering, 0.540 to 1.013; posterior end of body broadly rounded. Oral sucker 0.157 to 0.280, subcircular, subterminal. Acetabulum at or slightly posterior to midbody, 0.337 to 0.637 in diameter, aperture circular. Sucker ratio approximately 1:2 or 2:5. Pharynx 0.102 to 0.153 in length by 0.078 to 0.133 in width; esophagus very short (often not evident); ceca more or less undulating, extending to posterior end of body, bowing outward near acetabulum, inward at testicular level and again outward near widest portion of body, bending medianly toward one another near posterior end. A pair of conspicuous muscle bands extends from sides of pharynx diagonally outward and backward. Another shorter pair extends

diagonally backward from sides of oral sucker. Genital pore a muscular, transverse slit opposite base of pharynx.

Testes rounded, smooth, symmetrical, far apart, wholly or chiefly extracecal, a short distance posterior to acetabulum. Seminal vesicle sometimes inconspicuous, a more or less straight tube extending from pars prostatica to acetabulum. Prostate gland large, free in parenchyma, filling intercecal space from immediately dorsal and posterior to sinus sac almost halfway to acetabulum, surrounding a finely tubular pars prostatica and small spherical prostatic vesicle. Sinus sac large, ovoid, thick walled, a little larger than pharynx, overlapping intestinal bifurcation, containing in its basal half a tubular, thick-walled portion of the genital sinus, in its anterior half a more or less spherical portion of the duct with radiating muscles.

Ovary globular, smooth, median, halfway between testes and posterior end of body. Flask-shaped seminal receptacle to right of ovary, extending anteriorly. Mehlis' gland just posterior to seminal receptacle at right posterior border of ovary. Two large, compact vitellaria, smooth or with only slightest indication of lobing, directly to the right of ovary, one diagonally posterior to the other; anterior vitellarium more globular and chiefly extracecal, partly ventral to right cecum; posterior vitellarium more elongate, median to cecum, and largely posterior to ovary. Uterus extending backward to a level opposite posterior edge of hind vitellarium, then forward in transverse coils, straightening opposite acetabulum, again coiling between acetabulum and sinus sac. Eggs 31 to 37 by 10 to 15 μ.

Excretory pore subterminal; excretory vesicle at first wide, then abruptly narrowing and bending to the left as if it were a left branch, then extending forward dorsally, forking opposite anterior ends of testes. The two crura diverge to pass lateral to acetabulum. Anterior to acetabulum they become greatly inflated and convoluted, filling body lateral to ceca and overlapping ceca. One of these folds on each side is longer than the others and corresponds to the pronounced bend of these organs in *Leurodera decora*. The crura unite dorsal to the oral sucker.

The name *pacifica* is for the locality.

Comparisons. This species is very similar to the Atlantic form and is the only other species yet known in the genus. It differs from *L. decora* in more broadly rounded posterior end, more anterior genital pore, larger prostate gland, in slightly larger acetabulum, in unlobed vitellaria, in the intercecal position of the posterior vitellarium, and in slightly smaller eggs. While the crura of the excretory vesicle are more inflated in *L.*

pacifica, both species show at least one conspicuous loop of each crus in the forebody.

The two species occur in closely related hosts in the two oceans and can be considered as examples of "twin species."

The only other species in the genus Leurodera is *L. decora* Linton, 1910, common in Haemulon species at Tortugas, Florida. This species has been studied by the writer and since some details of Linton's description are incorrect and no diagnosis for the genus has been given, the following diagnosis of Leurodera is proposed.

LEURODERA Linton, 1910

Smooth-bodied hemiurids, without ecsoma, subfamily Derogeninae. Acetabulum in or posterior to midbody. Genital pore near intestinal bifurcation. Testes symmetrical, far apart, largely extracecal. Sinus sac ovoid, muscular, containing a muscular ductus hermaphroditicus and genital atrium. Prostatic vesicle external; seminal vesicle tubular. Ovary median, posttesticular; seminal receptacle present; vitellaria compact, oblique, to right of ovary; uterus extending a short distance posterior to ovary but not posterior to posterior vitellarium; eggs without filament. Excretory vesicle forking posterior to acetabulum; the excretory crura folded in loops anterior to acetabulum, uniting dorsal to oral sucker. Type species: *Leurodera decora* Linton, 1910.

Gonocercella pacifica, new genus, new species

(Plate 49, fig. 128)

Host: *Trachinotus rhodopus* (Gill)
Location: Stomach
Locality: Port Utria, Colombia
Frequency: A single specimen from one of the hosts examined

SPECIFIC DIAGNOSIS OF GONOCERCELLA PACIFICA

Body cylindrical, thick skinned, smooth except for flexture wrinkles, rounded at each end, tapering only slightly from the acetabular region, ecsoma lacking. Acetabulum posterior to midbody. Total length of body 3.604, of which 2.173 is forebody (anterior to acetabulum); greatest width, at acetabular level, 0.972. Oral sucker subterminal, subspherical, slightly longer than wide, 0.405 in transverse diameter. A distinct large papilla or small lobe projects on the ventral surface of the anterior

end immediately anterior to oral sucker. Acetabulum subspherical, 0.622 in diameter; sucker ratio approximately 2:3. Pharynx close to oral sucker, 0.165 long and 0.150 wide; short esophagus bearing a rather long ovoid ventral diverticulum; ceca extending rather close together to posterior end of the body where they do not unite. Genital pore median, a short distance posterior to intestinal bifurcation. A nipplelike genital papilla can be seen within the genital atrium. It is actually the tip of a large muscular genital cone measuring 0.119 in length and 0.093 at its broad base. (This genital cone is similar to that found in Derogenes and related genera.) Prostatic vesicle very large, ovoid, 0.240 long and 0.180 wide, largely filling intercecal space at that level, surrounded by a few prostatic cells and serving as both prostatic vesicle and pars prostatica; seminal vesicle a coiled tube overlapping posterior part of prostatic vesicle, extending only a short distance posterior to it. It makes one diagonal hairpin loop and is bent sharply at each end. The testes are large, immediately postacetabular, diagonal, in contact with one another, overlapping at least one cecum. Ovary immediately posttesticular, somewhat wider than long, unlobed, overlapping both ceca ventrally; vitellaria two small compact masses, unlobed, immediately postovarian, side by side, overlapping the ceca ventrally; uterus not extending posterior to ovary, in short more or less lateral coils, overlapping the ceca at first dorsally then ventrally; seminal receptacle apparently lacking; normal eggs not present in type specimen, very thin-shelled eggs of extremely variable size present, no filaments visible, probable usual size about 34 by 15 μ. Crura of excretory vesicle unite dorsal to pharynx.

This trematode is unique especially in the male terminal genital organs and seems to warrant a new genus of the family Hemiuridae, subfamily Derogeninae. The following diagnosis is proposed.

GENERIC DIAGNOSIS OF GONOCERCELLA

Smooth bodied, cylindrical hemiurids of fairly large size, without ecsoma; acetabulum posterior to midbody; ceca do not unite; genital pore near or posterior to intestinal bifurcation; testes preovarian, postacetabular, diagonal, close together; seminal vesicle a coiled tube far anterior to acetabulum; prostatic vesicle very large, surrounded by prostatic cells; genital cone large and muscular, projecting into a spacious genital atrium; ovary ovoid, posttesticular; vitellaria two unlobed masses, postovarian; seminal receptacle lacking; uterus not extending posterior to ovary. Type species: *Gonocercella pacifica.*

The name Gonocercella indicates the resemblance of the genus to Gonocerca Manter, 1925. The specific name refers to the geographical region.

Discussion. The most distinctive characters of this genus are the large prostatic vesicle and location of the prostatic gland around it, and the coiled tubular seminal vesicle. The genus differs from Derogenes in these characters and in the preovarian uterus. It differs from Progonus in that the ceca do not unite, from Liopyge in the preovarian position of the testes, from Genarchopsis in the separated ceca and nonfilamented eggs. It has the esophageal pouch (at least, in *G. pacifica*) of Ophiorchis, but the ceca do not unite and the eggs are nonfilamented. In general appearance it is much like Gonocerca, especially in the short hindbody crowded with reproductive organs and in the preovarian uterus. But in Gonocerca the ovary is pretesticular, and the seminal vesicle and prostatic vesicle are different.

At least one other species of Gonocercella occurs in the Atlantic. Linton in 1905 described a peculiar distome from *Trachinotus carolinus* at Beaufort, North Carolina (Linton, 1905, p. 367 and fig. 204). He did not name this trematode but referred to it as "Distomum sp." Linton confused gland cells in the cortical parenchyma as vitellaria, and classification of the species has been impossible from his description. His figure clearly shows the large prostate gland, coiled seminal vesicle, and the same arrangement of organs (except the vitellaria) found in Gonocercella. The "lobed" ovary described by Linton evidently is an ovary with closely applied vitellaria. The writer has collected at Tortugas, Florida, from *Monacanthus hispidus* (Linn.) a specimen (not quite mature) very probably of the same species as Linton's. Its immaturity is perhaps due to the probable abnormal host. In any case, the Atlantic specimens are congeneric with but specifically distinct from the Pacific form. The name *Gonocercella atlantica,* new species is proposed for Linton's "Distomum sp." (Linton 1905, p. 367) with the specific characters noted by him. A further account of this species will be given in a later paper.

Hirudinella clavata (Menzies, 1791)

Host: *Gymnosarda alletterata* (Raf.)
Location: Stomach
Locality: Hood Island, Charles Island, Galapagos
Number: 2 from one host, one from another

Identification of this species was made on the size and shape of the body, on the separate sex openings on the genital papilla, and on egg size (31 by 23 μ). Specific identification is difficult in this group. While *G. alletterata* is apparently a new host, this trematode is known from a number of related fishes.

Hirudinella beebei Chandler, 1937

Host: *Acanthocybium solandri* (Cuv. and Val.)
Location: Stomach
Locality: Galapagos Islands
Number: Several collected; usually one to 3 present in a host

These giant trematodes, probably the largest species known, have been reported from the wahoo *(Acanthocybium petus)* by Chandler (1937) and from *A. solandri* from Bermuda and Yucatan by Nigrelli and Stunkard (1937). The author has a specimen collected by Dr. A. O. Foster from *A. solandri* from Panama Bay. The trematode evidently has a wide distribution in both oceans.

Living specimens when extended (stretched) attained a length of 125 mm, when contracted only about 40 mm. My largest preserved specimen is 65 mm, the same length reported by Nigrelli and Stunkard.

Syncoeliidae Dollfus, 1923

Paronatrema mantae, new species

(Plate 50, figs. 129-133)

Host: *Manta birostris* (Walbaum)
Location: External, on the skin
Locality: Bahia Honda, Panama
Number: 4 specimens

This trematode furnishes additional data on the little-known genus Paronatrema Dollfus, 1937. From its study, the following generic diagnosis is proposed.

GENERIC DIAGNOSIS OF PARONATREMA

Syncoeliidae. Large-sized distomes with unspined skin; suckers large, forebody narrow, hindbody wide. Acetabulum with a ring of small accessory suckers; a ring of accessory suckers may also occur in oral sucker. Glands in forebody. Intestinal ceca sinuous, probably opening into ex-

cretory vesicle. Genital pore opposite pharynx. Testes tubular, irregularly segmented, in region immediately postacetabular; vasa efferentia swollen; vas deferens coiled, tubular; prostatic cells free; no cirrus or cirrus sac; genital atrium large. Ovary globular (or follicular ?), posttesticular; uterus very well developed, extending to near posterior end of body, in many narrow transverse coils filling most of hindbody and covering all organs, only slightly coiled in forebody; uterine seminal receptacle present; vitellaria tubular or more or less segmented into elongate follicles, anterior and posterior to ovary. Eggs small, thick shelled. Excretory vesicle short; lateral collecting tubes bend posteriorly to posterior end of body, then extend coiling to extreme anterior end, forming a ring (with branches) around the anterior edge of oral sucker. Type species: *P. vaginicola* Dollfus, 1937.

SPECIFIC DIAGNOSIS OF PARONATREMA MANTAE

Length 17.5 to 19.8; greatest width (just posterior to acetabulum) 4.18 to 4.61. Forebody 6.68 to 7; hindbody 6.3 to 8.4. Oral sucker 1.809 to 1.971 in transverse diameter, with an internal ring of 41 to 47 accessory suckers. Acetabulum 3.064 to 3.591 in transverse diameter; sucker ratio approximately 1:2. Acetabulum with a ring of 29 to 37 accessory suckers. Pharynx 1.147 to 1.215 long by 0.634 to 0.815 wide. Esophagus lacking or very short; ceca bending anteriorly to midpharynx level where small cecal pouches (the "Drusenmagen" of Buttel-Reepen, Muhlschlag, and Odhner) occur; ceca sinuous. Genital pore submedian, opposite anterior edge of pharynx. Testes irregularly tubular, more or less segmented, from posterior edge of acetabulum halfway to ovary; seminal vesicle sinuous from atrium to midacetabulum; prostatic gland from base of atrium to slightly posterior to pharynx. Ovary median, smooth, globular; shell gland at posterior edge of ovary; vitellaria irregularly tubular, fragmented, from posterior edge of testes to near posterior end of body, becoming segmented posteriorly; uterus very long with many transverse coils, filling most of body from one side to the other, covering ceca and other organs; eggs with very thin shells until near the acetabulum, then with very thick shells, 24 to 25.5 by 19 to 22 μ; metraterm projecting into atrium; atrium ovoid, thick walled, with external muscles. Excretory pore terminal, vesicle short and wide; lateral tubules directed backward to posterior end (fig. 132), then (in sinuous curves and with branches) forward to extreme anterior end where they are connected by a sinuous branched ring around the anterior end of oral sucker.

The name *mantae* is for the generic name of the host.

Comparisons. This species differs from *P. vaginicola* in possessing accessory suckers in the oral sucker, in anterior extent of vasa efferentia, in more anterior genital pore, in shape of the genital atrium, in posterior extent of the testes, and, if Dollfus' identification of the ovary is correct, in the shape of the ovary.

Discussion. The genus Paronatrema was named by Dollfus in 1937 from two immature specimens from the oviduct of Squalus (?) sp. from New Guinea. Dollfus named the genus and the species *(P. vaginicola)* tentatively because of the scarcity and immaturity of the material. He noted relationships to the genus Otiotrema. The writer agrees with such indicated relationship and includes Paronatrema in the family Syncoeliidae.

The location of the trematodes on the surface of the ray (a large selachian approximately 14 feet in diameter) is unusual for a distome. The sex of the host was not recorded, and the reproductive ducts were not examined. It is quite possible that the specimens collected had migrated from the oviducts.

The peculiar accessory suckers arranged in a ring around the periphery of the acetabulum were noted by Dollfus. In *P. mantae* their numbers in 3 specimens are 29, 34, and 37, respectively. Each accessory sucker (fig. 131) is a subspherical body (muscular) with the free end cup shaped. Each is attached at the angles formed by a scalloping of the muscular border of the acetabulum.

A similar ring of small accessory suckers occurs just within the mouth cavity near the edge of the oral aperture. The anterior edge of the body surmounting the oral sucker is irregularly scalloped or indented, but the ring of suckers is internal just within the oral cavity. The number of these suckers is 41, 45, and 47 in 3 specimens. As compared with the acetabular suckers they are smaller, more numerous, and of different shape. They are flat, cuplike, pedunculated structures (fig. 130). They were not described for *P. vaginicola.*

The tips of the ceca come in very close association with the excretory vesicle. Dollfus suspected the ceca connected with the vesicle, and all my specimens suggest the same thing. Not even good frontal sections, however, conclusively show such a connection. The tip of each cecum becomes very thin at a spot in contact with the vesicle, and there is probably a fine connection.

The excretory system is peculiar in the backward direction of the collecting tubes which then coil forward, giving off some branches. The peculiar circumferential ring around the anterior edge of the oral sucker is clearly evident as are the short coiled, blunt branches it gives off.

The uterus is remarkably developed and obscures almost all other organs. It is surprising to find such a small ovary producing so many thousands of eggs.

Aporocotylidae Odhner, 1912

Psettarium tropicum, new species

(Plate 50, figs. 134-136)

Host: *Cheilichthys annulatus* (Jenyns)

Location: Recovered from washings of the coelom and once from the intestine. Probably originally in the blood vessels

Locality: San Francisco, Ecuador

Number: 3 specimens, 2 incomplete, from a single host

SPECIFIC DIAGNOSIS OF PSETTARIUM TROPICUM

Body flat, thin, elongate, spined, 3.483 in length by 0.412 in greatest width, tapering slightly toward each end, almost equally wide along most of body length. Spines along edge and extending inward dorsally or ventrally a short distance; near anterior end spines in short transverse rows, lateral and partly dorsal, each row containing about 12 small pointed spines which tend to fuse at edge of body to form a narrow blade. Posteriorly, the rows of spines become single bladelike spines. Not far from posterior end, the rows may extend onto ventral surface and again be composed of small, separated spines as in anterior region. Right unilateral lobe about 0.3 long at posterior end of body. Suckers lacking. Mouth terminal; esophagus 0.877 long or about ¼ body length, slightly sinuous; glandular cells around base of esophagus; anterior ceca about 0.112 long; posterior ceca about 1.728 long; about 0.9 or slightly over ¼ body length is posterior to intestinal ceca.

Testes diffuse, indistinct, with boundaries too indefinite to allow counting; small, irregular mass of testicular tissue (almost indistinguishable from vitellaria) in median, intercecal region of body. (Such indistinct testes seem to occur in related forms such as *Psettarium japonicum*.) Vas deferens slightly sinuous, becoming opposite posterior indentation of body a simple elongate seminal vesicle (fig. 135); cirrus sac weakly

developed, thin walled, nonmuscular, 0.076 by 0.019, containing very few prostatic cells. Male pore dorsal, to the right, a little posterior to lateral lobe of body. Ovary median, consisting of 2 fan-shaped lobes, a short distance anterior to lateral indentation of body; more or less porous and meshlike (as in some cestodes). Oviduct straight, extending directly backward to a level opposite male pore where it is joined by the single yolk duct; middle region of oviduct swollen to form a seminal receptacle (fig. 135). After union with vitelline duct the oviduct turns forward and enlarges to form the oötype. Mehlis' gland not clearly delimited but perhaps represented by glandular cells filling much of posterior end of body. Uterus postovarian with broad ascending limb and smaller descending coils. Uterine pore ventral, to the right, anterior to lateral indentation, postovarian. Eggs fairly numerous, very thin shelled, broadly ovoid, 29 to 32 by 18 to 20 μ. Vitellaria of small spherical masses chiefly between ovary and intestinal bifurcation; a few follicles extending along each side of esophagus as far as the nerve commissure; not extending posterior to ovary. Excretory pore terminal; excretory vesicle not traced.

The name *tropicum* is for the region where the parasite was collected.

Discussion. P. tropicum differs from *P. japonicum* (Goto and Ozaki, 1929), the only other species in the genus, in its longer esophagus, less extensive vitellaria, more slender body, bilobed ovary, weaker cirrus sac of different shape, and larger seminal vesicle. The bilobed ovary of *P. tropicum* suggests the genus Sanguinicola but the genital pores are postovarian. *P. japonicum* is from a related host as is also another related species *Paradeontacylix odhneri* (Layman, 1930) McIntosh, 1934.

The genus Psettarium was named by Goto and Ozaki in 1930 for the genus Plehnia Goto and Ozaki, 1929, the name of which was preoccupied. Its type species thus became *Psettarium japonicum* (Goto and Ozaki, 1929). McIntosh (1934) described the genus Paradeontacylix for a species of blood fluke *(P. sanguinicola)* from *Seriola lalandi.* He also transferred *Aporocotyle odhneri* Layman, 1930 to Paradeontacylix. Although Paradeontacylix was not compared with Psettarium, McIntosh in correspondence with the writer considers the reticular structure of the testis in Psettarium a generic character separating the two genera.

The family Aporocotylidae contains the following genera: Aporocotyle Odhner, 1910; Sanguinicola Plehn, 1905 (synonym, as indicated by McIntosh, Janickia Răšin, 1929); Deontacylix Linton, 1910; Psettarium Goto and Ozaki, 1930; and Paradeontacylix McIntosh, 1934.

It is not certain that members of the Aporocotylidae are limited to the blood of their hosts. *P. tropicum* was collected from washings of the coelom and apparently once from the intestine. Since the host had been dissected, the small flukes might easily have been in the blood vessels. But the writer has collected numbers of *Deontacylix ovalis* Linton from the coelom of the host even when the fish had been carefully opened.

HOST LIST

This list contains only those species of fishes from which trematodes were collected. The number in parentheses following the name of the host indicates the number examined. The number following the name of the parasite indicates the number of host specimens from which the parasite was collected. An asterisk (*) following the name of the host indicates that the fish was identified by G. S. Myers or E. D. Reid of the United States National Museum.

Trematodes without author names are species named in this paper.

For possible convenience, the common names of the fishes usually are given.

*Abudefduf saxatilis,** sergeant-major . . . . . (8)
Opegaster acuta (in 5)
Theletrum gravidum (in 4)

Acanthocybium solandri, wahoo . . . . . (2)
Gotocotyla acanthocybii Meserve (in 1)
Hirudinella beebei Chandler (in 2)

*Anchovia arenicola,** anchovy . . . . . (15)
Parahemiurus ecuadori (in 1)
P. merus (Linton) (in 2)

Angelichthys sp., angelfish . . . . . (1)
Opechona orientalis (Layman) (in 1)
Tetrochetus proctocolus (in 1)

Angelfish (unidentified) . . . . . (4)
Theletrum lissosomum (in 2)

*Anisotremus interruptus,** grunt . . . . . (4)
Hamacreadium oscitans Linton (in 1)
Leurodera pacifica (in 3)
Proctotrema longicaecum (in 1)

*Anisotremus scapularis,** grunt . . . . . (2)
Leurodera pacifica (in 1)
Podocotyle breviformis (in 2)
Stephanostomum anisotremi (in 2)

Balistes polylepis, triggerfish . . . . . (2)
Pseudocreadium scaphosomum (in 2)

Balistes verres, triggerfish . . . . . (6)
Opegaster pentedactyla (in 2)
Pseudocreadium scaphosomum (in 2)
Pseudolepidapedon balistis (in 1)

*Bathygobius soporator,** goby . . . . . (4)
Coitocaecum tropicum (in 2)

Blenny, unidentified . . . . . (9)
Coitocaecum tropicum (in 2)

Bodianus diplotaenia . . . . . (8)
Lepocreadium bimarinum (in 3)

Calamus brachysomus, porgy . . . . . (6)
Lecithochirium microstomum Chandler (in 2)
Plagioporus gastrocotylus (in 3)

Caranx caballus, jack . . . . . (2)
Tergestia laticollis (Rud.) (in 1)

Caranx hippos, jack; cavalla . . . . . (7)
Bucephalus introversus (in 1)
Dihemistephanus brachyderus (in 1)
Stephanostomum megacephalum (in 3)
S. longisomum (in 2)

Caranx lugubris, jack . . . . . (7)
Elytrophallus mexicanus (in 2)

Caranx melampygus, jack . . . . . (8)
Axine elongata Meserve (in 1)

Caulolatilus anomalus, whitefish . . . . . (4)
Choanodera caulolatili (in 4)
Proctoeces magnorus (in 1)

Caulolatilus sp., whitefish . . . . . (6)
Choanodera caulolatili (in 1)
Diclidophora caulolatili Meserve (in 2)
Encotyllabe pagrosomi MacCallum (in 1)

Lecithochirium microstomum Chandler (in 1)
Myzotus vitellosus (in 2)
Pseudocreadium spinosum (in 1)

Cheilichthys annulatus, puffer . . . . . (16)
Apocreadium longisinosum Manter (in 1)
Bianium adplicatum (in 5)
Heterobothrium ecuadori Meserve (in 3)
Psettarium tropicum (in 1)
Tetrochetus proctocolus (in 3)

Coryphaena hippurus, dolphin . . . . . (1)
Dinurus barbatus (Cohn) (in 1)
D. longisinus Looss (in 1)

*Cratinus agassizii** . . . . . (5)
Derogenes varicus (Müller) (in 1)
Entobdella muelleri Meserve (in 1)

Cypselurus californicus, flying fish . . . . . (10)
Cestracolpa yamagutii Meserve (in 1)

Cypselurus callopterus, flying fish . . . . . (12)
Cestracolpa cypseluri Meserve (in 1)

Elagatis bipinnulatus, runner . . . . . (1)
Gotocotyla elagatis Meserve (in 1)
Stephanostomum hispidum (Yamaguti) (in 1)

Epinephelus labriformis, grouper . . . . . (6)
Elytrophallus mexicanus (in 1)
Helicometra torta Linton (in 1)

Epinephelus sp. (?), grouper . . . . . (7)
Elytrophallus mexicanus (in 2)
Lecithochirium magnaporum (in 1)

Eucinostomus californiensis . . . . . (11)
Anisoporus eucinostomi (in 1)

Flounder, unidentified . . . . . (10)
Derogenes sp. (in 1)
Helicometra fasciata (Rud.) (in 1)

Flying fish, unidentified . . . . . (7)
Cestracolpa yamagutii Meserve (in 1)

Goby, unidentified . . . . . (2)
Parvacreadium bifidum (in 1)

Groupers, unidentified . . . . . (7)
Benedenia adenea Meserve (in 2)
B. anadenea Meserve (in 2)
B. isabellae Meserve (in 2)
Elytrophallus mexicanus (in 1)
Lepidapedon hancocki (in 1)
L. nicolli Manter (in 1)
Podocotyle mecopera (in 1)
Prosorhynchus gonoderus (in 2)
P. ozakii Manter (in 1)
P. pacificus (in 1)
Stephanostomum multispinosum (in 2)

Gymnosarda alletterata, bonito . . . . . (8)
Didymozoonidae (common)
Hirudinella clavata (Menzies) (in 4)
Octocotyle euthynni Meserve (in 1)

Gymnosarda pelamis, bonito . . . . . (4)
Didymozoonidae (in 4)

Gymnothorax sp., moray . . . . . (1)
Prosorhynchus aculeatus Odhner (in 1)

*Halichoeres dispilus,** slippery dick . . . . . (1)
Coitocaecum tropicum (in 1)

Jack, unidentified . . . . . (1)
Bucephalus varicus (in 1)

Kyphosus elegans . . . . . (7)
Haplosplanchnus acutus (Linton) (in 1)

*Labrisomus xanti** . . . . . (1)
Apocreadium mexicanum Manter (in 1)

Lutianus jordani, snapper . . . . . (3)
Paracryptogonimus americanus (in 1)
Stephanostomum casum (Linton) (in 1)

Lutianus novemfasciatus (?), snapper . . . . . (1)
Paracryptogonimus americanus (in 1)
Stephanostomum casum (Linton) (in 1)

Lutianus viridis (?), snapper . . . . . (10)
Elytrophallus mexicanus (in 5)
Hamacreadium mutabile Linton (in 1)
Opecoelus mexicanus (in 3)
Stephanostomum casum (Linton) (in 1)

Mackerel, unidentified . . . . . (4)
Lecithochirium magnaporum (in 1)
Octocotyle macracantha Meserve (in 1)
Opechona orientalis Layman (in 2)

*Malacoctenus zonifer** . . . . . (1)
Coitocaecum tropicum (in 1)

Manta birostris, blanket fish . . . . . (2)
Paronatrema mantae (in 1)

Medialuna sp. (?), halfmoon . . . . . (1)
Proctotrema costaricae (in 1)

Moray, unidentified . . . . . (4)
Helicometra sinuata (Rud.) (in 1)

Muraena clepsydra, moray . . . . . (2)
Sterrhurus fusiformis (Lühe) (in 2)

Mycteroperca olfax, yellow grouper . . . . . (2)
Lepidapedon hancocki (in 2)
Prosorhynchus ozakii Manter (in 1)
P. pacificus (in 1)
Stephanostomum multispinosum (in 1)

Mycteroperca xenarcha (?), grouper . . . . . (8)
Hamacreadium mutabile Linton (in 2)
Lepidapedon hancocki (in 4)
Prosorhynchus ozakii Manter (in 1)
P. pacificus (in 2)

Oligoplites saurus, runner . . . . . (3)
Axine oligoplitis Meserve (in 1)
Dihemistephanus brachyderus (in 2)
Mecoderus oligoplitis (in 2)

*Opisthognathus scops,** jawfish . . . . . (1)
Coitocaecum tropicum (in 1)

*Opisthonema libertate** . . . . . (7)
Parahemiurus merus (Linton) (in 1)

Orthostoechus maculicauda . . . . . (1)
Siphoderoides vancleavei (in 1)

*Paralabrax humeralis,** sea bass . . . . . (14)
Derogenes varicus (Müller) (in 1)
Lecithochirium magnaporum (in 2)
L. microstomum Chandler (in 6)

Paralabrax nebulifer, kelp bass . . . . . (3)
Helicometrina nimia Linton (in 2)
Opecoelus inimici Yamaguti (in 1)

Paralabrax sp. (?) . . . . . (3)
Opecoelina pacifica (in 1)

*Paranthias furcifer,** sea bass . . . . . (16)
Elytrophallus mexicanus (in 4)
Heterobothrium galapagoensis Meserve (in 1)
Lecithochirium microstomum Chandler (in 6)
Opechona orientalis (Layman) (in 1)
Opecoelus mexicanus (in 3)

*Pimelometopon pulcher,** fathead . . . . . (1)
Labrifer secundus (in 1)
Lepocreadium bimarinum (in 1)

*Polynemus approximans,** threadfin . . . . . (1)
Anisoporus eucinostomi (in 1)

Pomacentrus rectifraenum . . . . . (4)
Haplosplanchnus pomacentri Manter (in 3)

Priacanthus sp. (?) . . . . . (1)
Microcotyle priacanthi Meserve (in 1)

*Rypticus safronaceus bicolor** . . . . . (1)
Prosorhynchus rotundus (in 1)

Scomberomorus maculatus, Spanish mackerel . . . . (8)
Thoracocotyle paradoxica Meserve (in 1)

*Selar crumenophthalmus,** goggle-eye . . . . . (4)
Cymbephallus carangi Yamaguti (in 4)

Seriola dorsalis . . . . . (10)
Axine seriolae Meserve (in 1)
Bucephalus introversus (in 2)
Lecithochirium magnaporum (in 1)
Stephanostomum hispidium (Yamaguti) (in 2)

Seriola dumerili (?), amber jack . . . . . (1)
Bucephalus introversus (in 1)
Stephanostomum hispidum (Yamaguti) (in 1)

Seriola sp. . . . . (1)
Bucephalus introversus (in 1)

Silvery, small, tide-pool fish . . . . . (10)
Dactylostomum vitellosum (in 1)

Spheroides angusticeps, puffer . . . . . (2)
Apocreadium longisinosum Manter (in 2)
Bianium adplicatum (in 1)

Stargazer, unidentified . . . . . (4)
Helicometra fasciata (Rud.) (in 1)

*Symphurus atramentatus,** tonguefish . . . . . (3)
Paramonorcheides bivitellosus (in 2)

*Thyrinops pachylepis,** silversides . . . . . (10)
Anisoporus thyrinopsi (in 1)

Trachinotus paloma, pompano . . . . . (1)
Lobatostoma pacificum (in 1)

Trachinotus rhodopus, pompano . . . . . (5)
Aponurus trachinoti (in 1)
Gonocercella pacifica (in 1)
Opechona pharyngodactyla (in 3)
Opegaster parapristipomatis Yamaguti (in 2)
Tetrochetus proctocolus (in 1)

Tylosurus fodiator, needlefish . . . . . (7)
Axine abberans Goto (in 1)
Haplosplanchnus acutus (Linton) (in 1)

Xenistius californiensis . . . . . (6)
Opecoelus xenistii (in 1)

Xurel marginatus, jack . . . . . (3)
Protomicrocotyle pacifica Meserve (in 2)

Zalocys stilbe, pompano . . . . . (1)
Elytrophallus mexicanus (in 1)
Opechona pharyngodactyla (in 1)

SUMMARY AND CONCLUSIONS

Eighty-two species of digenetic trematodes are reported from 80 different species of marine fishes of the tropical American Pacific. Fifty-three new species and 7 new genera are named. The number of new genera compared with the number of new species is rather small considering the new locality. For example, among 33 new species from deep-water fishes at Tortugas listed by Manter (1934) there were 11 new genera. This rather small number of new genera in the tropical Pacific may possibly suggest that the number of unnamed genera in this group

of animals is now materially reduced, or that the trematodes of these regions are chiefly derived from (or ancestral to) relatives not yet generically differentiated.

In addition to new species and genera, the following taxonomic changes are proposed in this paper: (1) *Prosorhynchus caudovatus,* n. nom. is proposed for the *P. crucibulus* of Eckmann, 1932. (2) Dollfustrema Eckmann, 1932 is considered a synonym of Mordvilkovia Pigulewsky, 1931. (3) Pseudoprosorhynchus Yamaguti, 1938 is considered a synonym of Neidhartia Nagaty, 1937. (4) *Bucephalus varicus,* n. nom. is proposed for the *B. polymorphus* of Nagaty, 1937. (5) *Bucephalus kathetostomae* (Manter), n. comb. is proposed for *Rhipidocotyle kathetostomae* Manter, 1934. (6) Hypocreadium Ozaki, 1936 is considered a synonym of Pseudocreadium Layman, 1930 and *P. patellare* (Yamaguti, 1938) is a n. comb. (7) *Proctotrema truncata* (Linton), n. comb. is proposed for *Genolopa truncata* Linton, 1910. (8) Theledera Linton, 1910 and Cithara MacCallum, 1917 are considered synonyms of Tergestia Stoss., thus resulting in *Tergestia pectinata* (Linton), n. comb. and *T. priacanthi* (MacCallum), n. comb. (9) *Parahemiurus parahemiurus* Vaz and Pereira, 1930, *P. platichthys* Lloyd, 1939; *P. atherinae* Yamaguti, 1938, *P. harengulae* Yamaguti, 1938 all are considered to be synonyms of *P. merus* (Linton, 1910). (10) *Gonocercella atlantica,* new species is named for "Dist. sp." of Linton, 1905, p. 367, fig. 204. (11) Siphoderinae Manter, 1934, Neochasminae Van Cleave and Mueller, 1932, and Exorchiinae Yamaguti, 1938 all are considered synonyms of Heterophyinae Ciurea, 1924.

Twenty-three species (more than 25 per cent of the total number collected) are known from the American Atlantic. These 23 species are: *Bucephalus varicus, Derogenes varicus, Dinurus barbatus, D. longisinus, Hamacreadium mutabile, H. oscitans, Haplosplanchnus acutus, H. pomacentri, Helicometra fasciata, H. torta, Helicometrina nimia, Hirudinella beebei, H. clavata, Lecithochirium microstomum, Lepidapedon nicolli, Lepocreadium bimarinum, Parahemiurus merus, Proctotrema longicaecum, Prosorhynchus ozakii, Stephanostomum casum, S. megacephalum, Sterrhurus fusiformis, Tergestia laticollis.* Six species have been previously reported from Japanese or Siberian seas. These are: *Cymbephallus carangi, Opechona inimici, O. orientalis, Opegaster parapristipomatis, Prosorhynchus aculeatus, Stephanostomum hispidum.* A single species, *Helicometra sinuata,* is known elsewhere (to date) only from European waters.

Of 10 species of digenetic trematodes collected at Socorro or Clarion Island (Revillagigedo Islands), Mexico, 6 occurred also in the Galapagos Islands. Thus, the writer's preliminary observation (Manter, 1934a), that the trematodes of these two localities were essentially different, is not correct. However, species occurring in both localities may be much more common in one, and fishes found in both localities may show a different infection percentage in one region as compared with the other.

Thirteen species seem to be restricted to the American Atlantic and American Pacific (i.e., they are endemic amphi-American). In each case the hosts are different but related, and in each case the trematode genus is a common, very widely distributed genus.

The digenetic trematode fauna of the tropical American Pacific reveals a very distinct similarity to the trematode fauna of the tropical Atlantic. Otherwise, except for some similarity to that of the Japanese waters, it is distinctly different from known trematode faunas in other parts of the world.

This aspect of the subject will be considered in a later paper.

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EXPLANATION OF PLATES

All figures, except diagrams, were drawn with the aid of a camera lucida. The projected scale has the value indicated in each figure. Abbreviations are as follows:

a	anus	*mt*	metraterm
ac	anterior cecum	*o*	egg
act	acetabulum	*os*	oral sucker
af	anterior fold	*ov*	ovary
aml	anterior muscular lip	*pc*	papillated cirrus
ap	acetabular pore	*pce*	posterior cecum
as	accessory sucker	*pg*	prostate gland
ce	intestinal cecum	*pl*	posterior lip
cir	cirrus	*pp*	pars prostatica
cs	cirrus sac	*pph*	prepharynx
ed	esophageal diverticulum	*pr*	prostatic cells
ep	excretory pore	*prv*	prostatic vesicle
es	esophagus	*psp*	presomatic pit
esv	external seminal vesicle	*rh*	rhynchus
ex	excretory vesicle	*rvt*	rudimentary vitellaria
ga	genital atrium	*sr*	seminal receptacle
go	gonotyl	*ss*	sinus sac
gp	genital pore	*sv*	seminal vesicle
gs	genital sinus	*t*	testis
gsv	glandular seminal vesicle	*ts*	thin-walled portion of sinus sac
isv	internal seminal vesicle	*up*	uterine pore
lv	lymphatic vessel	*ut*	uterus
m	mouth	*utsr*	uterine seminal receptacle
mg	Mehlis' gland	*vt*	vitellaria
mp	male pore	*yd*	yolk duct
ms	metraterm sac	*yr*	yolk reservoir

PLATE 32

FIG. 1. *Lobatostoma pacificum.* Ventral view.

FIG. 2. *L. pacificum.* Enlarged view of region near the genital pore.

FIG. 3. *Bucephalus varicus* from Caranx species from Panama. Ventral view.

FIG. 4. *B. varicus* from same host. Tentacle extended. Enlarged.

FIG. 5. *B. varicus* from *Caranx latus* from Tortugas, Florida. Lateral view of extended specimen.

FIG. 6. *B. varicus* from same host. Variations in appearance of tentacles.

FIG. 7. *B. varicus* from same host. Variations in appearance of eggs.

FIG. 8. *B. varicus* from *Caranx ruber* from Tortugas, Florida. Ventral view.

FIG. 9. *B. varicus* from same host. Eggs.

FIG. 10. *Bucephalus introversus* from Seriola species from Port Culebra, Colombia. Lateral view.

FIG. 11. *B. introversus* from *Seriola dorsalis* from Port Utria, Colombia. Ventral view of anterior sucker.

FIG. 12. *B. introversus* from same host. Tentacle extended.

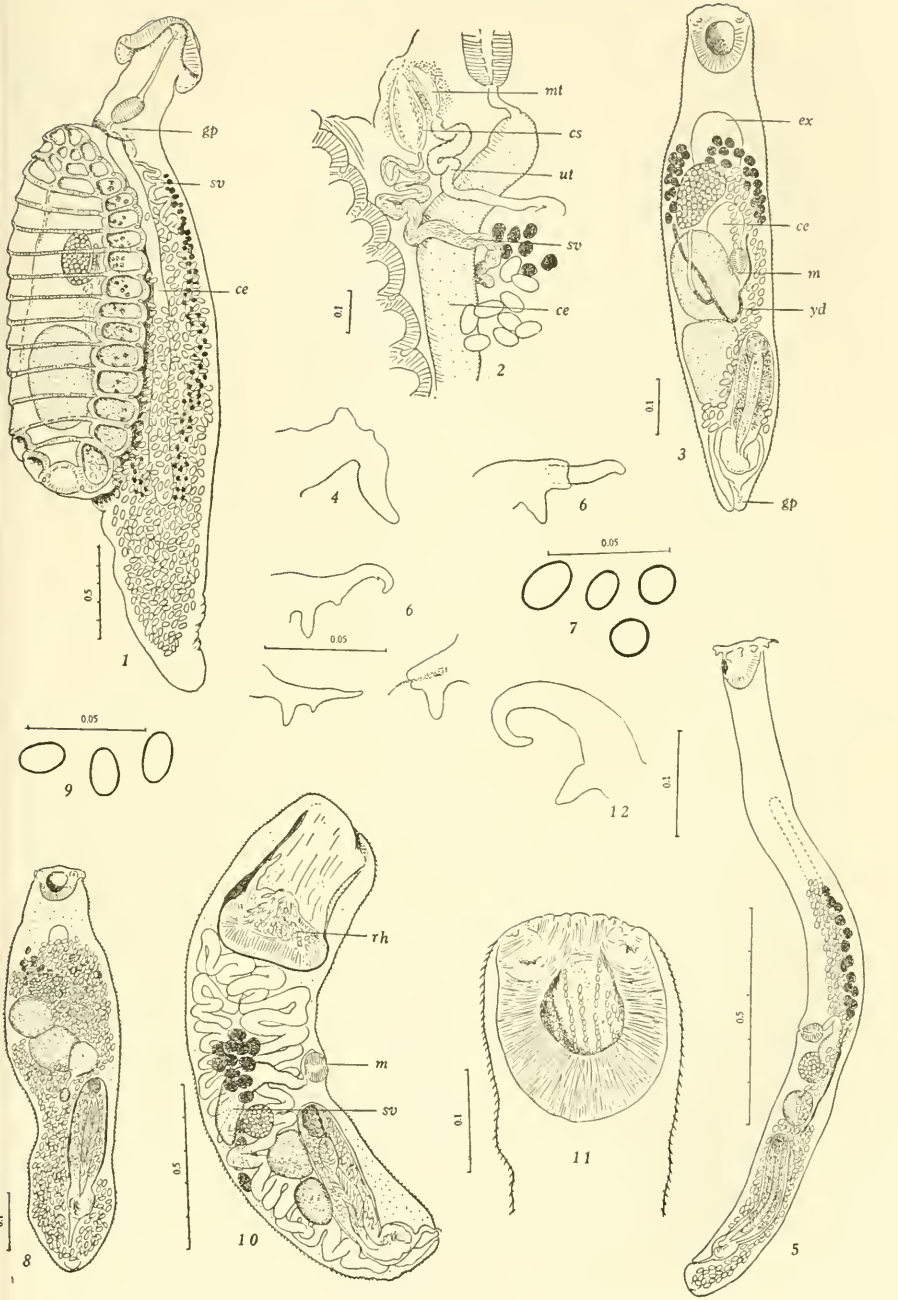
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PLATE 33

FIG. 13. *Prosorhynchus ozakii* from a spotted grouper from Isabel Island, Mexico. Ventral view.

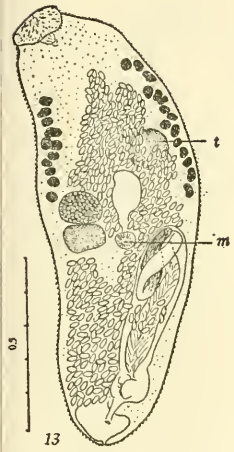
FIG. 14. *Prosorhynchus aculeatus* from Gymnothorax sp. from Charles Island. Ventral view.

FIG. 15. *Prosorhynchus rotundus* from *Rypticus safronaceus bicolor,* Albemarle Island. Ventral view.

FIG. 16. *Prosorhynchus gonoderus* from grouper from James Island. Ventral view.

FIG. 17. *P. pacificus* from *Mycteroperca olfax* from Albemarle Island. Ventral view.

FIG. 18. *Choanodera caulolatili* from *Caulolatilus anomalus.* Ventral view.



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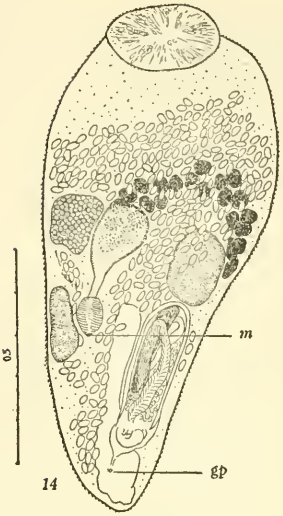

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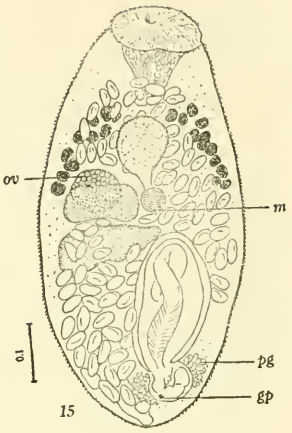

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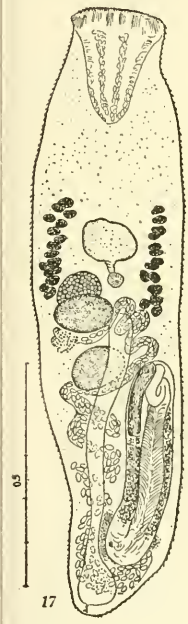

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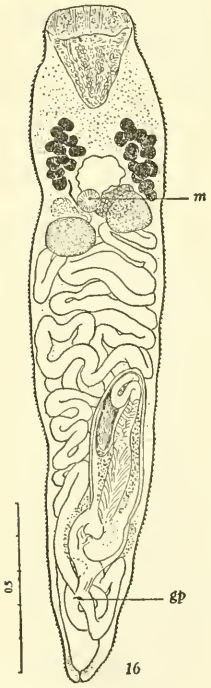

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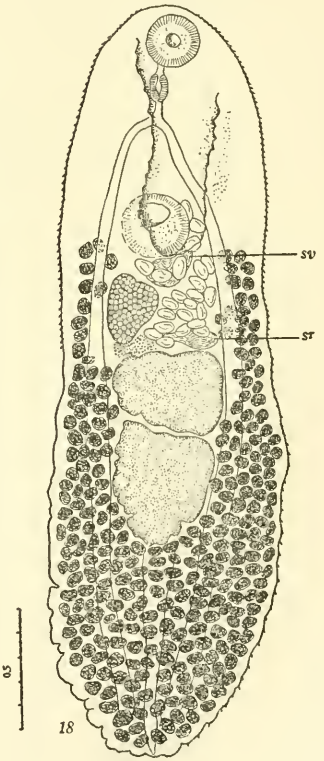

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PLATE 34

FIG. 19. *Lepocreadium bimarinum* from *Pimelometron pulcher* from Cerros Island, Mexico. Ventral view.

FIG. 20. *L. bimarinum.* Enlarged, dorsal view of region of the cirrus sac.

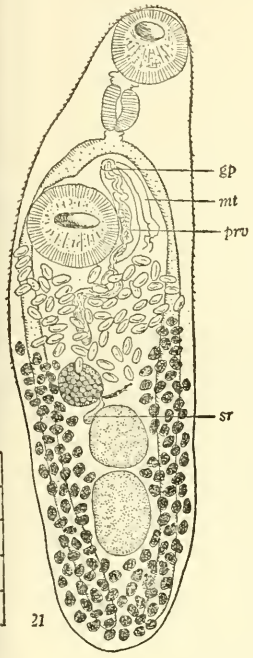
FIG. 21. *L. bimarinum* from *Lachnolaimus maximus* from Tortugas, Florida. Ventral view.

FIG. 22. *Opechona pharyngodactyla* from *Trachinotus rhodopus.* Ventral view.

FIG. 23. *O. pharyngodactyla.* Anterior end of pharynx, showing processes.

FIG. 24. *O. orientalis* from Angelichthys sp. Ventral view.

FIG. 25. *O. orientalis* from *Paranthias furcifer.* Ventral view.



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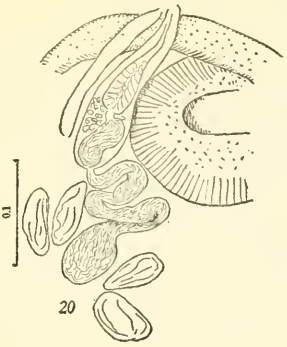

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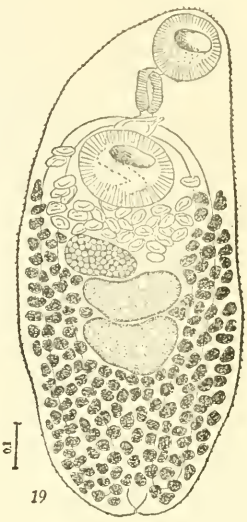

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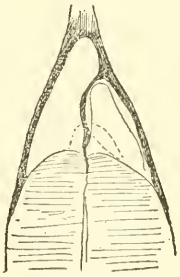
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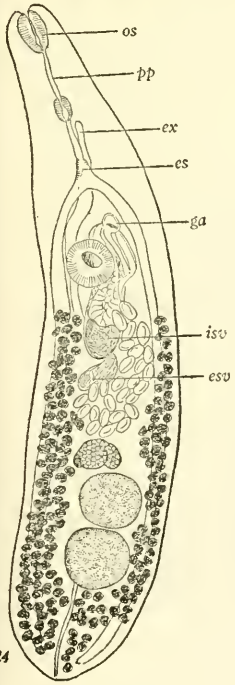

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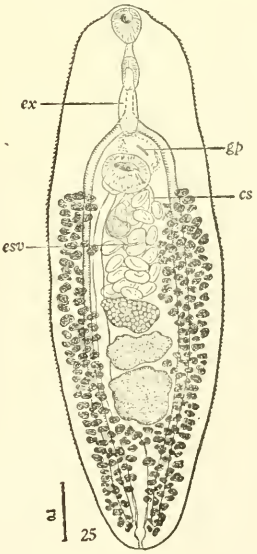

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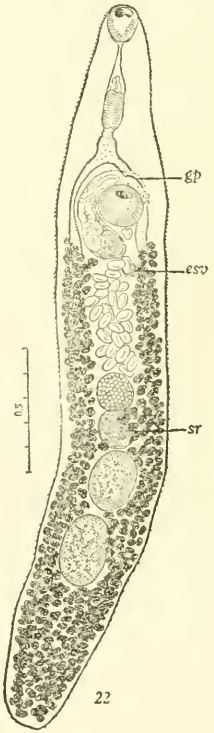

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PLATE 35

FIG. 26. *Lepidapedon hancocki* from *Mycteroperca olfax*. Ventral view.

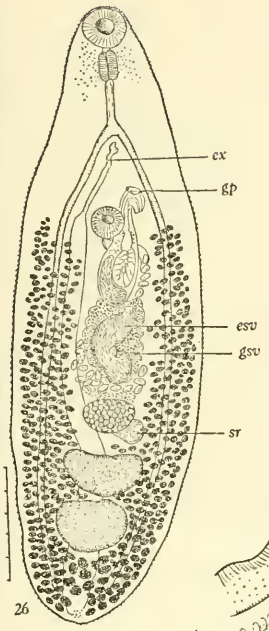
FIG. 27. *Pseudolepidapedon balistis* from *Balistes verres*. Ventral view.

FIG. 28. *Pseudocreadium scaphosomum* from *Balistes polylepis*. Ventral view.

FIG. 29. *P. scaphosomum*. Enlarged view of terminal genital organs.

FIG. 30. *P. spinosum* from Caulolatilus sp. Ventral view.

FIG. 31. *P. spinosum*. Enlarged view of cirrus sac.



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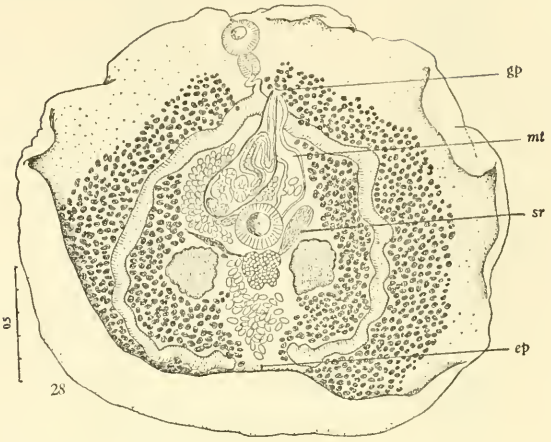

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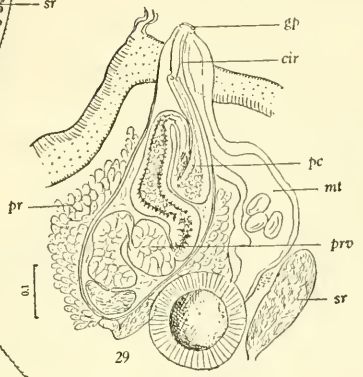

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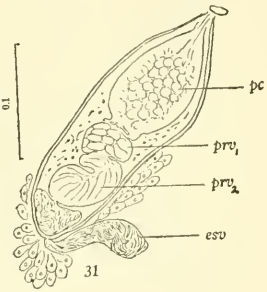

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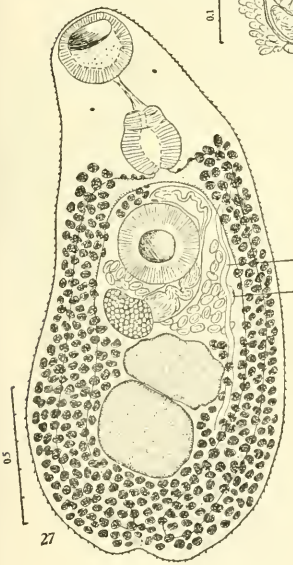

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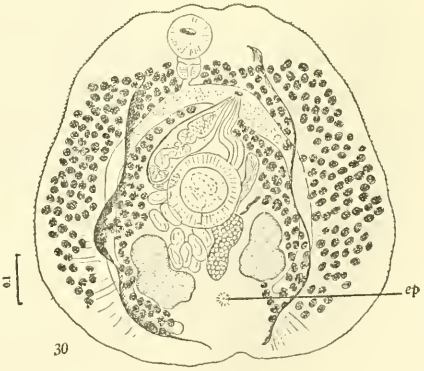

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PLATE 36

FIG. 32. *Anisoporus eucinostomi* from *Eucinostomus californiensis*. Ventral view.

FIG. 33. *A. eucinostomi* from same host. Enlarged, ventral view of anterior part of body.

FIG. 34. *Anisoporus thyrinopsi* from *Thyrinops pachylepis*. Ventral view.

FIG. 35. *Dactylostomum vitellosum* from unidentified, tide-pool fish. Ventrolateral view.

FIG. 36. *Opecoelus mexicanus* from *Paranthias furcifer*. Ventral view.

FIG. 37. *O. mexicanus*. Enlarged view of acetabular papillae showing manner of overlapping, like clasped fingers.

FIG. 38. *Opecoelus xenistii* from *Xenistius californiensis*. Ventral view.

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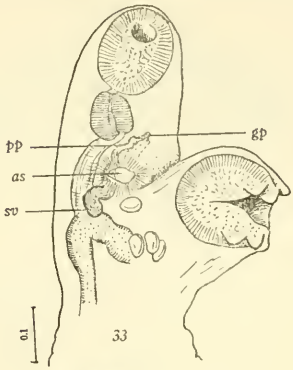

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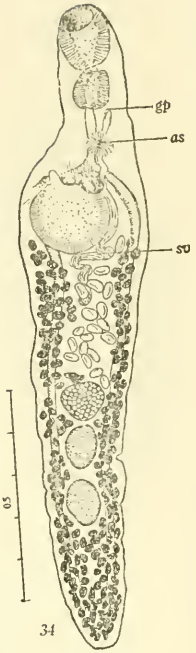

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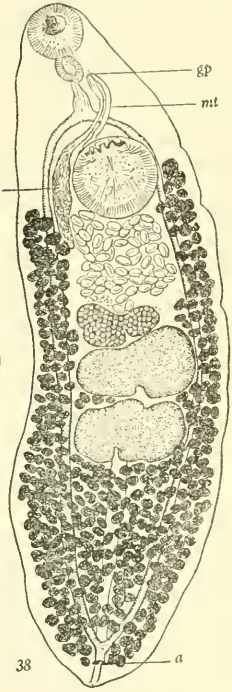

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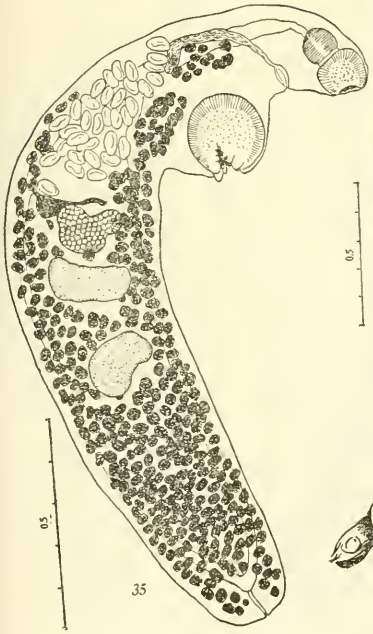

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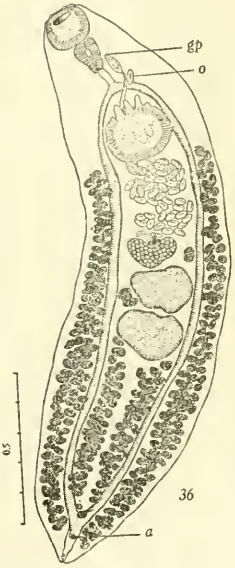

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PLATE 37

FIG. 39. *Opecoelus xenistii.* Enlarged view of acetabular papillae.

FIG. 40. *Opecoelus inimici* Yamaguti from *Paralabrax nebulifer.* Ventral view.

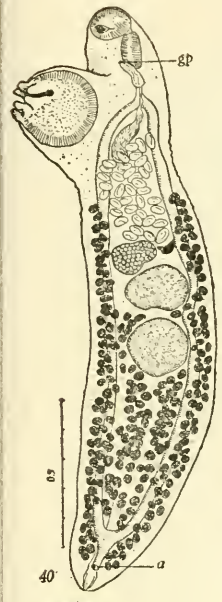
FIG. 41. *Opegaster acuta* from *Abudefduf saxatilis.* Ventral view.

FIG. 42. *Opegaster pentedactyla* from *Balistes verres.* Dorsal view.

FIG. 43. *Opegaster parapristipomatis* Yamaguti from *Trachinotus rhodopus.* Ventral view.

FIG. 44. *Coitocaecum tropicum* from *Halichoeres dispilus.* Dorsal view.

FIG. 45. *C. tropicum.* Enlarged, dorsal view of terminal reproductive organs.



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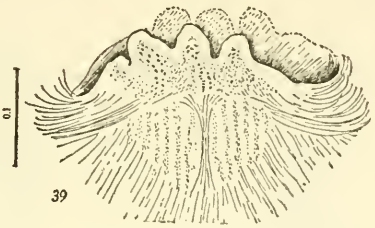

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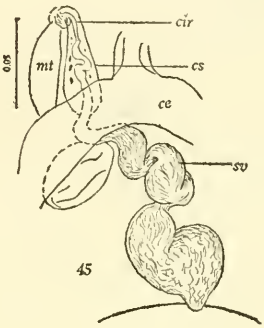

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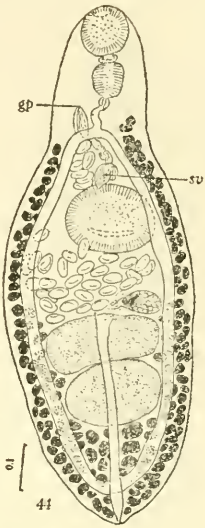

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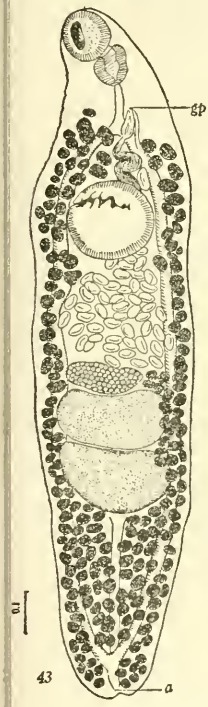

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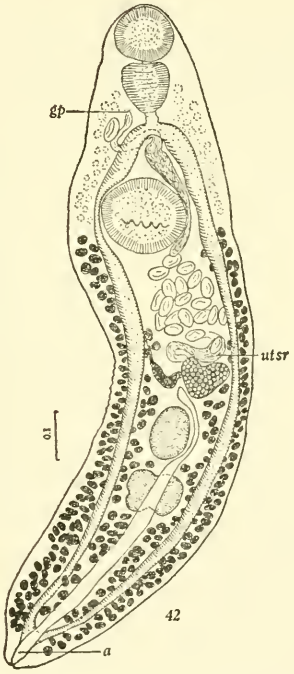

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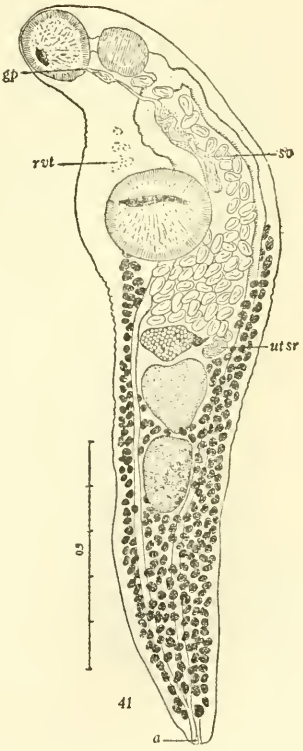

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PLATE 38

FIG. 46. *Opecoelina pacifica* from Paralabrax species. Dorsal view.

FIG. 47. *O. pacifica* from same host. Enlarged view of male terminal reproductive organs.

FIG. 48. *Cymbephallus carangi* Yamaguti from *Selar crumenophthalmus*. Ventral view.

FIG. 49. *C. carangi* from same host. Enlarged view of anterior end.

FIG. 50. *C. carangi*. Eggs.

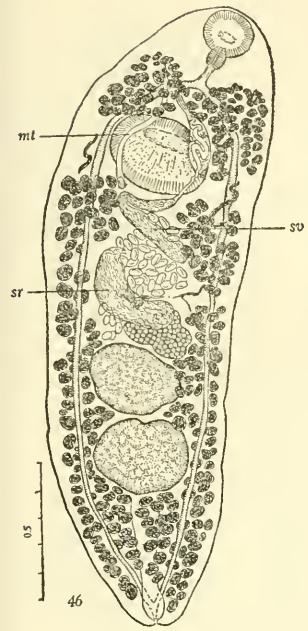
FIG. 51. *Parvacreadium bifidum* from goby. Ventral view.

FIG. 52. *P. bifidum*. Enlarged view of acetabular lobes.

FIG. 53. *P. bifidum*. Enlarged, dorsal view of anterior end.

FIG. 54. *P. bifidum*. Outline of posterior end of body showing papilla-like processes.

FIG. 55. Same.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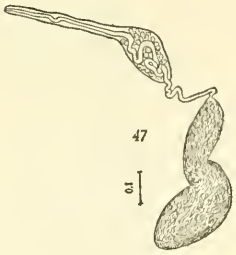
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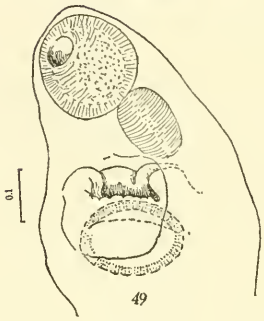
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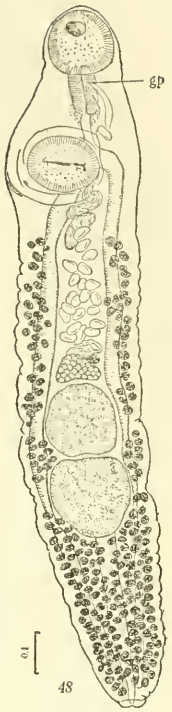
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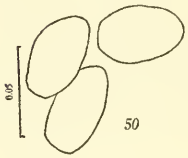
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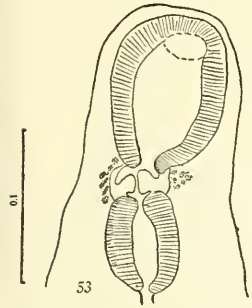
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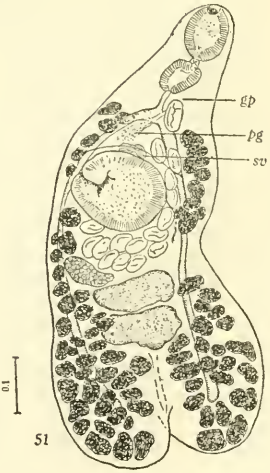
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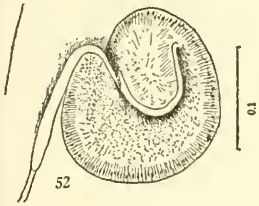
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PLATE 39

FIG. 56. *Bianium adplicatum* from *Cheilichthys annulatus*. Dorsal view.

FIG. 57. *B. adplicatum*. Enlarged view of pharynx.

FIG. 58. *Myzotus vitellosus* from Caulolatilus sp. Ventral view.

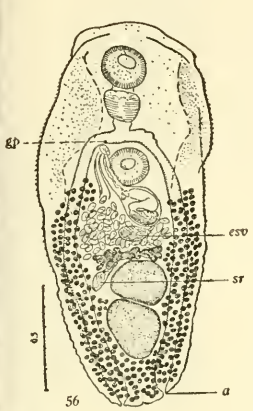
FIG. 59. *M. vitellosus*. Enlarged view of acetabular region to show acetabular flaps.

FIG. 60. *M. vitellosus*. Sagittal section through acetabular region showing location of genital pore and muscular structure of acetabulum.

FIG. 61. *Plagioporus gastrocotylus* from *Calamus brachysomus*. Ventral view.

FIG. 62. *P. gastrocotylus*. Cross section through acetabular region showing acetabular fold.

FIG. 63. *P. gastrocotylus*. Longitudinal section through acetabular region.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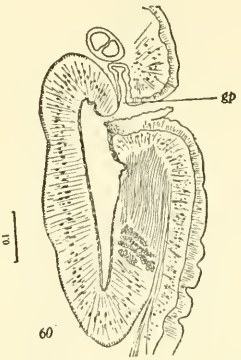
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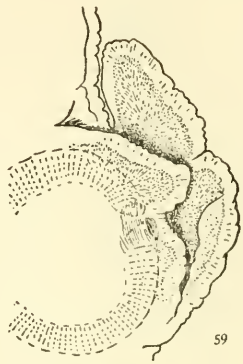
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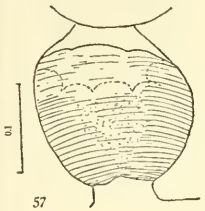
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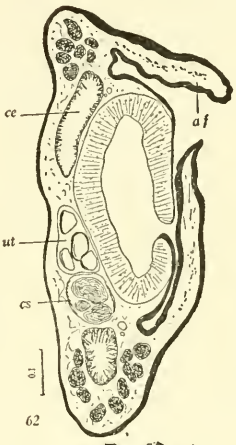
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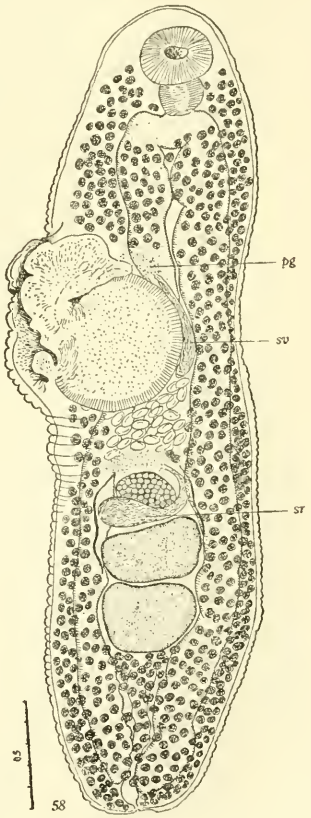
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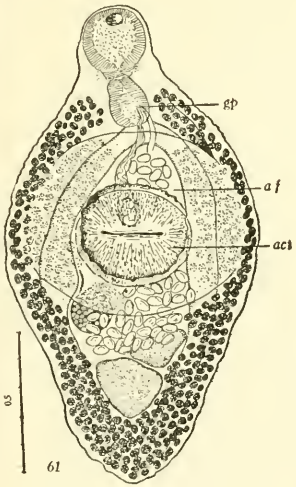
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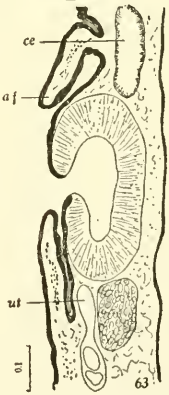
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PLATE 40

FIG. 64. *Hamacreadium mutabile* Linton from *Lutianus viridis*. Ventral view.

FIG. 65. *Podocotyle mecopera* from a large, spotted grouper. Dorsal view.

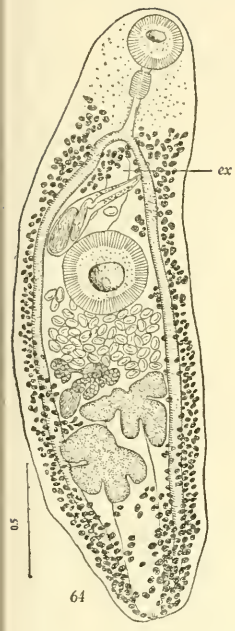
FIG. 66. *Podocotyle breviformis* from *Anisotremus scapularis*. Ventral view.

FIG. 67. *P. breviformis*. Enlarged, dorsal view of the cirrus sac region.

FIG. 68. *P. breviformis*. Eggs.

FIG. 69. *Helicometrina nimia* from *Paralabrax nebulifer*. Dorsal view.

FIG. 70. *Labrifer secundus*. Ventral view.



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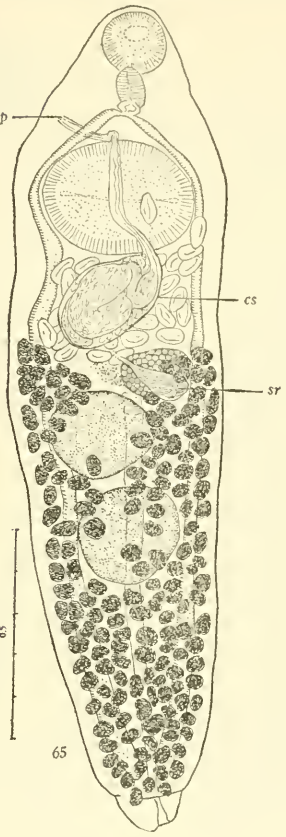

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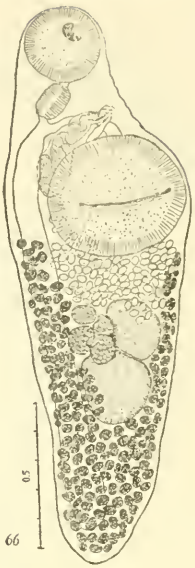

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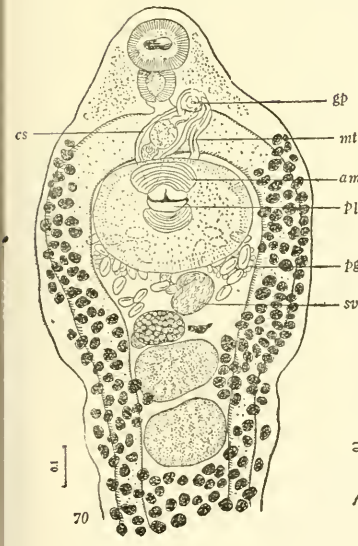

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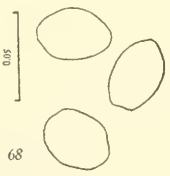

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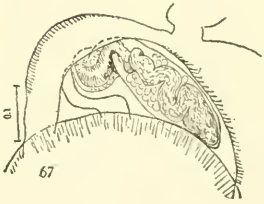

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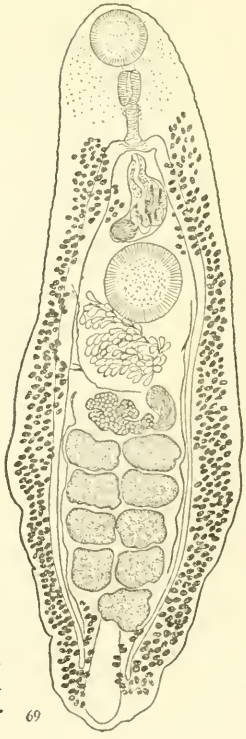


69

PLATE 41

FIG. 71. *Stephanostomum megacephalum* from *Caranx hippos*. Ventral view.

FIG. 72. *S. megacephalum* from *C. hippos*. Enlarged view of anterior end.

FIG. 73. Same.

FIG. 74. *Stephanostomum megacephalum* from *Caranx hippos*. Semi-ventral view.

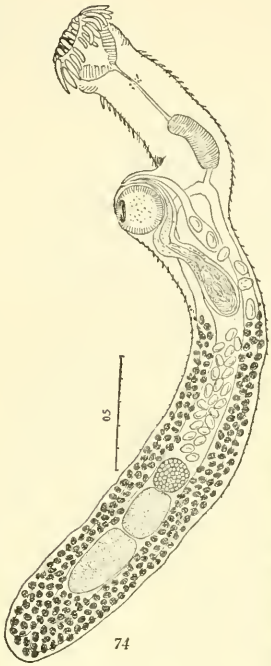
FIG. 75. *Stephanostomum longisomum*. Ventral view.

FIG. 76. *S. longisomum*. Enlarged view of anterior end.

FIG. 77. *Stephanostomum multispinosum* from *Mycteroperca olfax*. Ventral view.

FIG. 78. *S. multispinosum* from Mycteroperca sp. Enlarged view of anterior end.

71



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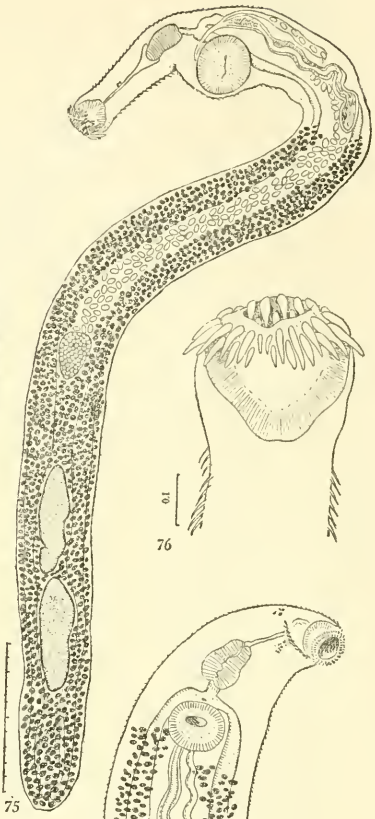

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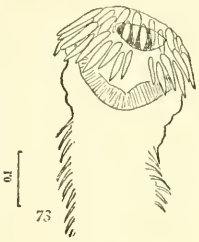

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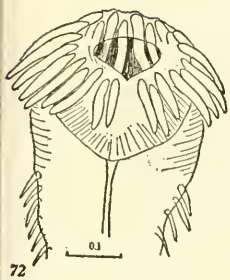

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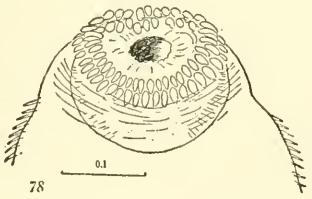

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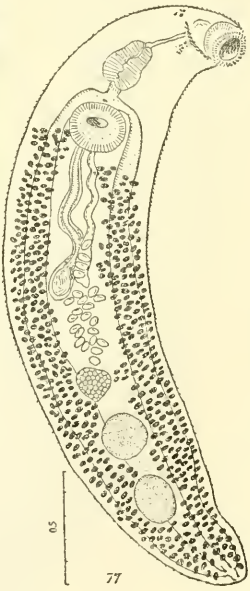


77

PLATE 42

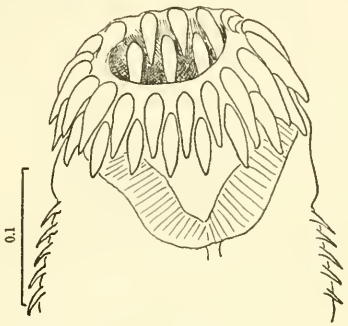
FIG. 79. *Stephanostomum hispidum* Yamaguti from *Seriola dorsalis*. Ventral view.

FIG. 80. *S. hispidum*. Enlarged view of anterior end.

FIG. 81. *Stephanostomum anisotremi* from *Anisotremus scapularis*. Ventral view.

FIG. 82. *S. anisotremi*. Enlarged view of anterior end.

79



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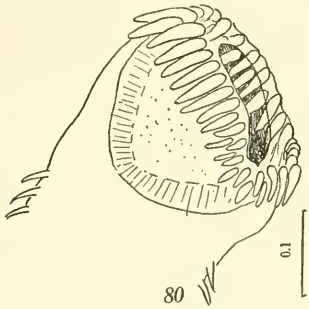

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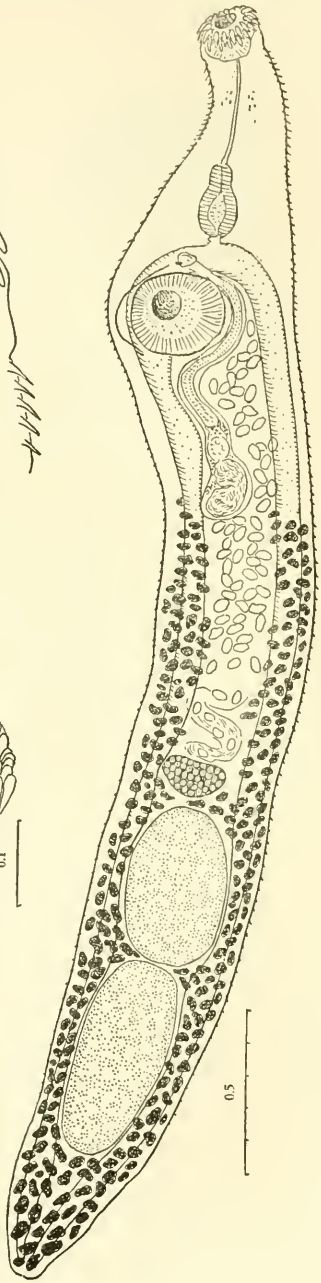


81

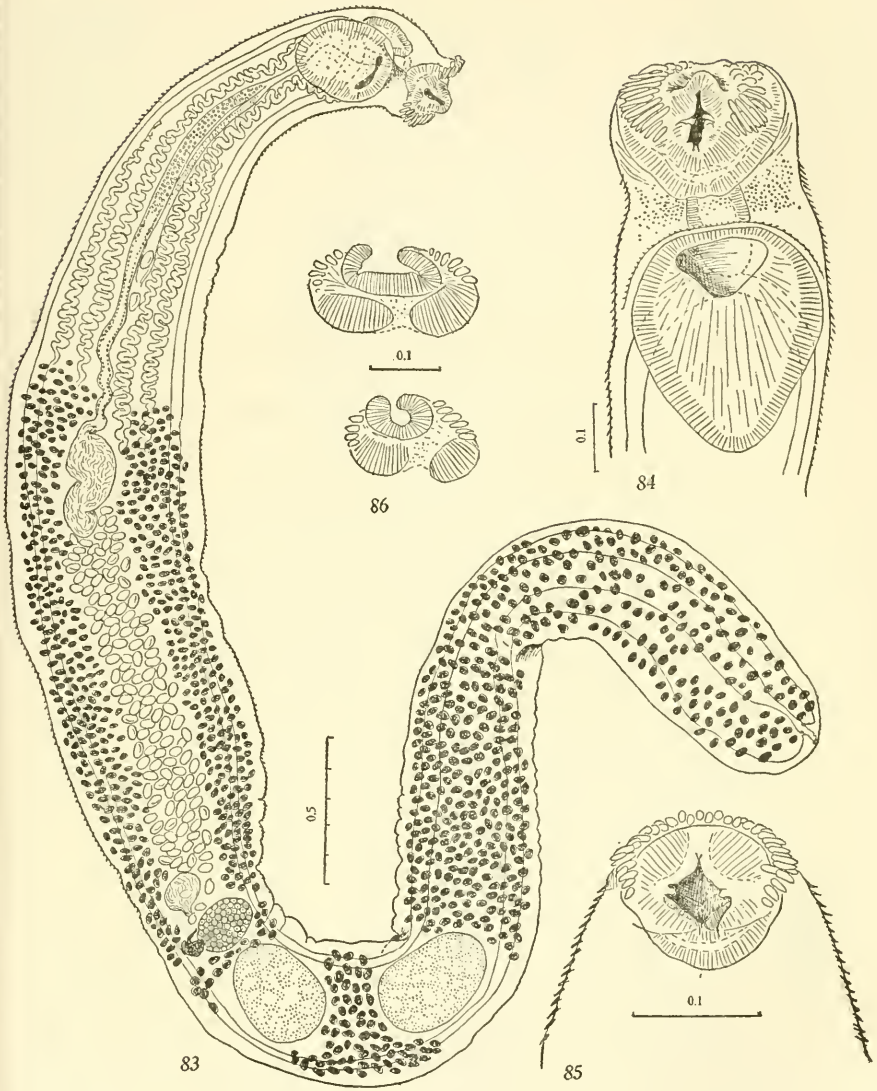
PLATE 43

FIG. 83. *Dihemistephanus brachyderus* from *Oligoplites saurus*. Ventral view.

FIG. 84. *D. brachyderus* from same host. Enlarged view of anterior end.

FIG. 85. *D. brachyderus*. Enlarged view of anterior end.

FIG. 86. *D. brachyderus*. Cross sections through aperture of oral sucker.



83 84 85 86

PLATE 44

FIG. 87. *Proctotrema longicaecum* from *Anisotremus interruptus*. Ventral view.

FIG. 88. *P. longicaecum*. Enlarged view of acetabular region showing metraterm sac.

FIG. 89. *P. longicaecum* from *Anisotremus virginicus* at Tortugas, Florida.

FIG. 90. *Proctotrema costaricae* from unidentified grunt or porgy. Dorsal view.

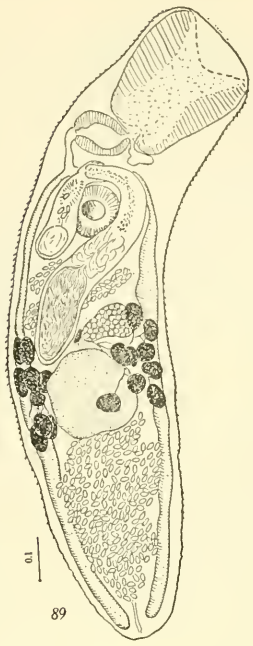
FIG. 91. *Paramonorcheides bivitellosus* from *Symphurus atramentatus*. Ventral view.

FIG. 92. *Telolecithus tropicus* from *Selar crumenophthalmus*. Ventral view.

FIG. 93. *T. tropicus*. Enlarged view of acetabular region showing terminal reproductive organs.

FIG. 94. *T. tropicus*. Eggs.

87



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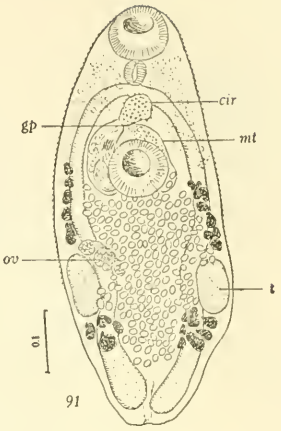

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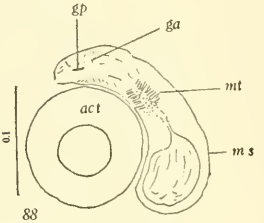

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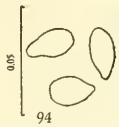

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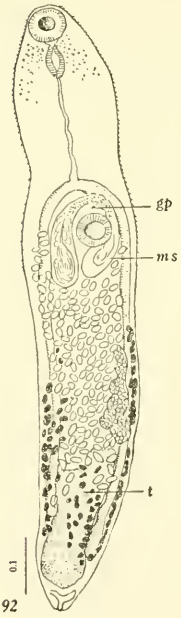

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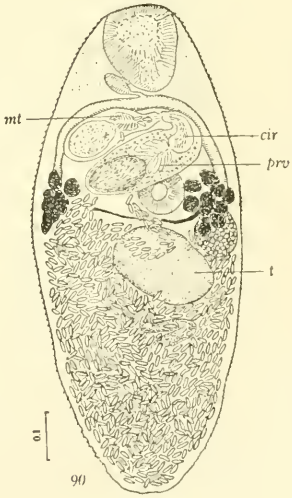

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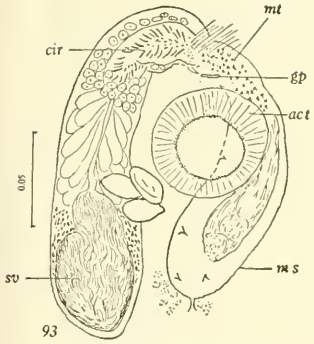

93

PLATE 45

FIG. 95. *Proctoeces magnorus* from *Caulolatilus anomalus*. Ventrolateral view.

FIG. 96. *Tetrochetus proctocolus* from *Cheilichthys annulatus*. Ventral view.

FIG. 97. *T. proctocolus*. Enlarged, dorsal view of region of intestinal bifurcation showing esophageal diverticula.

FIG. 98. *Paracryptogonimus americanus* from *Lutianus novemfasciatus*. Ventral view.

FIG. 99. *P. americanus*. Longitudinal section through oral sucker.

FIG. 100. *P. americanus*. Eggs.

FIG. 101. *Siphoderoides vancleavei* from *Orthostoechus maculicauda*. Ventral view.

FIG. 102. *S. vancleavei*. Enlarged, ventral view of acetabular region showing gonotyl.

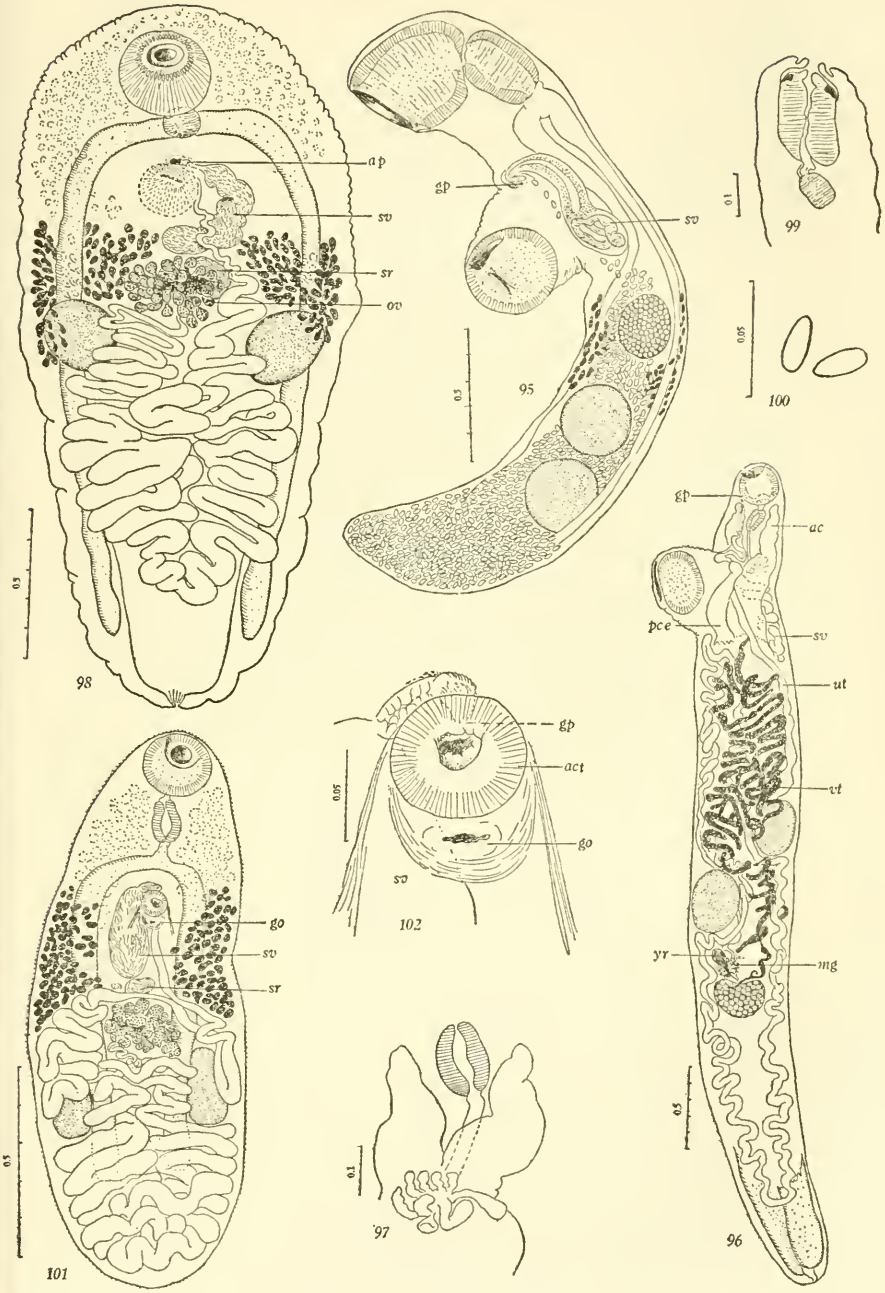
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PLATE 46

FIG. 103. *Parahemiurus merus* from *Opisthonema libertate*. Dorsal view to show extent of denticulations.

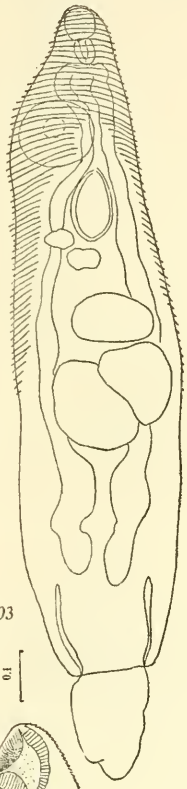
FIG. 104. *Parahemiurus ecuadori* from Anchoviella sp. Semiventral view.

FIG. 105. *Elytrophallus mexicanus* from *Lutianus viridis*. Ventral view.

FIG. 106. *E. mexicanus*. Diagram of terminal reproductive organs.

FIG. 107. *E. mexicanus* from *Paranthias furcifer*. Thin-walled portion of sinus sac showing the coiled penis-like sinus.

FIG. 108. *Mecoderus oligoplitis* from *Oligoplites saurus*. Ventral view of anterior end of body showing oral lobes and esophageal diverticulum.



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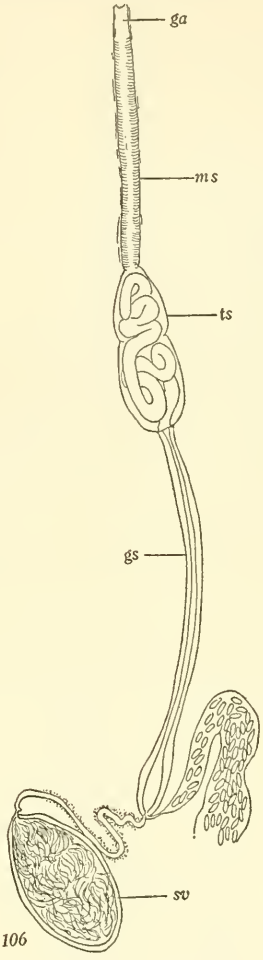

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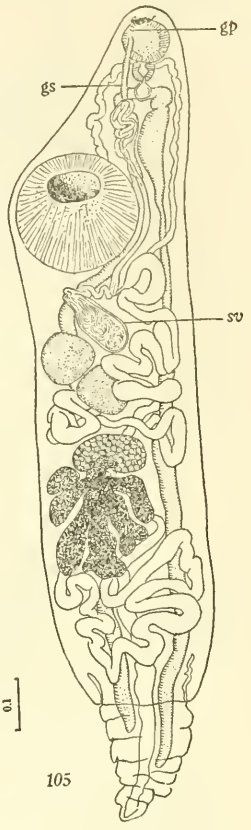

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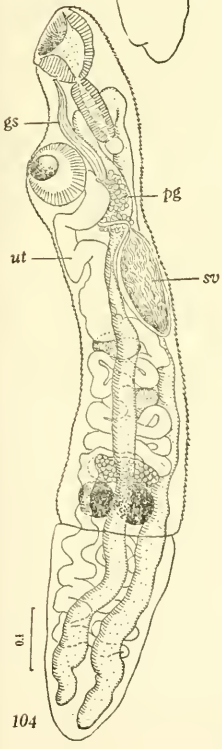

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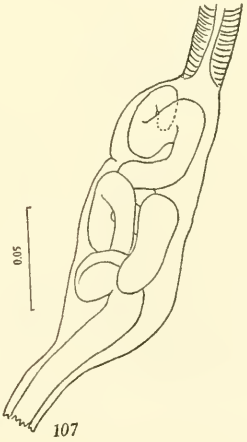

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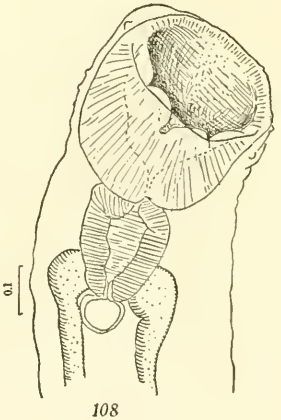


108

PLATE 47

FIG. 109. *Mecoderus oligoplitis* from *Oligoplites saurus*. Ventral view.

FIG. 110. *M. oligoplitis*. Diagram of terminal reproductive organs.

FIG. 111. *Lecithochirium microstomum* Chandler from *Paranthias furcifer*. Enlarged, semiventral view of forebody region showing presomatic pit and terminal reproductive organs.

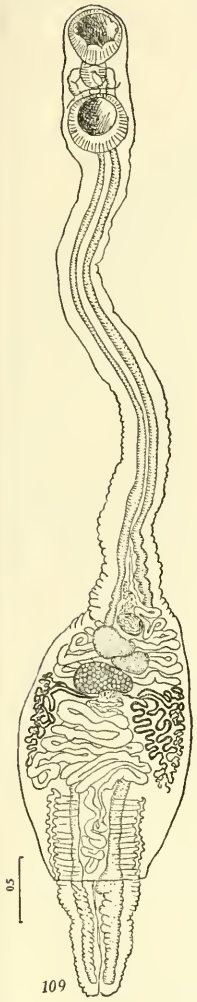
FIG. 112. *L. microstomum*. Vitellaria.

FIG. 113. *L. microstomum*. Eggs, showing variation.

FIG. 114. *Lecithochirium magnaporum* from *Paralabrax humeralis*. Ventral view.

FIG. 115. *L. magnaporum*. Enlarged view of anterior portion of body showing presomatic pit and terminal reproductive organs.

FIG. 116. *L. magnaporum*. Eggs.



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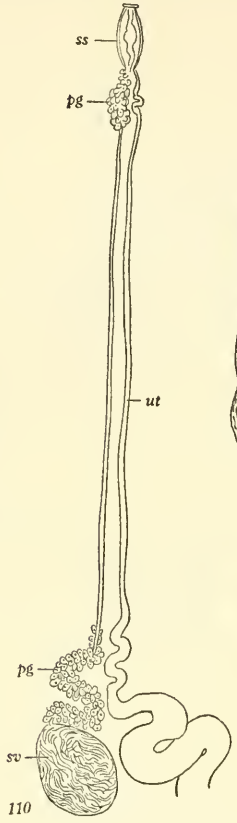

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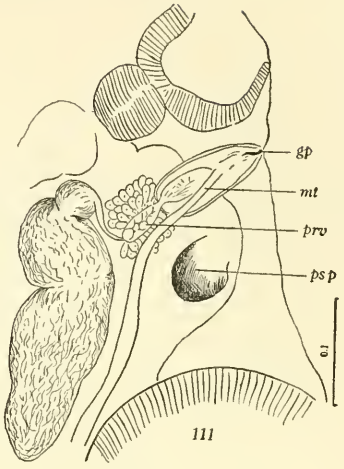

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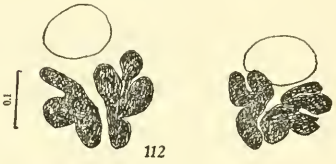

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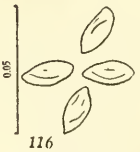

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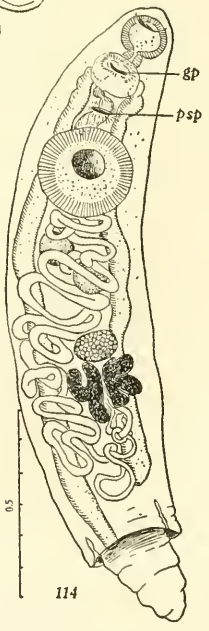

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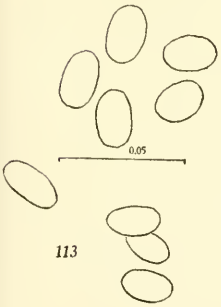

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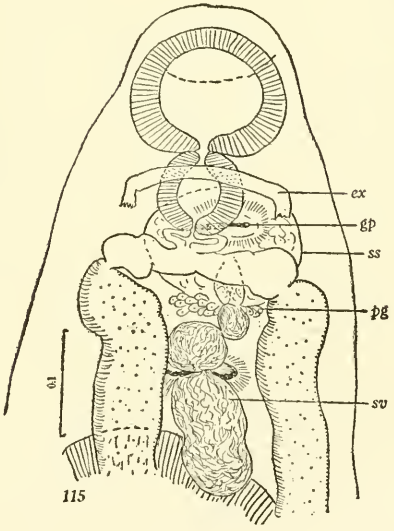

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PLATE 48

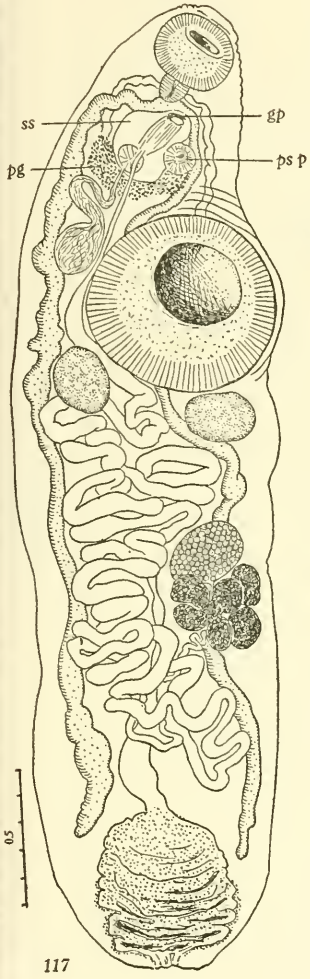
FIG. 117. *Lecithochirium muraenae* from *Muraena clepsydra*. Ventral view.

FIG. 118. *L. muraenae*. Enlarged, dorsal view of terminal reproductive organs.

FIG. 119. *Theletrum lissosomum* from angelfish. Ventral view.

FIG. 120. *T. lissosomum*. Sagittal section through region of sinus sac.

FIG. 121. *T. lissosomum*. Vitellaria.



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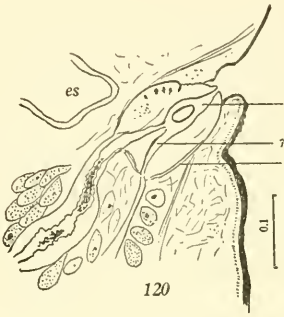

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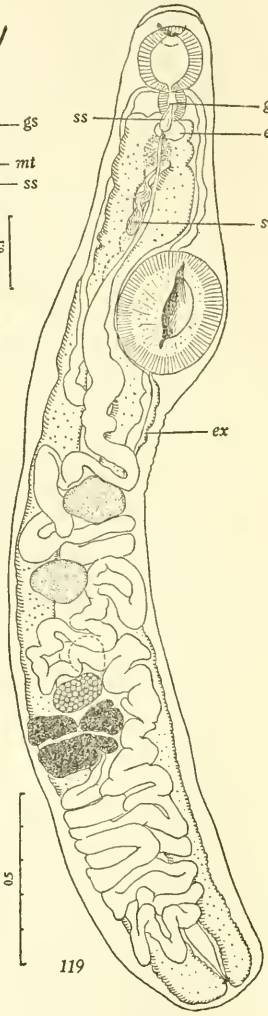

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PLATE 49

FIG. 122. *Theletrum gravidum* from *Abudefduf saxatilis*. Dorsal view.

FIG. 123. *T. gravidum*. Lateral view of terminal reproductive organs.

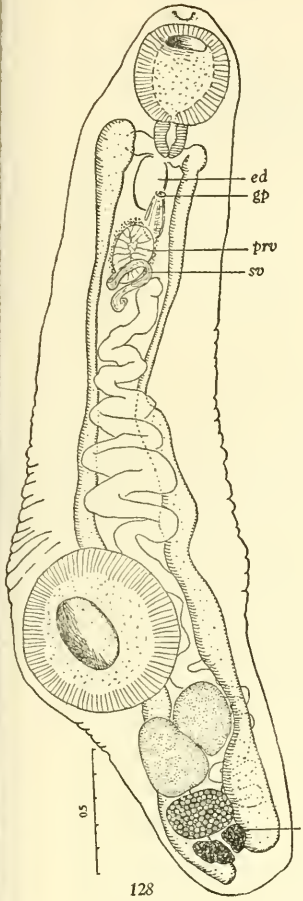
FIG. 124. *Aponurus trachinoti* from *Trachinotus rhodopus*. Dorsal view.

FIG. 125. *A. trachinoti*. Eggs.

FIG. 126. *Leurodera pacifica* from *Anisotremus scapularis*. Ventral view.

FIG. 127. *L. pacifica*. Eggs.

FIG. 128. *Gonocercella pacifica* from *Trachinotus rhodopus*. Ventral view.



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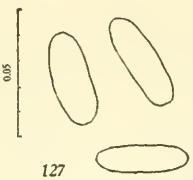

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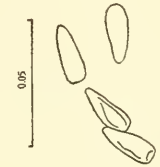

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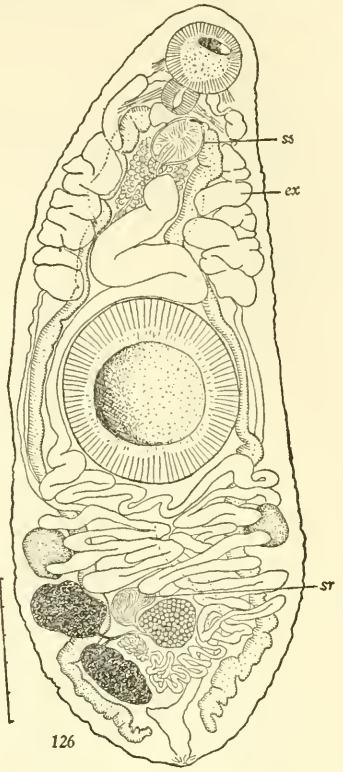

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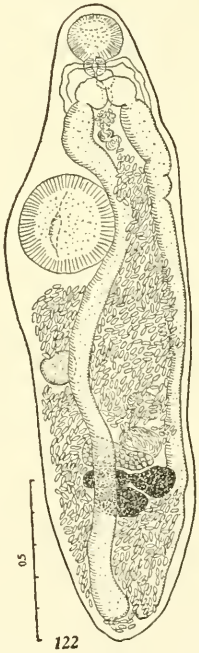

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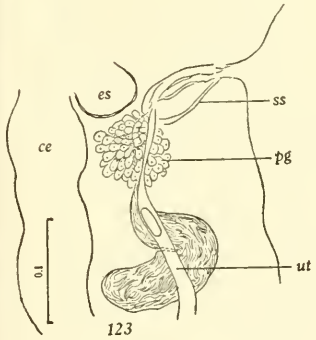

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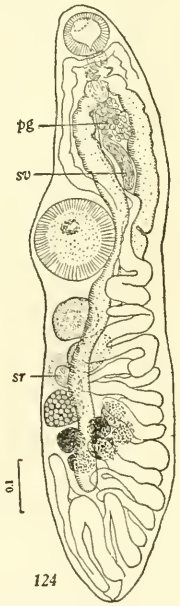

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PLATE 50

FIG. 129. *Paronatrema mantae* from *Manta birostris*. Dorsal view.

FIG. 130. *P. mantae*. Enlarged view of accessory suckers of oral suckers.

FIG. 131. *P. mantae*. Enlarged view of accessory suckers of acetabulum.

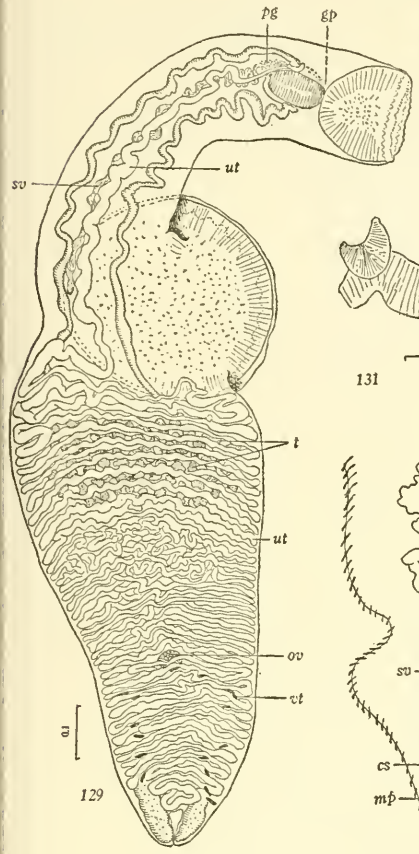
FIG. 132. *P. mantae*. Enlarged, ventral view of posterior end of body showing excretory vesicle.

FIG. 133. *P. mantae*. Enlarged, ventral view of terminal reproductive organs.

FIG. 134. *Psettarium tropicum* from *Cheilichthys annulatus*. Dorsal view.

FIG. 135. *P. tropicum*. Diagram of posterior end of body showing reproductive organs. The uterine pore is ventral; the male pore dorsal.

FIG. 136. *P. tropicum*. Eggs.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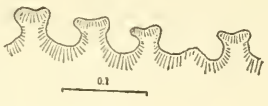
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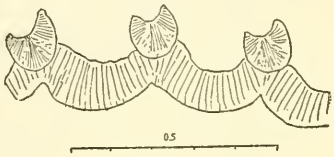
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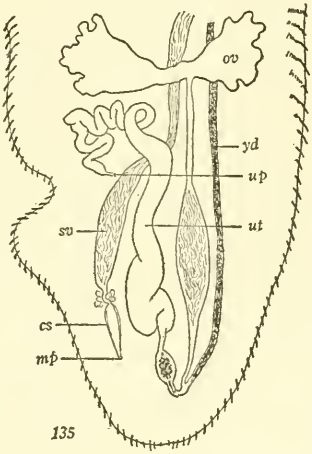
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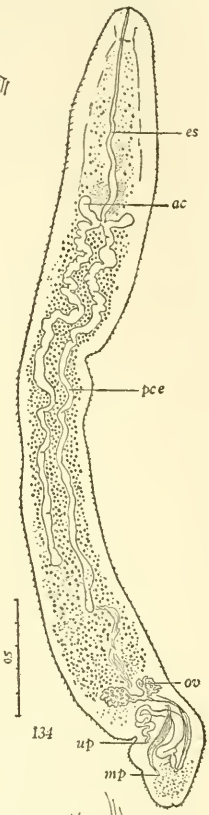
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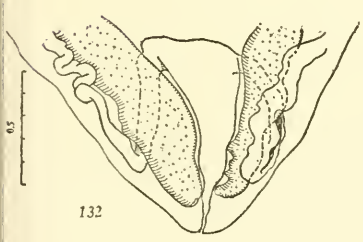
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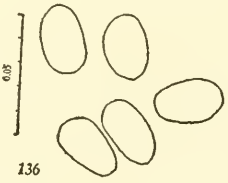
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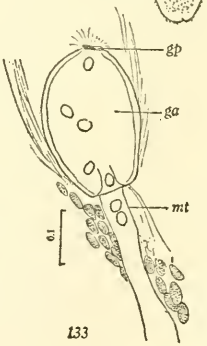
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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, AND IN 1938.

THE ACANTHOCEPHALA COLLECTED BY THE ALLAN HANCOCK PACIFIC EXPEDITION, 1934

(PLATES 51-55)

By HARLEY J. VAN CLEAVE

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THE ACANTHOCEPHALA COLLECTED BY THE ALLAN HANCOCK PACIFIC EXPEDITION, 1934*

(Plates 51-55)

Harley J. Van Cleave
University of Illinois

Through the courtesy of Dr. H. W. Manter and Dr. Irene McCulloch, I have had the opportunity of studying the Acanthocephala which Dr. Manter collected when he accompanied the Hancock Pacific Expedition of 1934 to the Galapagos Islands. The collection, although relatively small, is of great significance because 4 new species of Acanthocephala have been encountered and further biological and distributional data have been added for 3 previously known species. All of the new forms encountered are from fish hosts. They are *Gorgorhynchus lepidus, Gorgorhynchus clavatus, Filisoma bucerium,* and *Tegorhynchus pectinarius,* which are described in this report. The forms for which additional data become available are *Nipporhynchus ornatus* (Van Cleave, 1918) from a fish host and *Southwellina hispida* (Van Cleave, 1925) and *Centrorhynchus spinosus* (Kaiser, 1893) from avian hosts.

In the course of this study it is pointed out that *Gorgorhynchus gibber* is a synonym of *G. medius,* so the latter becomes type of the genus. Similarly, it is shown that *Nipporhynchus katsuwonis* is a direct synonym of *N. ornatus,* whereby *ornatus* becomes the type of Nipporhynchus.

Genus GORGORHYNCHUS Chandler, 1934

Chandler (1934, p. 356) applied the name Gorgorhynchus to a generic concept based on *Rhadinorhynchus medius* (Linton, 1907) and on *G. gibber,* which he designated as type of the genus and described in the same paper. In his original description, Chandler expressed the feeling that *G. gibber* and *G. medius* resemble each other so closely that "there might even be some question of their specific distinctness." In establishing the status of *G. gibber,* he made numerous comparisons with observations on *G. medius* published by Linton (1907), and, although he showed that some of Linton's observations were in error, he proceeded

* Contributions from the Zoological Laboratory of the University of Illinois, No. 536.

to justify his new species on differences that he observed between his own material and the description of Linton. The present writer has access to some of the cotypes of *G. medius*. These include the two specimens that were restudied in 1918 when *medius* was reassigned to the genus Rhadinorhynchus and three additional individuals that had been preserved in alcohol but are now stained and mounted for microscopical study. Measurements and other observations taken on this cotype material fail to agree with the data cited by Linton in the original characterization of the species.

The original description of *G. medius* gives 45 μ as length of the hooks on the base of the proboscis. On the cotypes these measure 59 to 70 μ, thus including the 70 μ cited by Chandler for *G. gibber*. Likewise, other hooks on the proboscis of *G. medius* were recorded as 60 μ while reaching 70 to 80 μ in *G. gibber*. Most of the hooks measured on the cotypes of *G. medius* were at least 70 μ long. Similarly, the spines on the body were recorded as distinctly larger in *G. gibber,* but spines 60 μ were very common on the cotypes of *G. medius,* thus eliminating spine size as a possible specific difference. In like manner, the cited range of hook formulas for the two presumed species does not fall beyond the range of individual variability commonly encountered in Gorgorhynchidae. Linton cited "about 22 ventral rows of hooks," while Chandler listed an unqualified 22 for *medius* and cited 24 for *G. gibber*. Bodily measurements and proportions cited in Chandler's comparison of the two presumed species are not sufficient ground on which to base specific distinction when other more stable characters, not affected by growth stages, are removed from the list of differences.

On the basis of the foregoing analysis the present writer is convinced that *G. gibber* must be considered as a direct synonym of *G. medius* (Linton, 1907). Since *G. gibber* had been cited as genotype by original designation, its valid synonym *G. medius* (Linton, 1907) becomes the type of the genus Gorgorhynchus. In a paper now in press (Van Cleave and Lincicome), the genus Gorgorhynchus is separated from the family Rhadinorhynchidae and is designated as type of a new family Gorgorhynchidae, separable from the Rhadinorhynchidae chiefly on the basis that the Gorgorhynchidae have males with four cement glands, while the Rhadinorhynchidae have males with eight cement glands.

Two distinct species of Gorgorhynchus were taken from marine fishes of Albemarle Island by the Hancock Expedition. These are described in the following section.

Generic diagnosis. The genus Gorgorhynchus includes species parasitic in marine fishes. Body elongate and usually slender, somewhat expanded anteriorly. Body spines in a single field at the anterior extremity of the body. Proboscis cylindrical or barrel shaped, relatively stout, densely armed with numerous hooks arranged in quincunxial order of alternating longitudinal and circular rows not showing profound regional or dorsoventral differentiation. Proboscis receptacle double walled with the brain well forward toward its anterior end. Lemnisci long, slender. Male genitalia occupy more than the posterior half of the body with the testes just posterior to the widest part of the body. Testes usually separated some distance and followed by four extremely long, tubular cement glands.

Type species. *Gorgorhynchus medius* (Linton, 1907).

Gorgorhynchus lepidus, new species

(Plate 51, figs. 1-5)

Host: *Cratinus agassizii* Steindachner, Tagus Cove, Albemarle Island, Galapagos, January 14, 1934.

Types. Eleven specimens (5 males and 6 females). Holotype male (VC 3126.6) and allotype female (VC 3126.7) and series of paratypes in the Allan Hancock Foundation of The University of Southern California. Paratypes also deposited in the collection of H. J. Van Cleave, Urbana, Illinois, and of the U.S. National Museum.

Specific diagnosis. No fully mature individuals available. Body of immature specimens 7 to 10 mm long with greatest diameter (0.8 to 0.9 mm) posterior to the tip of the proboscis receptacle. Posterior region of body much reduced in diameter (about 0.4 mm). Anterior region of body closely set with spines in a single continuous field which on the ventral surface extend from one half to three fourths the length of the receptacle but on the dorsal surface from one fourth to one half the length of the receptacle. Spines 65 to 90 μ long, often with a root process extending anteriorly from the base of the spine. Proboscis large, somewhat barrel shaped with greatest diameter (0.46 to 0.5 mm) near the middle tapering slightly toward each end; 1.6 to 0.8 mm long, armed with 20 longitudinal rows of 14 to 16 hooks each. Near middle of proboscis the ventral hooks are 106 to 120 μ long, dorsal hooks in corresponding location 96 to 118 μ long; those on ventral surface usually much heavier. Proboscis receptacle 1.7 to 2.2 mm long with the brain

near its anterior end at a level near the anterior limit of the body spination. Lemnisci very long, at times more than three times the length of the receptacle, one usually considerably longer than the other. A small rounded papilla (figs. 2 and 3) 20 to 23 μ in diameter on each lateral surface of the proboscis, slightly anterior to the level of the posteriormost hooks lying between adjacent longitudinal rows of hooks and slightly modifying the hook arrangement.

Testes ovoid, about 0.3 mm long, in some individuals contiguous but more often separated by a distance equal to 1.5 times the length of a testis. Cement glands 4, very long, tubular. Genital orifice of female usually slightly dorsal, subterminal, associated with a slight posterodorsal extension of the body. Embryos not available.

Comparisons. *G. lepidus* differs from *G. medius* in that the former has fewer longitudinal rows of hooks as well as fewer hooks in each row, but the hooks are distinctly larger than in *G. medius*. Comparing *G. lepidus* with *G. clavatus,* which is described in this same paper, the latter has conspicuously fewer hooks in each longitudinal row, and the hooks are distinctly larger than in *G. lepidus*.

Gorgorhynchus clavatus, new species

(Plate 52, figs. 6, 7; Plate 54, fig. 16)

Host: *Paralabrax humeralis,* Tagus Cove, Albemarle Island, Galapagos, January 13, 1934.

Types. Description based on 5 individuals and a few additional fragments. Holotype female (VC 3127.1) and allotype male (VC 3127.5) in the Allan Hancock Foundation of The University of Southern California. Paratypes in the collection of H. J. Van Cleave, Urbana, Illinois, and in the U.S. National Museum.

Specific diagnosis. Mature females about 26 mm long, body very heavy, 1.8 to 2.4 mm in greatest diameter, tapering gradually to 1.5 to 1.8 mm posteriorly. (Males, body broken; hence, entire length not observable.)

Body spines arranged in a single field, extending almost as far posteriorly on dorsal as on ventral surface; ventrally one half to three fifths the length of the receptacle; dorsally one fourth to two fifths the length of the receptacle. Body spines 48 to 84 μ long.

Proboscis cylindrical, reduced by slight rounding at either extremity, 1.25 to 1.5 mm long by 0.51 to 0.58 mm in maximum diameter; armed with 20 longitudinal rows of 13 to 15 hooks each. Longest hooks, near

anterior end of proboscis, 120 to 142 μ long on ventral surface, those on dorsal somewhat shorter. One small papilla (sensory?) on each midlateral surface of the proboscis at the level of the basal hooks and influencing the arrangement of adjacent basal hooks as described for *G. lepidus*.

Lemnisci very long, in some as much as two and one-half times the length of the receptacle.

Proboscis receptacle in mature females 3.23 mm long, with brain located about one third the distance from its anterior extremity.

Testes contiguous, about 1.5 mm long.

Mature embryos within body of female 105 to 120 μ long by 36 to 43 μ wide.

Among some broken specimens of *G. clavatus* were found the terminal regions of male and female in copula. This condition is so relatively unusual in preserved material that a drawing of the stained whole mount is shown as fig. 16 on Plate 54.

Comparisons. *Gorgorhynchus clavatus* differs from *G. medius* in that there are fewer hooks on the proboscis of *G. clavatus*. This applies to both the number of longitudinal rows and the number in each row. The largest hooks in *G. clavatus* are nearly twice the size of those found in *G. medius*. The chief point of difference between *G. clavatus* and *G. lepidus* is the fact that the proboscis hooks of the former are considerably larger than those of *G. lepidus*.

Both *G. clavatus* and *G. lepidus* have as hosts marine fishes of the family Serranidae or sea basses. The host from which Linton reported *G. medius* belongs to a genus which is placed in the family Epinephelidae adjacent to the Serranidae. These forms seem to be the natural hosts of members of the genus Gorgorhynchus, although Chandler (1924) found this genus in Galeichthys, a marine catfish, belonging to an entirely different order of the fishes.

Genus TEGORHYNCHUS Van Cleave, 1921

The genus Tegorhynchus was recognized by the present author in 1921 to accommodate a species of acanthocephalon encountered in a marine fish of Masa Tierra of the Juan Fernandez Islands off the coast of Chile. As shown by Van Cleave and Lincicome (in press), this genus belongs in the family Gorgorhynchidae. It is closely related to the genus Illiosentis Van Cleave and Lincicome.

Generic diagnosis. Gorgorhynchidae of small to medium size with body spination in an uninterrupted mantle restricted to the anterior part of the body. Proboscis long, relatively few longitudinal rows of hooks. The entire proboscis invested by a thick hyaline cuticular membrane or the individual hooks ensheathed in prominent cuticular elevations of the proboscis surface. Proboscis receptacle double walled. Brain near anterior extremity of receptacle. Lemnisci at least as long as the receptacle. Testes contiguous followed by four clavate cement glands. Parasitic as adults in intestine of marine fishes.

Type species. *Tegorhynchus brevis* Van Cleave, 1921.

In the parasitic worms collected by the Allan Hancock Pacific Expedition of 1934, 2 specimens represent a previously unknown species which is assigned to this genus and is named *Tegorhynchus pectinarius.*

Tegorhynchus pectinarius, new species

(Plate 52, figs. 8, 9)

Host: Medialuna (?) taken from stomach of Seriola sp., Puerto Culebra, Costa Rica, February 24, 1934.

Types. Description based on 2 females, one of which, designated as holotype (VC 3124.2), is deposited in the Allan Hancock Foundation of The University of Southern California and the other, as a paratype, is deposited in the collection of H. J. Van Cleave, Urbana, Illinois.

Specific diagnosis. Body slightly fusiform, anterior extremity clothed with scattered spines about 30 to 48 μ long, not disposed in distinct zones but extending backward as a continuous mantle along almost three fourths the length of the body. Body proper 8.4 to 8.8 mm long. Proboscis, fully extended, about 1.4 mm long; armed with 12 longitudinal rows of about 28 to 30 hooks each (see figs. 8 and 9), the hooks displaying profound regional differentiation. A series of 6 or 7 hooks at the base of each longitudinal row forms a closely set, comblike series of thorns (fig. 9). The thorns of these combs are arranged in check rows in both directions, not in the alternating quincunxial order characteristic of the hook arrangement on the anterior region of the proboscis. Besides this regional specialization involving the base of the proboscis there is a conspicuous dorsoventral differentiation of the proboscis. Each of the 4 middorsal rows of hooks has one very heavy, strongly recurved hook with an exaggerated root standing immediately anterior to the basal comb. These peculiarly modified heavy hooks have a length of about 27 μ, while the large, recurrent root is almost twice the length of the hook proper. In

the 2 dorsalmost rows, either the space immediately anterior to the hook with the enlarged root is entirely devoid of hooks, or the hooks are represented by poorly formed vestiges for a space corresponding to the positions of 4 hooks in adjacent longitudinal rows. The third row from the median dorsal line of the proboscis on each lateral surface possesses a basal comb containing 5 thorns, one less than in the 4 dorsal combs. In these third rows from the middorsal surface, a single enlarged thorn occupies a position comparable to the location of the heavily rooted hooks in the dorsal series. A single thorn, slightly detached from the comb series, lies between the comb and the hook standing on the same level as the hooks with enlarged roots. In this same third row from the median dorsal plane on the lateral surface of the proboscis, the location of the vestigial hooks of the dorsal series is occupied by 2 very heavy hooks with heavy roots, but the roots are approximately 40 μ long with the recurved hook portion 27 μ long. The 6 ventral rows of hooks show very little regional specialization. In these, the basal comb of 6 or 7 thorns is followed anteriorly by 2 very heavy, thornlike hooks, of which one serves as transition to the form of the long, arcuate hooks characteristic of the anterior region of the proboscis. Anterior to the various characteristic basal modifications, the remaining hooks show little regional differentiation, except that hooks on the ventral surface are somewhat heavier and more strongly recurved than those on the corresponding region of the dorsal surface. The hyaline cuticular membrane surrounding the proboscis is not so pronounced as in *Tegorhynchus brevis* but surrounds each hook in a sheath much as in the genus Leptorhynchoides.

Lemnisci very thin and much coiled, apparently a little longer than the length of the receptacle.

Embryos within one gravid female 84 to 93 μ long by 21 to 24 μ wide. Males not observed. Genital extremity of female rather bluntly truncated, with genital orifice posterior but near the dorsal edge of the posterior end.

Comparison. *T. pectinarius* differs from *T. brevis,* the only other known member of the genus in (1) the extreme regional specialization of its proboscis hooks, (2) the number of hooks on the proboscis, and (3) the size of the embryos.

Genus **FILISOMA** Van Cleave, 1928

The genus Filisoma was proposed by the present writer for a concept based on *Filisoma indicum,* a species found in the intestine of a fish,

Scatophagus argus, from India. In males of the type material, the cement glands were described as "very long, individual glands not recognizable." The writer was then of the impression that these glands are syncytial, as in the Neoechinorhynchidae, but the lack of giant nuclei in the subcuticula and the presence of a double-walled proboscis receptacle gave conclusive evidence that Filisoma cannot be considered as belonging to the order Eoacanthocephala. Meyer (1933) without further evidence than that presented in the description of the type species ascribed Filisoma to the family Rhadinorhynchidae. A preliminary examination of materials in the collections of the Hancock Pacific Expedition revealed worms of an undescribed species which obviously belongs to the genus Filisoma. In the males of these specimens, 4 elongate cement glands characteristic of the family Gorgorhynchidae (Palaeacanthocephala) are observable. The cement glands have numerous relatively large nuclei such as are found in the genus Gorgorhynchus, but these are much more numerous and much smaller than the giant nuclei characteristic of the cement glands and subcuticula of the Eoacanthocephala. On the basis of the foregoing observations upon this previously unknown species, Van Cleave and Lincicome (in press) have assigned the genus Filisoma to the family Gorgorhynchidae within the order Palaeacanthocephala.

Recently, Harada (1938) has described another species which he ascribed to Filisoma as *F. microcanthi,* but, since males were lacking in his material, he could not offer additional evidence for the assignment of the genus beyond that given in the original incomplete description of *F. indicum.*

Generic diagnosis. Gorgorhynchidae parasitic in marine fishes. Body very long, slender, approximately cylindrical in preserved specimens, without body spination. Proboscis very long, cylindrical, arcuate. Proboscis receptacle very long, double walled, with brain at its base. Retinacula at posterior tip of receptacle. Lemnisci about the same length as the receptacle. Male genitalia widely separated from the receptacle of the proboscis. Testes several times as long as wide, followed by four extremely long cement glands.

Type species. Filisoma indicum Van Cleave, 1928.

Filisoma bucerium, new species
(Plate 53, figs. 10-14)

Host: *Kyphosus elegans* (Peters), Socorro Island, Mexico, January 3, 1934.

Types. Description based on 10 individuals (6 males, 4 females) of which one male (VC 3125.2) designated as holotype and 2 paratypes are deposited in the Allan Hancock Foundation of The University of Southern California; allotype female (VC 3125.1) and 2 paratype males in the collection of H. J. Van Cleave, Urbana, Illinois; and one male and one female paratype in the U.S. National Museum.

Specific diagnosis. Gorgorhynchidae without body spines. Mature females about 60 mm long, males about 45 mm. Body very much attenuated, slightly enlarged just posterior to the posterior tip of the receptacle, in females about 0.6 to 1 mm in diameter for most of its length; in males about 0.4 to 0.6 mm. Proboscis long, cylindrical, about 1.5 to 2 mm long, slightly to strongly arcuate, armed with 16 longitudinal rows of 38 to 45 hooks each. The median dorsal row of hooks differentiated from all the remainder in that they lack sharp points but each ends in a blunt tip of hornlike appearance. Near the middle of the length of the proboscis the ventral hooks are stout, sharp, strongly recurved, about 57 μ long and 21 μ in diameter at the base; on the dorsal surface hooks in the median row are bluntly pointed, 57 μ long, 21 μ in diameter at base; dorsal but lateral to the median row the hooks are simple, slender, sharp pointed, about 43 to 51 μ long by 9 μ in diameter at base. Papillae not observed on neck or proboscis. Proboscis receptacle double walled, very long (2.3 mm to 4.2 mm), with brain located at base and retinacula emerging from its posterior tip. Lemnisci fairly heavy, often almost as broad as receptacle, approximately the same length as receptacle.

Male genitalia restricted to approximately the posterior half of the body. The 2 testes elongate, slightly separated, followed by a series of 4 very long, tubular cement glands.

Posterior extremity of female obliquely truncated in posterior-dorsal area, with the female orifice subterminal on the dorsal surface. Embryos within body cavity of mature female 56 to 69 μ long by 12 to 18 μ wide.

Comparison. *F. bucerium* differs from the other 2 species of the genus Filisoma in the presence of one middorsal longitudinal row of conspicuously modified, heavy, blunt, hornlike proboscis hooks and in the possession of a larger number of hooks in each longitudinal row than in any other species.

Of the 2 previously described species, *F. indicum* has been recorded from India only, while *F. microcanthi* rests on a single record from Formosa. *F. bucerium* is the first species described from the Western Hemisphere.

Genus NIPPORHYNCHUS Chandler, 1934

Chandler (1934, p. 355) recognized Nipporhynchus as a new genus based on the concept of *Rhadinorhynchus katsuwonis* Harada, 1928. To this genus he tentatively ascribed *R. ornatus* Van Cleave, 1918, because details of structure were too imperfectly known to warrant unqualified assignment of the species in his new series of generic concepts. A number of specimens in the collections of the Hancock Pacific Expedition agree with the original material of *R. ornatus*. Fortunately, among these one male individual is included. Since males were previously unknown and since some of the most stable generic characters in this family rest on characteristics of the male, this material offers the first opportunity for confirming Chandler's tentative assignment of *R. ornatus* to the genus Nipporhynchus.

Previously, the only concept of *R. ornatus* was based on the rather inadequate description given by Linton (1892). The discovery of additional specimens in the Hancock Expedition collections enables the writer to give a more comprehensive description of this species. In doing so it has become evident that *Nipporhynchus katsuwonis,* described as a new species by Harada (1928), cannot be differentiated from *N. ornatus* and must fall as a synonym. Detailed comparisons on which this conclusion is based are shown in Table I. Since Chandler (1934) had cited *N. katsuwonis* as genotype by original designation, its valid synonym *N. ornatus* (Van Cleave, 1918) becomes the genotype of Nipporhynchus.

The present writer cannot agree with the position of Yamaguti (1938, p. 271), who states "There is no sound reason for separating this species [*R. katsuwonis*] from Rhadinorhynchus Lühe, 1911, as type of Nipporhynchus Chandler, 1934." The genus Nipporhynchus is a valid concept under the family Gorgorhynchidae as expressed by Van Cleave and Lincicome (in press).

Generic diagnosis. Gorgorhynchidae with long proboscis, armed with many longitudinal rows of hooks which are longer and stouter on ventral surface than on dorsal, basal row forming a complete circle. Proboscis receptacle double walled. Anterior body region beset with spines which may be in a single or double field. Lemnisci ribbon shaped, about as long as proboscis receptacle. Testes elongate. Cement glands 4 in number, elongated, cylindrical or club shaped, and may be paired.

Type species. Nipporhynchus ornatus (Van Cleave, 1918).

The only representative of this genus encountered in this study is the genotype.

TABLE I

Comparison of *Nipporhynchus katsuwonis* and *N. ornatus*

	N. katsuwonis after Harada, 1928	*N. ornatus* after Van Cleave
Body length, females	up to 35 mm	about 25 mm
Body length, males	up to 17 mm	about 17 mm
Proboscis dimensions	1.8 to 2.4 mm by 0.2 mm	2 to 2.5 mm by 0.23 mm
Proboscis hooks	22 rows of 32 to 39 each	22 to 24 rows of 38 to 45 each
Proboscis hook size	55 to 60 μ	50 to 80 μ
Basal hooks on proboscis	circle of 22; 100 μ	circle of 22 (to 24); 82 to 100 μ
Body spines	50 to 60 μ	48 to 74 μ
Brain	Slightly anterior to middle of receptacle	2/5 way from anterior end of receptacle
Lemnisci	slightly shorter than receptacle	slightly shorter than receptacle
Cement glands	4	4
Male genitalia	Posterior half of body	Posterior half of body
Embryos	65 to 80 μ by 21 to 25 μ	59 to 69 μ by 20 to 24 μ
Hosts	*Euthynnus vagans*	*Euthynnus alletteratus* *Katsuwonis pelamis* *Tylosurus acus*

Nipporhynchus ornatus (Van Cleave, 1918)

(Plate 54, fig. 15; Plate 55, fig. 18)

Synonymy: *Echinorhynchus pristis* (in part) of Linton, 1892

Rhadinorhynchus ornatus Van Cleave, 1918

Rhadinorhynchus katsuwonis Harada, 1928

Nipporhynchus katsuwonis (Harada, 1928) Chandler, 1934

Hosts: *Euthynnus alletteratus* (Raf.), Charles Island, Galapagos, January 27, 1934

Katsuwonis pelamis (Linn.), Charles Island, Galapagos, January 30, 1934

Euthynnus alletteratus (?) or *Katsuwonis pelamis* (Linn.), Galapagos Islands, June 11, 1934

Specific diagnosis. Fully mature females about 25 mm long, with maximum diameter of about 0.7 mm, tapering toward either extremity to a diameter of about 0.5 mm. Male about 17 mm long with a diameter of about 0.6 in region of the testes. Proboscis cylindrical to clavate, 2 to 2.5 mm long by about 0.23 mm in diameter, often with a slight swelling near anterior tip; armed with 22 to 24 longitudinal rows of 38 to 45 hooks each. Hooks of basal circle approximately 82 to 100 μ long, without any specialized ventral crescent; on mid-ventral surface of proboscis about 59 μ; on middorsal more slender; near anterior end about 76 μ long. Testes contiguous; cement glands 4, long, tubular. Lemnisci distinctly shorter than proboscis receptacle. Body spines arranged as a collar of scattered spines on anterior body extremity followed by an unspined area and then with scattered spines, chiefly on ventral surface but not extending posteriorly as far as the end of the proboscis receptacle. Spines about 76 μ long. Retinacula about three fifths the length of the proboscis receptacle from its posterior end. Embryos within body of gravid female 59 to 69 μ long by 20 to 24 μ in diameter.

The geographical range of this species has been greatly extended by this record. Previously known only from northeastern United States, the species is here recorded from Charles Island of the Galapagos group. The species evidently has wide range of host relationships. The present record is the first instance of description of a male of this species.

Southwellina hispida (Van Cleave, 1925) Witenberg, 1932
(Plate 54, fig. 17)

Synonymy: *Arhythmorhynchus hispidus* Van Cleave, 1925
Arhythmorhynchus fuscus Harada, 1929

Host: An undetermined heron, Indefatigable Island, Galapagos, January 20, 1934

Under the name *Arhythmorhynchus hispidus,* the writer (1925) described 5 specimens of immature worms taken from mesenterial cysts of *Rana nigromaculata* of Musashi Province, Japan. In 1929, Fukui described the adult of this species from the intestine of *Nycticorax nycticorax nycticorax* (Linn.) from Shizuoka Province. In the same year, Harada described apparently the same species as *Arhythmorhynchus fuscus* from the same host as recorded by Harada. Fukui (1929, p. 270) and Yamaguti (1935, p. 269) both list *A. fuscus* as a direct synonym of *A. hispidus,* while the latter accepted the proposal of Witenberg (1932), who recognized this species as genotype of his new genus Southwellina, changing the termination of the specific name to agree with the gender of the generic name. The valid name thus became *Southwellina hispida* (Van Cleave, 1925).

To date, all published records of the occurrence of this species have been confined to hosts taken in Japan. It was with some surprise that the author encountered 4 specimens (2 males and 2 females) of this species in material removed from the intestine of an unidentified heron on Indefatigable Island, January 20, 1934. The species probably has broad geographical distribution that has not yet been adequately understood

Centrorhynchus spinosus (Kaiser, 1893)
(Plate 55, figs. 19, 20)

Synonymy: *Echinorhynchus spinosus* Kaiser, 1893
Centrorhynchus spinosus Van Cleave, 1916

Host: "Galapagos hawk," Galapagos Islands, January 22, 1934

Echinorhynchus spinosus was originally described by Kaiser from an unrecorded host from Florida. The present writer (Van Cleave, 1916), misinterpreting Kaiser's description, described and renamed the same species *Centrorhynchus spinosus.* Several birds, all from Florida, have been listed as hosts for this species.

A fine series of 22 specimens from an unidentified Galapagos hawk have been identified as *C. spinosus*. In these the body of mature females ranges from 15 to 22 mm long with a conspicuous inflation of the anterior third or fourth of the body in mature worms but occupying more than one half the body length in immature individuals (fig. 19). Proboscis longer than originally described for this species (1 to 1.3 mm). Hooks in 30 to 34 longitudinal rows of 22 to 24 hooks each from 36 to 60 μ long. Embryos within gravid females 50 to 60 μ long by 20 to 24 μ wide.

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EXPLANATION OF PLATES

All drawings are from stained, permanent mounts in balsam and were made by the use of a camera lucida.

PLATE 51

Gorgorhynchus lepidus, new species

FIG. 1. Immature female, entire, showing general organization and relation of the proboscis and related structures to the body.

FIG. 2. Proboscis of a young female showing its form and arrangement of the hooks.

FIG. 3. Detail of basal region of proboscis of a young male showing particularly the small papilla in the basal row of hooks.

FIG. 4. Posterior extremity of an immature female showing part of the uterus, the vagina, and genital orifice.

FIG. 5. Detail of a portion of body wall showing in lateral view the arrangement of vessels of lacunar system.

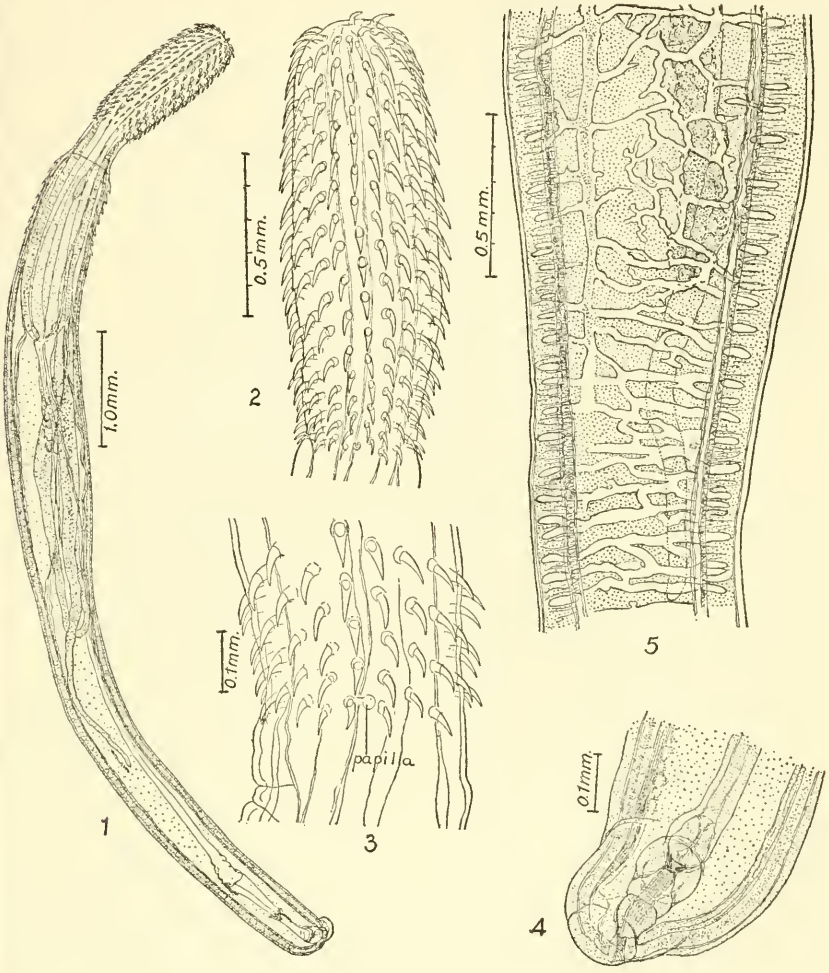
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PLATE 52

Gorgorhynchus clavatus, new species, and *Tegorhynchus pectinarius,* new species

FIG. 6. *G. clavatus,* proboscis of mature female showing arrangement of hooks and attachment to body.

FIG. 7. *G. clavatus,* detail of anterior dorsal surface of body showing shape and arrangement of cuticular spines.

FIG. 8. *T. pectinarius,* anterior region of body and proboscis showing particularly the high degree of regional differentiation of proboscis hooks and cuticular sheaths around hooks.

FIG. 9. *T. pectinarius,* detail of basal region of proboscis, dorsal surface showing modifications of hooks.

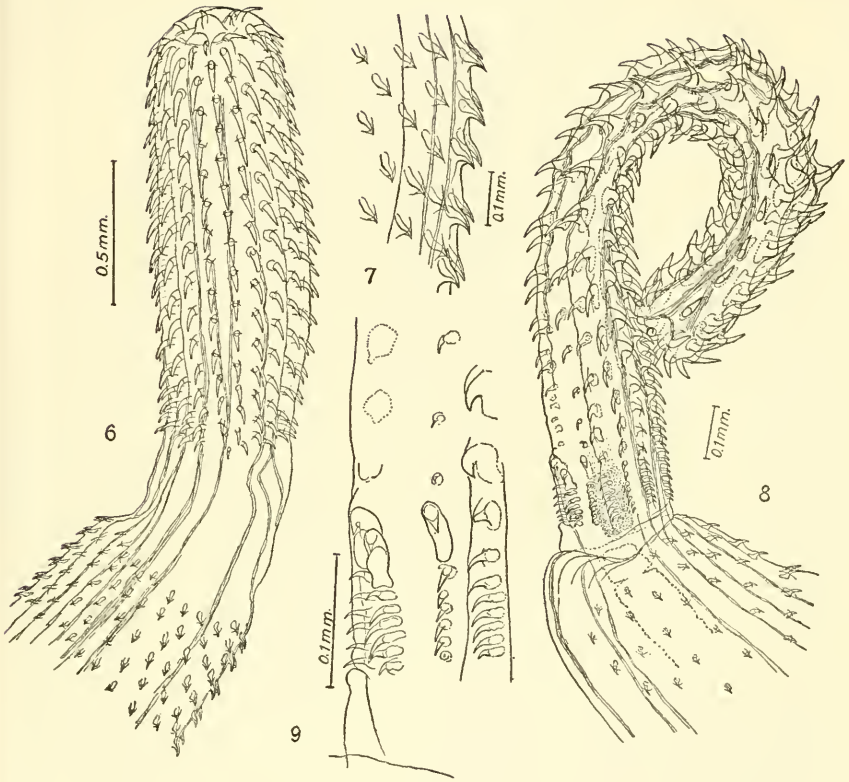
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PLATE 53

Filisoma bucerium, new species

FIG. 10. Anterior extremity of male showing relations of proboscis to the body, the receptacle of the proboscis and associated structures, and the lemnisci.

FIG. 11. Detail of tip of same proboscis as shown in Fig. 10.

FIG. 12. Detailed drawing of proboscis of a male showing distinctive cowhorn-shaped single row of middorsal hooks.

FIG. 13. Posterior extremity of gravid female showing copulatory cap.

FIG. 14. Section of body of mature female anterior to copulatory cap, showing uterine apparatus.

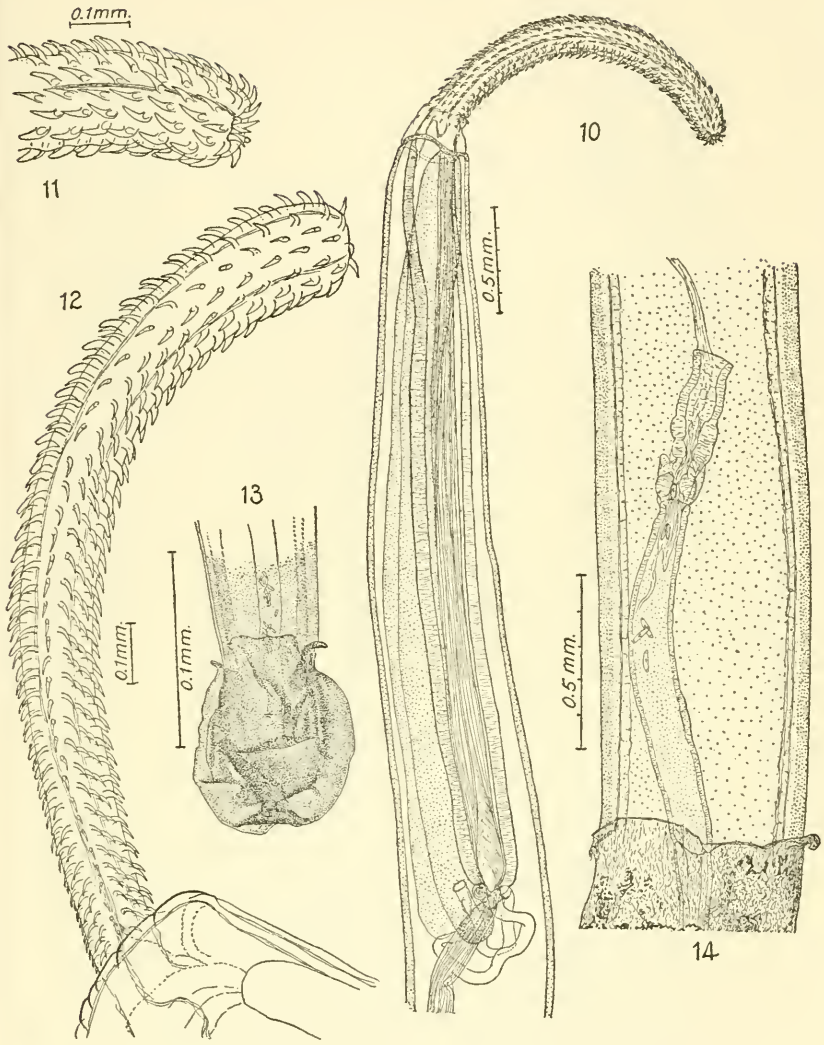
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PLATE 54

Nipporhynchus ornatus (Van Cleave), *Gorgorhynchus clavatus,* new species, and *Southwellina hispida* (Van Cleave)

FIG. 15. *N. ornatus,* anterior extremity of female showing characteristic form of proboscis and its hooks and arrangement of cuticular spines on body surface arranged in two distinct fields.

FIG. 16. *G. clavatus,* posterior extremities of male and female in copula.

FIG. 17. *S. hispida,* proboscis of mature male showing form of proboscis and arrangement of hooks. The body spination begins posterior to the region shown in this sketch.

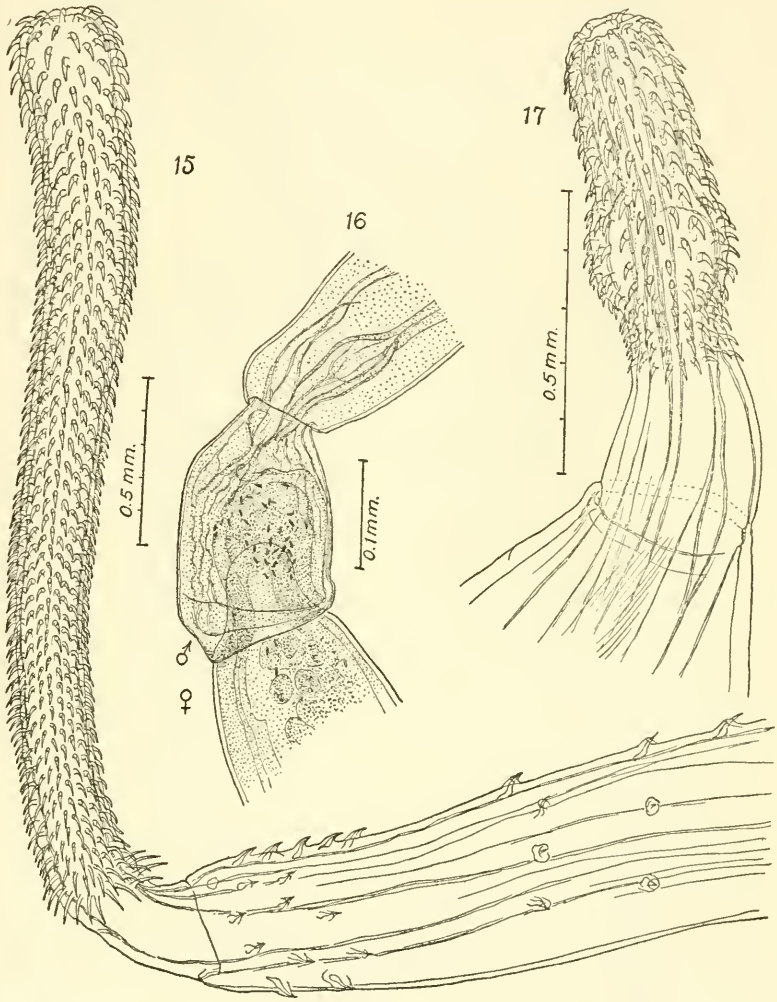
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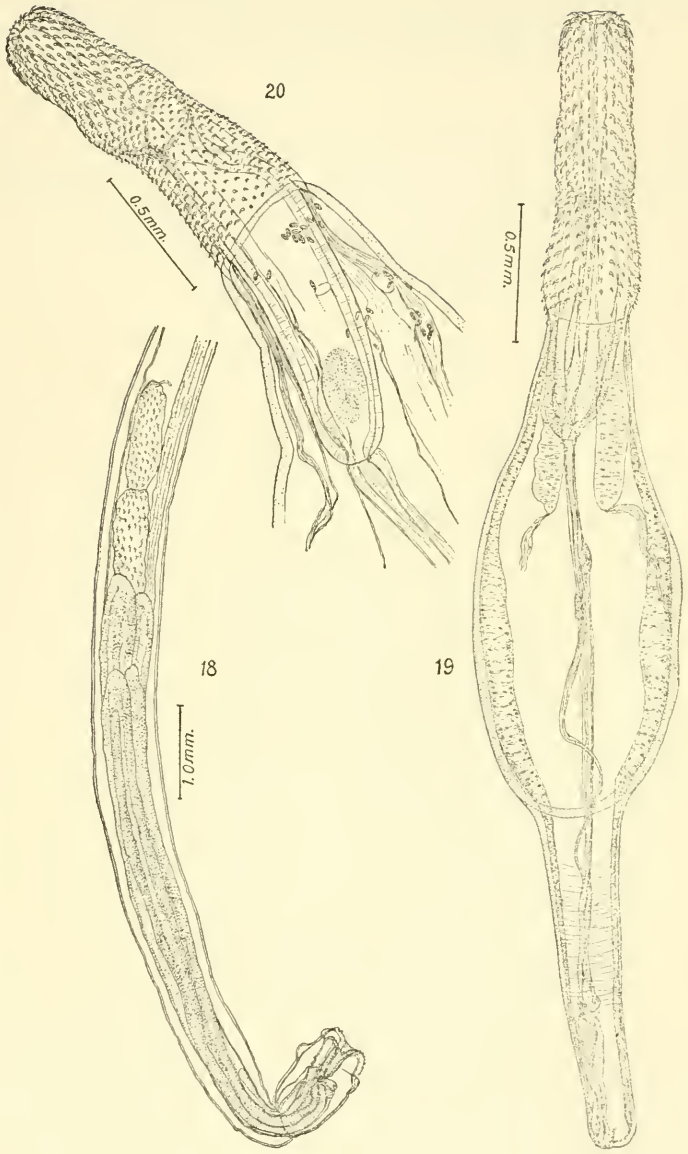
PLATE 55

Nipporhynchus ornatus (Van Cleave) and *Centrorhynchus spinosus* (Kaiser)

FIG. 18. *N. ornatus,* posterior extremity of male showing relations of testes, four cement glands, and everted bursa.

FIG. 19. *C. spinosus,* entire immature male showing differentiation of bodily regions.

FIG. 20. *C. spinosus,* proboscis of mature female and associated structures in anterior region of body.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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III OFF THE COAST OF MEXICO, CENTRAL AMERICA, SOUTH AMERICA, AND GALAPAGOS ISLANDS IN 1932, IN 1933, IN 1934, IN 1935, IN 1936, IN 1937, IN 1938, AND IN 1939.

THE GEOGRAPHICAL DISTRIBUTION OF DIGENETIC TREMATODES OF MARINE FISHES OF THE TROPICAL AMERICAN PACIFIC

By HAROLD W. MANTER

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TABLE OF CONTENTS

THE GEOGRAPHICAL DISTRIBUTION OF DIGENETIC TREMATODES OF MARINE FISHES OF THE TROPICAL AMERICAN PACIFIC*

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INTRODUCTION

Many comparisons of marine animals of the tropical Atlantic and tropical Pacific strongly support other evidence (geological and paleontological) that the two oceans were formerly connected. Panama and Central America, however, have probably separated the two oceans since the middle of the Miocene, between 7,000,000 and 13,000,000 years ago. Specialists in almost all groups of marine animals have been impressed by similarities of genera and species on the two coasts of tropical America, but as a rule relatively few of the animal species are identical. The similarity is more generally evidenced by numbers of so-called geminate or twin species and by identical genera endemic to and limited to the two oceans (the so-called endemic amphi-American genera). Such findings are especially impressive among Crustacea and fishes. For example, according to the review of this subject by Ekman (1935) of 157 genera of crabs in tropical America, 33 genera are endemic amphi-American, 8 others occur elsewhere only in the Eastern Atlantic, and 3 others only in temperate South American waters. In this group of animals, however, the number of identical endemic amphi-American species is small. Of 582 littoral species of crabs of the tropical Atlantic, only 9 are common to both oceans and not found elsewhere.

Geminate species and genera are best known among the decapods, sea urchins and fishes. Rathbun (1917-1937) and Finnegan (1931) note many twin-pairs of species and of genera among crabs. Jordan (1908) notes "a hundred or more" twin-pairs of littoral fishes on the two sides of the Isthmus of Panama. Jordan's observations of such twin-species led him to formulate "the Law of Geminate Species" (Jordan, 1908), which may be stated in his words as "broadly speaking . . . given any form of animal or plant in any region, the nearest related form is not found

* Studies from the Zoological Laboratories, University of Nebraska, No. 206.

in the same region nor in a remote region, but in a neighboring region, separated from the first by a barrier of some sort, not freely traversible."

In view of these significant comparisons of free-living animals of the two oceans, a comparison of some of the parasites of these animals becomes a subject of some interest. The geographical distribution of parasites has often been found to furnish considerable light on problems of relationship among hosts and to furnish evidence of earlier distribution of the hosts as well as probable land connections of the past. Conclusions rely chiefly upon a certain amount of host specificity on the part of parasites, a characteristic almost always exhibited to a greater or lesser degree.

Von Ihering (1902) proposed that genetic relationship among parasites was a good index of genetic relationship of the hosts involved and that two host species were related if they contained identical or similar parasites. Zschokke (1904) applied this principle to the distribution of certain cestodes of marsupials. Perhaps the outstanding classical example of this type of research is that of Metcalf (1923), who found that certain ciliated protozoa of South American and Australian Leptodactylidae are so similar that a genetic relationship between these amphibia of the two continents is clearly indicated and, as a corollary, a one-time land connection between the two continents. Similar studies have been made on the distribution of bird lice (Kellogg, 1905).

The author (Manter, 1940) recently reported 82 species of digenetic trematodes from marine fishes of the tropical American Pacific, a region hitherto unexplored for such parasites. These trematodes proved to be generally different from those found in other parts of the world with the exception of the tropical Atlantic. A rather large number of the species (23, or more than 25%) are known to occur also in the American Atlantic, and 13 species are actually (so far as is known) endemic amphi-American species not known elsewhere. Furthermore, 11 additional species from the Pacific find their nearest related species in the Atlantic. At least 7 of these 11 species are so closely similar to their Atlantic relatives that they could be termed geminate species. Only 7 species of the 83 are known to occur elsewhere other than in the Atlantic. Six of these 7 are reported from Japan.

It should be noted that trematodes of the tropical Pacific are still incompletely known. While all of the digenetic trematodes collected are considered here, these probably represent not more than a good sampling of the region. The same incomplete knowledge of the trematode fauna of the more northern Pacific and Atlantic coasts of America exists. Marine

fish trematodes of Tortugas, Florida, are better known, as are those of Japanese and European waters. However, it is believed that the trematodes considered in this paper constitute a representative sample of the region explored, and one should expect the similarity to the Atlantic fauna to be maintained by the discovery of additional representatives. Actually, more game fishes and relatively fewer shore fishes were examined by the author in the Pacific than at Tortugas, so that more closely comparative studies might even reveal increased similarity in the two regions.

Another qualification to be noted is that the validity of conclusions from such data presumes the correct identification of both parasite and host.

In spite of these handicaps, some rather distinct tendencies appear in the tables below, and these tendencies seem to be consistent with other known conditions. The trematodes are grouped according to the distribution indicated for each table. Some comments regarding the data follow each table. Authors of scientific names are included in the earlier paper (Manter, 1940) but omitted in this paper.

The numbers of fishes examined in the different localities are as follows: from Mexican waters, 147; from the Galapagos Islands, 110; from South American coast, 110; from Panama and Central America, 60.

TABLE 1

DIGENETIC TREMATODES OCCURRING IN BOTH THE TROPICAL PACIFIC AND THE TROPICAL ATLANTIC; THEIR HOSTS AND DISTRIBUTION

(Species marked with an asterisk (*) are endemic amphi-American as far as known)

Trematode and Pacific hosts	*Atlantic hosts*	*Extra-American distribution*
1. Bucephalus varicus Caranx species	*Caranx ruber* *C. latus* *C. bartholomaei*	Red Sea
2. Derogenes varicus *Cratinus agassizii* *Paralabrax humeralis*	*Dibranchus atlanticus* *Helicolenus dactylopterus* *Merluccius bilinearis* *Scorpaena cristulata* *Urophycis regius*	World-wide, at least in cool waters
3. Dinurus barbatus *Coryphaena hippurus*	*Coryphaena hippurus*	European Atlantic
4. Dinurus longisinus *Coryphaena hippurus*	*Coryphaena hippurus*	Red Sea

TABLE 1 *(Continued)*

Trematode and Pacific hosts	*Atlantic hosts*	*Extra-American distribution*
5. Hamacreadium mutabile*		
Lutianus viridis	*Anisotremus virginicus*	
Mycteroperca xenarcha	*Haemulon plumieri*	
	Lutianus apodus	
	L. griseus	
	L. synagris	
	L. jocu	
	Ocyurus chrysurus	
	Pomacanthus arcuatus	
6. Hamacreadium oscitans*		
Anisotremus interruptus	*Anisotremus virginicus*	
	A. carbonarium	
	Haemulon plumieri	
	H. sciurus	
7. Haplosplanchnus acutus*		
Kyphosus elegans	*Tylosurus raphidoma*	
Tylosurus fodiator	*T. marinus*	
	T. acus	
8. Haplosplanchnus pomacentri*		
Pomacentrus rectifraenum	*Eupomacentrus leucostictus*	
	P. xanthurus	
9. Helicometra fasciata		
flounder	*Bellator militaris*	European coasts;
star-gazer	*Prionotus alatus*	Mediterranean
	Prionodes species	
10. Helicometra torta*		
Epinephelus labriformis	*Epinephelus morio*	
	E. striatus	
11. Helicometrina nimia*		
Paralabrax nebulifer	*Amia pseudomaculatus*	
	A. maculata	
	Balistes vetula	
	Calamus calamus	
	Eupomacentrus leucostictus	
	Gnathypops maxillosa	
	Lutianus apodus	
	L. griseus	
	L. synagris	
	Ocyurus chrysurus	
	Scorpaena agassizii	
	S. brasiliense	
	S. plumieri	
	Syacium papillosum	
12. Hirudinella beebei*		
Acanthocybium solandri	*Acanthocybium petus*	

TABLE 1 *(Continued)*

Trematode and Pacific Hosts	*Atlantic hosts*	*Extra-American distribution*
13. Hirudinella clavata *Gymnosarda alletterata*	*Coryphaena hippurus* *Pelamys sarda* *Scomber pelamys* swordfish *Thunnus thynnus* *Thunnus vulgaris* *Xiphias gladius*	Probably wide; identifications sometimes questionable
14. Lecithochirium microstomum* *Calamus brachysomus* Caulolatilus species *Euthynnus alletterata* *Paralabrax humeralis* *Paranthias furcifer*	*Trichiurus lepturus*	
15. Lepidapedon nicolli* spotted grouper	*Epinephelus niveatus*	
16. Lepocreadium bimarinum* *Bodianus diplotaenia* *Pimelometopon pulcher*	*Lachnolaimus maximus*	
17. Parahemiurus merus *Anchovia arenicola* *Opisthonema libertate* and at Puget Sound: *Platichthys stellatus*	*Abudefduf saxatilis* *Clupanodon pseudohispanicus* *Ocyurus chrysurus* *Sardinella aurita* *S. humeralis* *S. macrophthalmus* *Trachurops crumenophthalmus*	Japan
18. Proctotrema longicaecum* *Anisotremus interruptus* *A. pacifici*	*Anisotremus virginicus*	
19. Prosorhynchus ozakii* grouper-like fish *Mycteroperca olfax* *M. xenarcha*	*Epinephelus niveatus*	
20. Stephanostomum casum* *Lutianus jordani* *L. novemfasciatus* *L. viridis* from British Columbia: Sebastodes species	*Lutianus analis* *L. griseus*	A Japanese record is very doubtful
21. Stephanostomum megacephalum* *Caranx hippos*	*Caranx latus*	

TABLE 1 *(Continued)*

Trematode and Pacific hosts	*Atlantic hosts*	*Extra-American distribution*
22. Sterrhurus fusiformis		
Muraena clepsydra	*Gymnothorax funebris* *G. moringa*	Mediterranean
23. Tergestia laticollis		
Caranx caballus	*Auxis thazard* *Gymnosarda alletterata* *G. pelamis*	Mediterranean

These 23 species constitute approximately 28% of the total number collected. However, 9 of them have a wide distribution, and their occurrence in both the Atlantic and Pacific may have no particular significance. Such species are: *Bucephalus varicus, Derogenes varicus, Dinurus barbatus, D. longisinus, Helicometra fasciata, Hirudinella clavata, Parahemiurus merus, Sterrhurus fusiformis, Tergestia laticollis.* In most of these cases either the fish host is widely distributed or the trematode is highly cosmopolitan in its variety of hosts. *Parahemiurus merus* is known (to date) only from both coasts of America and from Japan.

The remaining 14 species (about 17% of the total), marked with an asterisk (*) in the table, are endemic amphi-American species known (to date) only from the tropical regions of the two oceans. A comparison of the Pacific and Atlantic hosts of these species is of some interest. In no case are the hosts the same in the two oceans. In practically every case (two exceptions) the hosts of any particular trematode species in the two oceans are closely related (either closely related genera or species in the same genus). In other words, the parasite is apparently identical in the two oceans, but the hosts are not identical, although almost always closely related. Or, one can say the parasites are even more similar than are the hosts. The two exceptions are *Helicometrina nimia,* which shows little specificity at Tortugas, and *Lecithochirium microstomum,* which shows little specificity in the Pacific. The report of *Stephanostomum casum* from Japan is probably erroneous, although this species might extend into the North Pacific where it has been reported. The presence of *Haplosplanchnus acutus* in *Kyphosus elegans* might be a third exception, but, if the record is correct, the host is probably an accidental one.

A point of some interest is the fact that none of the trematode genera involved is endemic amphi-American. On the contrary, all these genera

are widely distributed common genera of fish trematodes. Such a condition is to be contrasted with the condition of endemic amphi-American representatives of free-living animals where the genera are likely to be endemic but the species different in the two oceans.

TABLE 2

PAIRS OF GEMINATE SPECIES AND THEIR DISTRIBUTION

Trematodes	*Hosts*	*Distribution*
1. *Bianium adplicatum*	*Spheroides annulatus* *S. angusticeps*	Galapagos Islands; Ecuador
B. plicatum	*S. maculatus*	Tortugas, Florida Beaufort, N.C. Woods Hole, Mass.
2. *Lepidapedon hancocki*	*Mycteroperca olfax* *M. xenarcha*	Galapagos Islands
L. nicolli	*Epinephelus nivcatus*	Tortugas, Florida
3. *Lobatostoma pacifica*	*Trachinotus paloma*	Galapagos Islands
L. kemostoma	*T. carolinus*	Not recorded but host is distributed along the South Atlantic and Gulf coasts of the U.S.
4. *Plagioporus gastrocotylus*	*Calamus brachysomus*	Galapagos Islands
P. crassigula	*C. bajonado* *C. calamus* *Diplodus holbrooki*	Tortugas, Florida
5. *Prosorhynchus pacificus*	*Mycteroperca olfax* *M. xenarcha* unidentified grouper	Galapagos Islands
P. atlanticus	*M. bonaci* *M. microlepis* *M. venenosa*	Tortugas, Florida
6. *Stephanostomum anisotremi*	*Anisotremus scapularis*	Galapagos Islands
S. sentum	*Calamus bajonado* *C. calamus* *Caranx latus* *C. ruber* *Haemulon plumieri* *H. sciurus*	Tortugas, Florida
7. *Tetrochetus proctocolus*	*Cheilichthys annulatus* *Trachinotus rhodopus* Angelichthys species	Galapagos Islands
T. coryphaenae	*Coryphaena hippurus*	Tortugas, Florida; Japan

These 7 species are so closely similar to their Atlantic mates that they might be considered by some as no more than varieties of the same species. They probably correspond to the pairs of geminate species known in other groups. Except in the case of *Tetrochetus coryphaenae* (which apparently occurs in Coryphaena both at Tortugas and Japan) all of these species are limited to the Atlantic or Pacific coast of America, and in the case of every pair the fish hosts in the two oceans are closely related. The 7 Pacific species involved in these pairs were collected only from the Galapagos Islands and not from the coast of the mainland. Furthermore, the Atlantic representatives all occur in the warmer southern waters (all being definitely known at Tortugas except *L. kemostoma,* which probably occurs there). Only *B. plicatum* also extends north to Woods Hole. Only one (Lobatostoma) of the 7 genera is an endemic amphi-American genus. Thus, these twin-species have somewhat the same complexion as the identical and endemic species (Table 1) except that on the Pacific side they seem to be restricted to the Galapagos Islands. Is this condition more evidence of the species-stimulating isolation enjoyed there?

TABLE 3

PACIFIC SPECIES WITH NEAREST RELATED SPECIES IN THE ATLANTIC BUT WITH ORDINARY SPECIFIC DIFFERENCES

(Arranged in pairs with the Atlantic species unnumbered)

Trematodes	*Hosts*	*Distribution*
1. *Gonocercella pacifica*	*Trachinotus rhodopus*	Colombia
G. atlantica	*T. carolinus*	Beaufort, N.C.
2. *Leurodera pacifica*	*Anisotremus interruptus*	Galapagos Islands
L. decora	*A. virginicus* *Haemulon plumieri* *H. carbonarium* *H. macrostomum* *H. sciurus* *H. flavolineatus* *H. parra* *Lutianus griseus*	Tortugas, Florida
3. *Opecoelina pacifica*	Paralabrax species	Galapagos Islands
O. scorpaenae	*Scorpaena cristulata*	Tortugas, Florida
4. *Theletrum lissosomum*	angelfish	Socorro Island, Mexico
T. fustiforme	*Pomacanthus arcuatus*	Tortugas, Florida

Four genera and 8 species are involved here. In contrast to the wide distribution of the genera in which amphi-American endemic species occurred, all of these 4 genera are endemic amphi-American genera. Two species of Theletrum occur in the tropical American Pacific and one species at Tortugas. Opecoelina occurs in the Galapagos and at Tortugas but also has one species known from the coast of the state of Washington.

TABLE 4

PACIFIC SPECIES OCCURRING ELSEWHERE BUT NOT IN THE ATLANTIC

Trematodes	*Hosts*	*Distribution*
1. *Opechona orientalis*	Angelichthys species	Mexico; Galapagos Islands
	Paranthias furcifer	
	small mackerel	
	Engraulis japonicus	Japan; Peter the Great Bay
	Scomber japonicus	
	Spheroides rubripes	
2. *Cymbephallus carangi*	*Selar crumenophthalmus*	Ecuador
	Caranx mertensi	Japan
3. *Helicometra sinuata*	moray	Costa Rica
	Ophidium imberbe	Mediterranean
	Trachinus draco	
4. *Opecoelus inimici*	*Paralabrax nebulifer*	Mexico
	Inimicus japonicus	Japan
5. *Opegaster parapristipomatis*	*Selar crumenophthalmus*	Panama; Galapagos Islands
	Trachinotus rhodopus	
	Parapristipoma trilineatum	Japan
6. *Prosorhynchus aculeatus*	Gymnothorax species	Galapagos Islands
	Conger myriaster	Japan; Mediterranean; Belgium; Sweden
	Conger vulgaris	
7. *Stephanostomum hispidum*	*Elagatis bipinnulatus*	Mexico; Panama
	Seriola dorsalis	
	Seriola species	
	Seriola quinqueradiata	Japan

This table shows a fairly distinct connection between the Japanese trematode fauna (now well known) and the tropical American Pacific fauna. The number of species, however, is half the number found elsewhere only in the American Atlantic, although the Atlantic fauna is less well known than the Japanese. *Helicometra sinuata* seems out of place in its Mediterranean and Costa Rican distribution. Its identification seemed correct but was based on a single specimen from Costa Rica.

SPECIES COLLECTED FROM THE GALAPAGOS ISLANDS AND THEIR RELATIONSHIPS

Of the 82 species collected, 39 occurred in the Galapagos Islands. These 39 species may be considered in two groups: (a) endemic and (b) nonendemic species.

Twenty-one species (all new) were endemic to the Galapagos Islands. Their relationship to other regions can be suggested by the distribution of their closest related species. In most but not all instances some certain other species can be recognized as the most closely related species. Eight species have nearest related species in the region of Tortugas, Florida; 4 have nearest relatives along the Pacific coast of Mexico; 3 have nearest relatives in Japanese waters; 2 have nearest relatives in the northern American Pacific. In no case was a nearest related species found along the Pacific coast of South America (where an equal number of fishes was examined). Nearest related species were not clearly evident in the case of 4 species. The following list shows these relationships.

TABLE 5

DISTRIBUTION OF NEAREST RELATIVES OF ENDEMIC GALAPAGOS SPECIES

A. Endemic Galapagos species with nearest related species occurring in the tropical Atlantic (species marked with an asterisk (*) occur elsewhere *only* in the Atlantic, as far as is known)

Galapagos Species	Nearest Related Species and Its Locality	
1. *Lecithochirium magnaporum*	*L. microstomum*	Gulf of Mexico; Galapagos
2. *Leurodera pacifica*	*L. decora**	Tortugas, Florida
3. *Lepidapedon hancocki*	*L. nicolli**	Tortugas, Florida
4. *Lobatostoma pacifica*	*L. kemostoma**	tropical American Atlantic
5. *Plagioporus gastrocotylus*	*P. crassigula**	Tortugas, Florida
6. *Prosorhynchus pacificus*	*P. atlanticus**	Tortugas, Florida
7. *Stephanostomum anisotremi*	*S. sentum**	Tortugas, Florida
8. *Tetrochetus proctocolus*	*T. coryphaenae*	Tortugas, Florida Japan

B. Endemic Galapagos species with nearest related species occurring along the Pacific coast of Mexico

1. *Apocreadium longisinosum*	*A. mexicanum*	Pacific Mexican coast
2. *Myzotus vitellosus*	Choanodera or Apocreadium	Pacific Mexican coast; Galapagos
3. *Opecoelus xenistii*	*O. mexicanus*	Pacific Mexican coast
4. *Opegaster pentadactyla*	*O. acuta*	Pacific Mexican coast

C. Endemic Galapagos species with nearest related species occurring in Japanese waters		
1. *Paramonorcheides bivitellosum*	*P. awatati* *P. sirembonis*	Japan
2. *Pseudocreadium spinosum*	Pseudocreadium species	Japan
3. *Pseudolepidapedon balistis*	*P. kobayashii* *P. paralichthydis*	Japan
D. Endemic Galapagos species with nearest related species in the northern American Pacific		
1. *Opecoelina pacifica*	*O. theragrae*	British Columbia
	(two other species in this genus occur at Tortugas, Florida)	
2. *Prosorhynchus rotundus*	*P. scalpellus*	British Columbia
E. Endemic Galapagos species with nearest related species not clearly evident		
1. *Parvacreadium bifidus*		
2. *Podocotyle breviformis*		
3. *Podocotyle mecopera*		
4. *Prosorhynchus gonoderus*		

A consideration of the above 21 species endemic to the Galapagos Islands suggests closer relationship to the region of Tortugas, Florida (West Indian and Gulf of Mexico regions), than to any other.

The 18 additional species collected from the Galapagos Islands are also known from other parts of the world. Ten of these are known from Tortugas or the tropical American Atlantic; 6 were collected from the Pacific coast of Mexico; 3 from the Pacific South American coast. Five of the 18 species are known elsewhere only from the Tortugas region; 3 only from the Mexican Pacific; one only from Europe; one only from the Pacific South American coast. A tabulation of these 18 species follows.

TABLE 6

DISTRIBUTION OF NONENDEMIC GALAPAGOS SPECIES

A. Galapagos trematodes occurring also at Tortugas or the tropical American Atlantic

(* = occurring elsewhere only at Tortugas)

Species	*Localities (other than Galapagos)*
1. *Derogenes varicus*	Tortugas and many parts of the world
2. *Hamacreadium mutabile**	Tortugas, Florida
3. *Hamacreadium oscitans**	Tortugas, Florida
4. *Haplosplanchnus acutus*	Tortugas, Florida; Colombia
5. *Haplosplanchnus pomacentrus**	Tortugas, Florida
6. *Hirudinella beebei*	Bermuda; Panama; Gulf of Mexico
7. *Hirudinella clavata*	American Atlantic; probably elsewhere
8. *Lecithochirium microstomum**	Gulf of Mexico
9. *Proctotrema longicaecum**	Tortugas, Florida
10. *Prosorhynchus ozakii*	Tortugas, Florida; Mexican Pacific

B. Galapagos trematodes occurring also along the Pacific coast of Mexico

(* = occurring elsewhere only along Mexican coast)

1. *Coitocaecum tropicum*	Socorro Island; Colombia
2. *Elytrophallus mexicanus**	Socorro and Clarion islands
3. *Opechona orientalis*	Clarion Island; Peter the Great Bay
4. *Prosorhynchus ozakii*	Isabel Island; Tortugas, Florida
5. *Pseudocreadium scaphosomum**	Isabel Island
6. *Stephanostomum multispinosum**	Clarion Island

C. Galapagos trematodes occurring also along the Pacific coast of South America

(* = occurring elsewhere only along coast of South America)

1. *Coitocaecum tropicum*	Colombia; Socorro Island, Mexico
2. *Bianium adplicatum**	Ecuador
3. *Haplosplanchnus acutus*	Colombia; Tortugas, Florida

One species, *Prosorhynchus aculeatus,* is known only from Europe; one species, *Opegaster parapristipomatis,* is known only from Japan.

These nonendemic species from the Galapagos suggest the same condition indicated by the endemic species except that similarity to Japanese waters is not so evident. The Tortugas region continues to be the most similar.

Since the same number of fishes was examined from the Pacific coast of South America as from the Galapagos Islands, it might be of some

interest to group the trematodes of the mainland in the same manner as has been done above for Galapagos trematodes. Twenty-one species were collected; 9 species were endemic; 12 species were found or are known elsewhere. The nearest related species of the endemic trematodes indicate no single similar region. Two of such related species are from Japan, one from Panama; one from Australia; one from Europe; one from North Carolina and Tortugas; none from the Galapagos. Of the 12 nonendemic species, 6 occur along the Pacific coast of Mexico or Panama (all 6 are known only from there); 4 occur at Tortugas (one of these only from there); 3 occur at Galapagos (one of these only from there); 2 occur in Japan (one of these only from there). Therefore, the nonendemic species from the Pacific coast of South America show most relationship to the Pacific coast of Mexico and some slight similarity to the fauna of Tortugas, Galapagos Islands, and Japan.

DISCUSSION

The foregoing material reveals a very pronounced similarity between the trematode fauna of the tropical American Pacific and the tropical American Atlantic. In fact, the similarity is almost as great as would be expected if the two oceans were still continuous. Judging from the trematode faunas, the Galapagos Islands might seem almost to be a part of the West Indian archipelago. The regions of the world most similar to the Galapagos Islands, judging from the trematodes collected, are in order: (1) the region of Tortugas, Florida; (2) the west coast of Mexico; (3) Japan; (4) northern Pacific coast of America; (5) Pacific coast of South America. However, it should be noted that the Tortugas region in comparison with the Galapagos region has a somewhat different status than the Pacific coastal waters in that many more fishes from the Florida waters have been examined. Probably more examinations along the Mexican coast would reveal additional Galapagos species there. Such findings would not alter the similarity between the Galapagos and Tortugas faunas, and the general tendencies indicated in the above tables would remain more or less marked. If, when the Pacific Mexican fauna is as well known as the Tortugas fauna, it should be found that the Galapagos region was still more similar to Tortugas than to Mexico, the evidence would indicate considerable age for the Galapagos Islands.

Other kinds of evidence indicate that Galapagos affinities are strongly Atlantic in nature. A submarine plateau of relatively shallow water (less

than 1,500 fathoms) extends from the Galapagos Islands past Cocos Island almost to Panama, while deeper water lies between the Galapagos Islands and South America. Thus, a possible former shallow-water connection with the present Gulf of Mexico is suggested.

While the present fauna and flora of the Galapagos Islands are doubtless of multiple origin, affinities to the West Indian region have been frequently noted. Agassiz (1892, pp. 74-75), discussing the deep sea fauna of the Panamic district, says: ". . . we found, in the first place, a great many old West Indian friends. In nearly all the groups of marine forms among the Fishes, Crustacea, Worms, Mollusks, Echinoderms, and Polyps, we brought up familiar West Indian types or east coast forms."

Swarth (1934) found the avifauna of the Galapagos more like that of the West Indies than like that of any other region. He states (p. 215): "There is an important element clearly recognizable as of West Indian affinities, that could have had no other derivation. There are other species that might have come from either a West Indian or a Central American source, and there are a few species that definitely do not belong to the West Indian avifauna. There is not one species that can be recognized as having necessarily come from the adjacent South American coast." Later (p. 233) Swarth states ". . . the relationship of the fauna of the West Indies and the Galapagos is to be regarded in the same light as relationships from one to another of the West Indian Islands."

Fisher (1938) finds somewhat similar evidence regarding the hydrocorals. He states (p. 495): "I have also examined material from the Galapagos Islands, which is well represented in the National Museum. This fauna has nothing to do with that of the north Pacific. If it points anywhere it is to the West Indian region."

Thus, conditions revealed by the distribution of trematodes support conclusions arrived at by various other lines of evidence. It might be noted that there is greater similarity among the trematodes of the two oceans than among the hosts involved. Such a condition might be expected from the more uniform environment of the endoparasites and from their rather specialized form.

The interoceanic similarity of these trematodes could be explained in four different ways: (1) a continuous distribution around the entire South American continent: (2) recent transfer through the Panama Canal; (3) transfer by fish-eating birds; (4) the influence of a former continuity between the two oceans. The first two of these explanations are very unlikely if not impossible. Although no collections have been made

from southern South America, it is known that fish trematodes of colder oceans differ greatly from trematodes of warm waters, and not only is the Panama Canal too recent to explain the widespread similarity but little transfer could take place through its fresh waters. Transfer by birds is more possible. Only very rarely, however, would trematodes of fishes survive long in a bird, so that such transfer would probably involve passage from the bird of viable eggs of digested trematodes. Such a thing is very possible but hardly seems sufficient to explain the widespread similarity in many diverse genera of trematodes. Much more likely, it seems to the writer, is the influence of a former continuity between the two oceans known to have existed in the past. Persistence of this influence might be expected to be greater in a group of endoparasites. Such an interpretation is in harmony with observations made in other groups of animals.

In other words, conclusions from a study of digenetic trematodes reiterate a claim that the Galapagos Islands represent an outpost of the West Indies rather than an outpost of South America. A land connection is not, of course, necessarily indicated. A relatively shallow water continuity between the two oceans is indicated.

SUMMARY

The digenetic trematode fauna of marine fishes of the tropical American Pacific shows a very marked similarity to that of the tropical American Atlantic especially as compared with such trematodes in other regions.

This similarity extends to specific identity in the case of 23 of 82 species collected. Thirty-five of the 82 species (about 41%) are either identical with species found in the American Atlantic or are more closely related to Atlantic species than to species in other regions of the world.

Fourteen species (about 17% of the total) are endemic amphi-American species. These are practically always in related hosts, but in no case were the hosts the same in the two oceans.

Five genera (of 51) are endemic amphi-American genera (about 10% of the total number of genera).

Trematodes (39 species) from the Galapagos Islands show greatest similarity to trematodes of Tortugas, Florida; some similarity to trematodes of the Pacific coast of Mexico, but relatively little similarity to trematodes collected from the adjacent mainland of South America.

Some evidence is seen of relationship to the trematode fauna of Japanese waters.

Two possible explanations seem worthy of consideration, (1) the interoceanic transfer of adult trematodes or their eggs by fish-eating birds; (2) the influence of a former continuity between the two oceans. The latter view is favored by the author.

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INDEX

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NEMATODE PARASITES OF THE GALAPAGOS LAND IGUANA

(With Three Plates)

BY

ASHTON C. CUCKLER

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A NEW SPECIES OF NYCTERIBIIDAE (DIPTERA PUPIPARA) FROM ISLANDS IN THE GULF OF CALIFORNIA

(PLATE 16)

by

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(PLATE 17)

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MARINE MOLLUSKS FROM PANAMA COLLECTED BY THE ALLAN HANCOCK EXPEDITION TO THE GALAPAGOS ISLANDS, 1931-1932

(PLATES 18-23)

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REVISION OF THE NEMERTEAN FAUNA OF THE PACIFIC COASTS OF NORTH, CENTRAL, AND NORTHERN SOUTH AMERICA

(PLATES 24-31)

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(PLATES 51-55)

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