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INTRODUCTION

THERE HAS LONG BEEN EVIDENT a need for a study of the polyclads of the Pacific coast of North America. The existing studies cover only part of the polyclad fauna of the region, and most of them require extensive revision. Polyclads from the Pacific coast of North America have been described by Stimpson (1857), Woodworth (1894), Plehn (1896b, 1898), Heath and McGregor (1912), Bock (1925), Boone (1929), Freeman (1930, 1933), and Hyman (1939c). The description of Stimpson is probably unrecognizable, Woodworth's species has fortunately been refound, the descriptions of Plehn leave something to be desired, despite being based on sections, and those of Heath and McGregor, Boone, and Freeman are unsatisfactory, being limited wholly or mainly to whole mount studies. Already in 1884, Lang in his classical monograph of the Polycladida had made extensive use of sections, and since the invaluable revision by Bock in 1913, the necessity of serial sections of the sexual region for taxonomic determinations in this group, especially in the Acotylea, should have been evident. Descriptions based entirely on whole mounts can result only in trouble for future workers.

Every effort has been made to recover the type specimens of the existing descriptions of Pacific coast polyclads. Prolonged search has been made for the type specimens of Heath and McGregor, but they cannot be found. I have been in communication with the late Dr. Heath, who had no knowledge of the whereabouts of the original specimens and who in fact disclaimed all responsibility for the Heath and McGregor article. I have also been able to get into communication with Mr. McGregor, who kindly replied that he believed he had left the original mounts in the laboratory of invertebrate zoology at Stanford University. Inquiry of zoologists there elicited the information that Dr. Heath some years previously had removed all the polyclad material of any value. Fortunately, however, Dr. W. K. Fisher, former director of the Hopkins Marine Station at Pacific Grove, California, presented me with a box of slides of Californian polyclads, some of which are stated to have been labeled by Heath himself, and these have proved invaluable in

enabling me to elucidate some of the species of Heath and McGregor, although unluckily the more difficult of their species are not represented in this collection. I have been able to get into communication with Miss Boone, and she has generously sent me the type specimens of her species so that I have been able to elucidate all of them. I am also fortunate in having come into possession, through the kindness of the late Dr. J. E. Guberlet, of much of Freeman's material, including several type specimens. These sources are here referred to as the Fisher, Boone, and Freeman collections, respectively.

I have also had at my disposal a number of vials from the collections of the United States National Museum and about 100 vials from the Pacific expeditions of the Allan Hancock Foundation of Los Angeles. Further, the late Mr. E. F. Ricketts presented me with the whole of the polyclad material secured on his collecting expeditions to Vancouver Island and vicinity and to Lower California and the Gulf of California. Dr. and Mrs. MacGinitie, of the Kerckhoff Marine Laboratory at Corona del Mar, California, have shown great kindness and energy in collecting polyclads for me along California and Mexican coasts. I am especially grateful to them for their trouble and for the sketches and color notes that have accompanied many of their specimens. Other California zoologists have occasionally sent specimens, as is duly acknowledged in the descriptions of the species concerned. Finally, I have personally collected in Puget Sound and Monterey Bay.

Useful bits of information about Pacific coast polyclads appear in various books on the seashore life of the western shores of the United States. The following books make mention of polyclads: Johnson and Snook, 1927, "Seashore animals of the Pacific coast"; Ricketts and Calvin, 1939, "Between Pacific tides"; Steinbeck and Ricketts, 1941, "Sea of Cortez"; and G. E. and N. MacGinitie, 1949, "Natural history of marine animals."

The Pacific coast of North America is here taken to extend from the Aleutian Islands and northern boundary of Alaska to the southern border of Mexico. The available ma-

terial covers much of this territory. No material is available from the Mexican coast south of the tip of Lower California. Despite the large amount and varied localities of the available material, one cannot suppose that the present account exhausts the polyclad fauna of the region. I would be grateful for polyclad material from localities not represented in the present study or appearing to differ from the species herein described.

As already intimated, the polyclads, especially the *Acotylea*, cannot be identified without recourse to serial sections of the copulatory apparatus of sexually mature specimens. Unfortunately, much of the material was found to be in bad histological condition. Most of the specimens collected prior to 1910 were so hardened and blackened by long preservation that it was next to impossible to work with them. Because of the poor state of most of the material, histological preparation and examination were confined to the copulatory apparatus. No doubt some interesting points were missed by this limitation, but in the absence of well-fixed material they must go undiscovered for the present. Staining was limited to the usual haematoxylin-and-eosin technic. The drawings were made with the aid of measurements but are otherwise free hand, except that enlarged views of eye patterns were done with a camera lucida. Sections of the copulatory apparatus were made in the sagittal plane when material was limited, but also sometimes in other planes when material was available and further understanding of the copulatory structures was desirable.

Care has been taken to designate type specimens for all new species and neotypes or lectotypes for species for which no types exist, and to deposit such specimens in museums where they will be available for future workers. The United States National Museum is hereafter referred to as U.S.N.M., the American Museum of Natural History as A.M.N.H., and the Hancock Foundation as A.H.F. where reference is made to the official catalogues of those institutions.

The following suggestions are offered to those who wish to identify Pacific coast polyclads by means of the present study. After the species of a locality have been taxonomically elucidated by a specialist, many of them

can be recognized by the non-specialist. Non-specialists should not attempt the identification of unknowns. Live specimens should be carefully observed, and notes and sketches taken of the shape and dimensions when crawling extended, the presence and form of tentacles, the color, and any other conspicuous features. However, the identification of live specimens, except those having conspicuous coloration or other conspicuous features, is very uncertain. It is usually indispensable to examine cleared specimens. Therefore the worms must be fixed, and since it may be necessary to section them they should be given a good fixation. Sea water saturated with mercuric chloride and thrown on the worm hot as it is crawling extended in as small an amount of sea water as practicable is a satisfactory fixative. After half an hour the fixative should be thoroughly washed out in a number of changes of tap water. The worm, if not flat, must then be flattened between two slides or pieces of slide held together with a paper clip or thread or rubber band. It should then be passed up through the alcohols. At 70 per cent alcohol a little iodine solution should be added to the alcohol to insure complete removal of the mercuric chloride. If the brown color of the iodine fades, this indicates presence of mercuric chloride, and small amounts of iodine solution should be added until the brown color no longer fades. It may be desirable to free the worm from the slides during this process to ensure complete removal of the fixative, and replace the pressure before proceeding further. The worm is now passed into the higher alcohols and finally into absolute alcohol. After half an hour, or less in small specimens, the worm will be stiffened into the flattened form and pressure may be removed. Two changes of absolute alcohol are necessary, and then the worm is passed into the clearer. Oil of wintergreen (synthetic) is recommended, as this does not evaporate as do xylol and similar clearers. The cleared flattened worm may now be examined and compared with the figures in the present study. Whether the worm is a cotylean or acotylean is usually obvious while it is alive; therefore the first point to determine in the cleared specimen, if an acotylean, is the arrangement of the eyes. This usually cannot be deter-

mined in live specimens; hence the necessity for killing, dehydrating, and clearing the specimen. In cotyleans, the degree of tentacle development is important, and this is best determined in the worm while living. After study of the eye pattern, the general taxonomic placement of the worm will be evident, and one can then proceed through the family and generic definitions. Members of the family Leptoplanidae, especially of the genus *Notoplana*, are so much alike in general features that it is often impossible to identify them with certainty as cleared specimens or stained whole mounts. In such cases the preparation of serial sagittal sections of the copulatory region is indispensable. Specimens that are already preserved may be softened in the lower alcohols or water, then flattened between slides and handled as above.

TERMINOLOGY

As it is hoped that this study will prove generally useful to western zoologists, the technical terms applied to polyclads are herewith explained.

SUCKER: In the midventral line at varying levels there is found in some polyclads a so-called sucker, which is not really a true sucker but a glandulo-muscular adhesive organ. This forms a noticeable elevation or depression. Its presence or absence determines the primary division of the polyclads into the suborders Cotylea and Acotylea.

TENTACLES: A pair of tentacles is frequently present, in the Acotylea as *nuchal* tentacles in the brain region well back from the anterior margin, in the Cotylea as *marginal* tentacles, located at the middle of the anterior margin and formed by the upfolding of this margin.

EYES: The polyclads are usually provided with numerous eyes, or at least more than two, and their arrangement, as first pointed out by Bock (1913), is of great taxonomic importance. Eyes are termed *marginal* when occurring along the body margin; *tentacular* when situated in or around the tentacles or at the sites where tentacles would be located if present; *cerebral* when situated over the brain region; and *frontal* when strewn over the anterior region between the brain and the anterior margin.

PHARYNX: The pharynx of polyclads is of

the plicate type, i.e., consists of a body fold projecting free into the pharyngeal cavity. This exists in polyclads in two variants, the *ruffled* and the *tubular*. The ruffled pharynx is an oval ruffled curtain that hangs from the roof of the pharyngeal cavity. The tubular pharynx is a long, cylindrical or short, bell-like projection directed forward, hence attached to the posterior end of the pharyngeal cavity. The pharyngeal cavity opens to the exterior by the mouth which as in planarians is not used directly for the intake of food but only as an aperture through which the pharynx is protruded to the exterior. The mouth is in the midventral line anywhere along the extent of the pharyngeal cavity. Pharyngeal cavity and contained pharynx are often more or less central but may be located anteriorly or posteriorly.

INTESTINE: The pharynx leads into the main intestine, a central tube that runs most of the body length above the ruffled type of pharynx or behind the tubular type. From this main intestine branches radiate to the periphery in a pattern more or less characteristic of each family or genus. In cotyleans, but rarely in acotyleans, these branches may anastomose into a peripheral network. In a very few polyclads the main intestine may open on the surface at its rear end, or the peripheral tips of branches may so open. Such *anal pores* are obviously detectable only by sectioning the entire animal. As this was not done in the present study, anal pores, if present, would have been missed. However, they so rarely occur that it is permissible to assume their absence.

GONADS: The polyclads, like other platyhelminths, are hermaphroditic. The testes and ovaries are numerous small bodies scattered throughout lateral body regions. Yolk glands are wanting.

SPERM DUCTS: There is usually present one pair of male ducts, here called *sperm ducts* in preference to the usual term, *vasa deferentia*. They course along either side of the median region in sinuous coils. I see no point to Bock's attempt to limit the term sperm duct (vas deferens) to that part of the male ducts adjacent to the copulatory apparatus. Before entering the latter, the sperm ducts may fuse to a single duct, here called *common sperm duct*. Delicate, usually un-

detectable, connections between testes and sperm ducts are called *sperm ductules*.

SPERMIDUCAL VESICLES: The distal portions of the sperm ducts are usually much expanded into thin-walled tubes serving for the storage of sperm. These are here termed *spermiducal vesicles* to replace Bock's expression (1913, p. 36) "enlarged seminal canals" (*grosse Samenkanäle*).

SPERMIDUCAL BULBS: In some polyclads, the distal parts of the sperm ducts, next to the copulatory apparatus, are heavily muscularized, presumably to assist the onward propulsion of the sperm. For such muscularized terminations of the sperm ducts Lang proposed the name *accessory seminal vesicles*, also adopted by Bock. This name appears to me rather clumsy and also somewhat misleading, as the structures in question are admittedly anatomically distinct from the true seminal vesicle. Therefore I propose for these muscular thickenings of the sperm ducts the name *spermiducal bulbs*.

MALE COPULATORY APPARATUS: This generally consists of three structures, the seminal vesicle, the prostatic vesicle, and the penis or cirrus.

SEMINAL VESICLE: The seminal vesicle is a tubular, oval, pyriform, spherical, or crescentic, heavily muscularized body that receives the sperm ducts, either separately or after a brief union. The term seminal vesicle appears to be somewhat of a misnomer, for apparently this structure serves, not for the storage of sperm, but rather as a propulsion apparatus. When spermiducal bulbs are present these may be continuous with the seminal vesicle, producing the appearance of a tripartite seminal vesicle. For this compound structure the expression *tripartite seminal vesicle* is used for convenience and brevity.

PROSTATIC VESICLE: The prostatic vesicle or granule vesicle (*Körnerdrüsenblase* of German authors) is a spherical, oval, or cylindroid body composed of a muscular wall and a granular epithelial lining. The lining epithelium may be thrown into chambers, and such a prostatic vesicle is spoken of as *chambered*. The granular, highly eosinophilic secretion is produced either by the lining epithelium itself or by gland cells situated in the muscular wall of the vesicle or outside the vesicle and penetrating to the interior of the

vesicle by their long necks. The granular secretion, of unknown nature and function, presumably is of importance for the health and vitality of the sperm, as it is ejaculated with the sperm at copulation. The lumen of the prostatic vesicle may form part of the ejaculatory duct so that the sperm must traverse the vesicle, and the latter is then said to be *interpolated*. The prostatic vesicle may also be set off from the ejaculatory duct as a blind vesicle not traversed by the sperm and is then spoken of as *free*: in such case the vesicle is connected with the ejaculatory duct by a slender *prostatic duct*.

PENIS: I restrict the term penis, or better, penis papilla, to a muscular projection that terminates the male system and is employed by simple *protrusion* to the exterior. The penis papilla varies from a very low eminence to a pronounced conical projection.

PENIS STYLET: Not uncommonly the penis papilla (being then greatly reduced) bears a hard hollow tube, the *penis stylet*, that may be long or short, straight or curved or coiled. A penis bearing a stylet is said to be *armed*. The stylet is used in the same manner as the papilla, by protrusion.

PENIS SHEATH: The male antrum may bear a circular eminence, simulating a small penis papilla, that is termed the *penis sheath* and appears to serve as a guide for penis papilla or stylet.

CIRRUS: The term *cirrus* is limited to a male copulatory apparatus that is employed by *eversion* to the exterior, i.e., by turning inside out. The cirrus consists of a hollow muscular body called the *cirrus sac* that is lined by a varied assortment of teeth, spines, and so on that are brought to the outer surface of the cirrus when it everts.

EJACULATORY DUCT: It seems proper to me to employ this term for the entire terminal part of the male duct from the proximal end of the seminal vesicle to the tip of the penis or everted cirrus, or, in other words, the ejaculatory duct is that part of the common sperm duct that traverses the male copulatory apparatus, forming the lumen of the various parts of this apparatus. I am not in sympathy with Bock's attempt to restrict the term. When the prostatic vesicle is interpolated, the ejaculatory duct includes the lumen of the seminal vesicle, the lumen of the

prostatic vesicle, and the lumen of the penis papilla, penis stylet, or cirrus sac and the ducts connecting these parts. When the prostatic vesicle is free, its lumen is excluded from participation in the ejaculatory duct.

MALE ANTRUM: This term is applied to the cavity that extends between the gonopore and the base of the male copulatory organ and that houses the penis papilla and stylet when present. It varies from a shallow depression to a broad or elongated tube and appears to evert partially during copulation. When a penis sheath is present, that part of the male antrum proximal to the sheath is the *penis pocket*.

OVIDUCTS: The oviducts are a pair of tubes that course along either side of the median region and collect eggs from the numerous ovaries by way of usually undetectable delicate ducts here termed *oviductules*. In polyclads the oviducts serve to store ripe eggs during breeding and then are distended into wide tubes called *uteri*. The two uteri may or may not unite into a common oviduct before entering the female copulatory apparatus. Uteri may bear sacciform appendages, the *uterine vesicles*, and may take the form of networks.

FEMALE COPULATORY APPARATUS: This consists of the terminal female duct distal to the oviduct entrance, and any posterior appendages to this.

VAGINA: The terminal female duct distal to the entrance of the paired or common oviduct is termed *vagina*.

LANG'S VESICLE: In many acotylean polyclads the vagina is continued proximal to the entrance of the oviducts by a duct or canal that terminates in a blind sac, known as *Lang's vesicle*. Although Bock assigns a secretory function to this vesicle, it appears more probable that it is a seminal receptacle as sperm are often seen in it. Its tall lining epithelium does in fact present a secretory appearance but more likely serves for the digestion of excess sperm and prostatic secretion. The tube between the vagina and Lang's

vesicle may be called duct or canal of Lang's vesicle.

VAGINAL DUCT: The *vaginal duct* or *ductus vaginalis* is a duct that continues proximally from the entrance of the oviducts into the vagina and proceeds either to the ventral surface where it opens as a *vaginal pore* separate from the regular female gonopore or recurves and enters the vagina or opens into the intestine. It would appear that the vaginal duct often represents the duct of a lost Lang's vesicle. It is present in only a limited number of polyclads.

GENITOINTESTINAL CANAL: This name is applied to a connection sometimes present between the female copulatory apparatus and the intestine.

CEMENT GLANDS AND CEMENT DUCT: The vagina is usually entered for most of its course by an immense number of *cement glands*, long-necked eosinophilous glands that secrete the gelatinous material in which the eggs are laid. That portion of the vagina that receives the cement glands is termed *cement duct* (Kittdrüsengang of German writers).

FEMALE ANTRUM: Bock (1913) is of the opinion that a female antrum is usually wanting in polyclads and that the vagina continues to the gonopore. It appears to me, however, that what Bock calls the external part of the vagina or *vagina externa* is in reality the female antrum, that is to say, inturned body wall. I therefore regard the tube or chamber distal to the cement duct as a female antrum. It very often is identical in histology with the adjacent body wall and in any case differs histologically from the vagina proper. It may be immensely thickened muscularly, forming what Bock calls a bulbous vagina or *vagina bulbosa* but which I term a *bulbous antrum*.

GNOPORE: Polyclads may have separate male and female gonopores, or both sex systems may open by a common gonopore. The female gonopore and female copulatory apparatus are always posterior to those of the male.

EXPLANATION OF SUBSIDIARY NUMBERING IN TEXT FIGURES 1 TO 161

1 Marginal eyes	32 Vaginal duct
2 Frontal eyes	33 Pore of vaginal duct
3 Cerebral eyes	34 Eye cluster
4 Tentacular eyes	35 Granule masses of brain
5 Brain	36 Cement ducts
6 Pharynx	37 Diverticulum of prostatic vesicle
7 Mouth	38 Bulbous antrum
8 Main intestine	39 Ovaries
9 Male gonopore	40 Duct through prostatic vesicle
10 Female gonopore	41 Tooth in wall of vagina
11 Seminal vesicle	42 Projection of ejaculatory duct into prostatic vesicle
12 Prostatic vesicle	43 Genitointestinal connection
13 Ejaculatory duct	44 Cirrus sac
14 Spermiducal vesicles	45 Tooth in cirrus sac
15 Spermiducal bulbs	46 Cuticularizations of cirrus wall
16 Penis papilla	47 Teeth in cirrus sac
17 Male antrum	48 Bursa copulatrix
18 Female antrum	49 Accessory prostatic vesicles
19 Vagina	50 Gland pocket of male antrum
20 Cement glands	51 Spaces in wall of cirrus sac
21 Entrance of oviduct	52 Anterior gland pouch of cirrus sac
22 Duct of Lang's vesicle	53 Sac of unknown function
23 Lang's vesicle	54 Marginal tentacles
24 Nuchal tentacles	55 Sucker
25 Uteri with eggs	56 Uterine vesicle
26 Prostatic duct	57 Uterine network
27 Common antrum	58 Intestinal network
28 Sperm ducts	59 Cement pouch
29 Penis pocket	60 Accessory vesicles
30 Penis stylet	
31 Penis sheath	

SYSTEMATIC ACCOUNT

ORDER POLYCLADIDA

SUBORDER ACOTYLEA

DEFINITION: Polyclads without a sucker behind the female gonopore; tentacles when present of the nuchal type; marginal eyes when present never limited to a pair of clusters on the anterior margin; copulatory complex usually in the posterior body half.

SECTION CRASPEDOMMATA Bock, 1913

DEFINITION: Acotylea with a band of eyes along the whole or the anterior part of the body margin; eyes usually also present elsewhere or, rarely, completely devoid of eyes; pharynx ruffled; copulatory apparatus in the posterior body half behind the pharynx, with male apparatus directed backward and uteri extending forward.

FAMILY LATOCESTIDAE LAIDLAW, 1903

DEFINITION: Craspedommata of elongated form, without tentacles; brain and region between the brain and the anterior margin strewn with small eyes, spreading anteriorly in a fan-like manner, often in streaks along the main nerve trunks; seminal vesicle generally wanting; prostatic vesicle free.

GENUS ALLEENA MARCUS, 1947

DEFINITION: Latocestidae similar to *Latocestus*, with pharynx near the posterior end, hence with very long main intestine extending forward to the brain; copulatory complex close behind the pharynx, hence near the posterior margin; gonopores separate; spermiducal bulbs present; chambered prostatic vesicle situated directly above the penis papilla; small Lang's vesicle present.

TYPE SPECIES: *Alleena callizona* Marcus, 1947.

Alleena mexicana, new species

Figures 1, 2, 3

MATERIAL: A number of specimens sent by Ricketts, the MacGinities, and the Allan Hancock Foundation.

FORM: Long and slender, to 35 mm. long preserved, probably to 50 mm. when alive and extended; about 7 mm. wide; smooth, of firm consistency (fig. 1). Tends to curl when

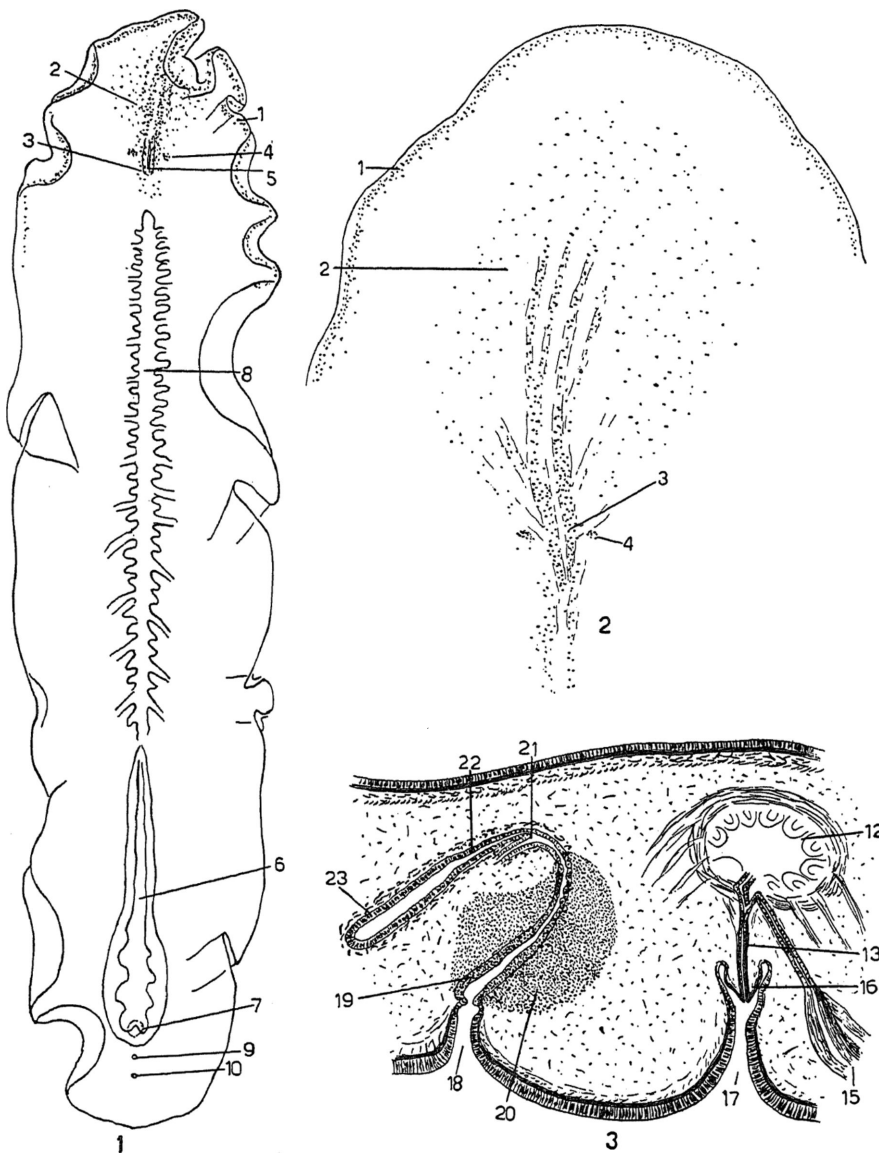
preserved, apparently because of greater contraction of median than lateral regions.

COLOR: Gray.

EYES: Marginal band of eyes limited to the anterior end, extending only a short distance posterior to the level of the brain; fan-like arrangement of small eyes begins shortly behind the brain and diverges anteriorly towards the anterior margin but does not quite reach this; these eyes occur somewhat in streaks along the main nerves (fig. 2); a peculiarity of this species, not usual in latocestids, is the presence of a small cluster of eyes to either side of the brain, presumably representing tentacular groups (fig. 2).

DIGESTIVE SYSTEM: The elongated pharynx occurs in the posterior third or fourth of the worm; it is considerably ruffled posteriorly, but the ruffles decrease in the anterior half of the pharynx which passes insensibly into the long main intestine, extending forward to a point shortly behind the brain and giving off regular lateral branches (fig. 1). The mouth occurs close to the posterior end of the pharynx.

COPULATORY APPARATUS: This, situated directly behind the pharynx, is typical of the genus (fig. 3). There are well-developed spermiducal bulbs that continue into a common sperm duct extending dorsally, then, with an abrupt turn, entering the ejaculatory duct. The latter, after receiving the prostatic duct, proceeds directly ventrally through the short conical penis papilla. The oval chambered prostatic vesicle is situated directly above the penis papilla, as characteristic of the genus *Alleena*. It has a muscular wall penetrated by muscle fibers and gland ducts from without and is lined by the usual chambered glandular epithelium. The moderate-sized penis papilla projects directly downward into the dorsal part of a rather long male antrum. The female system is typically latocestid. The female gonopore lying well behind the male pore leads into a short female antrum that receives the vagina. The latter ascends dorsally with a forward slant as a cement duct that is entered on all sides by a vast cloud of cement glands (fig. 3); it then curves posteriorly and after receiving the common oviduct continues back-



FIGS. 1-3. *Alleena mexicana*. 1. Dorsal view. 2. Enlarged view of anterior end, showing eye arrangement. 3. Sagittal view of copulatory apparatus, anterior end to right.

ward as the duct of Lang's vesicle. This terminates in a small, slender, but somewhat elongated Lang's vesicle.

DIFFERENTIAL CHARACTERS: *Alleena mexicana* differs from the only other species of the genus, *A. callizona* Marcus, 1947, in that the band of marginal eyes encircles the entire margin in the latter.

DISTRIBUTION: Common along the shores.

of the Gulf of California, under rocks. Taken by the MacGinities at Puerto Penasco, December, 1947; by Ricketts at Angeles Bay, San Carlos Bay, and Puerto Escondido during March and April, 1940; and by the Allan Hancock Foundation at Puerto Escondido in March, 1936, and March, 1949; at Cabeza Ballena, March, 1937; at Willard Island, Gonzaga Bay, January, 1940; at Puerto

Refugio, Angel de la Guardia Island, January, 1940; at Agua Verde Bay, February, 1940; at Guaymas, May, 1946; and at San Ignacio lagoon, February, 1950.

HOLOTYPE: One whole mount, A.M.N.H. No. 355.

REMARKS: This is one of the most common species encountered in the present study, easily recognized by the long, slender, smooth, firm body, uniform gray coloration, and the eye arrangement. It is the one referred to by Ricketts in "Sea of Cortez" (p. 336), as *Latocestus* sp. Both *Alleena* and *Latocestus* are restricted to tropical and subtropical waters. *Alleena* differs from *Latocestus*, the most common genus of the family, only in the orientation of the prostatic vesicle. It may well be questioned whether this character is of generic significance, but for the present I am acknowledging the genus *Alleena*. Whereas the type species, *Alleena callizona*, is not particularly suggestive of *Latocestus* in body shape, *A. mexicana* presents the typical aspect of a *Latocestus*.

JUVENILE LATOCESTID

Figure 4

REMARKS: It appears desirable to record the fact that there was found in the material from the Allan Hancock Foundation an unidentifiable latocestid apparently distinct from *Alleena mexicana*. This specimen was taken on a rocky shore at Coyote Bay, Concepcion Bay, Lower California, in March, 1937. The worm was very badly crumpled, but I succeeded in straightening it out fairly well and it is represented in figure 4, which, however, does not attempt to reproduce all of the folds and creases of the specimen. The worm is typically latocestid in appearance, with a slender elongated body measuring 23 by 7 mm. The specimen is presumed not to be a young *Alleena mexicana* from the fact that the marginal band of eyes completely encircles the margin and that definite tentacular clusters are lacking. The digestive tract, in so far as it could be seen through the numerous folds, is typical of *Latocestus*, with a short ruffled pharynx in the extreme posterior part of the body. The specimen gave no evidence when whole of sexual de-

velopment, and sections of the postpharyngeal region showed a complete lack of a copulatory apparatus. It is therefore impossible to identify the specimen. It together with the sections has been returned to the Allan Hancock Foundation, their station number 689-37.

FAMILY PLEHNIIDAE BOCK, 1913

DEFINITION: Craspedommata of rounded, oval, or elliptical shape and of thick, opaque consistency; either entirely devoid of eyes or provided with eyes that include cerebral and tentacular clusters; pharynx central or somewhat posterior, slightly ruffled; prostatic vesicle free, receiving the sperm duct or ducts into its neck; seminal vesicle wanting but spermiducal bulbs present.

GENUS PLEHNIA BOCK, 1913

DEFINITION: Plehniidae with or without eyes; glandular part of the prostatic vesicle much exceeding the muscular part; Lang's vesicle present or absent; female system lacks a vaginal duct.

TYPE SPECIES: *Plehnia arctica* (Plehn), 1896.

Plehnia caeca, new species

Figures 5, 6

MATERIAL: One specimen sent by the United States National Museum, four specimens sent by the Allan Hancock Foundation.

FORM: Small, elliptical or fusiform, widest through the middle, bluntly pointed at both ends (fig. 5), thick, opaque; 10-14 mm. long by 4-7 mm. wide.

COLOR: Not determinable, apparently brown or grayish brown.

EYES: Completely wanting. To make certain of the absence of eyes, the anterior part of the United States National Museum specimen to a level behind the brain was sectioned frontally. The sections showed the specimen to be in good histological condition, but no trace of eyes was found.

DIGESTIVE SYSTEM: Pharynx small, slightly posterior to the central area of the body, slightly ruffled, with a few shallow folds (fig. 5).

COPULATORY APPARATUS: Somewhat pos-

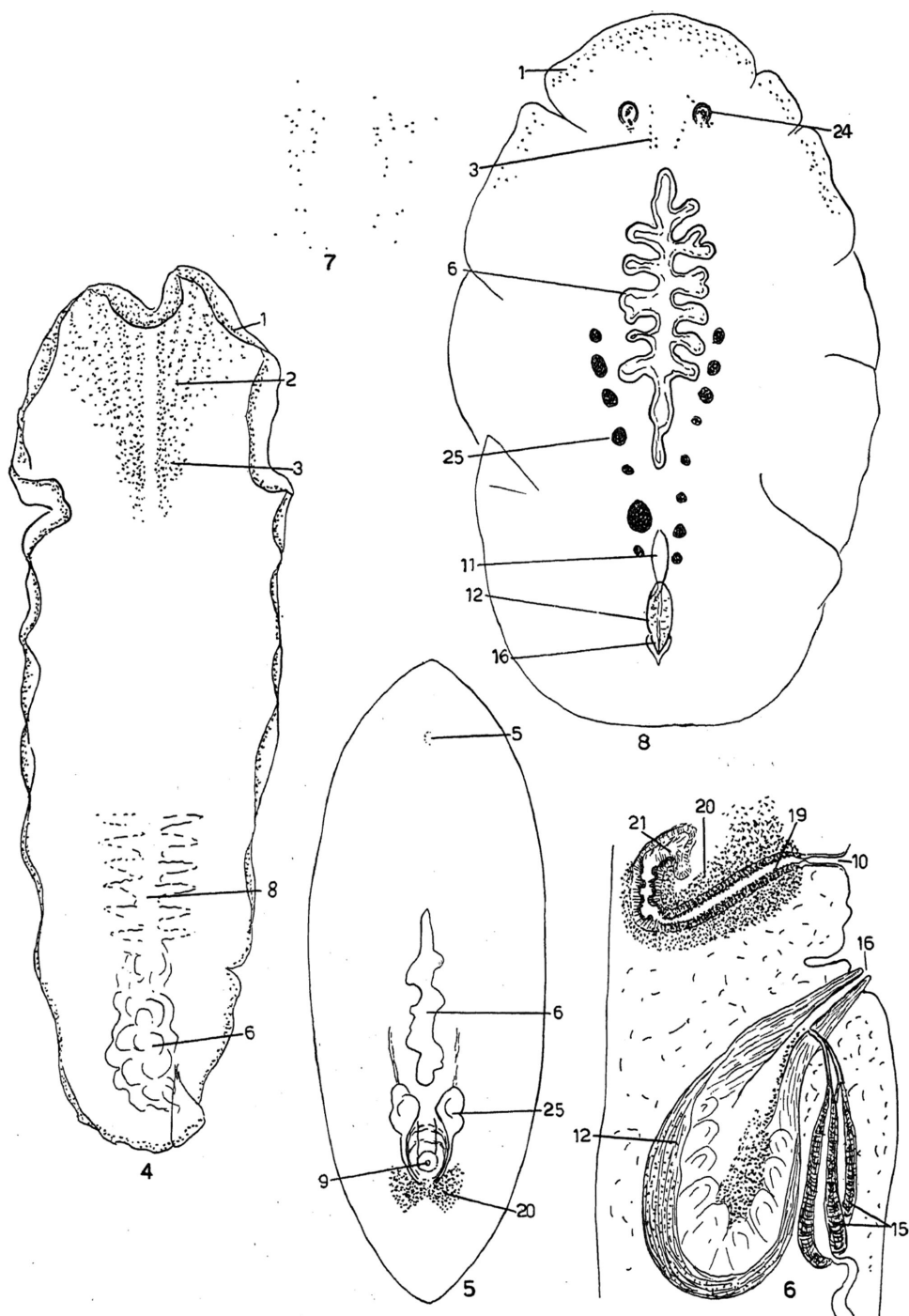


FIG. 4. Juvenile latocestid.

FIGS. 5, 6. *Plehnia caeca*. 5. Dorsal view. 6. Sagittal view of the copulatory apparatus, anterior below.

FIG. 7. *Plehnia caeca* variety *oculifera*, cerebral eyes.

FIG. 8. *Stylochus franciscanus*, dorsal view.

terior to the pharynx (fig. 5). The sperm ducts as they approach the copulatory apparatus become provided with thick muscular walls, thus forming spermiducal bulbs; these narrow again caudally (fig. 6) and enter the neck of the prostatic vesicle from the ventral side, immediately uniting after this entrance to form a common duct (fig. 6). A true seminal vesicle is wanting. The male apparatus consists chiefly of a large prostatic vesicle, somewhat horizontally oriented, which tapers posteriorly and ventrally to a projecting papilla that may be considered a penis papilla (fig. 6). There is a slight indication of a male antrum. The prostatic vesicle consists mainly of the chambered glandular interior enclosed in a muscular wall that is somewhat thick dorsally, thin ventrally. The small distal part of the prostatic vesicle continuous with the penis papilla is wholly muscular. The female apparatus lacks a Lang's vesicle, although there is a slight projection behind the entrance of the oviducts into the vagina that suggests the remnant of a previously existing Lang's vesicle. The vagina opens ventrally by a short female antrum, then slants forward as it pursues a dorsal course, and finally curves posteriorly and ventrally to terminate blindly immediately after receiving the oviducts which unite just at their entrance into the vagina. Cement glands accompany the vagina along its entire course but are most thickly developed along its vertical portion. The male and female gonopores are distinct but rather close together (fig. 6). A feature of the female system is the sacciform enlargement on each uterus between the pharynx and the prostatic vesicle (fig. 5).

DIFFERENTIAL CHARACTERS: *Plehnia caeca* differs from *Plehnia arctica*, the only other eyeless species of *Plehnia*, as well as from all other known Plehniidae, in the absence of Lang's vesicle.

DISTRIBUTION: Collected by the "Albatross," Station 5788, near the Farallones Light, outside the Golden Gate, San Francisco Bay, California, at 68 fathoms, October 21, 1912; collected by the Allan Hancock Foundation off Redondo Beach, California, at 13 fathoms on muddy bottom, May, 1940, $13\frac{1}{2}$ miles south of Seal Beach, California, at 215 fathoms on muddy bottom, July, 1940,

off Santa Catalina Island at 130 fathoms on muddy bottom, September, 1940, and off Santa Rosa Island at 47 fathoms on muddy bottom, April, 1941. The species thus appears to occur on muddy bottoms at considerable depths along the California coast.

HOLOTYPE: One set of serial sections (four slides), U.S.N.M. No. 23780.

REMARKS: The Plehniidae comprise a small number of species mostly limited to colder waters. Of the three species already assigned to *Plehnia*, *P. arctica* most nearly resembles the present species, not only in the absence of eyes, but also in the structure of the prostatic vesicle, which in both species consists largely of the glandular interior with only a moderate muscle coat. In the other two species, *Plehnia japonica* Bock, 1923, and *Plehnia pacifica* Kato, 1939, the glandular part of the prostate is of small extent and the proximal two-thirds of the organ is composed entirely of muscle fibers as if a true seminal vesicle were fused to the prostatic vesicle. Bock remarks that "it would be easy to defend the placing of this new species [i.e., *Plehnia japonica*] in a separate genus" and with the finding of *P. pacifica*, agreeing very closely in sexual anatomy with *P. japonica*, the erection of such a genus appears desirable. I therefore propose that *japonica* and *pacifica* be transferred to a new genus, *Paraplehnia*, while *caeca* and *arctica* are retained in *Plehnia*. The Plehniidae would then at present comprise three genera: *Plehnia*, in which the glandular part of the prostatic vesicle much exceeds the muscular part; *Paraplehnia*, in which the glandular part of the prostatic vesicle is reduced to a small distal region and most of the vesicle is composed of muscle; and *Discocelides*, with a vaginal duct. In accordance with these definitions it appears necessary to transfer "*Leptoplana*" *ellipsoides* Girard, 1854, which I previously assigned to *Discocelides* (Hyman, 1940), to *Plehnia*. *Plehnia japonica* becomes the type of *Paraplehnia*.

***Plehnia caeca* variety *oculifera*, new variety**

Figure 7

REMARKS: There were found in the Allan Hancock Foundation material two specimens believed to be *Plehnia caeca*, but they showed cerebral eyes in the form of a pair of loose

groups composed of very small eyes. These cerebral groups are illustrated in figure 7. The posterior part of one of the specimens was sectioned, and the copulatory apparatuses were found to be identical with those of eyeless specimens of *Plehnia caeca*. The anterior half of this specimen was then sectioned frontally in the hope of finding marginal eyes, as Bock (1923) was unable to find any marginal eyes in *Paraplehnia japonica* except in sections. However, I was unable to see any marginal eyes in the sections of *Plehnia caeca* var. *oculifera*. This does not necessarily prove that marginal eyes are absent, since the sections exhibit so many granules of one kind and another that it would be very difficult to distinguish minute eyes with certainty. Nevertheless, it appears that for practical purposes *Plehnia caeca* var. *oculifera* does not conform to the definition of the Craspedommata and would present difficulties of identification to the non-specialist.

The two specimens were taken by the Allan Hancock Foundation off Redondo Beach, California, at 26 meters, May 6, 1940, and near Santa Cruz Island, at 78 meters, October 31, 1940, in both cases on muddy bottom.

The Redondo Beach specimen has been mounted whole as a holotype of the variety and deposited in the Allan Hancock Foundation.

FAMILY STYLOCHIDAE STIMPSON, 1857

DEFINITION: Craspedommata of oval form and thick opaque consistency; with or without tentacles; with tentacular and cerebral eye clusters, often also with frontal eyes; with or without true seminal vesicle and spermiducal bulbs; prostatic vesicle free.

GENUS STYLOCHUS EHRENBURG, 1831

DEFINITION: Stylochidae with conspicuous retractile tentacles, at least when young, nearly always throughout life; with large, central, much ruffled pharynx; with true single or compounded tripartite seminal vesicle; prostatic vesicle large, chambered; vagina simple, not extending proximal to the entrance of the uteri, hence Lang's vesicle and its duct wanting.

TYPE SPECIES: *Stylochus suesensis* Ehrenberg, 1831.

Stylochus franciscanus, new species

Figures 8, 9

MATERIAL: Many specimens sent by the United States National Museum, collected by the "Albatross"; one specimen collected by the MacGinities and one found in the Freeman collection.

FORM: Small, oval, anterior end bluntly narrowed, posterior end broad, truncate; to 10 mm. long by 6 mm. wide across the widest region; with a pair of conspicuous nuchal tentacles, located rather far forward (fig. 8).

COLOR: In life, according to MacGinitie, creamy, with minute tan specks; preserved specimens appear dark brown.

EYES: Marginal band limited to the anterior margin, for a distance comprising only about one-fourth of the total margin; tentacular eyes occur inside the tentacles, with sometimes a few at the tentacular bases (fig. 8); cerebral eyes very scanty, in a linear arrangement of a maximum of about eight eyes to either side between the tentacles; apparently fewer in the smaller specimens where they were very difficult to see at all; frontal eyes wanting, although scattered eyes from the inner side of the marginal band extend somewhat towards the cerebral eyes.

DIGESTIVE SYSTEM: There is present the usual, more or less centrally located, conspicuous ruffled pharynx (fig. 8), typical of the genus; mouth about central with respect to the pharynx.

COPULATORY APPARATUS: Situated about halfway between the posterior end of the pharynx and the posterior body margin (fig. 8). The apparatus is shown in sagittal view in figure 9. The sperm ducts enter separately the anterior end of the seminal vesicle. This is a simple muscular body of elongated form that narrows distally to become the ejaculatory duct. The latter passes ventral to the prostatic vesicle and enters the penis papilla. The prostatic vesicle, of moderate size and oval form, lies horizontally above the ejaculatory duct but slants slightly downward in the anterior direction (fig. 9). It consists as usual in the genus of a thick, chambered, glandular interior enclosed in a muscular wall

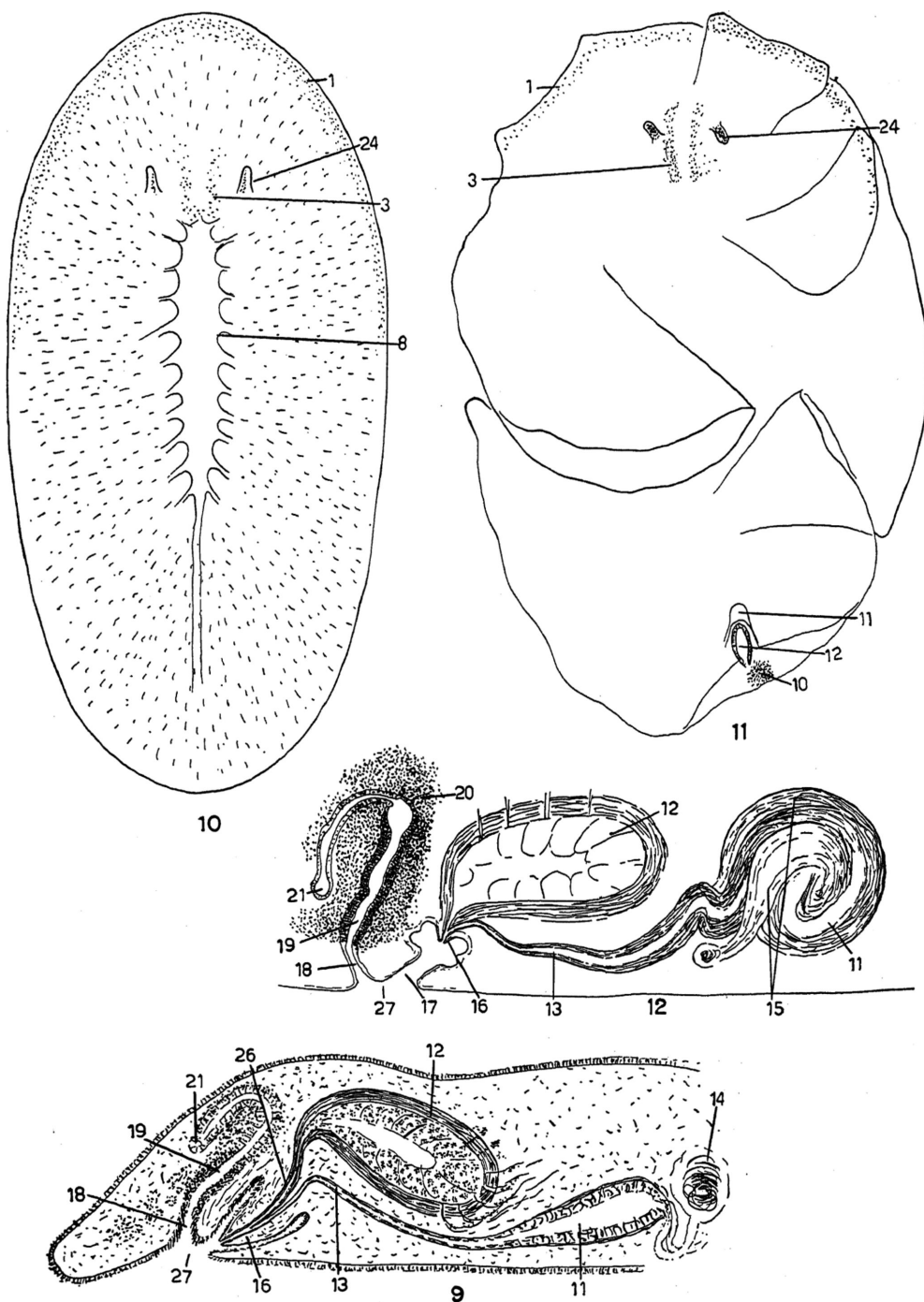


FIG. 9. *Stylochus franciscanus*, sagittal view of the copulatory apparatus, anterior end to right.
 FIGS. 10-12. *Stylochus tripartitus*. 10. Dorsal view, from life. 11. Dorsal view, preserved. 12. Sagittal view of the copulatory apparatus, anterior end to right.

penetrated by fibers and gland ducts. The prostatic duct joins the ejaculatory duct inside the penis papilla. The latter is a good-sized conical eminence enclosed in a shallow male antrum. The male and female gonopores are so close together that they may be considered as combined to a common gonopore. There is a short female antrum from which the vagina, accompanied by cement glands, ascends dorsally with a slight anterior slant; it then curves posteriorly and downward and, as diagnostic of the genus, terminates with the entrance of the oviducts, which come into it separately.

DIFFERENTIAL CHARACTERS: Limitation of the marginal eyes to the anterior fourth of the body margin; anterior position of the tentacles; scantiness of the cerebral eyes; simple form of the seminal vesicle; good development of the penis papilla; presence of a common gonopore.

DISTRIBUTION: Collected by the "Albatross" in abundance at Station 5817, San Francisco Bay, at $5\frac{1}{2}$ fathoms, at Lone Tree Point, Point Pinole, and Mare Island Light, December 9, 1912; also at Station 5795, Angel Island and Southampton Light, San Francisco Bay, at 13 fathoms, October 29, 1912; taken by the MacGinities at Corona del Mar, California, November 27, 1937, in an old barnacle shell, and by Freeman at San Pedro, California.

HOLOTYPE: MacGinitie's specimen as whole mount, A.M.N.H. No. 356.

REMARKS: This species appears to be rather common on the California coast, especially in San Francisco Bay. It should be readily recognized by its small size, somewhat pointed anterior end, rather anterior position of the tentacles, and limitation of the marginal band of eyes to the anterior body fourth.

Stylochus tripartitus, new species

Figures 10-13

MATERIAL: Four specimens, one personally taken alive, one each sent by the MacGinities, Ricketts, and the Allan Hancock Foundation.

FORM: Large; live specimen was 42 mm. long by 20 mm. wide but contracted to 22 mm. in length on preservation; other specimens measured 30 by 22, 30 by 12, and 13

by 10 mm. preserved; oval (fig. 10) in life, with rounded ends and conspicuous conical tentacles situated well back from the anterior end. The Ricketts specimen, much contracted to a broadly oval form and thrown into folds that obscure the internal structures, is shown in figure 11, and the Allan Hancock Foundation specimen, more elongated, in figure 13. This species becomes very hard and opaque on preservation so that it is difficult to see anything on cleared specimens.

COLOR: In life buff, covered with short brown streaks; preserved specimens appear brown, with the color made up of closely placed spots.

EYES: Marginal band extends around the anterior margin for one-fourth to nearly one-half of the body length; the tentacles contain eyes and the cerebral clusters are two elongated groups between the tentacles (figs. 10, 11). The cerebral eyes were very difficult to see on some specimens and could not be found in figure 13 because of a split in this region. Frontal eyes are wanting.

DIGESTIVE SYSTEM: Owing to the great opacity of this species, the pharynx could not be seen in two of the specimens, either in life or after clearing. In the other two it appeared as a central elongated tube with shallow lateral branches (fig. 13). In the living specimen the main intestine with its lateral branches was visible (fig. 10). The position of the mouth was not ascertained.

COPULATORY APPARATUS: This was sectioned for three of the specimens and found characterized by a tripartite seminal vesicle (fig. 12), whence the specific name. As shown in figures 11 and 13, the copulatory apparatus is near the posterior margin; in figure 11 the female gonopore is about 1 mm. anterior to the margin. The sperm ducts, approaching the male apparatus from behind, take on heavy muscular coats and become spermiducal bulbs that curve dorsally and become continuous with the main mass of the true seminal vesicle, forming a tripartite seminal vesicle (fig. 12). This main median mass of the seminal vesicle is a large, rounded, highly muscularized bulb that continues posteriorly as a slightly sinuous muscular tube, gradually narrowing to an ejaculatory duct as it approaches the penis papilla. The prostatic vesicle is the usual blind oval body, here

oriented horizontally, provided with a moderately thick muscular wall and a chambered glandular interior. The prostatic vesicle narrows distally to form a very short duct that joins the ejaculatory duct, and the common duct so formed passes through the middle of the small penis papilla lodged in a male antrum of moderate size. The female gonopore lies close behind the male pore, without being in common with the latter. It leads into a female antrum from which the vagina surrounded by numerous cement glands ascends dorsally, then makes the usual downward and backward bend, terminating at the entrance of the two oviducts. The female tract appears to lack muscularity.

DIFFERENTIAL CHARACTERS: *Stylochus tripartitus* differs from other *Stylochus* species of the region except *exiguus* in the tripartite seminal vesicle. Other characters are the eye arrangement, rounded anterior end, and small penis papilla.

DISTRIBUTION: One specimen taken alive at Pacific Grove, California, on kelp rhizoids, August, 1936; MacGinitie specimen collected under shore rocks at Newport Bay, California, September, 1932; the Ricketts specimen came from El Mogote, Lower California, March, 1940, and the Allan Hancock Foundation specimen from Fossil Point, Coos Bay, Oregon, August, 1942. The species thus appears distributed from Oregon to the lower end of Lower California.

HOLOTYPE: Pacific Grove specimen deposited in the American Museum of Natural History (A.M.N.H. No. 357), anterior half as whole mount, posterior part as sections (two slides).

REMARKS: *Stylochus tripartitus* is one of the two California species of *Stylochus* provided with a tripartite seminal vesicle. The other one, *exiguus*, however, is a very small species with marginal eyes completely encircling the margin.

***Stylochus atentaculatus*, new species**

Figures 14-17

MATERIAL: One specimen sent by J. Mohr, University of California; about 10 specimens sent by the Allan Hancock Foundation.

FORM: Very large, thick and opaque, to 60 mm. long by 25 mm. wide through the mid-

dle, preserved; elongated oval narrowing towards the ends, with anterior end apparently more pointed than the posterior end (fig. 14). Figure 17 is a sketch of the type specimen as it appears to the naked eye, preserved. Tentacles are completely wanting in the larger specimens; young specimens show rounded tentacles containing eyes (fig. 16, specimen 22 by 14 mm., preserved). The absence of tentacles in a species of *Stylochus* is very surprising. The Allan Hancock Foundation material contained an assortment of sizes, and inspection of these indicates that as the animal grows the tentacles gradually become incorporated into the dorsal surface.

COLOR: Apparently dark brown, composed of closely set dots.

EYES: The marginal band of eyes completely encircles the margin (fig. 14), thinning posteriorly as usual. The other eyes were very difficult to see in the larger specimens and appear deeply insunk into the interior. In young specimens the tentacles contain a mass of eyes which appear in older specimens as a deeply placed rounded black area. The cerebral eyes are rather numerous in young animals, forming a pair of poorly separated groups lying between the tentacles, beginning some distance behind these and extending forward to a much less distance (fig. 16). The cerebral eyes were very difficult to see in cleared specimens of the larger individuals, and very likely what is shown of them in figure 14 does not represent their full extent. Frontal eyes are wanting.

DIGESTIVE SYSTEM: The centrally located pharynx has a number of rather narrow lateral lobes (fig. 14). The mouth is found below the posterior part of the pharynx.

COPULATORY APPARATUS: As shown in figure 14, this is situated about halfway between the posterior end of the pharynx and the posterior body margin, hence well anterior to the latter. A sagittal view of the copulatory apparatus of the Mohr specimen is given in figure 15; one of the Hancock specimens was also sectioned and found in agreement. The principal features of the male apparatus are the simple seminal vesicle, the very small penis papilla, and the relatively large and deep male antrum. The male and female gonopores are well separated. The

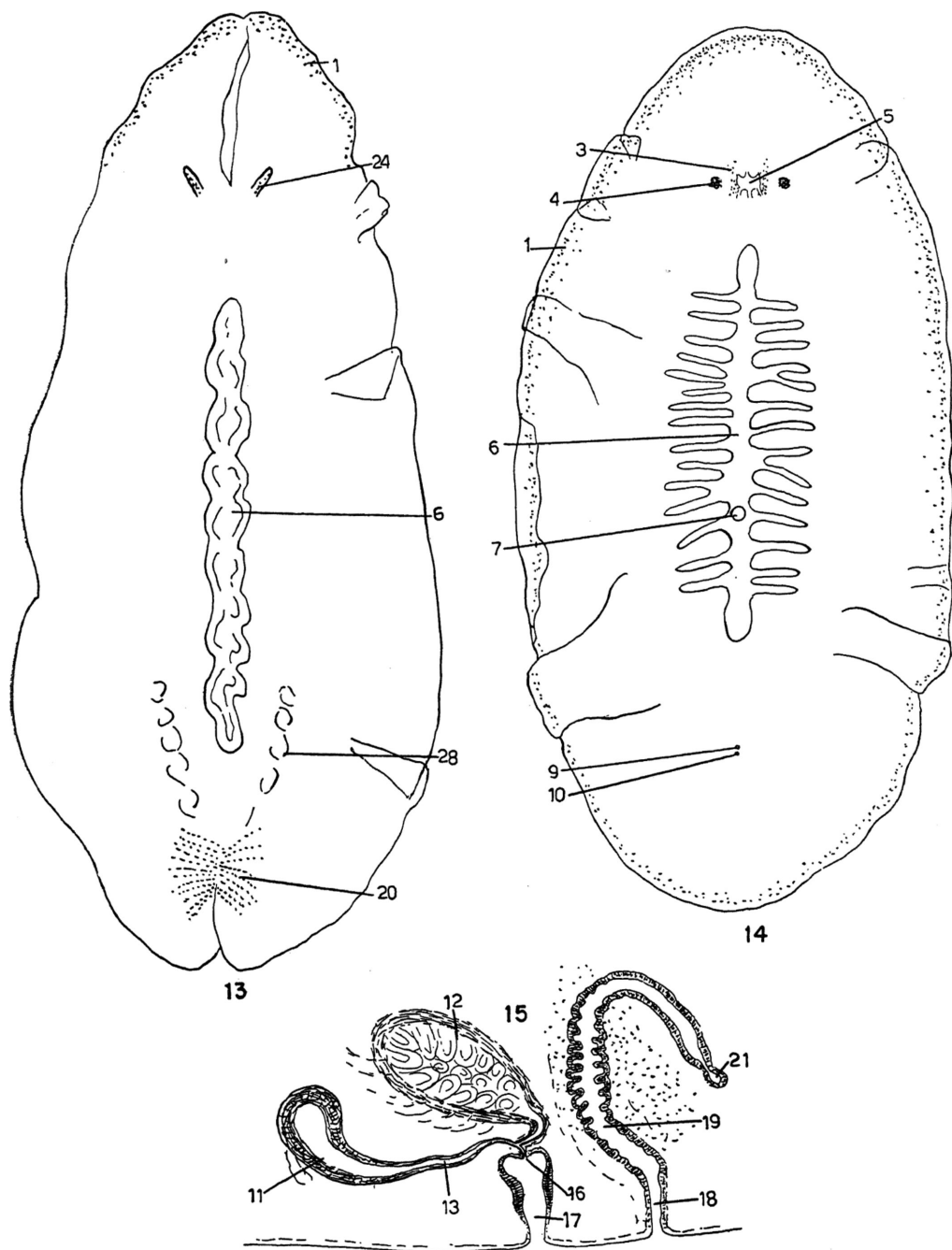


FIG. 13. *Stylochus tripartitus*, preserved, dorsal view.

FIGS. 14, 15. *Stylochus atentaculatus*. 14. Dorsal view. 15. Sagittal view of the copulatory apparatus, anterior end to left.

vagina continues dorsally from the tubular female antrum and pursues the usual course typical of the genus.

DIFFERENTIAL CHARACTERS: *Stylochus atentaculatus* is distinguished from all other species of *Stylochus* by the lack of tentacles in mature specimens. Other features are the large size, complete band of marginal eyes, lack of frontal eyes, simple form of the seminal vesicle, very small size of the penis papilla, and deep male antrum.

DISTRIBUTION: Collected by Mohr in a rocky crevice between tide marks at Moss Beach, San Mateo County, California, June 1, 1939; taken by the Allan Hancock Foundation at 3 to 5 fathoms in San Lorenzo Channel, Gulf of California, March 1937, at 28 fathoms off San Nicholas Island, California, April, 1940, in the intertidal zone at Anaheim Landing, California, February, 1942, in the intertidal zone at Charleston, Oregon, July, 1942, in the intertidal zone at Cape Arago State Park, Coos County, Oregon, July, 1942, and at Campbell Cove, Bodega Lagoon, Sonoma County, California, December, 1948, and January, 1949. The last two collections were made by R. J. Menzies. The species appears to have a distribution similar to the foregoing, that is, from Oregon to Lower California, being apparently more common in the northerly part of its range.

HOLOTYPE: One large preserved specimen deposited in the Allan Hancock Foundation.

REMARKS: This is one of two very large species of *Stylochus* found on the California coast. It probably reaches a length of 4 inches or more when alive and extended. It is easily distinguished from the other large species (*californicus*) by the lack of tentacles.

***Stylochus californicus*, new species**

Figures 18, 19

MATERIAL: Five specimens collected by the MacGinities; two specimens sent by the United States National Museum, accession numbers 3946 and 61149.

FORM: Very large, up to nearly 6 inches long when extended alive according to the MacGinities, but usually 2 to 4 inches in length; available preserved specimens are under 2 inches long; of elongated oval form,

relatively thin, somewhat narrowed at the ends (fig. 18), broadest near the middle, nearly half as broad as long; with a pair of conspicuous nuchal tentacles. A sketch of this species from life appears in "Natural history of marine animals" (p. 152), erroneously labeled "*Cryptophallus magnus*."

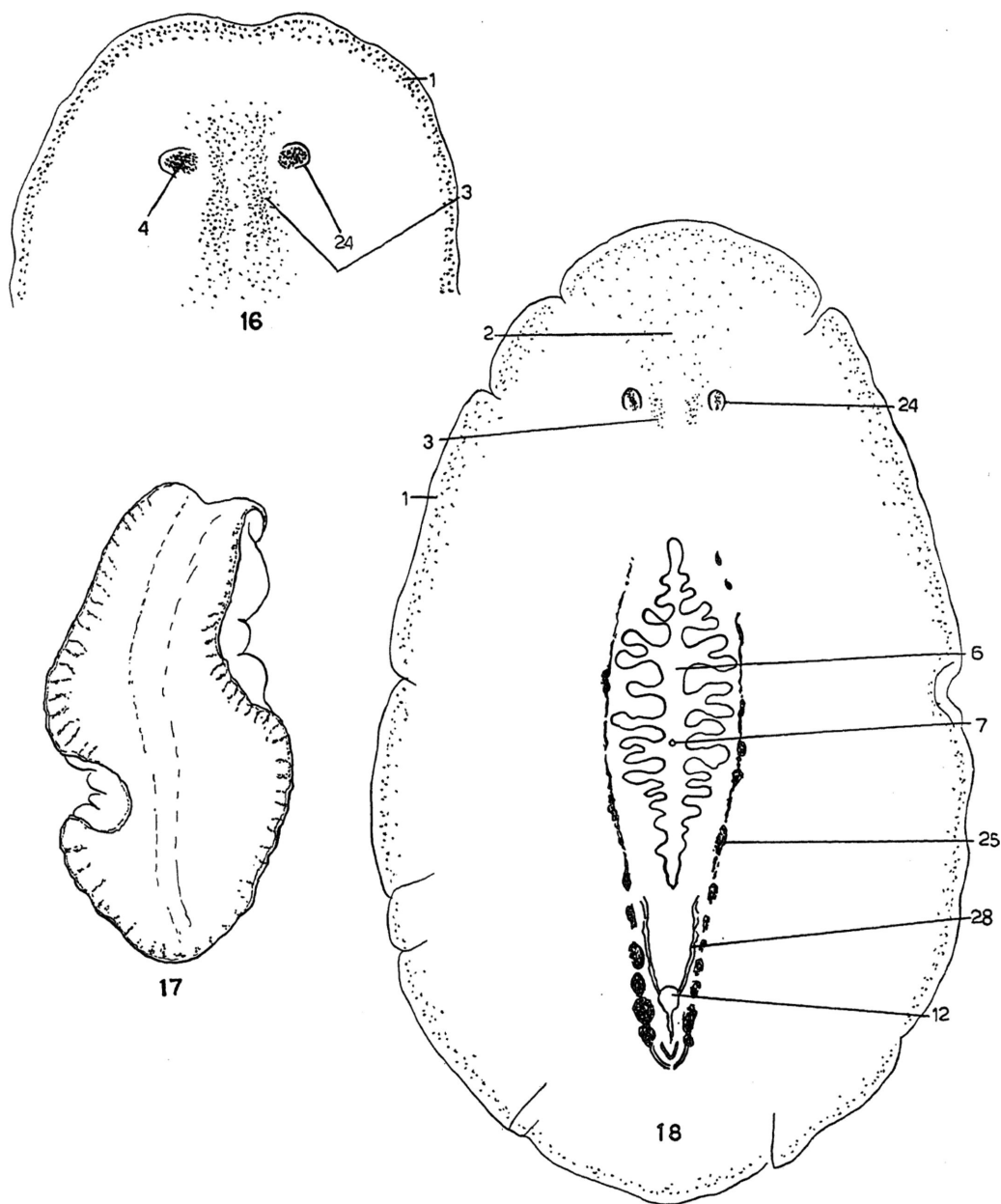
COLOR: Gray, inconspicuously dotted with darker spots.

EYES: The marginal eyes completely encircle the margin, forming a rather wide band anteriorly and gradually diminishing in width posteriorly (fig. 18). The tentacles as usual contain eyes. The cerebral eyes form elongated groups between the tentacles, beginning behind the level of the latter and extending forward to join the frontal eyes that diverge in a fan-like pattern to merge with the marginal eyes (fig. 18).

DIGESTIVE SYSTEM: The well-ruffled, centrally located pharynx is a conspicuous structure in ventral view of preserved specimens, extending up to one-half of the body length (fig. 18). The mouth is situated a little behind the middle of the pharynx.

COPULATORY APPARATUS: This is situated about halfway between the posterior end of the pharynx and the posterior margin, hence well anterior to this margin. It is shown in sagittal view in figure 19. It is devoid of any distinctive features, following the pattern usual to the genus. In the male system, the seminal vesicle is of the simple type, consisting of an elongated muscular tube that is bulbous anteriorly where it receives the two sperm ducts separately and narrowed posteriorly to a sinuous ejaculatory duct. The latter joins the prostatic duct inside the short but broad penis papilla, lodged in a very shallow male antrum. The prostatic vesicle, obliquely oriented, is the usual oval body with muscular wall and chambered glandular interior (fig. 19). The male and female gonopores are quite distinct but not far apart. The vagina follows the usual course and receives the cement glands only into its vertical portion; ventrally it opens by a widened chamber into the shallow female antrum.

DIFFERENTIAL CHARACTERS: Large size, thin texture, complete encirclement of the margin by the marginal eyes, presence of frontal eyes continuous with both the cere-



FIGS. 16, 17. *Stylocheus atentaculatus*. 16. Anterior part of a young specimen, to show eye arrangement. 17. Type specimen.

FIG. 18. *Stylocheus californicus*, dorsal view.

bral and marginal eyes, simple seminal vesicle, and slight development of the male antrum.

DISTRIBUTION: Recorded by the MacGinities at Monterey Bay and Corona del

Mar, California; United States National Museum specimens came from Laguna Beach and San Diego, California.

HOLOTYPE: One whole mount, A.M.N.H. No. 358.

REMARKS: This seems to be one of the largest known polyclads, probably the largest on the California coast, although *Stylochus atentaculatus* is also very large. These two species can be distinguished by the conspicuous tentacles of *californicus*, lacking in *atentaculatus*, also by the thinness of the former, whereas *atentaculatus* is very thick. *Stylochus californicus* seems to occur usually in association with bivalve mollusks. The specimens sent to me by the MacGinities were taken in burrows of the rock-boring clam *Barnea pacifica*. Mention is made by the MacGinities in their book "Natural history of marine animals" of a boat bottom covered with bivalves among which crawled dozens of specimens of *Stylochus californicus* (erroneously referred to as "*Cryptophallus magnus*"). It is very common for stylochids to associate themselves with bivalves, as the latter constitute the main food of many species; *Stylochus* species may also use mollusks as shelters and refuges.

***Stylochus exiguus*, new species**

Figures 20, 21

MATERIAL: Two specimens sent by the MacGinities; two furnished by the Allan Hancock Foundation.

FORM: Small, oval, 7 by 4 mm. preserved; with conspicuous nuchal tentacles; anterior end rounded; posterior end with a median notch marking position of the copulatory apparatus (fig. 20).

COLOR: Not determinable.

EYES: Marginal eyes completely encircle the margin, becoming sparser posteriorly. Tentacular eyes occur inside the tentacles. The cerebral eyes consist of a few eyes in a linear row to either side of the median line shortly in front of the tentacles (fig. 20). In the type specimen there are three such eyes on one side and four on the other. Frontal eyes are wanting.

DIGESTIVE SYSTEM: There is a centrally located pharynx of elongated form, equaling about half the body length (fig. 20); it is provided with a fair number of side branches. The mouth was found slightly anterior to the pharynx middle in the type specimen.

COPULATORY APPARATUS: As shown in figure 20, this occurs at the middle of the extreme posterior end, directed into a notch

of the posterior margin. Difficulty was met with in obtaining sections of the copulatory apparatus. Although the copulatory apparatus of the MacGinitie specimens could be seen when whole, sections of the posterior part of both showed such a bad histological condition that nothing definite could be found of the apparatus. It is unfortunate that one of the specimens was not retained intact. One of the Allan Hancock Foundation specimens was injured in the essential region, but adequate sections were obtained of the other, a small individual. Owing to distortion of the body of the latter, the sections were not strictly sagittal but suffice to give the main characters (fig. 21). This species is one of those with a tripartite seminal vesicle. The sperm ducts approaching the male apparatus from behind acquire muscular walls and become spermiducal bulbs that fuse with the proximal end of the true seminal vesicle to form a tripartite seminal vesicle. The true seminal vesicle, somewhat smaller and less muscular than the spermiducal bulbs, proceeds posteriorly, narrowing to the usual sinuous ejaculatory duct. This unites with the prostatic duct inside the short but broad penis papilla. The prostatic vesicle is of oval form, with a moderately thick muscular wall and chambered glandular interior. The penis papilla is lodged in a moderately sized male antrum opening ventrally by the male gonopore. Owing to a tear in the worm, the female tract could not be traced to the exterior but appeared to open close behind the male gonopore. The vagina ascends dorsally, then makes the usual backward and downward bend, terminating at the entrance of the oviducts. The proximal part of the vagina is characterized by large, vacuolated cells, the vertical part, receiving the cement glands, by tall narrow cells.

DIFFERENTIAL CHARACTERS: Small size, eye arrangement, extreme posterior position of the copulatory complex, posterior notch, and tripartite seminal vesicle.

DISTRIBUTION: Collected by the MacGinities from burrows of *Upogebia pugetensis* at Newport Bay, California, December 15, 1927; taken by the Allan Hancock Foundation in Tomales Bay, Marin County, California, October 19, 1948.

HOLOTYPE: Anterior part of one of the

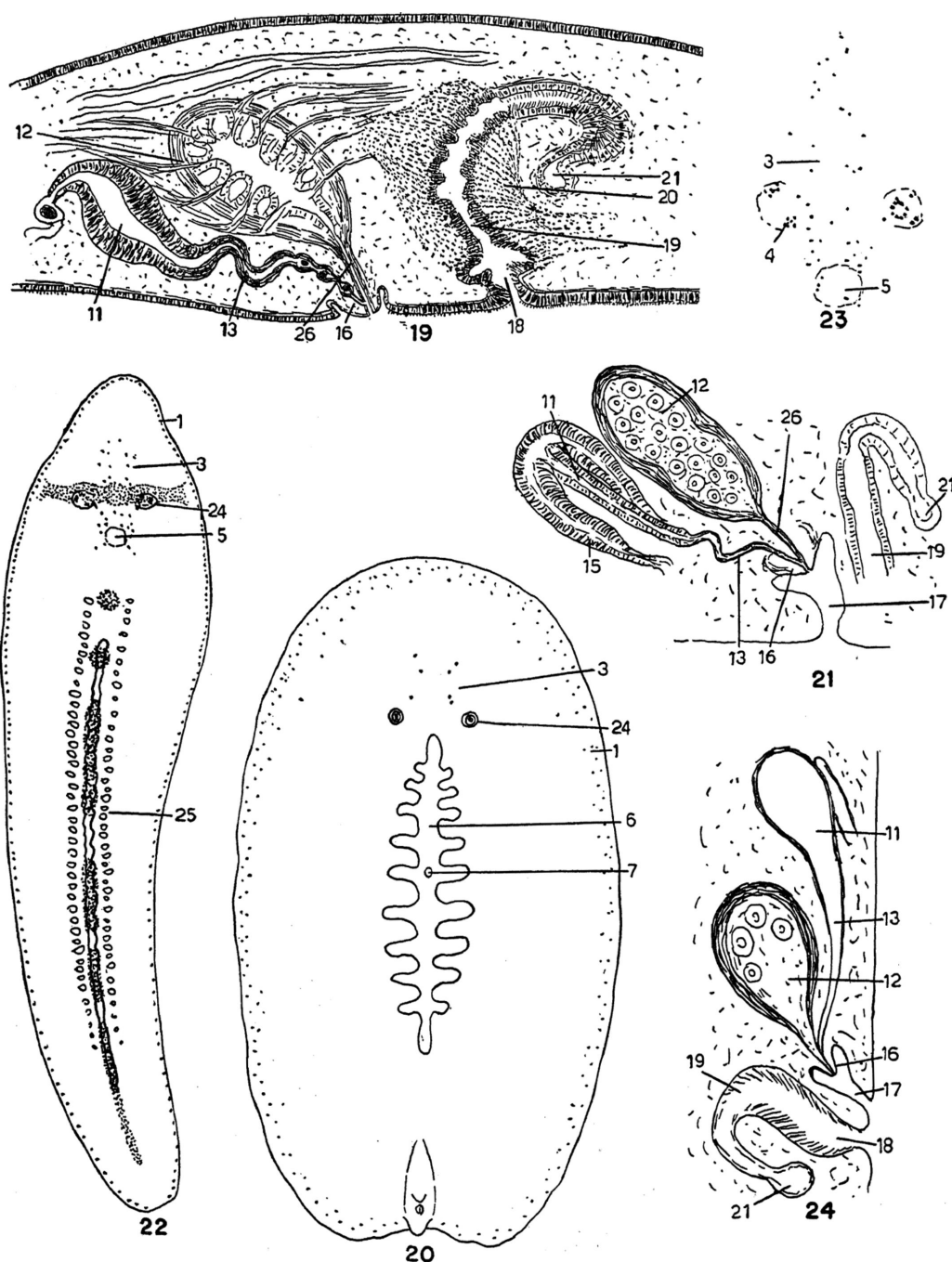


FIG. 19. *Stylochus californicus*, sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 20, 21. *Stylochus exiguus*. 20. Dorsal view. 21. Sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 22-24. *Stylochus insolitus*. 22. Dorsal view. 23. Enlarged view of cerebral eyes. 24. Sagittal view of the copulatory apparatus, anterior end above.

MacGinitie specimens as whole mount, deposited in the Allan Hancock Foundation; also accompanied by sections (four slides) of one of the Allan Hancock Foundation specimens.

REMARKS: This species appears limited to the California coast and is one of the less common polyclads of that region. It should be readily recognizable by the small size, oblong shape, posterior notch, and few eyes.

***Stylochus insolitus*, new species**

Figures 22-24

MATERIAL: One specimen sent by the Allan Hancock Foundation.

FORM: Small, elongate, slender, slightly widened through the brain region (fig. 22), 10 mm. long by 2.5 mm. across the widest region; with a pair of relatively large, rounded, nuchal tentacles. The shape differs so much from that usual to the genus that one suspects it may be an accidental result of fixation.

COLOR: Across the tentacles there is a brown bar that appears part of a pigment pattern. Along the middorsal line there is a series of rounded and elongate patches of a similar brown color, apparently representing an interrupted middorsal brown line. Otherwise the specimen appears transparent.

EYES: The marginal band consists of a single row of eyes completely encircling the margin (fig. 22), closely spaced anteriorly, more widely spaced posteriorly. There are groups of eyes in the tentacles. There are a fair number of loosely arranged cerebral eyes beginning at the brain (located well behind the tentacles) and extending forward between the tentacles to some distance anterior to them (fig. 23).

DIGESTIVE SYSTEM: The pharynx is very narrow and elongated (fig. 22), extending for most of the postcerebral part of the body. Nothing else could be seen of the digestive tract.

COPULATORY APPARATUS: Although this was not visible in the specimen when whole, the presence of eggs in the uteri extending along the sides of the pharynx indicated sexual maturity. The postpharyngeal region of the specimen was removed and sectioned sagittally. It was found in bad histological condition but revealed, to my great surprise,

a copulatory apparatus typical of the genus *Stylochus* (fig. 24). There would seem to be no doubt of the specimen's belonging to this genus. The copulatory apparatus occurs about halfway between the posterior end of the pharynx and the posterior margin, hence is not at the margin as in *exiguus* but definitely a short distance anterior to it. The sperm ducts, approaching the seminal vesicle from behind, have rather firm walls but are not sufficiently muscularized to constitute definite spermiducal bulbs. They enter the proximal end of the seminal vesicle separately, one on each side of the bulbous proximal end of the vesicle. The seminal vesicle continues posteriorly, gradually narrowing as usual to an ejaculatory duct that joins the prostatic duct in the base of the short conical penis papilla lodged in a fairly developed male antrum. The prostatic vesicle occupies a slightly oblique position and shows a chambered interior enclosed in a moderately thick muscular wall. The female gonopore is situated close behind the male pore and leads into a rather expanded vagina that ascends vertically, then curves backward and downward, terminating with the entrance of the common oviduct. Owing to the poor histological condition of the specimen no details of the copulatory apparatus could be ascertained, and all that could be seen is represented in a rather sketchy manner in figure 24. The copulatory apparatus appears to offer no distinctive features except that it belongs to the type having a simple seminal vesicle.

DIFFERENTIAL CHARACTERS: Small size, slender shape, single row of marginal eyes, arrangement of the cerebral eyes, and color pattern.

DISTRIBUTION: Taken February 15, 1941, near the San Pedro Breakwater, California, at 18 fathoms on a bottom consisting of coarse sand and shell.

HOLOTYPE: Anterior part as whole mount, postpharyngeal region as sections (one slide), deposited in the Allan Hancock Foundation.

REMARKS: This species appears to be rather rare and cannot be fully understood until better preserved specimens become available.

The present study adds six species to the already populous genus *Stylochus*. Bock in

1925 listed 26 valid species of *Stylochus* but overlooked *S. oculiferus* (Girard), 1853, and *S. megalops* (Schmarda), 1859 (determined by Stummer-Traunfels, 1933), so that the number of described species to 1925 totals 28. Since then there have been described: *flevensis* Hofker, 1930; *aomori* Kato, 1937; *speciosus* Kato, 1937; *alexandrinus* Steinböck, 1937; *castaneus* Palombi, 1939; *pulcher* Hyman, 1940; *uniporus* Kato, 1944; *hamanensis* Kato, 1944; *izuensis* Kato, 1944; *miyadaii* Kato, 1944; *martae* Marcus, 1947; and *sixteni* Marcus, 1947 (new name for *crassus* Bock, 1931), or, with the present six species, a total of 46 undoubted species of *Stylochus* at the present writing. Of these, 23 are listed by Marcus (1947) as forms in which the marginal band of eyes is limited to the anterior part of the margin. The inclusion of *megalops* and of two of the present species, *franciscanus* and *tripartitus*, makes 26 species with partial marginal bands of eyes, leaving 20 with complete bands. Apparently, therefore, partial rather than complete provision of the margin with eyes is the more common condition in the genus.

The genus *Stylochus* is more or less restricted to warmer waters. Thus of the five species known for the Atlantic coast of North America (Hyman, 1940) two have not been found north of Massachusetts, and three are distinctly southern. In the present study no species of *Stylochus* has turned up north of Oregon.

The numerous species are distinguished mainly by external characters, as size, shape, color, and especially eye arrangement. The female copulatory apparatus, while diagnostic of the genus, offers scarcely any specific characters, but the male apparatus may present some distinguishing characters, as the orientation of the prostatic vesicle, the size of the penis papilla and male antrum, and the form of the seminal vesicle, whether simple or tripartite. A tripartite seminal vesicle occurs in two of the present species, *tripartitus* and *exiguus*.

GENUS *KABURAKIA* Bock, 1925

DEFINITION: Stylochidae with tentacles; seminal vesicle wanting but spermiducal bulbs present; prostatic vesicle well developed; vagina is continued posterior to the

entrance of the oviducts as a vaginal duct that opens into the female antrum or on the midventral surface by a separate pore shortly behind the female gonopore.

TYPE SPECIES: *Kaburakia excelsa* Bock, 1925.

Kaburakia excelsa Bock, 1925

Cryptophallus magnus Freeman, 1933, p. 113, figs. 1, 2, 26, 38, 39.

MATERIAL.—Many specimens seen alive in Puget Sound; others sent by Ricketts and Paul Illg; one fine preserved specimen presented by Ralph Buchsbaum.

FORM: Very large, to 10 cm. long alive, extended, by 7 cm. wide; broadly oval, rounded when at rest; very thick and tough; with conspicuous retractile tentacles.

COLOR: Tan, heavily marked with uniformly distributed dark brown dashes. A colored figure of this species appears in Johnson and Snook, "Seashore animals of the Pacific coast" (pl. 4, fig. 4, p. 116).

EYES: Marginal band completely encircles the margin, composed of numerous eyes densely arranged anteriorly, thinning posteriorly (figure in Bock, 1925, p. 134). Numerous eyes inside each tentacle with a few more near the tentacle bases; cerebral eyes also numerous in two elongated clusters between the tentacles and extending before and behind their level. The eye arrangement is figured and described by Bock (1925, pp. 134, 135) and by Freeman (1933, pp. 114, 115).

DIGESTIVE SYSTEM: The pharynx is centrally located, very large, and heavily ruffled. It is well shown on photographs in Freeman's article (*ibid.*, p. 141).

COPULATORY APPARATUS: As this has been thoroughly described by both Bock and Freeman, I have not made a personal study of it. The sperm ducts course along either side of the pharynx and at the level of the prostatic vesicle become moderately muscularized, thus constituting spermiducal bulbs. These continue towards the median line as narrowed ducts that unite ventral to the posterior part of the prostatic vesicle to a sinuous ejaculatory duct. The relatively small, clavate, prostatic vesicle with the usual muscular wall and folded (but not definitely chambered) glandular interior lies

in a horizontal position and narrows posteriorly to a prostatic duct that joins the ejaculatory duct inside the penis. The ejaculatory duct then proceeds to the penis tip. The penis papilla is of elongated conical form tapering to a pointed tip, and lodged in a deep, narrow, male antrum. The female gonopore lies well behind the male pore. From the small female antrum, the vagina slants forward and then vertically, receiving cement glands throughout these regions; it then curves posteriorly and after receiving the common oviduct continues posteriorly and ventrally as a vaginal duct that opens to the exterior close behind the female gonopore. For a figure of the copulatory apparatus, Bock (1925, p. 139) should be consulted.

DISTRIBUTION: Common in Puget Sound, also along the shores of Vancouver Island and British Columbia at least as far north as Sitka, Alaska; rocky shores, under rocks, sluggish.

REMARKS: Freeman in giving this species the name *Cryptophallus magnus* was obviously unaware of the fact that it had already been named *Kaburakia excelsa* by Bock. This circumstance is unfortunate, for the erroneous name *Cryptophallus magnus* has become incorporated into the literature on Pacific coast animals and it will prove difficult to eradicate it. Thus Ricketts and Calvin in "Between Pacific tides" devote a paragraph to "*Cryptophallus magnus*" (p. 175). As already mentioned, the polyclad called by this name in "Natural history of marine animals" (p. 153) is in reality *Stylochus californicus*. *Kaburakia excelsa* is distinctly a resident of cold waters and is not known to occur south of Puget Sound.

I am in accord with Bock on the desirability of separating this species into a genus distinct from *Cryptophallus* on the grounds of the presence of well-developed tentacles, the location of the male apparatus well behind the pharynx (not beneath its caudal part as in *Cryptophallus*), and the good development of the prostatic vesicle (much reduced in *Cryptophallus*). The only other species assigned to *Kaburakia* since Bock's article is *K. gloriosa* Kato, 1938, a species that seems to be somewhat intermediate between *Cryptophallus* and *Kaburakia*.

MEXISTYLOCHUS, NEW GENUS

DEFINITION: Stylochidae without tentacles but with tentacular eye clusters; with numerous cerebrofrontal eyes; intestinal branches anastomosed into a small-meshed network; male apparatus as in *Stylochus* but penis sheath present; vagina continued posteriorly behind the oviduct entrance as a large, highly developed vaginal duct that opens to the exterior midventrally well behind the female gonopore.

TYPE SPECIES: *Mexistylochus tuberculatus*, new species.

Mexistylochus tuberculatus, new species

Figures 25, 26

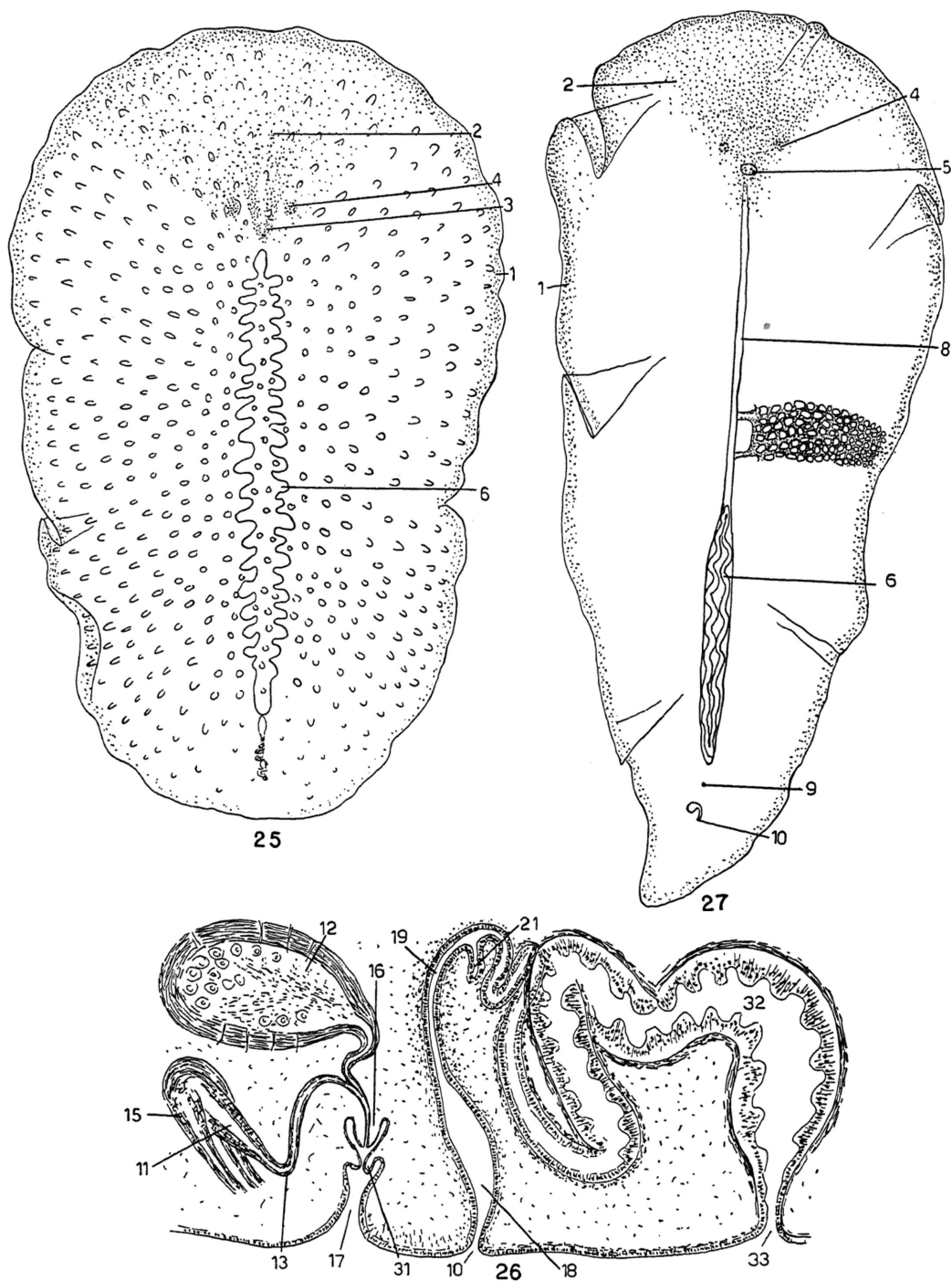
MATERIAL: Two specimens sent by the MacGinities; one specimen sent by the Allan Hancock Foundation.

FORM: Oval, thick, of moderate size, 21 mm. long preserved, 12 mm. across widest part; both ends rounded but anterior end broader (fig. 25), width then diminishing posteriorly; tentacles wanting; dorsal surface covered with low blunt tubercles.

COLOR: Tan, tubercles white.

EYES: Band of marginal eyes almost completely encircles the margin, leaving a small area at the posterior end devoid of eyes (fig. 25); band very wide anteriorly, diminishing posteriorly. There are two rounded tentacular clusters of about 30 eyes each. Numerous small eyes are strewn over the anterior end, not distinctly separable into cerebral and frontal clusters. These cerebrofrontal eyes begin somewhat behind the level of the tentacular eyes as two elongated dense eye aggregations that undoubtedly represent the cerebral groups; these proceed forward between and around the tentacular groups and, spreading fanwise, extend to the anterior margin, meeting the inner, more loosely arranged eyes of the marginal band. As they spread anteriorly, the cerebrofrontal eyes become more scattered. All the eyes are small but readily seen in cleared specimens.

DIGESTIVE SYSTEM: There is an elongated, centrally placed ruffled pharynx beginning just behind the most posterior of the cerebral eyes and extending to the male apparatus. It presents some 20 or more relatively short lateral pouches (fig. 25). The mouth



FIGS. 25, 26. *Mexistyllochus tuberculatus*. 25. Dorsal view. 26. Sagittal view of the copulatory apparatus, anterior end to left.

FIG. 27. *Mexistyllochus levis*, dorsal view.

could not be located on the type specimen. The intestinal branches anastomose at once into a small-meshed network.

COPULATORY APPARATUS: This is located directly behind the rear end of the pharynx, not far from the posterior margin (fig. 25). The male apparatus (fig. 26) is practically identical with that of *Stylochus* except for the presence of a penis sheath. There is a tripartite seminal vesicle of moderate size and muscularity of which the median limb (true seminal vesicle) continues posteriorly beneath the prostatic vesicle, narrowing as an ejaculatory duct that, after receiving the prostatic duct, continues through the center of the penis papilla. The prostatic vesicle is a fairly large oval body, horizontally oriented, with muscular wall and chambered glandular interior; the chambers appear less distinct than in *Stylochus*, and the interior in the specimen sectioned contained a great deal of secretion. The penis papilla is a conical eminence enclosed in the proximal portion of the male antrum which is separated from the distal portion by a penis sheath (fig. 26). The male antrum is thus a somewhat elongated cavity. The female gonopore, shortly behind the male pore, leads into a vertical tube not distinctly differentiated into antrum and vagina. This is rather wide at first and then narrows, receiving scanty cement glands into the narrowed portion. The vagina then curves posteriorly as usual but after receiving the common oviduct into its ventral wall it continues posteriorly as a sinuous vaginal duct. This descends ventrally as a rather narrow tube suggesting the duct of Lang's vesicle, then widens into a large and elongated tube suggestive of a Lang's vesicle. This proceeds dorsally, then posteriorly in a horizontal plane, and finally descends ventrally, steadily increasing in width, to open by a vaginal pore situated some distance behind the regular female gonopore (fig. 26). *Mexistylolochus* therefore has three genital pores as in some other stylochid genera, namely, *Kaburakia* and *Bergendalia*. The vaginal duct is lined by a thick, much folded, apparently glandular epithelium, covered externally by a fairly thick and definite muscular coat. The vagina proper shows but little muscularity.

DISTRIBUTION: Gulf of California; taken by the MacGinities at Miramar Beach,

Guaymas, Sonora, Mexico, February 9, 1948, on a rocky shore; collected by the Allan Hancock Foundation near Cabeza Ballena, Lower California, at 30 fathoms, March 11, 1949, on coarse sandy and shelly bottom.

HOLOTYPE: One whole mount, A.M.N.H. No. 359.

REMARKS: It seems possible that the "large, buff-colored bumpy specimen at Pt. Lobos" mentioned by Ricketts in "Sea of Cortez" (p. 336) might have been *Mexistylolochus tuberculatus*, but unfortunately the specimen in question could not be found in the material sent by Ricketts.

Mexistylolochus levis, new species

Figure 27

MATERIAL: One specimen collected by the MacGinities.

FORM: Very large, thick, 67 mm. long by 21 mm. wide through the widest part when alive, extended, 45 by 24 mm. preserved; cuneate, widest through the anterior third, gradually tapering to a pointed, tail-like caudal end (fig. 27); smooth, tentacles wanting.

COLOR: Medium brown spotted with white.

EYES: The marginal band completely encircles the margin, very wide anteriorly, gradually diminishing in width posteriorly. There are tentacular clusters, not well demarcated, of about 40 eyes each. The cerebrofrontal eyes are very similar to those of the preceding species, beginning somewhat behind the brain, proceeding forward between and around the tentacular clusters, and then spreading fanwise to merge with the marginal band along the anterior margin (fig. 27). All the eyes are rather small.

DIGESTIVE SYSTEM: Pharynx posteriorly located, well behind the body middle, of slender form, with slight ruffling (fig. 27); from it the main intestine is readily seen extending anteriorly to the brain. The intestinal branches immediately anastomose to a small-meshed network which is a very conspicuous feature of the specimen. On figure 27 there is an attempt to depict a small area of this network.

COPULATORY APPARATUS: Located behind the pharynx in the tail-like region of the

body. Owing to the folding and curvature of this region, it was impossible to obtain exact sagittal sections, but the apparatus appears identical with that of the preceding species and therefore is not figured. No definite points of difference could be found.

DIFFERENTIAL CHARACTERS: *Mexistylolus levis* differs from *M. tuberculatus*, the only other species of the genus, in body shape, lack of tubercles, and shorter and more posteriorly located pharynx.

DISTRIBUTION: Collected by the MacGinities December, 1947, beneath rocks on a rocky point at Puerto Penasco, Sonora, Mexico.

HOLOTYPE: One whole mount, copulatory apparatus as serial sections (five slides), A.M.N.H. No. 360.

REMARKS: This completes the Stylochidae in the material. The "two large, brown, dark-speckled forms at Pulmo Reef" mentioned in "Sea of Cortez" (p. 336) as stylochids are cryptocelids. The "large thin flatworms with nuchal tentacles taken on the reef at Pt. Marcial" supposed (on the same page) to be stylochids are planocerids.

FAMILY CRYPTOCELIDAE LAIDLAW, 1903

DEFINITION: Craspedommata of broad to elongate oval form and often thick consistency; without tentacles; with or without tentacular eye clusters; often with frontal or cerebrofrontal eyes; all eyes small; pharynx usually large and well ruffled; prostatic vesicle interpolated or wanting; with or without Lang's vesicle; penis unarmed.

GENUS CRYPTOCELIS LANG, 1884

DEFINITION: Cryptocelidae of oval form with tentacular eye clusters; marginal eyes completely encircle the margin; seminal vesicle wanting; with or without spermiducal bulbs; with massive elongated prostatic vesicle differentiated into a rounded glandular proximal portion and an elongated very muscular distal portion traversed by a more or less sinuous ejaculatory duct underlain by glandular tissue; penis papilla wanting or poorly developed; gonopores separate; female apparatus consisting of a simple vagina accompanied by a large mass of cement glands; Lang's vesicle wanting.

TYPE SPECIES: *Cryptocelis alba* Lang, 1884.

Cryptocelis occidentalis, new species

Figures 28-31

MATERIAL: Three specimens sent by the Allan Hancock Foundation.

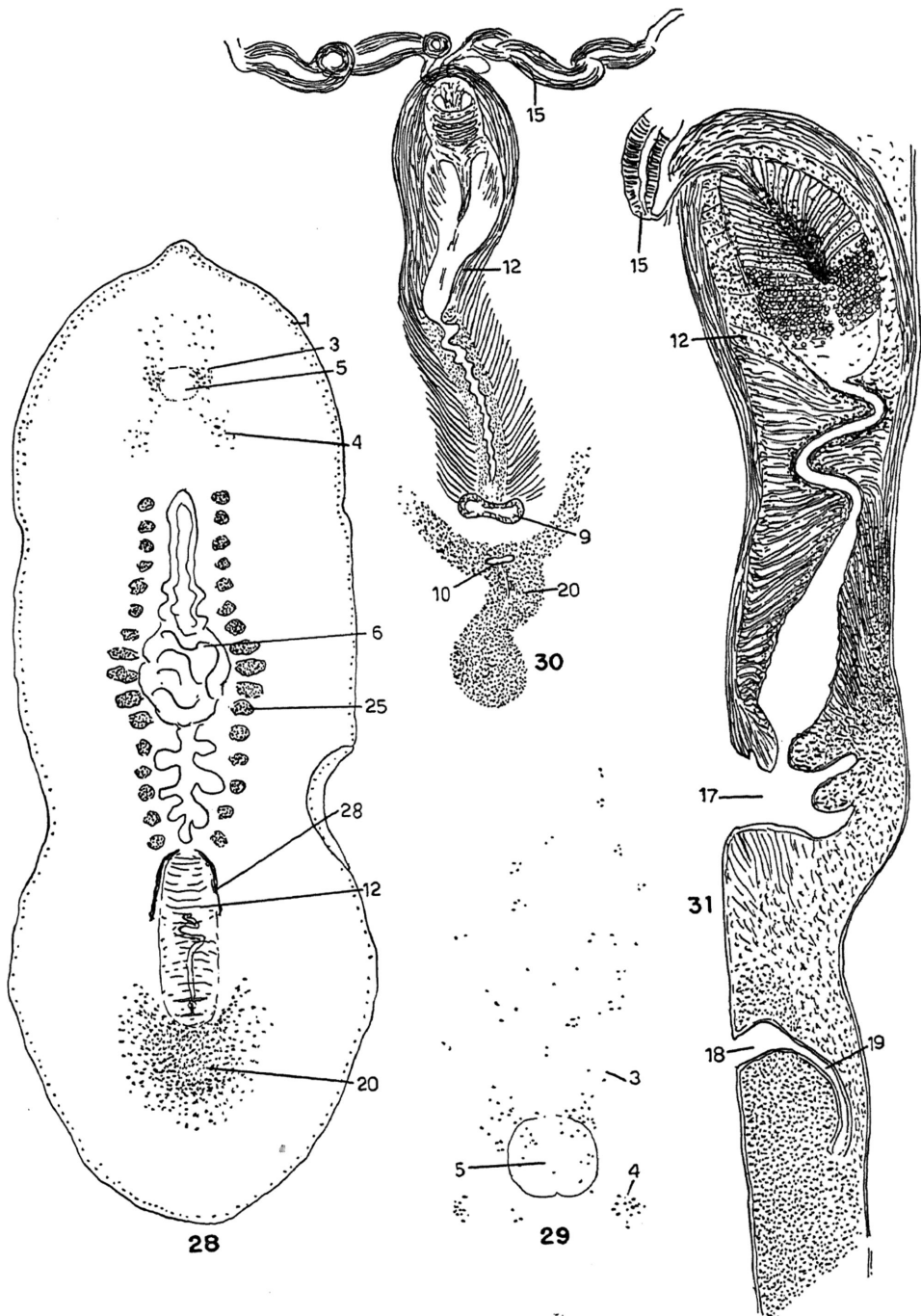
FORM: Elongate oval, somewhat pointed anteriorly, rounded posteriorly, 15 to 17 mm. long by 5 to 7 wide, preserved; thin; tentacles wanting (fig. 28).

COLOR: Indeterminable; appears transparent.

EYES: Marginal band completely encircles the margin (fig. 28); on either side a little behind the brain level is a small group of tentacular eyes (fig. 29); the cerebral eyes begin over and a little anterior to the brain as paired groups but continue forward as loosely arranged eyes not definitely paired and probably to be considered as frontal eyes (fig. 29); there are also a few loose eyes behind the brain.

DIGESTIVE SYSTEM: There is a centrally located, moderately ruffled pharynx (fig. 28); the mouth is central with respect to the pharynx as shown by the protrusion through it of part of the pharynx in figure 28.

COPULATORY APPARATUS: This is typical of the genus; it is located immediately behind the pharynx, hence well anterior to the posterior body margin (fig. 28). The copulatory region of one specimen was sectioned but, owing to the great hardness of the massive prostatic vesicle and huge cloud of cement glands, the sections were not altogether satisfactory and showed considerable breakage so that some points are not clear. The copulatory apparatus as viewed in the type specimen mounted whole is shown in figure 30 and a sagittal view of sections of another specimen in figure 31. Some difference in appearance between the two specimens is no doubt to be attributed to accidents of fixation. As shown in figure 30, the sperm ducts acquire muscular walls as they approach the prostatic vesicle from the sides and may be considered to form spermiducal bulbs. They are oriented in a transverse position. Neither on the whole mount nor in the sections could the sperm ducts be followed into the prostatic vesicle satisfactorily, but the impression was gained that they unite to a common duct that opens on a median papilla projecting into the lumen of the proxi-



FIGS. 28-31. *Cryptocelis occidentalis*. 28. Dorsal view. 29. Enlarged view of tentacular and cerebro-frontal eyes. 30. Copulatory apparatus seen from above in whole mount. 31. Sagittal view of the copulatory apparatus, anterior end above.

mal end of the prostatic vesicle (fig. 31). The prostatic vesicle, as diagnostic of the genus, is a massive, highly muscularized cylinder, differentiated into a shorter proximal region and a longer distal region. The proximal region resembles the prostatic vesicle of other Craspedommata. It has a fairly thick muscular wall and a glandular interior made up of long narrow folds projecting into the lumen. The glandular interior appeared to be eosinophilous anteriorly and cyanophilous posteriorly. The heavy secretion accumulates into a central projection very evident in figure 30, less so in figure 31. The distal part of the prostatic vesicle is heavily muscularized; its lumen is more or less tubular and sinuous, presenting different appearances in figures 30 and 31. As first pointed out by Bock (1923), the epithelium lining the lumen is underlain by a glandular layer of eosinophilic nature; this was evident in the whole specimen (fig. 30) but less discernible in the sections (fig. 31). The prostatic vesicle finally opens into a broad male antrum by way of a shallow projecting fold that may perhaps be considered a penis papilla. The male gonopore is a broad crescentic aperture.

On account of breakage caused by the large mass of cement glands, the female apparatus could not be made out satisfactorily, and its representation in figure 31 is somewhat conjectural. The female gonopore appeared to be situated well behind the male pore and to lead into a wide antrum, from which the slender vagina ascended dorsally and posteriorly terminating with the entrance of the common oviduct. A great mass of cement glands surrounds the vagina, especially posteriorly.

DIFFERENTIAL CHARACTERS: *Cryptocelis occidentalis* differs from other species of the genus in eye arrangement and the details of the male copulatory apparatus.

DISTRIBUTION: Taken by the Allan Hancock Foundation near Santa Cruz Island, California, at 39 fathoms on a bottom of gray sand, October 31, 1940, off Santa Rosa Island at 15 fathoms on a shelly bottom, April 10, 1941, and off Redondo Beach, California, at 13 fathoms on a muddy bottom, May 6, 1940.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: This species appears to be somewhat uncommon around the southern part of the California coast. It is the first member of the genus to be found in the Western Hemisphere. To date there have been described seven certain species of *Cryptocelis*, namely: *alba* and *compacta* Lang, 1884, from the Mediterranean, *glandulata* Jacobowa, 1909, from the Black Sea, and *Ijimai* Bock, 1923, *amakusaensis* Kato, 1936a, *littoralis* Kato, 1937, and *orientalis* Kato, 1939b, from Japan. In two of these species, *alba* and *Ijimai*, the lumen of the muscular part of the prostatic vesicle takes the form of a duct that pursues a spiral course through the musculature. *Glandulata* is poorly described; in the other four species, there is an ordinary lumen with somewhat irregular walls. The present species seems intermediate between these conditions, as the anterior part of the lumen spirals, very definitely so in one of the specimens.

MARCUSIA, NEW GENUS

DEFINITION: Cryptocelidae without tentacular eyes; with cerebral and frontal eye groups; marginal band with a pair of eye clusters in the anterior margin; prostatic vesicle wanting; cement glands enter the common antrum by a pair of ducts.

TYPE SPECIES: *Marcusia ernesti*, new species.

Marcusia ernesti, new species¹

Figures 32, 33

MATERIAL: Fifteen specimens in eight different vials, collected by Ricketts and the MacGinities; one specimen sent by the Allan Hancock Foundation.

FORM: Elongate oval with rounded ends (fig. 32), to 35 mm. in length alive, extended, width one-third to one-half of the length; rather thin, fragile, with ruffled margins; the specimens were all much crumpled and most had suffered some damage.

COLOR: Usually black or gray, dotted with white spots; this pattern was evident on most of the preserved specimens. However, from notes furnished by the collectors, it appears that this species is sometimes brown or olive-tan with darker splotches (really dark

¹ Named in honor of Dr. Ernesto Marcus, of the University of São Paulo, Brazil, in recognition of his pioneer work on the Turbellaria of Brazil.

with lighter spots?), and a few of the specimens gave this impression.

EYES: Marginal band completely encircles the margin, at least in the larger specimens. A very remarkable feature of this species, not known in any other acotylean, is the aggregation of the marginal eyes into a pair of clusters on the anterior margin (fig. 32). This feature enables instant recognition of the cleared specimen. It frequently seemed that a marginal fold tended to occur at these aggregations, but as all the specimens are much folded, this appearance may have been fortuitous. From the areas of the margin bearing these clusters frontal eyes extend inward towards the cerebral clusters. The latter occur as two elongated groups of 40 to 50 eyes each in the larger specimens. There is thus left a narrow strip in front of the cerebral clusters and between the frontal eyes that is free of eyes up to the marginal band (fig. 32). Tentacular groups of eyes are wanting. Contrary to the condition in most Cryptocelidae, all the eyes are large and conspicuous.

DIGESTIVE SYSTEM: There is a large, conspicuous, highly ruffled pharynx, centrally located (fig. 32).

COPULATORY APPARATUS: This is located just behind the pharynx, well anterior to the posterior margin. The distended uteri, containing the unusually large eggs, are conspicuous features alongside the male part of the apparatus. The sperm ducts (not illustrated) form wide, thin-walled, spermiducal vesicles that ascend on either side of the seminal vesicle and enter it separately at its sides. The seminal vesicle (fig. 33) is a large bulb with a heavy muscular wall and passes directly into the penis papilla without the intervention of any prostatic vesicle. The penis papilla is an elongated cylindrical projection with a muscular wall continuous with that of the seminal vesicle. It is contained in a conspicuous male antrum readily seen on whole mounts as an oval chamber behind the pharynx. The male antrum opens through its posterior wall by a narrow canal into the common antrum that exits ventrally by the common gonopore (fig. 33). From the common gonopore, the common antrum proceeds dorsally as a narrowed channel, then widens into a chamber that receives the male opening in its anterior wall. This chamber can be

regarded as a cement pouch, for into its roof open a pair of ducts by which the numerous cement glands centered about this region empty their secretion. These ducts are obviously evaginations of the lining epithelium of the roof of the cement pouch. The vagina proper continues dorsally from the openings of the cement ducts, then curves posteriorly, becoming somewhat wider, with a thickened lining epithelium, and terminates with the separate entrance of the two uteri (fig. 33). The female apparatus shows but slight muscularity.

DISTRIBUTION: Collected by Ricketts at Point Marcial Reef and Pulmo Reef, Gulf of California, in March, 1940; taken by the MacGinities at Puerto Penasco, Gulf of California, in December, 1947, and at Guaymas, Gulf of California, in February, 1948; found by the Allan Hancock Foundation on the shores of Clarion Island, off the coast of Mexico.

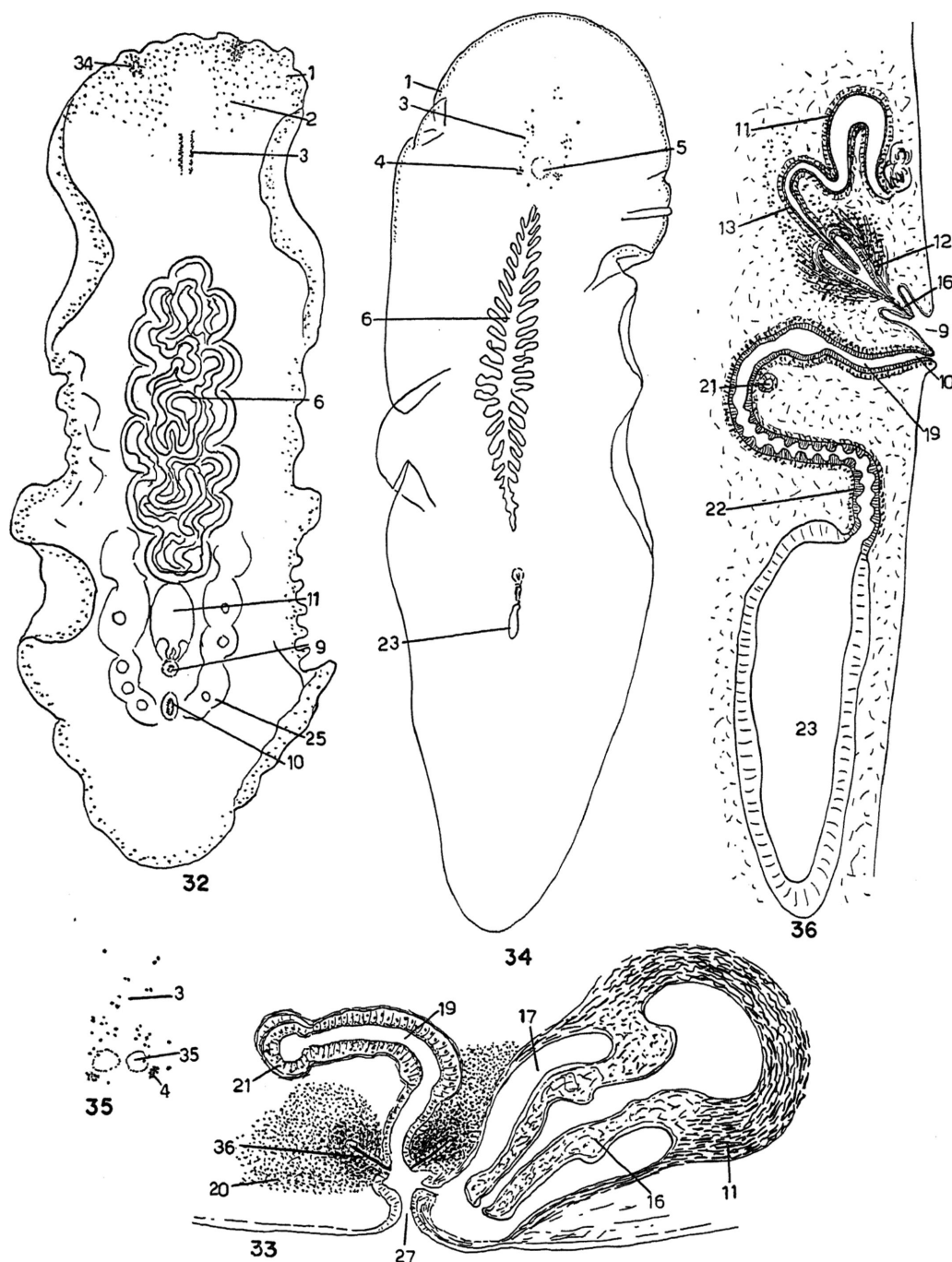
HOLOTYPE: One specimen, anterior part as whole mount, copulatory region as serial sections (three slides), A.M.N.H. No. 361.

REMARKS: This species is quite common along both shores of the Gulf of California and probably occurs along the entire Mexican coast. It is presumably the species mentioned by Ricketts in "Sea of Cortez" (p. 336) as "two large, brown, dark-speckled forms at Pulmo Reef." *Marcusia ernesti* is a very remarkable acotylean in two respects: the presence of a pair of eye clusters on the anterior margin, and the presence of a cement pouch into which the cement glands empty by a pair of ducts. Both characters are distinctly cotylean and suggest that of all acotylean families the Cryptocelidae are closest to the Cotylea. In any case, the Cotylea evidently derive from the Craspedommata, as shown by their possession of marginal eyes which in two cotylean genera (*Pericelis*, *Enchiridium*) completely encircle the margin as in many Craspedommata.

GENUS PHAENOCELIS STUMMER-TRAUNFELS, 1933

Comprostatum HYMAN, 1944, p. 7.

DEFINITION: Cryptocelidae of long slender form, with anteriorly located pharynx; with minute marginal eyes and definite cerebral and tentacular eye groups of relatively few eyes; with true seminal vesicle, interpolated



FIGS. 32, 33. *Marcusia ernesti*. 32. Dorsal view. 33. Sagittal view of the copulatory apparatus, anterior end to right.

FIGS. 34-36. *Phaenocelis mexicana*. 34. Dorsal view. 35. Enlarged view of tentacular and cerebral eyes. 36. Sagittal view of the copulatory apparatus, anterior end above.

prostatic vesicle, and large Lang's vesicle; ejaculatory duct from seminal vesicle projects as a papilla into the prostatic vesicle.

TYPE SPECIES: *Phaenocelis purpurea* (Schmarda), 1859.

***Phaenocelis mexicana*, new species**

Figures 34-36

MATERIAL: One specimen collected by the MacGinities; two sent by Ricketts; two sent by the Allan Hancock Foundation.

FORM: Elongated, very long and narrow in life, according to the MacGinities; preserved specimens appear somewhat cuneate, with expanded rounded anterior end, gradually tapering to a bluntly rounded posterior end (fig. 34); to 26 mm. long preserved by 6 to 7 mm. wide across the widest part; tentacles wanting.

COLOR: Gray.

EYES: A narrow band, scarcely more than an irregular row, of minute eyes occurs around the anterior margin back to about the level of the anterior pharyngeal folds (fig. 34). There are distinct tentacular and cerebral clusters of larger eyes than those of the margin (fig. 35); the tentacular clusters are composed of seven to 12 closely placed eyes, and the cerebral clusters of about 15 to 20 loosely arranged eyes extending forward from the tentacular clusters, with a few eyes behind the latter. In this and other species of *Phaenocelis*, the granule clusters of nerve cells at the anterior margin of the brain are unusually large (fig. 35).

DIGESTIVE SYSTEM: The moderately elongated pharynx with many narrow lateral folds occurs in the anterior body half (fig. 34), with the mouth at about its center. The intestinal branches radiate to the periphery without anastomoses as in leptoplanids.

COPULATORY APPARATUS: This is situated a little behind the pharynx and far removed from the posterior end (fig. 34). The copulatory region of the MacGinitie specimen and one of the Ricketts specimens was sectioned; the latter was found the more advanced sexually and is illustrated in figure 36 in sagittal view. The two sperm ducts, expanded as spermiducal vesicles, narrow as they approach the seminal vesicle to short tubes that enter the proximal end of this organ. The seminal vesicle is a slender curved tube

of moderate muscularity that narrows to an ejaculatory duct proceeding to the prostatic vesicle. The latter is a relatively small, ill-defined, but clearly present body composed of muscle fibers and strands of eosinophilous secretion and lined by a glandular epithelium. The ejaculatory duct projects prominently into its interior in the Ricketts specimen (fig. 36), less so in the MacGinitie specimen. The prostatic vesicle narrows distally and enters the base of the short conical penis papilla housed in a small male antrum. The female gonopore, lying close behind the male pore, leads into a vertical vagina that makes the usual backward curve and after receiving the common oviduct continues posteriorly and ventrally as the duct of Lang's vesicle, terminating in a rather large and elongate Lang's vesicle (fig. 36). The vagina has only a moderate muscular investment that declines towards the gonopore. The epithelial lining of the duct of Lang's vesicle is thrown into numerous folds in the Ricketts specimen, but not in the MacGinitie specimen, and it appears that these rings simply express a state of contraction of the duct. Cement glands are poorly evident in both specimens.

DIFFERENTIAL CHARACTERS: *Phaenocelis mexicana* differs from the other known species of the genus in the small size of the penis papilla, poor definition of the prostatic vesicle, and lack of a sphincter muscle around the distal end of the vagina.

DISTRIBUTION: Taken by the MacGinities on a rocky shore at Miramar Beach, Guaymas, Mexico, February 9, 1948; taken by Ricketts in San Carlos Bay, Sonora, Mexico, April 4, 1940; by the Allan Hancock Foundation in San Ignacio lagoon, Sinaloa, Mexico, March 16, 1939, and at Portuguese Bend, California, December 8, 1938.

HOLOTYPE: One whole mount, also two slides of the copulatory region, A.M.N.H. No. 362.

REMARKS: This species appears to be not uncommon on both shores of the Gulf of California and also occurs on the southern part of the California coast. It is among the forms recorded in "Sea of Cortez" (p. 337) as reminiscent of the genus *Leptoplana*. The only other known species of *Phaenocelis* are *purpurea* (Schmarda), 1859, allocated to

Phaenocelis by Stummer-Traunfels in 1933, and *insularis* (Hyman), 1944, for which I created the genus *Comprostatum*. Dr. Stephen Prudhoe of the British Museum (Natural History) kindly called my attention to the identity of my genus *Comprostatum* with *Phaenocelis*. In fact, it seems to me that my species *insularis* from the Florida keys is identical with Schmarda's species *purpurea* from Jamaica. *P. mexicana* shows great similarity to *P. purpurea* in general features, as shape, eye arrangement, and position of the pharynx. It has therefore seemed justifiable to me to place *mexicana* in *Phaenocelis*, despite the considerable differences in the male apparatus of the two species, and thus to avoid adding another genus to the Cryptocelidae. Stummer-Traunfels (1933) considered *Phaenocelis purpurea* so aberrant a craspedommatan because of the leptoplanid characters of its male apparatus, that he created a new family Phaenocelidae for the species. Although this family has been accepted by Kato (1944) in adding to it a new genus *Amemiyaia*, I see no adequate grounds for separating such a family from the Cryptocelidae. In remarking on the leptoplanid features of *Phaenocelis*, Stummer-Traunfels apparently referred to the interpolated prostatic vesicle, but all cryptocelids have an interpolated prostatic vesicle (if any). I therefore suggest that both *Phaenocelis* and *Amemiyaia* be returned to the Cryptocelidae.

LONGIPROSTATUM, NEW GENUS

DEFINITION: Cryptocelidae of moderately elongated form, with central pharynx; with tentacular and cerebrofrontal eye groups; prostatic vesicle very long and narrow, with sclerotized diaphragm separating its lumen from that of the penis papilla; seminal vesicle and Lang's vesicle present but reduced.

TYPE SPECIES: *Longiprostatum rickettsi*, new species.

Longiprostatum rickettsi, new species

Figures 37, 38

MATERIAL: One specimen collected by Ricketts.

FORM: Elongated oval, 22 by 9 mm. preserved; anterior end rounded, body then tapers slightly to the narrower but rounded posterior end (fig. 37); smooth, rather thin.

COLOR: Not determinable but apparently entire external appearance similar to that of *Alleena mexicana*, as the specimen was in a vial with a number of individuals of this species. Notes from Ricketts state: "all but one curled up similarly in preserving." The one that did not curl was *Longiprostatum rickettsi*.

EYES: Marginal band limited to anterior margin, extending posteriorly to a level nearly that of the anterior end of the pharynx. Band moderately wide, with usual arrangement of smaller eyes nearest the margin, larger ones internally. There is a pair of small tentacular clusters of about eight to 10 eyes each. Between these are two elongated groups of numerous, thickly placed cerebral eyes that continue forward as more scattered, frontal eyes (fig. 37), not reaching the margin. There is unfortunately present a fold at the location of the frontal eyes, but apparently this fold does not conceal any eyes.

DIGESTIVE SYSTEM: The elongated, moderately ruffled pharynx occupies a central position (fig. 37); mouth could not be located; intestinal branches appear anastomosed peripherally.

COPULATORY APPARATUS: Located immediately behind the pharynx, hence well anterior to the posterior margin (fig. 37). The distended spermiducal vesicles proceed posteriorly to a point beneath and at about the middle of the prostatic vesicle; they then turn forward and enter separately from each side the small rounded seminal vesicle that appears attached to the proximal end of the prostatic vesicle (fig. 38). Seminal vesicle moderately muscular; opens directly without the intervention of any duct into the proximal end of the remarkably long and narrow prostatic vesicle (fig. 38). Despite its aberrant shape, this has the usual structure, consisting of a muscular wall and a glandular epithelial lining. It is surrounded on all sides by the prostatic glands, and its lumen is filled with their eosinophilous secretion. Another unusual feature of the prostatic vesicle is the presence of a sclerotized diaphragm at its distal end, separating its lumen from that of the penis papilla. The diaphragm has a central aperture formed by the backward turning of its free edge. The penis papilla is a fairly large projection, lodged in a well-

developed male antrum; it is lined by sclerotized material continuous with the diaphragm just mentioned. The female gonopore, shortly behind the male gonopore, leads into a vagina that ascends dorsally, at the same time slanting forward to a marked extent (fig. 38); this slanting region is somewhat widened and receives cement glands throughout its course. The vagina then curves posteriorly as usual and runs horizontally for some little distance, then receiving the uterus into its ventral wall; thereafter it continues as the canal of Lang's vesicle that soon terminates in the small, oval, Lang's vesicle (fig. 38). The latter may be shrunken as it is surrounded in the sections by a considerable space that it presumably occupied in life.

DISTRIBUTION: Angeles Bay, western shore of the Gulf of California, April 1, 1940.

HOLOTYPE: Anterior part as whole mount, copulatory region as serial sections (three slides), A.M.N.H. No. 363.

REMARKS: I regret adding still another genus to the Cryptocelidae, but I found it impossible to fit the present species into any of the existing genera. To the present there have been described nine genera of the family, namely: *Cryptocelis* Lang, 1884; *Microcelis* Plehn, 1899; *Ommatoplanea* Laidlaw, 1903; *Mesocela* Jacobowa, 1906; *Aprostatum* Bock, 1913; *Phaenocelis* Stummer-Traunfels, 1933 (= *Comprostatum* Hyman, 1944); *Ilyplanoides* Kato, 1944; *Amemiyaiia* Kato, 1944; and *Triadomma* Marcus, 1947. The number is raised to 11 by the addition of the two present genera, *Marcusia* and *Longiprostatum*. *Cryptocelis* is represented by eight species, *Triadomma* and *Phaenocelis* by two each, and all the others are monospecific. This state of affairs would seem to indicate that the family is a heterogeneous assemblage in need of revision, but the available information does not suffice for a revision.

SECTION SCHEMATOMMATA Bock, 1913

DEFINITION: Acotylea without marginal eyes; eyes usually limited to paired tentacular and cerebral clusters but sometimes otherwise; with or without nuchal tentacles; pharynx ruffled or tubular; copulatory complexes behind the pharynx, with uteri extending forward.

FAMILY LEPTOPLANIDAE STIMSON, 1857

DEFINITION: Schematommata of small to moderate size, with smooth, oval, obovate, or cuneate bodies; with or without tentacles; pharynx ruffled; copulatory apparatus behind the pharynx with uteri extending forward and often confluent anterior to the anterior end of the pharynx; usually with true seminal vesicle, sometimes wanting; usually without spermiducal bulbs but present in some genera; prostatic vesicle interpolated, absent in some genera; penis armed or not; with or without Lang's vesicle.

GENUS STYLOCHOPLANA STIMPSON, 1857

DEFINITION: Leptoplanidae with or without tentacles; eyes in paired cerebral and tentacular clusters; with true seminal vesicle and interpolated prostatic vesicle; prostatic vesicle lacks chambers and ejaculatory duct does not project prominently into its interior; with or without penis stylet.

TYPE SPECIES: *Stylochoplana maculata* (Quatrefages), 1845.

Stylochoplana panamensis (Plehn), 1896

Figures 39-41

Leptoplana panamensis Plehn, 1896b, p. 151, pl. 10, figs. 3, 4, 5, 10, 11; pl. 13, fig. 11.

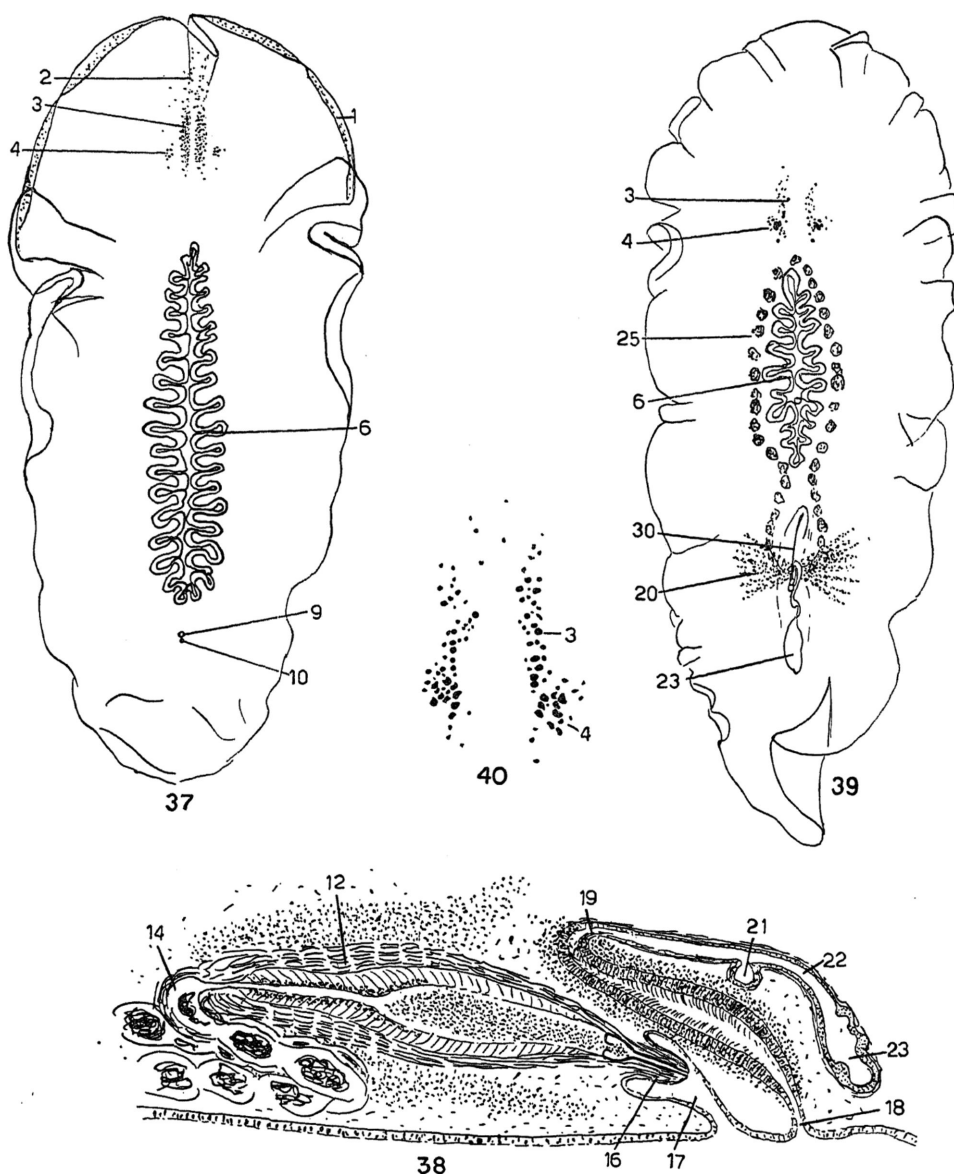
MATERIAL: One specimen collected by the MacGinities; many specimens sent by the Allan Hancock Foundation.

FORM: Moderate size, thin, of elongate obovate form, widest anteriorly, gradually tapering to a blunt point posteriorly (fig. 39); to 22 mm. long, preserved, by 7 mm. across the widest region; tentacles wanting.

COLOR: Gray.

EYES: Tentacular groups of about 12 to 15 eyes each, some large, others small; cerebral groups not distinctly separated from the tentacular groups, beginning behind them and extending forward along their inner side for some distance beyond them, rather numerous (fig. 40); the two elongated eye groups thus produced are rather distinctive of the species.

DIGESTIVE SYSTEM: Pharynx ruffled, distinctly anterior, as also shown in Plehn (pl. 10, fig. 3); relatively small, with seven to 10 folds on either side; mouth somewhat posteriorly located in the pharynx (fig. 39).



FIGS. 37, 38. *Longiprostatum rickettsi*. 37. Dorsal view. 38. Sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 39, 40. *Stylochoplana panamensis*. 39. Dorsal view. 40. Enlarged view of eyes.

COPULATORY APPARATUS: This is relatively voluminous, equaling or exceeding the pharynx in length; it lies as usual in Leptoplanidae directly behind the pharynx, hence well removed from the posterior body end (fig. 39). Shown in sagittal section in figure 41. The sperm ducts enter separately the proximal end of the oval muscular seminal

vesicle, passing through its wall to open separately into its lumen. The seminal vesicle continues distally as a narrow canal that soon widens slightly to form the long, narrow, prostatic vesicle, provided with a moderately thick muscular wall and glandular eosinophilous lining. This continues distally, with a slight narrowing into the penis pa-

pillae, a moderate conical projection armed with a long curved stylet that lies in the almost equally long male antrum. The latter is hence a long, curved, tubular cavity provided near the male gonopore with a small penis sheath (fig. 41). The female gonopore, situated well behind the male pore, leads into a vertical female antrum from which the C-shaped vagina proceeds forward, then dorsally, then posteriorly; after receiving the common oviduct into its ventral wall, the vagina becomes continuous with the duct of Lang's vesicle which after a short course enters the extraordinarily large and elongated Lang's vesicle. The vagina and Lang's canal are provided with a moderately thick muscular coat which reduces to a thin layer on Lang's vesicle; the latter is lined by the usual thickened epithelium suggestive of secretory activity. The uteri are confluent anterior to the pharynx (fig. 39).

DISTRIBUTION: Taken by the MacGinities on a rocky shore, Guaymas, Sonora, Mexico, February 9, 1948; collected by the Allan Hancock Foundation near Catalina Island, August 4, 1941, near Santa Barbara Island, August 28, 1941, at 40 fathoms on a sandy bottom, on a rocky shore on Santa Catalina Island, September 14, 1941, again near Santa Barbara Island at 40 fathoms on a sandy bottom, and at Newport Harbor, California, from floats and piles, March 13, 1942. The species is evidently distributed from southern California at least as far south as the Gulf of Panama.

SPECIMEN: As it is not clear that any type specimen of the species is available, one whole mount is deposited in the American Museum of Natural History (A.M.N.H. No. 364).

REMARKS: There cannot be any doubt of the identity of the present specimens with Plehn's *Leptoplana panamensis* which Bock in 1913 correctly transferred to the genus *Stylochoplana*. The outstanding features of Plehn's species (the long, tubular prostatic vesicle, long penis stylet, sinuous vagina, and enormous Lang's vesicle) are unmistakable in the present specimens. There are two minor points wherein the sectioned specimen differs from Plehn's description, namely, in its relatively larger and more elongated seminal vesicle and in the separate entrance

of the sperm ducts into the seminal vesicle. Such small differences cannot be regarded as of specific value but probably constitute geographic variations. This species should be easily recognized as a whole mount by the eye pattern, long penis stylet, and large Lang's vesicle.

***Stylochoplana gracilis* Heath and McGregor, 1912**
Figures 42-44

MATERIAL: One vial containing a number of specimens sent by the United States National Museum; two vials with several specimens each sent by the Allan Hancock Foundation; one specimen collected by C. M. Yonge, sent by E. Kozloff, of Lewis and Clark College.

FORM: Small, up to 9 mm. in length (preserved), up to 12 mm. alive, extended, according to notes sent by Kozloff; cuneate, expanded anteriorly, tapering to a bluntly pointed posterior end (fig. 42); with a pair of nuchal tentacles, pointed in life, contracted in most preserved specimens.

COLOR: Pale brownish yellow or buff according to the original description; translucent yellowish or light golden tan according to Kozloff.

EYES: Somewhat scanty, correctly figured by Heath and McGregor (their fig. 20); four to six in the tentacular clusters situated in and around the tentacles; 10 to 15 scattered eyes in the cerebral clusters, loosely arranged in two longitudinal tracts.

DIGESTIVE SYSTEM: The relatively small pharynx with shallow lateral folds occupies an approximately central or slightly anterior position; mouth below posterior part of the pharynx.

COPULATORY APPARATUS: Unusual in its far posterior position relative to the pharynx (fig. 42), as also shown in Heath and McGregor's figure 2. Usually in leptoplanids the copulatory apparatus occurs immediately behind the pharynx but in the present species is found well posterior to this organ. The uteri stuffed with eggs (and apparently beginning well behind the anterior end of the pharynx) course along either side of the pharynx and behind this organ veer towards the median line where they run posteriorly in the region between the posterior end of the pharynx and the anterior boundary of the

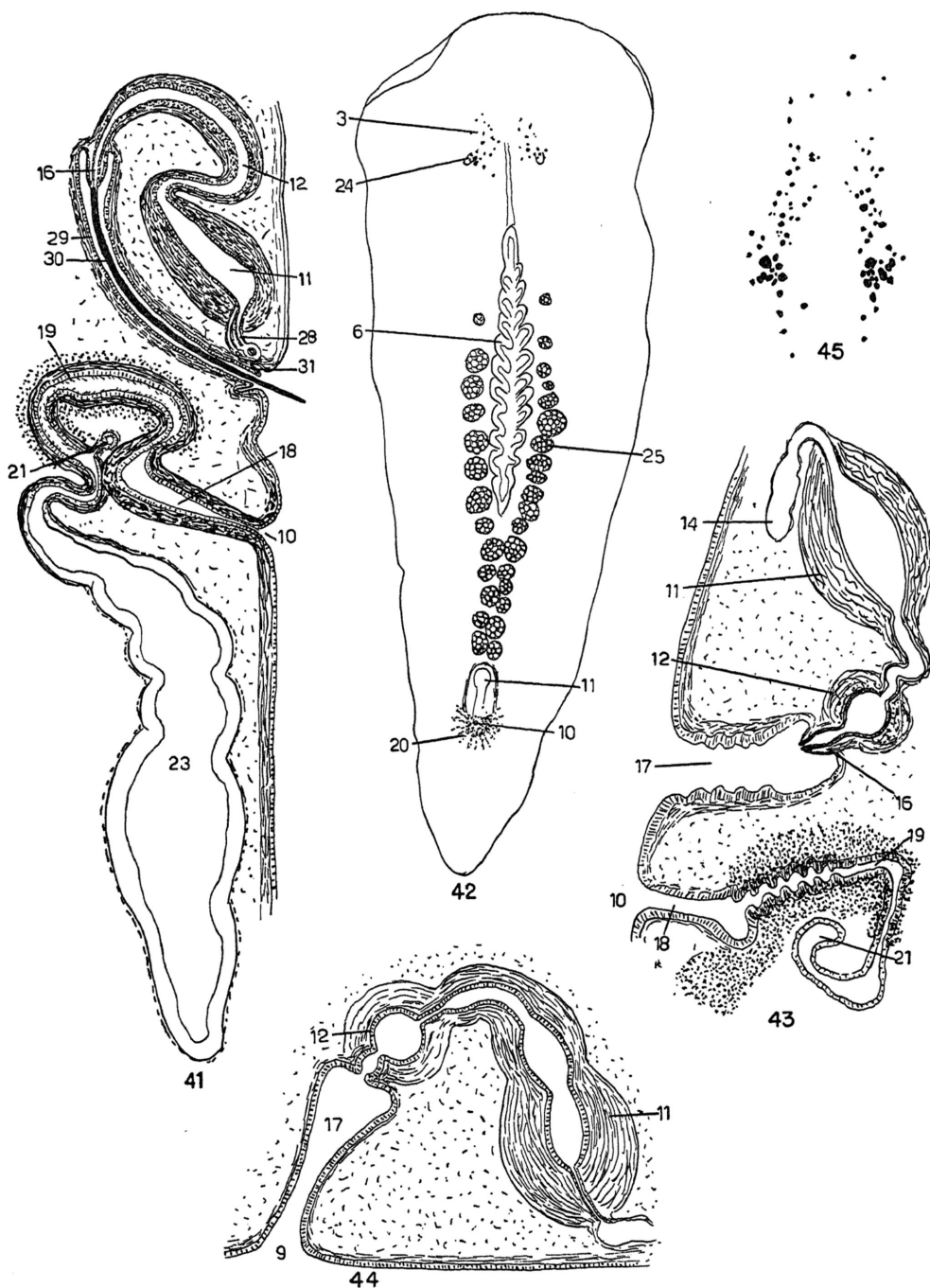


FIG. 41. *Stylochoplana panamensis*, sagittal view of copulatory complex, anterior end above.

FIGS. 42-44. *Stylochoplana gracilis*. 42. Dorsal view. 43. Sagittal view of copulatory apparatus, anterior end above. 44. Sagittal view of the male copulatory apparatus of another specimen.

FIG. 45. *Stylochoplana longipenis*, enlarged view of eyes.

copulatory apparatus. According to Heath and McGregor, the sperm ducts are connected by a loop extending backward behind the female gonopore, a condition quite common in the Leptoplanidae but usually evident only on pressed live specimens. The copulatory apparatus was studied in sagittal sections of two individuals, in one of which the apparatus agrees well with Heath and McGregor's figures 4 and 26 (my fig. 43), whereas the other (my fig. 44) differs slightly, no doubt through being somewhat contracted. The most conspicuous part of the male apparatus is the elongated oval, very muscular seminal vesicle, which receives the sperm ducts separately into its proximal end. The seminal vesicle narrows distally as it curves to enter the prostatic vesicle. This is a relatively small body of spherical form, with moderately muscular walls. It is followed by the rather small penis papilla projecting by its pointed tip into the inner end of the male antrum. In the other sectioned specimen, the penis was so contracted that no definite papilla is evident (fig. 44), but the small chamber that constitutes the penis lumen is plainly seen distal to the prostatic lumen. The lining of the penis papilla appears to consist of hardened material. The long and broad male antrum (figs. 43, 44) opens below by the male gonopore. The female gonopore, shortly behind but distinctly separate from the male pore in both specimens sectioned, leads into a tubular female antrum distinctly marked off from the vagina proper. The latter as usual ascends dorsally, then curves backward, receiving numerous cement glands throughout its course. It then makes a characteristic C curve downward and forward and terminates with the entrance of the common oviduct. Heath and McGregor state in their text that a Lang's vesicle ("accessory sac") of moderate size is present, but their figure fails to show it, and I was unable to find any Lang's vesicle on either series of sections.

DISTRIBUTION: United States National Museum specimens collected by Dr. Olga Hartman from a large floating kelp at a depth of 100 meters or more off La Jolla, California, May 27, 1938; collected by Heath and McGregor and Yonge at Pacific Grove, California, also on kelp; taken by the

Allan Hancock Foundation at White Cove, Catalina Island, California, also on kelp holdfasts, July 20 and August 4, 1941. The species would appear to be distributed along the entire California coast, often in association with kelp.

SPECIMEN: As it has proved impossible to locate the types of Heath and McGregor, a whole mount is deposited in the United States National Museum (U.S.N.M. No. 23778).

REMARKS: The identity of the above specimens with the *Stylochoplana gracilis* of Heath and McGregor does not appear open to any doubt. The original description is substantially correct.

Stylochoplana plehni Bock, 1913

Leptoplana californica PLEHN, 1898, p. 93, figs. 1, 2.

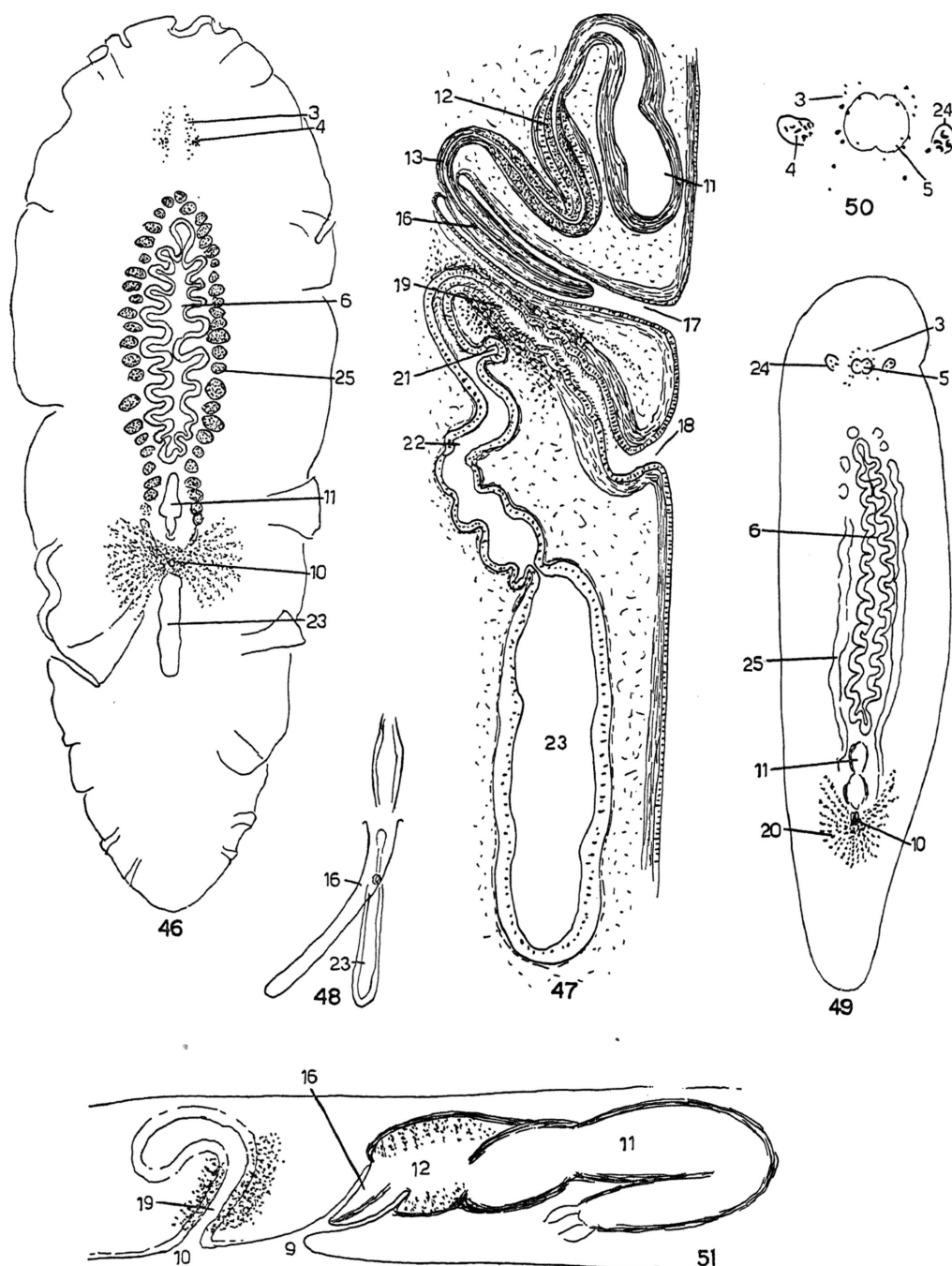
REMARKS: I have had no specimens attributable to this species, but I am strongly suspicious that it is identical with *Leptoplana inquieta* Heath and McGregor, which is a *Notoplana*. The question is considered further under the description of *inquieta*. If Plehn's figure of the prostatic vesicle is correct, then Bock was justified in placing the species in the genus *Stylochoplana*. But the strong folds of the prostatic vesicle described and figured by Plehn may well be chambers, and the species would then belong to *Notoplana*. At the time of Plehn's writing *Notoplana* had not been differentiated from other leptoplanid genera, and she may easily enough have misunderstood the structure of the prostatic vesicle. Heath and McGregor report finding two specimens they referred to Plehn's species, but they gave no original material about them. What Ricketts in "Sea of Cortez" (p. 337) identified as *Stylochoplana plehni* appears to be *Zygantriplana stylifera*.

Stylochoplana longipenis, new species

Figures 45-48

MATERIAL: One specimen collected by the MacGinities; several specimens sent by Donald Reish of the Allan Hancock Foundation, and many collected on Allan Hancock Foundation expeditions.

FORM: Slender, elongate, with rounded anterior end; preserved specimens appear



FIGS. 46-48. *Stylochoplana longipenis*. 46. Dorsal view. 47. Sagittal view of copulatory apparatus, anterior end above. 48. View of penis extended, from a whole mount.

FIGS. 49-51. *Stylochoplana hancocki*. 49. Dorsal view. 50. Enlarged view of eyes. 51. Sagittal view of copulatory apparatus, anterior end to right.

widest across the pharyngeal region, tapering from there to a bluntly pointed posterior end (fig. 46), but probably in life the worm is longer and more slender than indicated in figure 46; to 16 mm. long by 6 mm. across the widest part, most specimens smaller than this; tentacles wanting.

COLOR: Gray, according to the MacGinities.

EYES: The eye arrangement is very similar to that of *Stylochoplana panamensis*, i.e., the cerebral and tentacular clusters are distinct but are more or less incorporated into one tract on each side (fig. 45). Tentacular cluster rounded, of a few to about a dozen eyes, depending on the size of the worm, most tentacular eyes very large; cerebral clusters of much smaller but more numerous eyes, beginning behind and extending some distance anterior to the tentacular groups.

DIGESTIVE SYSTEM: Pharynx relatively small, central in the smaller individuals, slightly anterior in the larger ones, well ruffled; mouth central.

COPULATORY APPARATUS: Found immediately behind the rear end of the pharynx and shown in sagittal view in figure 47. The sperm ducts enter separately the proximal end of the elongated oval seminal vesicle which narrows distally to a duct that turns posteriorly and enters the prostatic vesicle. This is a long, tubular body bent into a V form by a pronounced curve; it is lined by a simple glandular epithelium covered externally by circular and longitudinal muscle layers. The prostatic vesicle narrows distally to an ejaculatory duct that enters the proximal end of the penis; this is a very long cylindrical projection housed in a long tubular male antrum. The penis papilla in figure 47 is evidently contracted; the full extent to which the penis can be elongated was evident on some other specimens, one of which as seen whole from above is shown in figure 48. The male and female gonopores are close together but distinct. The female gonopore leads into a muscular female antrum from which the vagina, accompanied by cement glands, ascends dorsally and then makes the usual backward curve. After receiving the common oviduct into its ventral wall it becomes continuous with Lang's duct, a rather elongated tube that enters the very large and

voluminous Lang's vesicle. The uteri are confluent anterior to the pharynx.

DIFFERENTIAL CHARACTERS: This species differs from others of the genus in the excessively long penis papilla. Other characters are the eye arrangement, tubular, V-shaped prostatic vesicle, and very large Lang's vesicle.

DISTRIBUTION: Taken by the MacGinities on a rocky shore, Miramar Beach, Guaymas, Sonora, Mexico, February 9, 1948; collected by Reish from *Cladophora* masses, at Point Fermin, San Pedro, California, in December, 1950, and January and February, 1951; taken by the Allan Hancock Foundation from kelp holdfasts, near White Cove, Santa Catalina Island, July 12, 1941, and August 4, 1941, and in the intertidal zone at Newport Bay, California, December 17, 1941, and February 13, 1942. The species appears to be distributed along southern California and the shores of the Gulf of California.

HOLOTYPE: One whole mount, A.M.N.H. No. 365.

REMARKS: This species is quite similar to *S. panamensis* both in external appearance, eye arrangement, and copulatory anatomy. It differs in having a long penis papilla in place of the long penis stylet of *panamensis*.

Stylochoplana hancocki, new species

Figures 49-51

MATERIAL: One specimen sent by the Allan Hancock Foundation.

FORM: Very similar to *S. gracilis*, cuneate, small, 6 mm. long by 1.5 mm. wide; with a pair of nuchal tentacles (fig. 49).

COLOR: Not determinable.

EYES: Very similar to those of *S. gracilis*; tentacular eyes situated inside the tentacles, four in one tentacle, about eight in the other; cerebral groups of about 10 eyes each, loosely spread over the brain region (fig. 50). The cerebral eyes appear slightly fewer in number than in *S. gracilis*.

DIGESTIVE SYSTEM: Pharynx central, long and narrow, with shallow lateral folds; position of mouth was not ascertained.

COPULATORY APPARATUS: Immediately behind the pharynx (fig. 49), hence immediately differentiating this species from *S. gracilis*, when examined whole. The rear part of the specimen was sectioned, but the sections showed a poor histological condition and

were further damaged by the mishap of inadvertently pressing on the cover glass while fresh. However, the main features of the apparatus are evident (fig. 51). This species is distinguished by the very elongated seminal vesicle. This receives the two sperm ducts into its proximal end, then extends forward, makes a sharp backward bend, and paralleling its former course proceeds posteriorly some distance beyond the level of its proximal end. At this level there is a constriction in its wall. The wall is composed of a relatively thin muscular layer, and in the present specimen the interior is filled with a great mass of sperm. The seminal vesicle leads into the prostatic vesicle without any intervening duct, in fact it appears as if pushed into the prostatic vesicle (fig. 51). The cylindrical prostatic vesicle is of asymmetrical form, longer dorsally than ventrally, so that dorsally it extends back over the distal part of the seminal vesicle. It has a thin muscular wall continuous with that of the seminal vesicle and a glandular lining. It bears directly the penis papilla without any intervening ejaculatory duct. The penis papilla is a sharply pointed conical projection that appears lined and covered with a hardened material. The male antrum conforms to the shape of the penis papilla and leads to the male gonopore. The female gonopore lies not far behind the male pore and leads into a female tract identical with that of *S. gracilis*. The uteri are confluent anterior to the pharynx.

DIFFERENTIAL CHARACTERS: *Stylochoplana hancocki* is characterized by the excessively long seminal vesicle, lack of ejaculatory duct between the parts of the male apparatus, dorsal extension of the prostatic vesicle over the distal part of the seminal vesicle, and lack of Lang's vesicle.

DISTRIBUTION: Taken in the intertidal zone on a rocky shore at Corona del Mar, California, December 19, 1941.

HOLOTYPE: One specimen, anterior half as whole mount, posterior half as sagittal serial sections (one slide) deposited in the Allan Hancock Foundation.

REMARKS: This completes the species of *Stylochoplana* in the material. This is a genus of over 30 valid species at present, but the literature includes many more species er-

roneously assigned to the genus, no doubt as a result of Lang's (1884) untenable conception of *Stylochoplana*. The genus as now understood was defined and limited by Bock (1913). The cuneate form and presence of tentacles are positively not diagnostic of the genus which can be differentiated from other leptoplanid genera only by microscopic examination of the copulatory apparatus. Other leptoplanids from the region here under study erroneously assigned to *Stylochoplana* by their authors are: *californica* Woodworth, 1894, requiring a new genus; *heathi* Boone, 1929, and *longastyletta* Freeman, 1933, which belong to *Notoplana*; and *viridis* Freeman, 1933, which is here placed in *Phylloplana*.

GENUS ZYGANTROPLANA LAIDLAW, 1906

DEFINITION: Leptoplanidae of oval or oblong form and firm consistency; without tentacles; eyes in cerebral and tentacular clusters or not clustered; copulatory apparatus at extreme posterior end; male apparatus similar to that of *Stylochoplana*, but prostatic vesicle may be poorly differentiated; with or without penis stylet; long tubular vagina proceeds anteriorly dorsal to the male apparatus, then curves dorsally and posteriorly above itself, terminating in a Lang's vesicle.

TYPE SPECIES: *Zygantriplana verrilli* Laidlaw, 1906.

Zygantriplana styliifera, new species

Figures 52-54

MATERIAL: Two specimens collected by Ricketts.

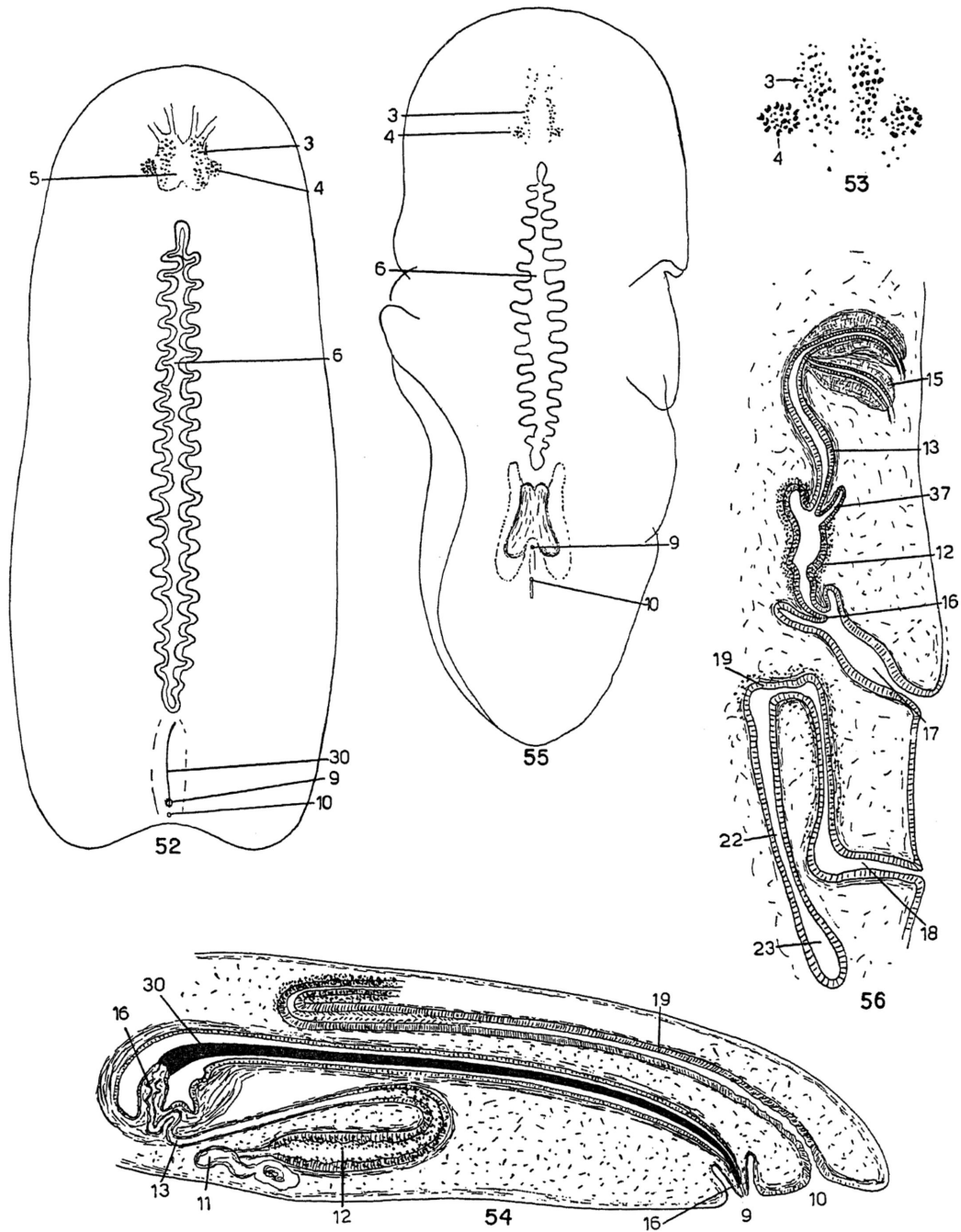
FORM: Oblong, anterior end rounded, posterior end truncate, with a central indentation marking the location of the gonopores (fig. 52); 9 mm. long by 3 to 4 mm. wide; firm and stiff; without tentacles.

COLOR: Not determinable.

EYES: Numerous, in four distinct clusters (fig. 53); tentacular clusters rounded of about 25, mostly rather large, eyes; cerebral clusters compact but elongated of somewhat smaller eyes, about 50 or more on each side.

DIGESTIVE SYSTEM: Pharynx central, long and narrow, extending about three-fifths of the body length; ruffles shallow.

COPULATORY APPARATUS: Occupies the short space between the posterior end of the



FIGS. 52-54. *Zygantriplana stylifera*. 52. Dorsal view. 53. Enlarged view of eyes. 54. Sagittal view of copulatory apparatus, anterior end to right.

FIGS. 55, 56. *Leptoplana chloranota*. 55. Dorsal view. 56. Sagittal view of copulatory apparatus, anterior end above.

pharynx and the posterior body margin (fig. 52); shown in sagittal view in figure 54. The small and weak seminal vesicle curves anteriorly and narrows to a short ejaculatory duct that enters the proximal end of the long, narrow, prostatic vesicle. This is lined by the usual simple glandular epithelium and has a relatively thin muscular wall. It curves back on itself, gradually narrowing to a long ejaculatory duct that enters the base of the penis papilla, pursuing therein a sinuous course, and finally proceeding along the center of the penis papilla. The latter projects into the expanded proximal end of the very long tubular male antrum and bears an equally long penis stylet. At the distal end of the male antrum is found a pronounced penis sheath that reaches to the wide male gonopore. The female gonopore, shortly behind the male pore, leads into a long tubular vagina that extends anteriorly dorsal to and parallel with the male antrum but is not quite so long as the latter. It then curves back upon itself, receiving cement glands, and runs posteriorly parallel to its former course. Unfortunately the one series of sections is broken here dorsally so that it was impossible to follow the further course of the vagina or to determine whether or not a Lang's vesicle is present. It appears to me that Lang's vesicle is either absent or greatly reduced as compared to its condition in other species of *Zygantriplana*. The female tract is provided with only a slight muscular coat.

DIFFERENTIAL CHARACTERS: This species differs from all other described species of the genus in having separate gonopores and, in all but *clepeasta*, in being provided with a penis stylet.

DISTRIBUTION: Collected by Ricketts at Puerto Refugio, Angel de la Guardia Island, and Tiburon Island, Gulf of California, April 2 and 3, 1940, rocky littoral.

HOLOTYPE: One whole mount, A.M.N.H. No. 366.

REMARKS: Very few species assignable to the genus *Zygantriplana* have been found up to the present time. They are: *angusta* (Verrill), 1892; *verrilli* Laidlaw, 1906; *clepeasta* Kato, 1944; *henriettae* Correa, 1949; and *plesia* Correa, 1949. All five have a common gonopore, but only *clepeasta* is provided with a penis stylet. Marcus (1947) suggests

that *verrilli* may be only an immature specimen of *angusta*, but this seems unlikely to me, as *verrilli*, according to Laidlaw's figure, lacks the posterior notch characteristic of *angusta* and has a relatively larger and more elongated Lang's vesicle than *angusta*. On the other hand the differences between *henriettae* and *angusta* seem very slight and probably should be attributed to geographical variation. The prostatic vesicle is poorly developed in *verrilli* and *clepeasta*, and the latter is further peculiar in that the eyes are not definitely arranged in cerebral and tentacular clusters, something very unusual in the Schematommata. A general consideration of the genus *Zygantriplana* with much histological detail has been published by Correa (1949).

Apparently *Z. stylifera* is the species referred to by Ricketts in "Sea of Cortez" (p. 337) as *Stylochoplana plehni*: at least it is the only leptoplanid in the Ricketts material that came from Tiburon Island.

GENUS *LEPTOPLANA* EHRENBURG, 1831

DEFINITION: Leptoplanidae of elongate oval or obovate form without tentacles; eyes in paired cerebral and tentacular clusters; with or without a genital pit between the male and female gonopores; prostatic vesicle interpolated, poorly differentiated, tubular, with or without a ventral diverticulum at its proximal end; with true seminal vesicle; with or without spermiducal bulbs; penis papilla small, unarmed; male antrum long, tubular, may have penis sheath; with or without Lang's vesicle.

TYPE SPECIES: *Leptoplana tremellaris* (O. F. Müller), 1774.

Leptoplana chloranota (Boone), 1929,
new combination

Figures 55, 56

Phylloplana chloranota BOONE, 1929, p. 43, text fig. 4; pl. 2, fig. 5; pl. 3, fig. 12.

Notoplana inquieta FREEMAN, 1933, p. 120, figs. 9, 10, 38.

MATERIAL: One whole mount (not the type) found in the Freeman collection labeled *Notoplana inquieta*; six immature specimens sent by the MacGinities; type of *Phylloplana chloranota* and the other whole mounts so labeled found in the Boone collection.

FORM: Elongate oval, rounded anteriorly, slightly tapering posteriorly (fig. 55); to 40 mm. in length alive, extended, by 6 mm. in width through the brain region; Freeman's whole mount 10 by 4 mm.; Boone's type specimen 12.5 by 4.5 mm.; body thick, firm.

COLOR: Gray, according to Freeman and the MacGinities, speckled; light tan, mottled with green and brown, according to Boone. As there can be no doubt of the identity of the Freeman and Boone forms, the reported difference in color is rather puzzling.

EYES: As the eye arrangement is accurately shown in Boone (text fig. 4) and in Freeman (fig. 9), it seems unnecessary to give a drawing here. Eyes in distinct cerebral and tentacular groups; tentacular groups oval, of 20 to 25 eyes in northern specimens, 45 to 50 in California worms; cerebral groups elongated, of 30 to 50 eyes each.

DIGESTIVE SYSTEM: Pharynx central, long and narrow, with a number of shallow lateral folds; mouth central with respect to the pharynx.

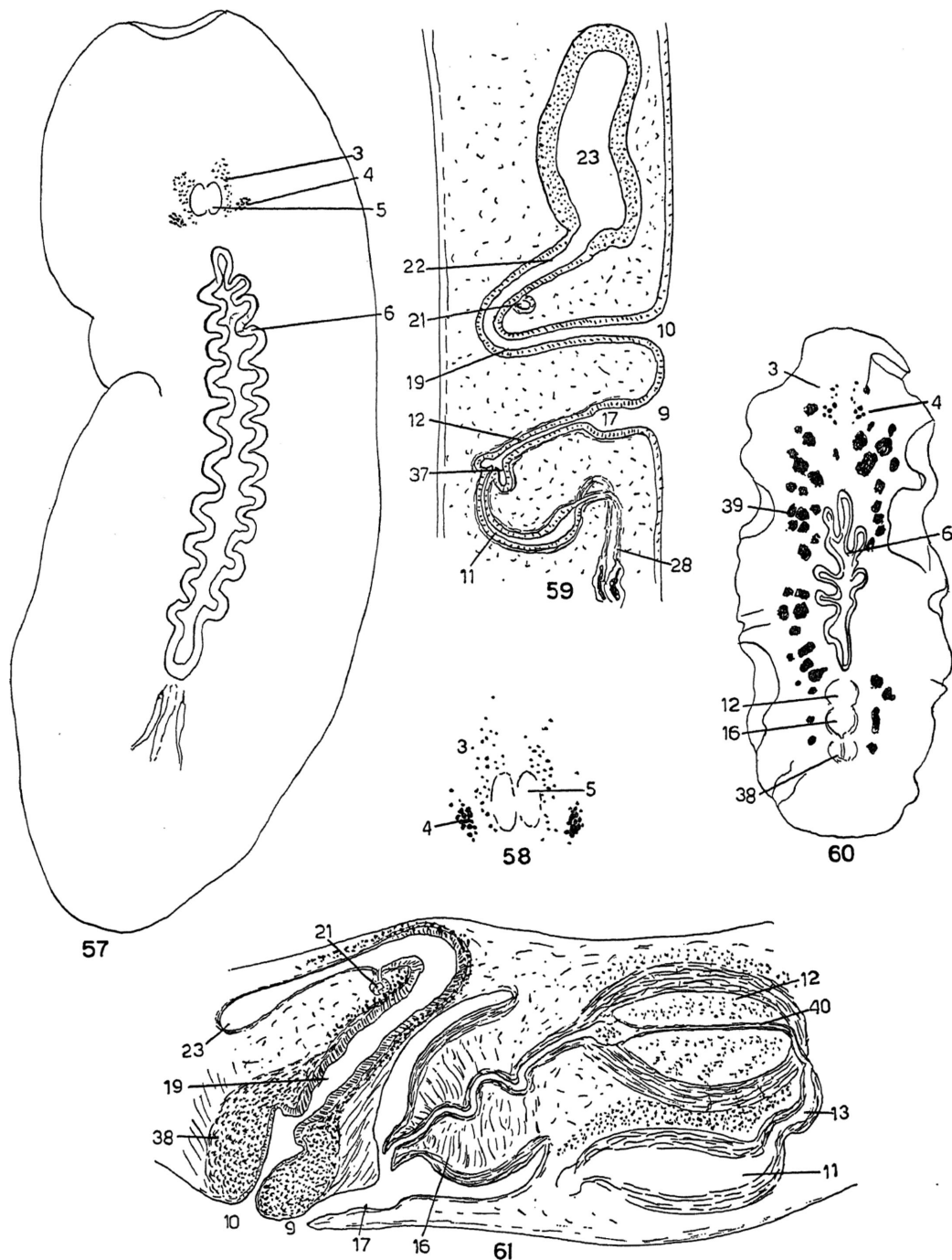
COPULATORY APPARATUS: The rear part of Freeman's specimen, also that of one of the Boone specimens (not the type), was sectioned and the copulatory apparatus (fig. 56) was found to correspond to that of the genus *Leptoplana*. The sperm ducts are connected by a backward loop that passes in front of the male gonopore in Freeman's specimens (my fig. 55; his fig. 10) but across Lang's vesicle in Boone's specimens. This difference may represent a real geographical variation. In the Freeman specimen as a whole mount no details were visible of the male copulatory apparatus which was marked off as a somewhat trapezoidal area (fig. 55), but the Boone type specimen shows the main parts of the copulatory apparatus fairly well. As the sperm ducts approach the male apparatus they acquire thick muscular coats, becoming spermiducal bulbs which enter separately the anterior end of the true seminal vesicle, forming a tripartite seminal vesicle. The true seminal vesicle, poorly shown in Boone's figure, is an elongated tubular body of slight muscularity (fig. 56). It continues distally into the tubular prostatic vesicle which at its proximal end bulges dorsally as a blind sac and ventrally as a similarly shaped diverticulum. Viewed from above in a whole mount

this dorsal bulge and ventral diverticulum give the impression of a small chambered prostatic vesicle of the *Notoplana* type; for this reason Freeman placed the species in the genus *Notoplana* but actually what both Freeman and Boone took to be the prostatic vesicle is only the proximal end of this vesicle. The prostatic vesicle is surrounded by eosinophilous granulations (wanting around the ventral diverticulum but present on the dorsal bulge), but no distinct prostatic glands could be noticed. The prostatic vesicle continues into the penis papilla without the intervention of any definite ejaculatory duct. The penis papilla, of low conical form, occupies the inner end of the long tubular male antrum. The male and female gonopores are well separated. No genital pit ("sucker" of Bock) is present between them, as is the case with some species of *Leptoplana*. From the female gonopore, the female antrum ascends dorsally, presenting a widened inner end from which the vagina springs at right angles, proceeding anteriorly, accompanied by cement glands; it then makes a backward turn and continues as Lang's duct, terminating in a small slender Lang's vesicle. The exact point of entrance of the oviduct into the vagina could not be ascertained in the available sections but appeared to lie somewhat caudad of the bend in the vagina. According to Freeman, the uteri coalesce anterior to the pharynx, but this could not be seen in the material available to me. The female copulatory apparatus shows but slight muscularity.

DISTRIBUTION: Puget Sound, British Columbia, region of Monterey Bay, California; littoral, under stones.

HOLOTYPE: Boone's type specimen deposited in the Natural History Museum, Stanford University, No. 5637; also specimen in the American Museum of Natural History (A.M.N.H. No. 367).

REMARKS: No student of the polyclads, examining the description and figures of "*Phylloplana*" *chloranota* and "*Notoplana*" *inquieta*, could possibly have guessed that the authors of these names were dealing with a species of *Leptoplana*. As already noted these authors mistook the proximal end of the prostatic vesicle for a small chambered prostatic vesicle. The figures of Boone and Freeman leave no doubt of the identity of their



FIGS. 57-59. *Leptoplana limnoriae*. 57. Dorsal view. 58. Enlarged view of eyes. 59. Sagittal view of copulatory apparatus, anterior end below.

FIGS. 60, 61. *Parviplana californica*. 60. Dorsal view. 61. Sagittal view of copulatory apparatus, anterior end to right.

species, and sections of specimens labeled by these authors prove the identity. In the past it was customary to throw almost any leptoplanid without tentacles into the genus *Leptoplana*. But in 1913 Bock investigated and described the sexual anatomy of the type species (*L. tremellaris*) and found it to show the peculiarities indicated in my definition of *Leptoplana*. Since that time there has been no excuse for continued dumping of various leptoplanids into *Leptoplana*. None of the species placed by Plehn, Heath and McGregor, and Boone in *Leptoplana* belong in this genus.

***Leptoplana vesiculata* Hyman, 1939**

REMARKS: I have had no new material of this species and hence have nothing to add to the original description. For some time I entertained the suspicion that *vesiculata* might be identical with *chloranota*, but reexamination of the type sections kindly lent for this purpose by the United States National Museum have proved the suspicions unfounded. *L. vesiculata* differs altogether from *chloranota* in the absence of spermiducal bulbs, the presence of a genital pit, the heavy muscularity of the female antrum, and the larger Lang's vesicle. I feel, however, that there may be some doubt as to the identity of the parts of the male apparatus in my figure (Hyman, 1939c, fig. 51). As no eosinophilous granulations were seen anywhere along the male apparatus on reexamination of the type sections, it becomes difficult to be sure just what part of this apparatus constitutes the prostatic vesicle. What I called the diverticulum of this vesicle is dorsal, not ventral, as typical of the genus, and I was not able to find any other diverticulum at the region in question. Decision must await finding of additional specimens of the species, which seems to be rather rare.

***Leptoplana limnoriae*, new species**

Figures, 57-59

MATERIAL: Several specimens sent by Reish.

FORM: Elongate, obovate, rounded anteriorly, tapering slightly posteriorly (fig. 57); small, under 10 mm. in length; without tentacles.

COLOR: Indeterminable; appears gray or

grayish brown with speckles, especially mid-dorsally.

EYES: Similar in arrangement to those of *L. chloranota*: tentacular groups oval, of about 15 to 20 eyes each; cerebral groups elongated, of 25 to 40 eyes (fig. 58).

DIGESTIVE SYSTEM: Pharynx central, narrow, elongated, with a number of shallow lateral folds (fig. 57); position of the mouth could not be ascertained.

COPULATORY APPARATUS: Most of the specimens received were juveniles, but two appeared mature, and their posterior portions have been sectioned. The sections showed the species to belong to *Leptoplana*, but because of the small size and poor differentiation of the male copulatory apparatus, it was difficult to make out the details of this apparatus. The copulatory structures occur shortly behind the pharynx (fig. 57). The male apparatus is very small and surrounded by densely nucleated tissue that obscures its details. The spermiducal vesicles narrow to slender ducts, apparently muscular, which approach the male apparatus from behind and enter the proximal end of the seminal vesicle (fig. 59). The latter is a curved tubular body with only a slight muscular investment. At its distal end it enters the prostatic vesicle. The latter is also a long tubular body expanded at its proximal end where there exist as in *L. chloranota* a dorsal bulge and a ventral diverticulum, the latter the larger of the two evaginations. The prostatic vesicle shows but slight muscularity, and no eosinophilous granulations could be noticed in either series of sections. Distally, the prostatic vesicle opens into the male antrum with practically no indication of a penis papilla (fig. 59). In the other set of sections, the male antrum is considerably longer than as shown in figure 59. The female gonopore lies close behind the male pore; no genital pit is present. The vagina ascends from the female pore, curves downward and backward, and after receiving the oviduct continues as Lang's duct opening into oval saciform Lang's vesicle of fair size relative to the rest of the copulatory apparatus (fig. 59). The whole female tract shows scarcely any muscularity, and cement glands were not in evidence in either series of sections. The course of the uteri was not determinable.

DIFFERENTIAL CHARACTERS: Small size, lack of a penis papilla, absence of a genital pit, proximity of the gonopores, and relatively large oval Lang's vesicle.

DISTRIBUTION: Taken by Reish in the burrows of the wood-boring snail *Limnoria* at the California Yacht Club, Los Angeles Harbor, in July, September, and December, 1950.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: This study reveals three species of *Leptoplana* (strict sense) on the Pacific coast of North America; none are known from the Atlantic coast or from South America. As the genus is now understood, very few valid species remain in what was once the most common polyclad assemblage. Besides the three mentioned, there are four other species found in the literature, namely: *tremellaris* (O. F. Müller), 1774; *trapezoglena* (Schmarda), 1859; *diaphana* (Stummer-Traunfels), 1933; and *nadiae* Melouk, 1941. Of these only *tremellaris*, *vesiculata*, and *trapezoglena* possess a genital pit between the gonopores, and a Lang's vesicle is present in *chloranota*, *vesiculata*, *nadiae*, and *limnoriae*. Hence the presence of the genital pit and the absence of a Lang's vesicle, listed by Bock (1913) as generic characters, cannot stand as part of the definition of *Leptoplana*. Nor do all of the foregoing species show a definite ventral diverticulum at the proximal end of the prostatic vesicle. The long, tubular, poorly differentiated prostatic vesicle remains as the most salient feature of the genus.

PARVIPLANA, NEW GENUS

DEFINITION: Leptoplanidae of small size without tentacles; eyes in cerebral and tentacular clusters; prostatic vesicle not chambered; ejaculatory duct crosses the prostatic vesicle and opens into a small distal chamber of the latter; with massive bulbous antrum; Lang's vesicle present.

TYPE SPECIES: *Parviplana californica* (Woodworth), 1894.

Parviplana californica (Woodworth), 1894
new combination

Figures 60, 61

Stylochoplana californica WOODWORTH, 1894, p. 50, figs. 1, 2.

MATERIAL: One specimen sent by the United States National Museum.

FORM: Very small, about 5 mm. long; Woodworth's specimen was cuneate, but mine fails to show any anterior expansion (fig. 60); tentacles wanting.

COLOR: Not determinable, presumably brown.

EYES: Scanty, correctly figured by Woodworth (his fig. 2); tentacular groups consist of four to five eyes; cerebral groups are elongated, of nine to 11 eyes in Woodworth's specimen and five in mine.

DIGESTIVE SYSTEM: Pharynx small, central, with three or four lateral folds on each side in my specimen (fig. 60), of about seven to nine in Woodworth's figure.

COPULATORY APPARATUS: Located directly behind the pharynx, showing three main masses when whole (fig. 60), as also in Woodworth's figure 1; these masses are the prostatic vesicle, the penis papilla, and the bulbous female antrum. The copulatory apparatus is shown in sagittal view in figure 61. It is remarkably massive for such a small worm. The oval seminal vesicle, with a muscular wall of moderate thickness, lying in a horizontal position, receives the common sperm duct into its proximal end and distally narrows and curves upward to enter the proximal end of the prostatic vesicle. This is an oval body with a fairly thick muscular wall surrounded by prostatic glands. No definite epithelial lining could be discerned in the sections; the interior contains strands of prostatic secretion. The remarkable feature of this species is the passage of the ejaculatory duct through the prostatic vesicle, apparently attached to one lateral wall, to open into a small distal chamber of the prostatic cavity (fig. 61). This chamber is cut off from the main lumen of the prostatic vesicle by the dorsal and ventral strands of attachment of the ejaculatory duct, but the chamber communicates laterally with the main cavity of the vesicle. Distally the ejaculatory duct continues from the prostatic vesicle and soon enters the massive penis papilla in which it pursues a sinuous course to the tip. The penis papilla is a thick, moderately elongated projection with a pointed extremity, and the sinuous course of its lumen indicates that it is somewhat contracted. The penis papilla

lies in an expanded male antrum that narrows to a short canal leading to the male gonopore. The female gonopore is distinct from but only a short distance behind the male pore; it leads into a massive bulbous antrum with very thick muscular walls (fig. 61). From this the vagina proper, supplied with cement glands, proceeds dorsally with a forward slant, then curves backward, and, after receiving the common oviduct into its ventral wall, becomes continuous with a short Lang's duct terminating in a small oval Lang's vesicle. Proximal to the bulbous antrum, the female tract is but slightly muscular.

DISTRIBUTION: Collected by Olga Hartman June 9, 1941, at Tomales Head, Marin County, California, on a rocky shore, among a mass of sponges and bryozoans. The type locality is the Gulf of California.

SPECIMEN: The entire specimen was sectioned, three slides, deposited in the United States National Museum (U.S.N.M. No. 23778).

REMARKS: The finding of a specimen of Woodworth's species was a piece of luck hardly to be hoped for. One would be inclined to list Woodworth's *Stylochoplana californica* among those species of which the identity must remain forever uncertain. I feel that there can be no doubt of the identity of the present specimen with Woodworth's species. The small size, eye arrangement, and indication of the copulatory apparatus as three rounded masses behind the pharynx appear sufficient grounds of recognition. The species is apparently not truly pelagic, however, but a littoral form. I hesitated about creating a new genus for this species, but it appeared impossible to fit it into any of the existing genera of the Leptoplanidae. The male apparatus in general corresponds to that of *Stylochoplana*, but the passage of the ejaculatory duct through the prostatic vesicle and the presence of a massive bulbous female antrum eliminate this genus from consideration. The relation of the ejaculatory duct to the prostatic vesicle suggests the genus *Notoplana*, but the most careful scrutiny of the prostatic vesicle failed to indicate any division of the interior into chambers.

GENUS *NOTOPLANA* LAIDLAW, 1903

DEFINITION: Leptoplanidae of oval, obo-

vate, or cuneate form, generally without tentacles; eyes in four clusters; spermiducal bulbs wanting; with true seminal vesicle; prostatic vesicle always present, its interior subdivided into longitudinal chambers that surround the central ejaculatory duct which therefore projects well into the interior of the prostatic vesicle; penis armed or not; Lang's vesicle usually present.

TYPE SPECIES: *Notoplana dubia* (Schmarda), 1859 (= *Notoplana evansi* Laidlaw, 1903).

Notoplana atomata (O. F. Müller), 1776

REMARKS: As this species has been sufficiently described by Bock (1913) and Hyman (1939a), it appears unnecessary to repeat the description here. Over 70 specimens of this species were taken by MacGinitie in the vicinity of Point Barrow, Alaska, at around latitude 70° N., at various depths to 741 feet. *Notoplana atomata* is a common polyclad of cold northern waters, having been taken in a number of localities along the northern coasts of the North Atlantic. It is common on the coast of Maine. It is readily recognized by the spherical prostatic vesicle, arched penis stylet of moderate length, and well-developed Lang's vesicle. The Point Barrow specimens are anatomically identical in all respects with those I previously studied from the coast of Maine.

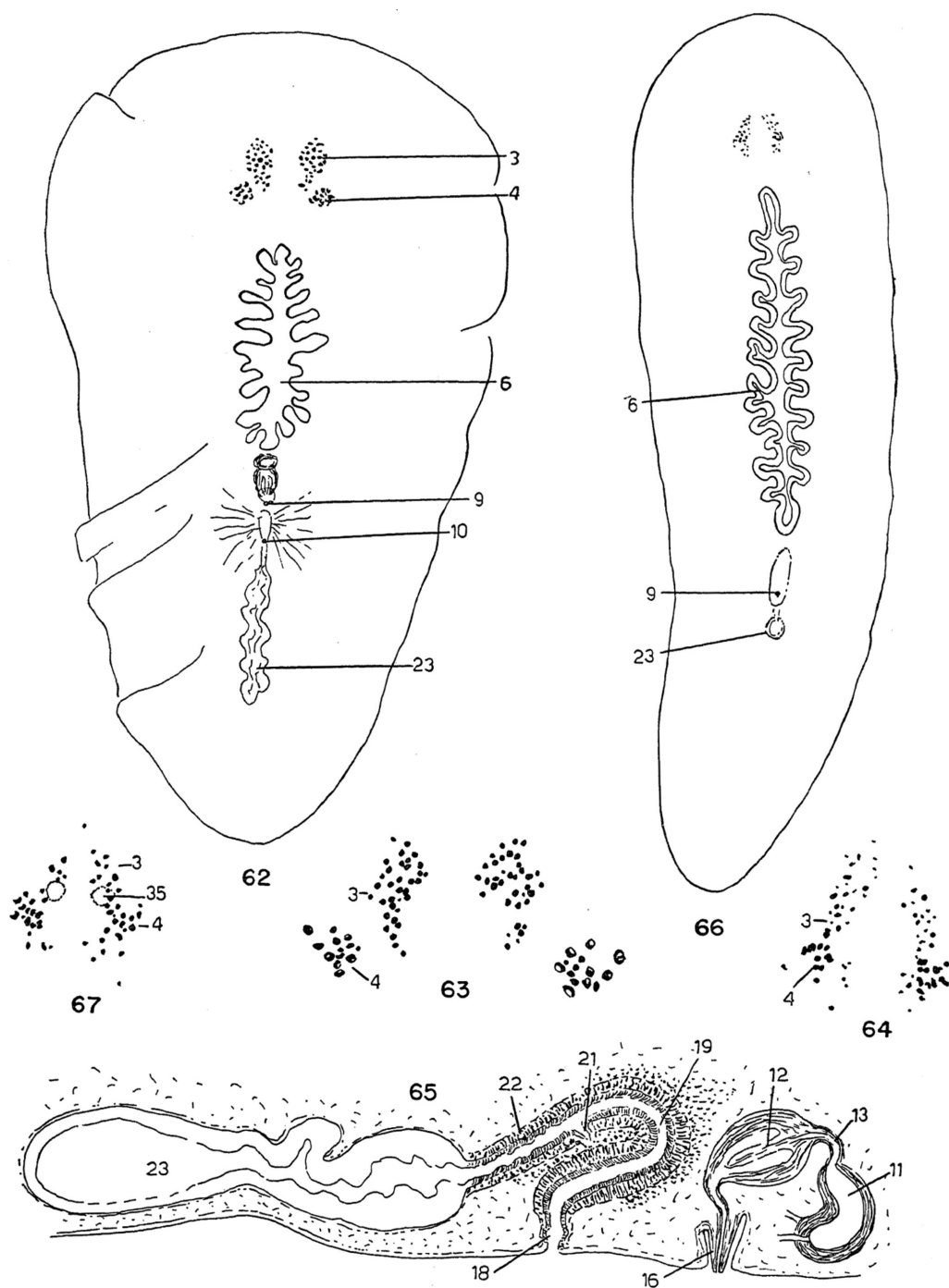
Notoplana rupicola (Heath and McGregor), 1912, new combination

Figures 62-65

Leptoplana rupicola HEATH AND MCGREGOR, 1912, p. 464, text fig. 2; pl. 12, fig. 3; pl. 13, figs. 10, 13, 15; pl. 15, fig. 22.

MATERIAL: Two specimens sent by the United States National Museum and several specimens from the Allan Hancock Foundation have been hesitatingly referred to this species.

FORM: Cuneate, expanded anteriorly, tapering posteriorly (fig. 62); type specimen was 35 mm. long by 15 mm. across the widest region (preserved), but specimens available to me are much smaller, with a maximum length of 17 mm. The one figured (fig. 62) is 13 by 8 mm., but is obviously somewhat contracted; others are more elongated, resembling those in Heath and McGregor (pl. 12, fig. 3).



FIGS. 62-65. *Notoplana rupicola*. 62. Dorsal view. 63. Eye pattern. 64. Eye pattern of another specimen. 65. Sagittal view of the copulatory apparatus, anterior end to right.

FIGS. 66, 67. *Notoplana saxicola*. 66. Dorsal view of Heath specimen. 67. Eye pattern of same specimen.

COLOR: According to Heath and McGregor, pale with a pinkish or reddish tinge, brown along the middorsal region.

EYES: In four distinct clusters (figs. 63, 64). Tentacular clusters rounded, of about 30 eyes each in the original description, 10 to 20 in my specimens; cerebral groups elongated, stated in the text of the original description to consist of about 30 eyes each, but the figure shows 70 to 80 eyes; of about 30 eyes each in my specimens. It appears to me that the eye arrangement of the specimens available to me sufficiently agrees with that of the original text and figure, and the fewer number of eyes in my specimens may be attributed to their much smaller size. The eye pattern of two of the specimens available to me is shown in figures 63 and 64; most of the specimens resembled figure 64.

DIGESTIVE SYSTEM: Pharynx central or slightly anterior, relatively small, with about 15 pairs of lateral pouches in the original description, fewer in my specimens, but this again may be attributed to their smaller size.

COPULATORY APPARATUS: Serial sections were prepared of two specimens. According to the figure of Heath and McGregor the sperm ducts are connected by a backward loop that passes above the duct of Lang's vesicle. I am unable to understand the statement of Heath and McGregor that the spermiducal vesicles consist of a network and know of no such condition among polyclads. Heath and McGregor give four enlarged figures of the copulatory apparatus of *rupicola*, but these figures agree poorly as to the shape of the penis papilla and the shapes and relative sizes of the seminal and prostatic vesicles. In view of these discrepancies and the lack of an authentic specimen of *rupicola*, identification of my specimens as *rupicola* remains uncertain. A sagittal view of the copulatory apparatus of one of the United States National Museum specimens is shown in figure 65. The sperm ducts enter separately the proximal angles of the retort-shaped seminal vesicle. This has a well-muscularized wall and curves dorsally, narrowing to an ejaculatory duct that enters the proximal end of the prostatic vesicle. The latter is pyriform, with a thick muscular wall and the usual longitudinal chambers in the interior surrounding the projecting ejaculatory duct.

Distally, the prostatic vesicle narrows to the ejaculatory duct which after a short course enters the base of the moderately elongated, conical penis papilla, housed in a male antrum of moderate depth. The features of the male apparatus that appear distinctive are the elongate form of the prostatic vesicle, its equality or slight superiority of size in comparison with the seminal vesicle, the moderately conical form of the penis papilla, and the lengths of ejaculatory duct between seminal and prostatic vesicles, and prostatic vesicle and penis papilla.

The female gonopore is well posterior to the male gonopore. It leads into a small antrum with poorly muscularized wall followed immediately by the heavily muscled vagina. This slants forward and dorsally, then makes the usual posterior turn and, after receiving the oviduct, descends as the duct of Lang's vesicle to open into the very long and moderately narrow Lang's vesicle. The vagina and the duct of Lang's vesicle are provided with eosinophilous glands.

DIFFERENTIAL CHARACTERS: The specimens here assigned to *N. rupicola* differ from other *Natoplana* species of the region by the equality or slight superiority of size of the prostatic vesicle in comparison with the seminal vesicle, the separation of the seminal and prostatic vesicles, and the prostatic vesicle and the penis papilla by distinct lengths of ejaculatory duct, the moderately long conical penis papilla, the considerable distance between the gonopores, the poor muscularity of the female antrum, the strong muscularity of the vagina, and the elongated Lang's vesicle.

DISTRIBUTION: Two United States National Museum specimens taken by the "Albatross" at Cape Kiwanda, Oregon, Station 5732, September 31, 1914, at 50 fathoms; several specimens taken off Catalina Island by the Allan Hancock Foundation at 40 fathoms on May 4, 1941, and one specimen off Santa Rosa Island at 104 fathoms on August 25, 1941. As the original locality was Monterey Bay, the species appears distributed throughout the California coast and northward along Oregon.

SPECIMENS: As none of the specimens came from the type locality, it appears inadvisable to declare a neotype. The two specimens have

been returned to the United States National Museum, one as a whole mount, the other in part as a whole mount and in part as sagittal serial sections (two slides), U.S.N.M. No. 23784.

REMARKS: I wish to emphasize that I have had no authentic specimens of *rupicola*, and, as the original description is unsatisfactory and its accompanying figures discrepant, my identification of the foregoing specimens as *rupicola* is tentative. They are placed in *rupicola* because they seem to correspond better with this species than with any other *Notoplana* of the region and because the alternative disposition of them as a new species appears unjustifiable.

Notoplana saxicola (Heath and McGregor),
1912, new combination

Figures 66-68

Leptoplana saxicola HEATH AND MCGREGOR,
1912, p. 467; pl. 12, fig. 4; pl. 14, figs. 19, 21; pl. 16,
fig. 30.

MATERIAL: One whole mount in the Fisher collection, labeled *Leptoplana saxicola*, Monterey, identified by Heath; three preserved specimens sent by the MacGinities; one individual taken alive at Pacific Grove, California.

FORM: Elongate, not expanded anteriorly, sides nearly parallel along anterior third, then tapering gradually to a blunt posterior end (fig. 66); size moderate, to 14 mm. long, preserved, by about 4 mm. through the anterior third; tentacles wanting.

COLOR: Yellowish gray.

EYES: Tentacular clusters of about 10 to 25 eyes, not clearly set off from the cerebral groups which occur in a linear arrangement of about 15 to 25 eyes to the inner side of the tentacular clusters (fig. 67). It is impossible to distinguish *saxicola* from other *Notoplana* species of the region by the eyes alone.

DIGESTIVE SYSTEM: Pharynx somewhat anteriorly placed (fig. 66), not posterior as stated in the original description (which is based on a specimen much contracted posteriorly); pharynx slender, elongated, with up to about 15 lateral folds in the available specimens. In the original description, the intestinal branches are said to be anastomosed into a "highly complicated intestinal net-

work." This is also stated to be the case for some of the other leptoplanids described by Heath and McGregor. It was pointed out by Lang in his 1884 monograph of the Polycladida that intestinal anastomoses are rare in the Acotylea and never occur in the Leptoplanidae. The intestinal branches of polyclads are peculiar in that they are marked off by constrictions into a succession of vesicles so that they present a beaded appearance. The walls of these vesicles can give the illusion of meshes of a network. Heath and McGregor and later Boone (1929) and Freeman (1933) were deceived by this appearance into thinking an intestinal network is present in several of the species they described.

COPULATORY APPARATUS: The copulatory region of the specimen identified by Heath, of the individual I took alive, and of one of the MacGinitie specimens has been sectioned and found identical in all of them, also in good correspondence with the original figures and description. It is shown in sagittal view in my figure 68. The sperm ducts are united by a backward loop passing dorsal to the female copulatory apparatus; they then extend forward to the level of the posterior end of the pharynx, where they turn abruptly posteriorly, converging towards the proximal end of the seminal vesicle, which they enter after uniting to a short common duct. The seminal vesicle is a large, heavily muscularized body of curved oval shape, notably larger than the prostatic vesicle. The seminal vesicle ascends dorsally, then arches posteriorly as a thick-walled ejaculatory duct that enters the prostatic vesicle. This is of the usual chambered type diagnostic of the genus and of slightly oval shape. From it the ejaculatory duct proceeds into the base of the penis papilla. The latter is exceptionally long and slender, lying within a male antrum of similar shape that leads to the common gonopore (fig. 68). From the common gonopore, the vagina ascends dorsally, then makes a forward slant, receiving the cement glands into this slanting part. It then as usual curves backward and slants downward and after receiving the common oviduct continues as the duct of Lang's vesicle. This is rather short and soon enters the small round Lang's vesicle. Heath and McGregor represent this (their fig. 30) as a large sac extending forward beneath the

male apparatus. Such a condition is unknown in the Leptoplanidae and is in fact an impossibility on anatomical grounds. Hence their figure and text are erroneous in regard to this point. The female antrum (or vagina externa in Bock's terminology) is rather muscular, but the vagina proper entered by the cement glands has only a slight muscular provision.

DIFFERENTIAL CHARACTERS: *Notoplana saxicola* is distinguishable from other *Notoplana* species of the region by the union of the sperm ducts prior to entry into the seminal vesicle, the large oval seminal vesicle, conspicuously larger than the prostatic vesicle, the exceptionally long, slender penis papilla, the common gonopore, and the reduced rounded Lang's vesicle.

DISTRIBUTION: Taken by the original describers near Monterey Bay on masses of algae in tide pools; by the MacGinities at Huntington Beach, California, on masses of *Mytilus*, December 18, 1937; and by me on kelp rhizoids at Pacific Grove, California, in August, 1936.

LECTOTYPE: Specimen identified by Heath declared a lectotype; anterior half as whole mount on original slide; posterior half as sagittal serial sections (two slides), deposited in the Natural History Museum, Stanford University, No. 5641.

REMARKS: This species appears not uncommon on the California coast, apparently usually in association with algae. Its sexual anatomy is distinctive, but it probably cannot be separated from other *Notoplana* species of the region by external features alone.

Notoplana inquieta (Heath and McGregor),
1912, new combination

Figures 69, 70

Leptoplana inquieta HEATH AND MCGREGOR,
1912, p. 470, pl. 13, figs. 8, 14; pl. 18, fig. 43.

Stylochoplana heathi BOONE, 1929, p. 35, text
fig. 1; pl. 2, fig. 2; pl. 3, fig. 9.

?*Leptoplana californica* PLEHN, 1898, p. 93, pl.
5, figs. 1, 2.

MATERIAL: One specimen taken alive in Monterey Bay, two taken alive in Puget Sound, one preserved specimen from Puget Sound sent by the United States National Museum, vial of 10 specimens collected by Ricketts in Puget Sound, and three specimens collected off British Columbia, one whole

mount in the Freeman collection labeled "*longastyletta?*," type specimen of *Stylochoplana heathi*, and two specimens sent by Reish.

FORM: Elongate, cuneate, with expanded anterior end, tapering to a bluntly pointed posterior end (fig. 69, drawn from life); attains considerable size, to 30 mm. or more alive, extended; preserved specimens wedge-shaped, largest 23 mm. long; tentacles wanting.

COLOR: Light brown or pale, dotted with reddish brown spots.

EYES: In four distinct clusters; tentacular clusters of relatively few, rather large eyes, ranging from seven or eight up to 13 in the largest available worm; cerebral clusters elongated, of about 20 to 50 eyes each, mostly smaller than the eyes of the tentacular clusters. An accurate figure of the eyes is given by Heath and McGregor (fig. 43).

DIGESTIVE SYSTEM: Pharynx central, with mostly six or seven lateral folds (fig. 69).

COPULATORY APPARATUS: The sperm ducts are confluent dorsal to Lang's vesicle, then proceed forward beside the posterior part of the pharynx, and then loop backward, converging medially to enter the seminal vesicle. The male copulatory apparatus lies close behind the pharynx, hence some distance from the posterior tip of the worm (fig. 69). The copulatory apparatus is shown in sagittal view in figure 70. The sperm ducts enter separately the proximal end of the retort-shaped seminal vesicle. This has a well-muscularized wall; it narrows distally to an ejaculatory duct that soon enters the spherical prostatic vesicle. The projection of the ejaculatory duct into the prostatic vesicle was mistaken by Heath and McGregor for a penis papilla. The prostatic vesicle is of about the same size as the seminal vesicle. It immediately, without any intervening ejaculatory duct, enters the penis papilla, a small eminence for holding the long, slightly curved penis stylet. This lies in the long tubular male antrum, which shows a penis sheath around the point of the stylet, then widens somewhat distal to the sheath, and finally joins the female antrum at the common gonopore. Heath and McGregor saw and figured the tubular male antrum but somehow missed the penis stylet, a conspicuous feature of this

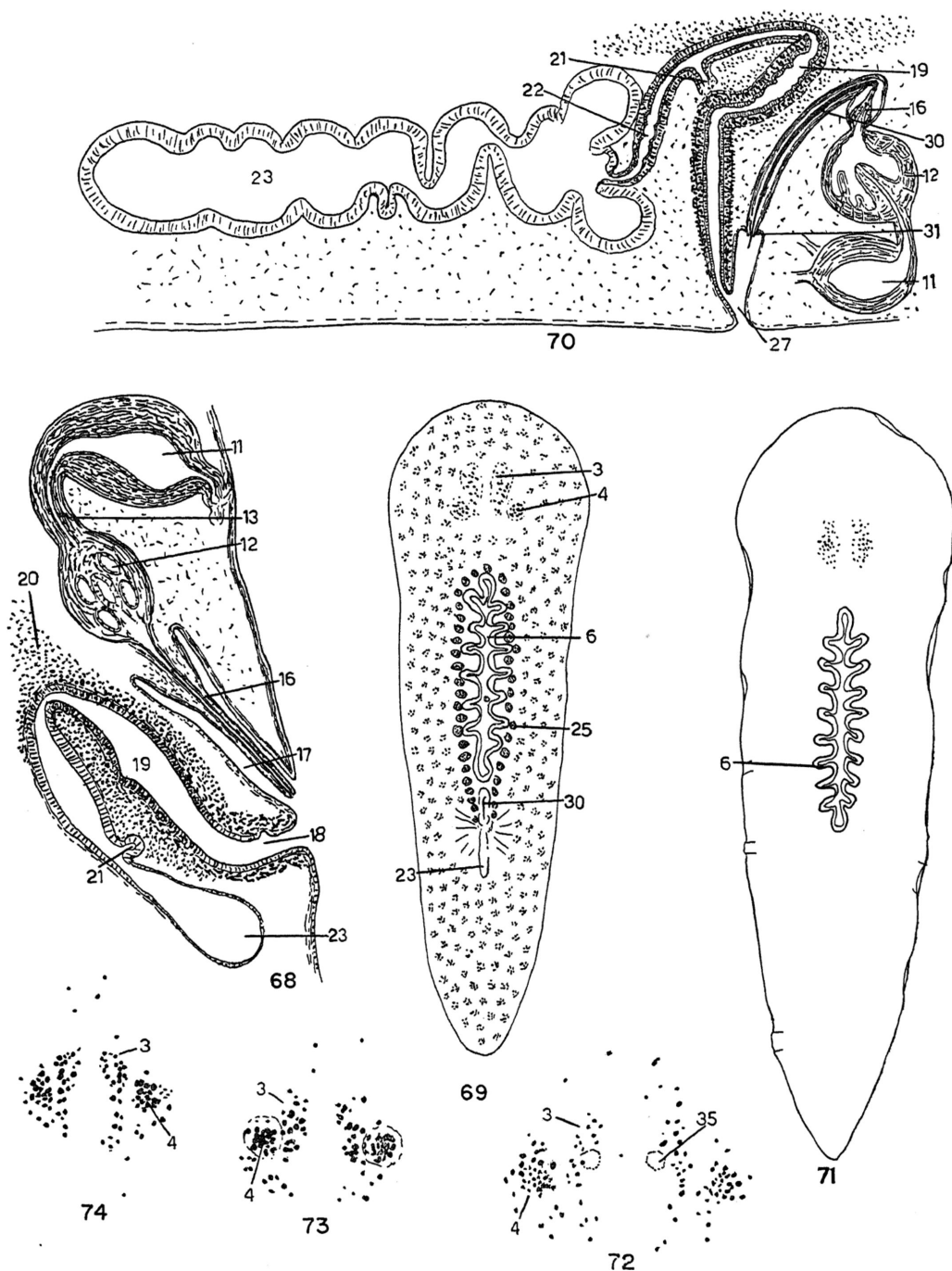


FIG. 68. *Notoplana saxicola*, sagittal view of the copulatory apparatus, anterior end above.

FIGS. 69, 70. *Notoplana inquieta*. 69. Dorsal view, from life, Monterey Bay. 70. Sagittal view of copulatory apparatus, anterior end to right.

FIG. 71. *Notoplana acticola*, dorsal view, from life, Pacific Grove.

FIGS. 72-74. *Notoplana acticola*, eye patterns of different specimens. 72. Specimen labeled "*Leptoplana timida* identified by Heath."

species. A short non-muscular female antrum ascends vertically from the common gonopore and passes imperceptibly into the rather muscular vagina. The vagina ascends vertically for some distance, then makes a forward loop, and after receiving the common oviducts into its ventral wall continues sharply downward as the duct of Lang's vesicle. This is an extremely long, tubular sac that bulges at its anterior end into two rounded projections to either side of the duct exit from the vesicle. Cement glands enter the vagina along its entire course. The uteri embrace the pharynx anteriorly.

DIFFERENTIAL CHARACTERS: This species is differentiated from other *Notoplana* species of the region by the spherical prostatic vesicle, about equaling in size the seminal vesicle, the long penis stylet housed in a tubular male antrum, the presence of a penis sheath and common gonopore, and the very long Lang's vesicle with two anterior sacculations.

DISTRIBUTION: Monterey Bay; Los Angeles Harbor; Puget Sound; Deadman's Island, British Columbia.

NEOTYPE: One whole mount, also one set of sagittal serial sections (one slide) deposited in the American Museum of Natural History (A.M.N.H. No. 369).

REMARKS: This species presumably occurs along the Pacific coast of North America from Los Angeles to British Columbia; I took live specimens of it in Monterey Bay in 1936 and in Puget Sound in 1938, and Ricketts collected many in 1942 at Bremerton, Washington, and off British Columbia in 1945. Freeman had a specimen but failed to recognize it as distinct. Reish found the species in Los Angeles Harbor.

Through the kindness of Miss Boone, I have had available the type (and only) specimen of *Stylochoplana heathi* that she described in 1929. Examination of this specimen as a whole mount showed without any doubt that it is identical with *Notoplana inquieta*. The penis stylet is plainly visible on the whole mount but was somehow missed by Boone. Boone's slide has been deposited in the Natural History Museum, Stanford University, No. 5626.

I feel there is a strong probability of the identity of *Leptoplana californica* Plehn, 1898, with *Notoplana inquieta*. Striking similarities

between the two forms are the presence in both of a long penis stylet, common gonopore, forward-looping vagina, and long Lang's vesicle. I have forborne to declare the synonymy, because there are irreconcilable differences between *N. inquieta* and Plehn's description. Thus Plehn figures and describes the tentacular eye cluster of *californica* as composed of numerous small eyes occupying an elliptical area, whereas it is characteristic of *inquieta* that the tentacular eyes are large and few in number and arranged in a rounded group. Plehn also figures the cerebral eyes of her worm as much more numerous than is the case with *inquieta* and makes much of a large eye at the anterior end of each cerebral cluster. There is such a large eye so situated in one of the available specimens of *inquieta*, but this is no larger than eyes elsewhere in the cerebral clusters, and its occurrence is not typical of *inquieta*. Then Plehn shows the copulatory apparatus as much nearer the posterior end than is true for *inquieta*. The folds in the prostatic vesicle mentioned and figured by Plehn could well be the chambers of the *Notoplana* vesicle, but Plehn gives the shape of the vesicle as oval, whereas a spherical prostatic vesicle is characteristic of *inquieta*. The vagina also appears more muscular in Plehn's worm than is the case in *inquieta*. Clearly the question of synonymy cannot be settled until a specimen corresponding to Plehn's account becomes available. For the present it seems best to follow Bock's allocation of Plehn's species to *Stylochoplana*.

Notoplana acticola (Boone), 1929,
new combination

Figures 71-75

Leptoplana acticola BOONE, 1929, p. 38, text fig. 2; pl. 2, fig. 7; pl. 3, fig. 11.

MATERIAL: One specimen taken alive at Pacific Grove, several specimens sent by Ricketts, the MacGinities, de Laubenfels, and the United States National Museum, collected at various points on the California coast, several whole mounts in the Fisher collection variously labeled *Leptoplana acticola*, *Leptoplana sciophila*, *Leptoplana timida*, the type specimen and some other whole mounts identified by Boone, and numerous specimens in the Allan Hancock Foundation material.

FORM: Somewhat cuneate, widest anteriorly, tapering to a pointed tail (fig. 71, drawn from life); to 28 mm. long, mostly smaller, hence a species of moderate size; tentacles wanting.

COLOR: Tan, shading to a patchy darker brown middorsally.

EYES: In usual four clusters; tentacular clusters characteristic of the species, consisting of a rounded cluster of closely placed eyes plus loose eyes in front of, behind, and often also to the outer side of the cluster; total eyes in the tentacular group 20 to 25 in the smaller specimens, around 35 in the majority, and up to 45 in the largest specimens; cerebral eyes in an elongated band of about 25 eyes, widening slightly in the region of the granule masses of the brain. Eyes of three specimens proved to be *acticola* by sections of the copulatory apparatus are shown in figures 72, 73, and 74. Boone's figure of the eyes (her text fig. 2) does not appear to me typical of the species.

DIGESTIVE SYSTEM: Pharynx slightly anterior (fig. 71), rather small, with about eight lateral folds. Boone's description of the intestinal branches as anastomosing is presumably erroneous.

COPULATORY APPARATUS: The posterior half of the type specimen has been removed and sectioned, and sections have also been made of specimens received from various sources, including mounts in the Fisher collection labeled *Leptoplana acticola*, *Leptoplana sciophila*, and *Leptoplana timida* (specimen identified by Heath). All have been found identical and in good agreement with those in Boone (1929, pl. 3, fig. 11). The sperm ducts are united by the usual backward loop passing above the female apparatus. Their main portions proceed posteriorly beside the rear end of the pharynx and enter separately the proximal angles of the retort-shaped seminal vesicle. A sagittal view of the copulatory apparatus of the type specimen is given in figure 75. The seminal vesicle has a thick muscular wall; it curves dorsally and narrows to a distinct length of ejaculatory duct that enters the elongated oval (not spherical as stated by Boone) prostatic vesicle ("ejaculatory organ" of Boone). This is distinctly larger than the seminal vesicle. It has a thick muscular wall and narrows to an

ejaculatory duct of some length that enters the base of the penis papilla. The elongated shape of the penis papilla is perhaps the most characteristic feature of the species; from a moderately broad base, the papilla rapidly narrows to a slender distal portion, but this is not so elongated as in *N. saxicola*. The penis papilla is housed in a male antrum of moderate depth. The female gonopore is well separated from the male pore. The female antrum ascends vertically from the pore and is strongly muscularized; it passes imperceptibly into the slightly less muscular vagina which makes the usual forward loop. After receiving the common oviduct into its ventral wall, the vagina continues as the duct of Lang's vesicle which descends and then enters the short plump Lang's vesicle. This vesicle and its duct are but slightly muscular; the lining epithelium of the duct is often thrown into regular folds, giving the duct a beaded appearance. This appearance probably results from a contracted state of the duct. Cement glands were not very evident in the sections of the type specimen but were found in other specimens to enter the vagina abundantly throughout its course. The ripe uteri are confluent anterior to the pharynx.

DIFFERENTIAL CHARACTERS: *Notoplana acticola* differs from other *Notoplana* species of the region except *rupicola* by the combination of elongated oval prostatic vesicle, larger than the seminal vesicle, moderately elongated penis papilla, well-separated gonopores, muscular female antrum and vagina, and short plump Lang's vesicle. It is definitely separable from *N. rupicola* only by the non-muscular female antrum and long Lang's vesicle of the latter.

DISTRIBUTION: Taken alive at Pacific Grove, California; collected by Ricketts at Tomales Point, California, December 25, 1939; by the MacGinities at Huntington Beach, December 18, 1937; by de Laubenfels at Laguna Beach, November 27, 1939; by the United States National Museum at San Diego, December 31, 1884, and at La Jolla by the "Albatross," March 6, 1898; by the Allan Hancock Foundation at Playa del Rey, October 27, 1940, and at Portuguese Bend, February 13, 1942, and by Reish at La Jolla; stated by Boone to be common in Monterey Bay, the type locality. All localities are

situated on the California coast, and the species has not as yet been taken elsewhere.

HOLOTYPE: The type specimen deposited in the Natural History Museum, Stanford University, anterior half as whole mount on original slide, posterior half as sagittal serial sections (three slides), No. 5620.

REMARKS: This species appears to be the most common leptoplanid of the California coast, occurring everywhere along that coast, but it is a question whether it can be recognized by external characters or even as a whole mount. The confusion of names applied to the whole mounts of *acticola* in the Fisher collection indicates that Californian zoologists have not learned to distinguish *acticola* from other leptoplanids. Characters to be sought in whole mounts are the slender penis papilla, the well-separated gonopores, and the short plump Lang's vesicle. Most specimens, however, can probably not be identified with certainty without recourse to serial sections, and even in sections confusion with *rupicola* must be guarded against. For a long time, in fact, I was of the opinion that *acticola* was identical with *rupicola*, but I now believe they are distinct species. In addition to the difference in eye pattern, *acticola* differs from *rupicola* in the muscular female antrum and short plump Lang's vesicle. There appears to be no dependable difference in the anatomy of the male copulatory apparatus of the two species.

***Notoplana sciophila* (Boone), 1929,**
new combination

Figures 76, 77

Leptoplana sciophila BOONE, 1929, p. 40, text fig. 3; pl. 2, fig. 3; pl. 3, fig. 8.

MATERIAL: Type specimen and three other whole mounts sent by Boone; one specimen sent by the MacGinities.

FORM: Elongate, anteriorly rounded, posteriorly bluntly pointed, to 18 mm. in length; tentacles wanting.

COLOR: Uniform medium tan, concentrated middorsally.

EYES: Similar to those of *acticola*, but fewer, and tentacular eyes less scattered. Tentacular eyes of a cluster of closely placed eyes plus a few scattered eyes behind this

cluster, totaling 15 to 25 eyes on each side (fig. 76); cerebral group linear, consisting of an irregular row of eyes over the brain region, broadening anterior to the granule masses.

DIGESTIVE SYSTEM: Pharynx slightly anterior, elongate, narrow, with a considerable number of lateral folds; intestinal branches arranged as usual in leptoplanids, not anastomosing.

COPULATORY APPARATUS: The posterior half of the type specimen and of one of the other specimens identified by Boone have been sectioned and found identical and in good agreement with those in Boone (1929, pl. 3, fig. 8). The sperm ducts are united, as usual in the Leptoplanidae, by a backward loop passing dorsal to the duct of Lang's vesicle. The copulatory apparatus is shown in sagittal view in figure 77. The sperm ducts enter separately the proximal angles of the slender, elongated, seminal vesicle provided with a well-developed muscular wall. This narrows to an ejaculatory duct that curves dorsally and enters the proximal end of the rather small, pyriform, prostatic vesicle, also well muscularized. Distally this narrows to the ejaculatory duct which pursues a considerable course before entering the base of the small, conical penis papilla. The latter projects into a large and broad male antrum, an outstanding feature of this species. The lining epithelium had become detached in both series of sections and filled the lumen of the male antrum. The large male gonopore, poorly muscularized, lies closely anterior to the small female gonopore. The two gonopores are a little farther apart in the second series of sections than in the sections of the type specimen drawn in figure 77. In the female tract no distinction could be noted between antrum and vagina, but the combination forms one continuous tube that ascends, curving slightly forward, then turns backward and after receiving the common oviduct into its ventral wall makes the usual curving descent as the duct of Lang's vesicle that enters the relatively short, plump Lang's vesicle. Antrum and vagina have a well-developed muscular wall as far as the entrance of the oviduct; this is particularly thick just above the gonopore where it seems to form a sphincter, not very definitely set off. The usual cloud of cement glands enters

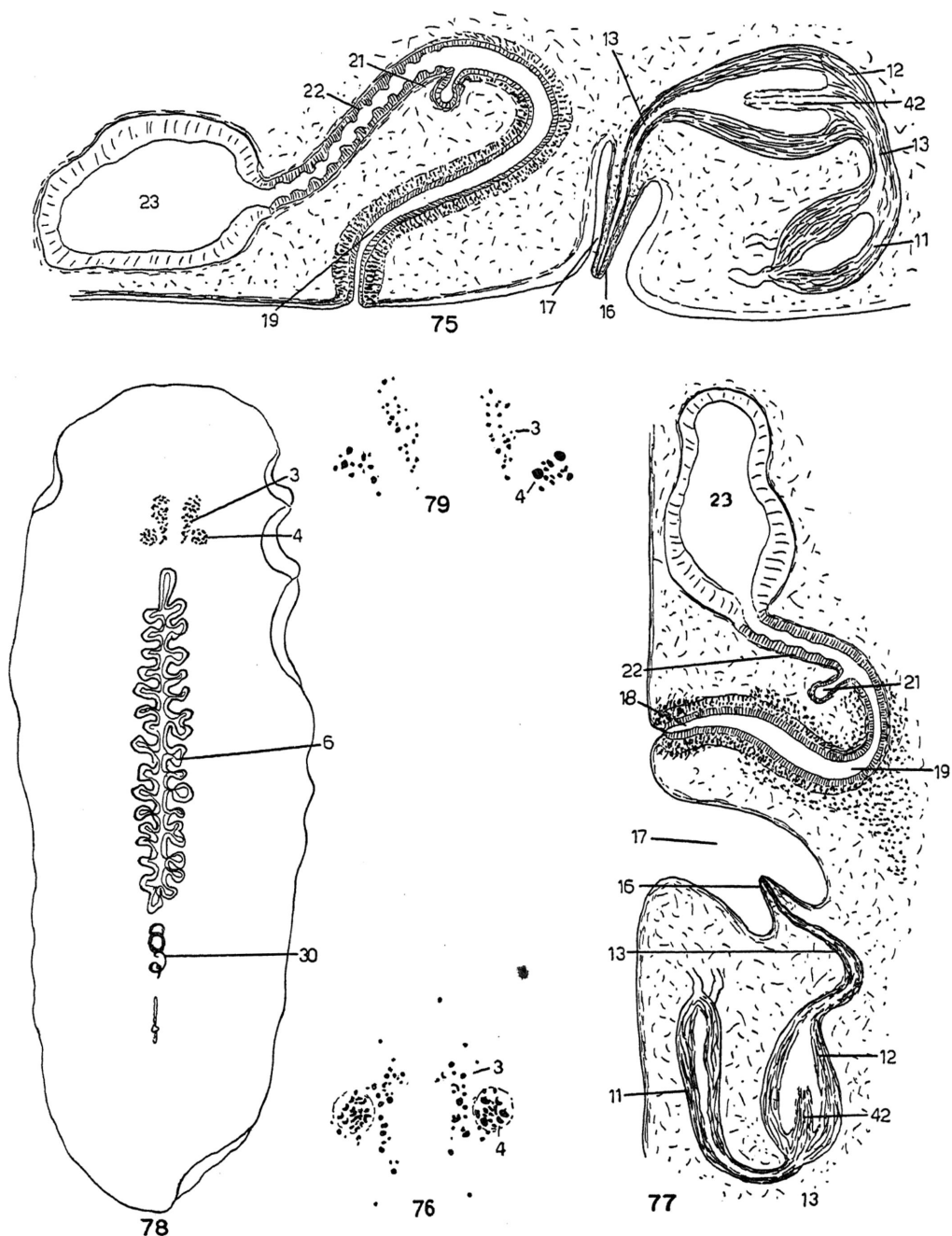


FIG. 75. *Notoplana acticola*, sagittal view of the copulatory apparatus, anterior end to right.

FIGS. 76, 77. *Notoplana sciophila*. 76. Eye pattern. 77. Sagittal view of the copulatory apparatus, anterior end below.

FIGS. 78, 79. *Notoplana longastyletta*. 78. Dorsal view. 79. Eye pattern of Aleutian Islands specimen.

the vagina proper. The uteri are confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Notoplana sciophila* is distinguished from other *Notoplana* species of the region by the combination of slender seminal vesicle, long stretch of ejaculatory duct between the prostatic vesicle and the penis base, small conical penis papilla, large and broad male antrum, and the proximity of the gonopores. The female tract offers scarcely any difference from that of *N. acticola*.

DISTRIBUTION: La Jolla, California; also stated by Boone to occur in the vicinity of Pacific Grove, but all specimens in the Fisher collection taken in Monterey Bay and labeled *sciophila* were found to be in reality *acticola*; one specimen taken by the MacGinities at Corona del Mar, California, February, 1948.

HOLOTYPE: The type specimen, anterior half as whole mount on original slide, posterior half as sagittal serial sections (one slide) deposited in the Natural History Museum, Stanford University, No. 5625.

REMARKS: This species appears to be rather uncommon, as no specimens assigned to it were found in the considerable material at my disposal other than stated above. It seems to be limited to the southern part of California.

***Notoplana sanpedrensis* Freeman, 1930**

REMARKS: I have had no specimens assignable to this species, and I strongly doubt its validity. It seems probable to me that the species is identical with *Notoplana acticola* (Boone). The only difference between the two species apparent from Freeman's description and figures is the alleged presence of a stylet in *sanpedrensis*. This is obscurely mentioned in the text in the following phrase: "an ejaculatory duct . . . continues its course through the base of the penis to the stylet at its point." The representation of the stylet in the figure is not very convincing either, and Freeman may have mistaken the slender penis papilla of *acticola* for a stylet. No specimens attributable to *sanpedrensis* were found in the Freeman collection, although this contains a number of specimens taken by Freeman at San Pedro.

***Notoplana longastyletta* (Freeman), 1933,
new combination**

Figures 78-80

Stylochoplana longastyletta FREEMAN, 1933, p. 119, figs. 6-8.

MATERIAL: One specimen taken alive in Puget Sound, two specimens collected in Puget Sound by F. A. Pitelka, University of California; a number of specimens from the Aleutian Islands sent by the United States National Museum.

FORM: Elongated oval, anterior end rounded, body of about the same width from brain to posterior end of pharynx, then narrowing slightly to rounded posterior end; to 40 mm. long and 11 mm. wide anteriorly; tentacles wanting. Unfortunately no drawing was obtained of the living specimen as it began to disintegrate and had to be fixed. Figure 78 shows the most extended of the preserved specimens.

COLOR: Tan to dark brown, with darker dots.

EYES: Eyes of Puget Sound specimens accurately figured by Freeman (his fig. 6); tentacular clusters rounded, of 17 to 20 eyes each; cerebral groups begin with sparse eyes over the brain, then expand anterior to the brain to occupy some width; up to 100 eyes in each cerebral cluster. But the eyes are much fewer in specimens from the Aleutian Islands (fig. 79); in these the tentacular clusters consist of about a dozen eyes, and the cerebral groups contain about 25 eyes in an elongated arrangement.

DIGESTIVE SYSTEM: Pharynx central, elongated, of a few lateral pouches in the smaller specimens, up to 20 in the larger ones (fig. 78). Freeman's statement that the gut branches anastomose centrally is presumably erroneous but could be settled only by means of frontal sections, not available.

COPULATORY APPARATUS: This is shown in sagittal view in figure 80. It is situated immediately behind the pharynx, hence some distance from the posterior end of the body. The sperm ducts enter separately the lateral angles of the retort-shaped seminal vesicle. This has thick muscular walls; it curves dorsally and narrows to the ejaculatory duct which quickly enters the muscular spherical prostatic vesicle, larger than the seminal

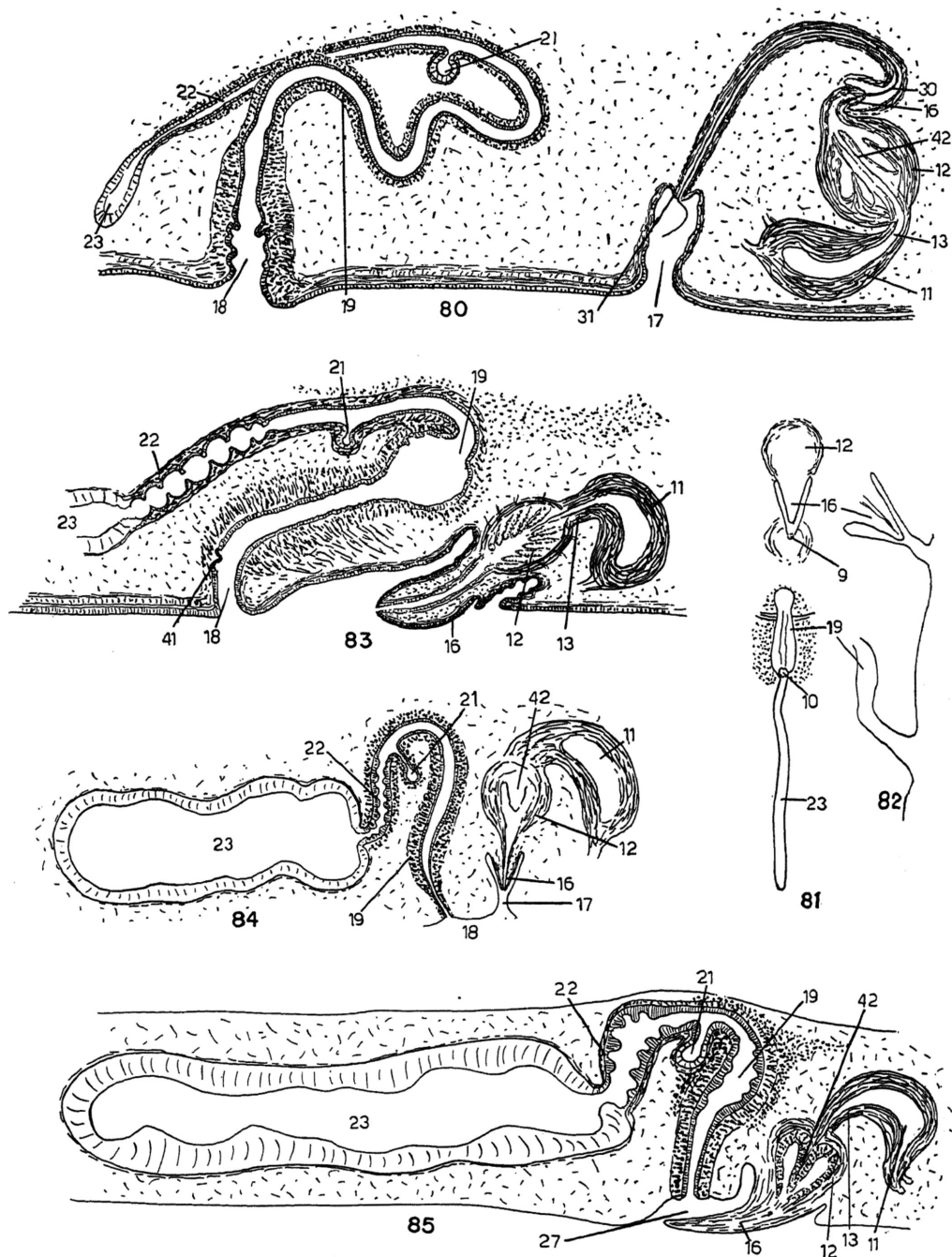


FIG. 80. *Notoplana longastyletta*, sagittal view of the copulatory apparatus, anterior end to right.

FIGS. 81-83. *Notoplana sanguinea*. 81. Copulatory apparatus seen from above. 82. Relations of gonopore with penis retracted. 83. Sagittal view of copulatory apparatus, with penis protruded, anterior end to right.

FIG. 84. *Notoplana natans*, sagittal view of copulatory apparatus, anterior end to right.

FIG. 85. *Notoplana celeris*, sagittal view of copulatory apparatus, penis protruded, anterior end to right.

vesicle, much larger in some individuals. This continues dorsally by a short length of ejaculatory duct into the small penis papilla which bears the very long slender stylet. In whole mounts this is usually seen more or less coiled and often projecting from the male gonopore. It is housed in a long tubular penis pocket that makes a forward curve immediately beyond the prostatic vesicle, then has a long backward arch, terminating at the small penis sheath. Distal to the penis sheath, the male antrum continues as a wider cavity to the male gonopore. The female gonopore is located very far posterior to the male pore. From it the muscular antrum and vagina ascend dorsally, then the vagina curves anteriorly, pursuing a more or less sinuous course for some distance anteriorly, finally curves backward and after receiving the common oviduct continues as a very long duct of Lang's vesicle that finally terminates in a small oval Lang's vesicle situated not far posterior to the distal part of the vagina. The antrum is quite muscular distally, perhaps without meriting the designation of bulbous antrum; the muscular wall then diminishes but continues of some thickness along the entire course of the vagina and duct of Lang's vesicle, finally vanishing at the neck of the vesicle. No cement glands accompanying the vagina were seen in three sets of sections available but presumably must be present.

DIFFERENTIAL CHARACTERS: This species has very distinctive characters, namely, the great distance between the male and female gonopores, the spherical prostatic vesicle, the very long, often coiled, penis stylet, the excessively long vagina and duct of Lang's vesicle, and the reduced Lang's vesicle.

DISTRIBUTION: Common in Puget Sound, taken by Freeman near Olga, by me near the Friday Harbor Laboratory, by Pitelka at Turn Rock; also common in the Aleutian Islands, taken by the "Albatross" on the Northwest Pacific Expedition in 1906 at Agattu Island, Attu Island, and Amchitka Island, also collected by the United States National Museum in Pavlov Bay.

NEOTYPE: As no specimen labeled *longa-styletetta* was found in the Freeman material, I have selected one of the specimens collected by Pitelka as a neotype: one whole mount,

also set of sagittal sections, deposited in the American Museum of Natural History (A.-M.N.H. No. 370).

***Notoplana sanguinea* Freeman, 1933**

Figures 81-83

MATERIAL: Several mounts in the Freeman collection labeled *sanguinea*; one specimen collected in Puget Sound by Pitelka.

FORM: Elongate oval, tapering to a bluntly pointed posterior end; to 25 mm. in length, mostly smaller; tentacles wanting.

COLOR: Pale or gray with a red saddle of varying size and shape across the central part of the dorsal surface, best developed in fully mature animals.

EYES: The eye arrangement is rather distinctive, consisting of four well-defined groups. The tentacular clusters consist of a few, mostly about 11, large eyes, forming a compact group. The cerebral eyes, of smaller size, begin behind the level of the tentacular eyes as a narrow band that widens anterior to the tentacular eyes, totaling about 20 to 25 eyes. The eye pattern is accurately shown in Freeman's figure 11.

DIGESTIVE SYSTEM: Pharynx central or slightly anterior, elongated with a number of lateral folds. Intestinal branches do not anastomose.

COPULATORY APPARATUS: Most of the specimens found in the Freeman collection were immature. Three showing copulatory apparatus as whole mounts were sectioned, but owing to mishaps and the poor state of the specimens, no satisfactory sections were obtained. Figure 81 shows the general appearance of the copulatory apparatus in the best of these three specimens before sectioning. A good series of sections was obtained of the Pitelka specimen, but in this specimen the penis papilla is protruded, with the result that there is some distortion of this region. A sagittal view of the copulatory apparatus of this specimen is given in figure 83. The sperm ducts enter separately the proximal end of the muscular seminal vesicle which arches dorsally and narrows to a short length of ejaculatory duct that enters the relatively small, slightly oval prostatic vesicle that is directly adjacent to the penis base. There appears to be no length of ejaculatory duct between the prostatic vesicle and the penis

papilla, but in the protruded condition of the penis papilla this point is difficult to decide. The penis papilla at rest (figs. 81, 82) is a short conical elevation with a broad base and rather pointed tip but appears much longer in the protruded condition (fig. 83), apparently because the male antrum is everted in copulation and thus adds to the length of the protruded papilla. The female gonopore lies some distance behind the male pore; the relations between the two pores with the penis papilla at rest is shown in figure 82. There is a vertical female antrum lacking in muscularity from which the vagina proper slants sharply forward and dorsally, enlarging to a chamber from which the vagina continues as a narrowed tube that curves posteriorly and after receiving the common oviduct merges into the rather long duct of Lang's vesicle. This descends and enters the Lang's vesicle which is of very long slender form (fig. 81). The vagina is well muscularized, especially in its distal portion between the antrum and the chamber. In the posterior wall of the antrum at its junction with the vagina there was seen a tooth-like elevation of hardened material. Whether or not this tooth is characteristic of the species cannot be stated from the one good series of sections available. The epithelial lining of the duct of Lang's vesicle is thrown into elevations, producing the bead-like appearance that seems to be common among leptoplanids. Cement glands appear limited to the chamber and that part of the vagina proximal to the chamber. The uteri are confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Notoplana sanguinea* is distinguishable from other *Notoplana* species of the region by the combination of color pattern, slightly oval, almost sperical prostatic vesicle, smaller than the seminal vesicle and immediately adjacent to the penis papilla, the short conical penis papilla, the well-separated gonopores, the chamber in the vagina, and the long slender Lang's vesicle.

DISTRIBUTION: Puget Sound, near the Oceanographic Laboratory, at Olga, and at Turn Rock; one of the less common leptoplanids of the region.

NEOTYPE: Specimen collected by Pitelka declared a neotype, anterior half as whole

mount, posterior half as sagittal serial sections (three slides), deposited in the American Museum of Natural History (A.M.N.H. No. 371).

REMARKS: This species can probably be recognized readily when alive by the red saddle across the dorsal surface. It may be pointed out that *Notoplana timida* (Heath and McGregor) is described as having a similar saddle, and the two species may well be identical. Should this prove to be the case, the name would of course become *N. timida*.

***Notoplana natans* Freeman, 1933**

Figure 84

MATERIAL: Several whole mounts in the Freeman collection labeled *natans* or *natantis*; several specimens taken alive in Puget Sound.

FORM: Elongate, moderately cuneate, widest anteriorly, tapering to a bluntly pointed posterior end; to 20 mm. in length extended; tentacles wanting.

COLOR: Light red according to the original description; according to my notes, grayish tan or pale, shading to light brown mid-dorsally.

EYES: Distinctive; tentacular eyes form a rounded compact group of mostly 10 to 15 eyes, many of them quite large; cerebral groups elongated, of loosely arranged eyes numbering 20 to 40, which spread both before and behind the tentacular groups so that the latter appear lodged in a depression of the cerebral groups. The eye pattern is well shown by Freeman in his figure 14.

DIGESTIVE SYSTEM: Pharynx central, elongated, of about eight to 12 lateral folds, depending on the size of the animal. Intestinal branches do not anastomose, but follow the usual leptoplanid pattern.

COPULATORY APPARATUS: According to Freeman's figure, the sperm ducts are united by a backward loop that passes dorsal to the duct of Lang's vesicle. A sagittal view of the copulatory apparatus is given in figure 84. The sperm ducts unite to a common duct that enters the proximal end of the seminal vesicle. This is a strongly muscularized curved oval body that joins directly the spherical prostatic vesicle by a backward arch. The prostatic vesicle is rather small, smaller than the seminal vesicle, well muscularized and of spherical form. It narrows distally to a short

ejaculatory duct that enters the base of the conical penis papilla. This is similar in form to that of *N. sanguinea*; it is lodged in a male antrum of similar size. The male and female gonopores are closely placed but still distinct. The short female antrum lacks muscularity and passes at once into the muscular vagina that ascends dorsally in a slight graceful curve, then curves posteriorly and receives the common oviduct. The duct of Lang's vesicle continues as a descending tube that enters the moderately long and rather broad Lang's vesicle. The muscular coat of the vagina continues up to the entrance of Lang's vesicle. The usual numerous cement glands can be seen radiating from the vagina in whole mounts but were not much in evidence in the set of sections; they accompany the vagina up to the entrance of the oviduct. The uteri are continuous around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: This species is differentiated from other species of *Notoplana* of the region by the close proximity of the parts of the male apparatus and of the gonopores, by the small spherical prostatic vesicle, smaller than the seminal vesicle, the absence of a marked forward loop of the vagina, and the rather broad, moderately long Lang's vesicle. Its habit of swimming readily also appears distinctive.

DISTRIBUTION: Common in Puget Sound, taken by Freeman at Olga and in False Bay, by me at Orcas Island and near the Oceanographic Laboratory, and by Pitelka at Turn Rock.

LECTOTYPE: One of Freeman's whole mounts declared a lectotype, A.M.N.H. No. 373.

REMARKS: This species would seem to be readily recognized when alive by the fact that it swims readily, fluttering the entire body. No other *Notoplana* species found in Puget Sound are able to swim.

***Notoplana celeris* Freeman, 1933**

Figure 85

MATERIAL: One whole mount found in the Freeman collection, labeled *Notoplana celeris*.

FORM: Cuneate, broadest anteriorly, tapering to a pointed posterior extremity; to 40 mm. long and 6 mm. wide across the widest region; thin, changeable, sides of body thrown

into waves by rapid movements; tentacles wanting.

COLOR: Wine, according to the original description.

EYES: Distinctive; tentacular groups of small, crescentic eyes, about 16 to 18 in number in a circular group located close to the middle of the cerebral groups; latter of small, mostly rounded eyes in an elongated irregular arrangement that extends about as far posterior to the level of the tentacular clusters as anterior to them; eyes correctly shown in Freeman's figure 18.

DIGESTIVE SYSTEM: Pharynx slightly anterior, narrow, elongated, of about "six to eight double lateral folds."

COPULATORY APPARATUS: The copulatory region of Freeman's specimen was removed and sectioned; a sagittal view of the apparatus is shown in figure 85. There is nothing very distinctive about the copulatory anatomy of this species. The sperm ducts, according to Freeman's account, do not loop back over the female apparatus. They enter separately the distal end of the curved, retractor-shaped seminal vesicle. This has a muscular wall and arches backward and downward to enter the cordiform prostatic vesicle with fairly muscular wall; this continues directly into the penis papilla of elongate conical form. In the one available specimen, the penis papilla is protruded, probably altering somewhat the relations here. There appear to be no lengths of ejaculatory duct between seminal and prostatic vesicles or between prostatic vesicle and penis papilla. There is a common shallow genital antrum from the posterodorsal wall of which the vagina proceeds dorsally. As usual the vagina curves forward, then turns posteriorly, soon receiving the common oviduct into its ventral wall. It then continues as the duct of Lang's vesicle, which turns sharply downward, presenting the usual beading of its lining epithelium, and enters the long and broad Lang's vesicle. The vagina is uniformly muscular along its vertical portion and receives cement glands from about the middle of this vertical part to the level of entrance of the oviduct. The uteri are confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Notoplana celeris* is characterized by the combination

of eye pattern, cordiform prostatic vesicle of about the same size as the seminal vesicle, lack of lengths of ejaculatory duct between seminal and prostatic vesicles and prostatic vesicle and penis base, long pointed penis papilla, common antrum, and broad and long Lang's vesicle. *N. inquieta* and *N. saxicola* are other *Notoplana* species from the region under consideration that have a common gonopore; *N. celeris* is easily distinguished from *inquieta* by the penis stylet of the latter and from *saxicola* by the reduced Lang's vesicle of the latter.

DISTRIBUTION: Puget Sound, not as yet taken elsewhere.

LECTOTYPE: Freeman's specimen declared a lectotype; anterior half as whole mount, posterior half as sagittal serial sections (two slides), deposited in the American Museum of Natural History (A.M.N.H. No. 372).

REMARKS: Although stated by Freeman to be fairly common in Puget Sound at the time of his collecting there, the species does not appear to have been retaken since, for it is not present in a number of collections from Puget Sound that have come to me since Freeman's publication.

***Notoplana sanjuaniana* Freeman, 1933**

Figure 86

MATERIAL: Several specimens personally collected alive in Puget Sound, many specimens sent by the United States National Museum, type and other whole mounts found in the Freeman collection.

FORM: Cuneate, anteriorly expanded, tapering posteriorly; to 40 mm. long and 10 mm. wide in widest region; tentacles wanting, but slight elevations present bearing the tentacular eyes.

COLOR: Grayish brown spots and granules on a pale grayish tan ground.

EYES: Distinctive; cerebral and tentacular groups well separated; tentacular eyes about 10 to 20 in a rounded group located on a slight elevation representing rudimentary tentacles; cerebral group linear, beginning posteriorly at about the level of the posterior end of the brain and extending forward, widening anterior to the brain, of about 20 to 30 eyes in available specimens, up to 60 according to Freeman; cerebral eyes mostly smaller than tentacular eyes. The eyes are

well shown in Freeman's figure 19, although in many specimens the cerebral groups are less expanded anteriorly than shown in this figure.

DIGESTIVE SYSTEM: Pharynx central, elongated, with up to 20 lateral folds.

COPULATORY APPARATUS: Shown in sagittal view in figure 86. The sperm ducts loop backward above the female apparatus; I am not able to understand Freeman's claim that most of this loop consists of interpolated testes with their sperm ductules. This was also claimed and illustrated by Heath and McGregor for *Notoplana rupicola*, but I know of no one else who has ever reported such a condition. Sections are usually not carried far enough laterally to enable one to trace this posterior extension of the sperm ducts. The sperm ducts enter separately the proximal end of the seminal vesicle. The latter is a curved, oval, inflated body with moderate muscular walls; it is unusually large compared to the prostatic vesicle. The prostatic vesicle is slightly oval, almost spherical, and appears perfectly spherical when viewed from above in whole mounts. Considerable lengths of ejaculatory duct intervene between seminal and prostatic vesicles and between prostatic vesicle and penis base. The penis papilla is of short conical form housed in the expanded inner end of the otherwise rather narrow and moderately long male antrum. A wavy condition of the lining epithelium of the male antrum appears characteristic of the species. The female gonopore is unusually far posterior to the male pore. There is no distinction between female antrum and vagina. The latter slants markedly forward, then curves posteriorly and after receiving the oviduct continues as the duct of Lang's vesicle, which is reduced to a small oval sac. The vagina is quite muscular throughout its course and supplied with cement glands from about halfway up on the forward slant to the entrance of the oviduct. The uteri are confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: This species is characterized by the large bulbous seminal vesicle, the nearly spherical prostatic vesicle, the short conical penis papilla, the considerable distance between the gonopores, and the reduced Lang's vesicle. The only other *Noto-*

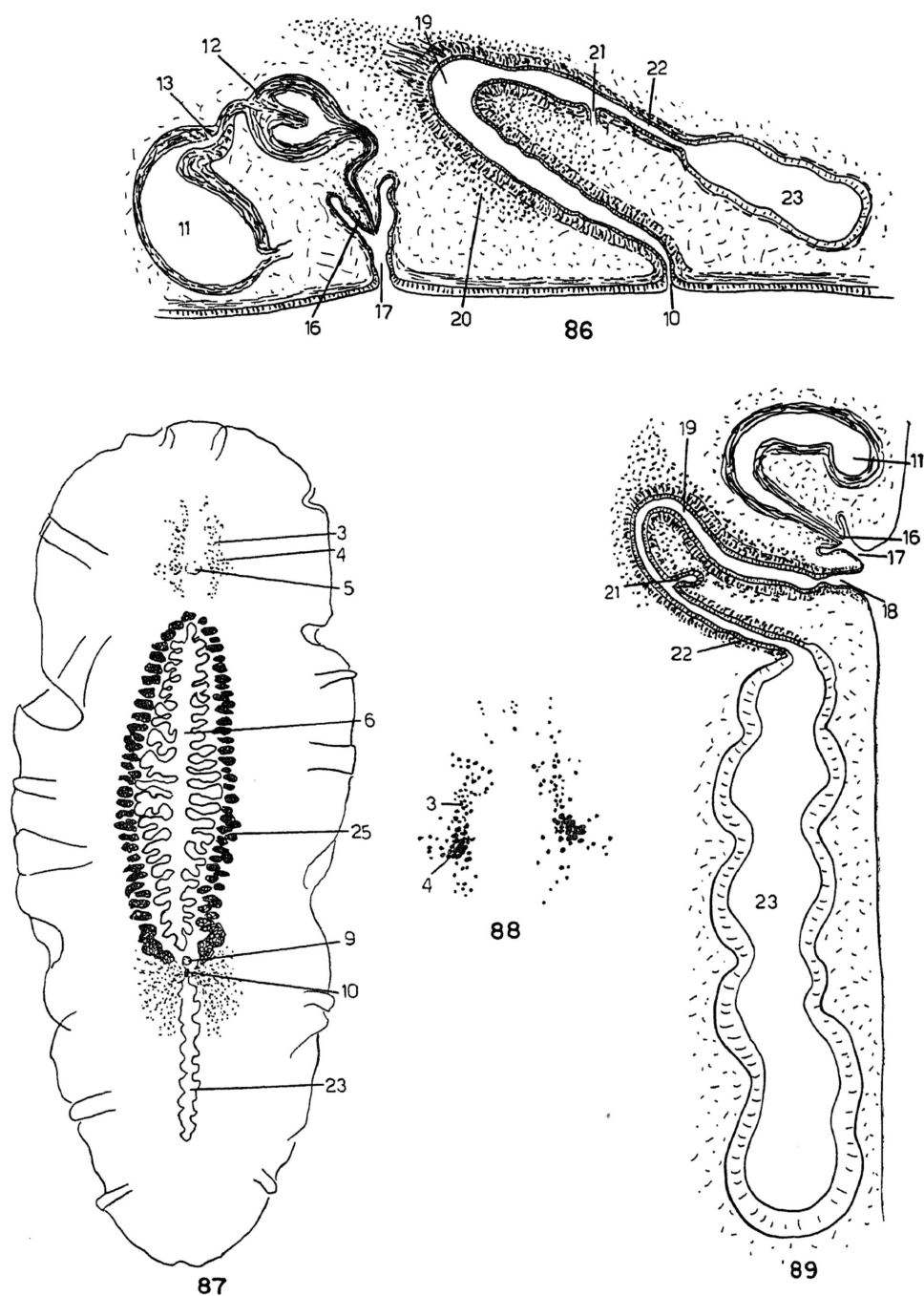


FIG. 86. *Notoplana sanjuania*, sagittal view of copulatory apparatus, anterior end to left.

FIGS. 87-89. *Euplanella pacifica*. 87. Dorsal view. 88. Eye pattern. 89. Sagittal view of copulatory apparatus of Gulf of California specimen, anterior end above.

plana species of the region under consideration with such widely separated gonopores is *N. longastyletta*, and this is easily distinguished from *sanjuania* by the presence of a long penis stylet.

DISTRIBUTION: Common throughout Puget Sound; many specimens sent by the United States National Museum, collected in Pavlov Bay, Alaska, September, 1940, mostly in association with a crab, *Paralithodes camtschatica*, found either on the crab's back or inside barnacles growing on the crab.

HOLOTYPE: Freeman's specimen labeled "type" deposited in the American Museum of Natural History (A.M.N.H. No. 374).

REMARKS: This is one of the most common polyclads of Puget Sound, also extending far northward from this area but not found southward. It can be recognized as a whole mount by the eye arrangement, inflated seminal vesicle, spherical prostatic vesicle, distant gonopores, and reduced Lang's vesicle.

This account completes the *Notoplana* species described for the region under consideration. There is a total of nine distinct species that have been identified without doubt, namely: *saxicola* and *inquieta* of Heath and McGregor; *acticola* and *sciophila* of Boone; and *longastyletta*, *sanguinea*, *natans*, *celeris*, and *sanjuania* of Freeman. It has been impossible to identify *timida* (Heath and McGregor), 1912, or *sanpedrensis* Freeman, 1930, and *rupicola* (Heath and McGregor), 1912, has been only tentatively identified. The Puget Sound species described by Freeman have all been found to be distinct from the Californian species except that there remains a possibility of the identity of *timida* and *sanguinea*. The genus *Notoplana* is a very difficult genus, containing a large number of species that look very much alike externally, having the typical leptoplanid appearance, and cannot be recognized with any certainty by external characters alone. Frankly, I have not made an exhaustive comparison of these Pacific coast species with *Notoplana* species described from other parts of the world but have more or less assumed that sufficient geographic distance makes specific difference probable. I have, however, been at some pains to inspect the descriptions of Japanese species of *Notoplana*

because of the proximity of Japan to the northern limits of the region here under study. Kato (1944) in his summary of the polyclads of Japan lists nine species of this genus in Japan, but all of them appear distinct from those of North American shores. I have also made comparisons with *Notoplana* species described from various Pacific islands near the coasts of the American continents but failed to find any possibility of identity.

GENUS EUPLANA GIRARD, 1893

DEFINITION: Leptoplanidae of moderately elongate body form, without tentacles; eyes in cerebral and tentacular groups; with true seminal vesicle; prostatic vesicle wanting; penis papilla armed or unarmed; Lang's vesicle present or absent.

TYPE SPECIES: *Euplana gracilis* (Girard), 1850.

Euplana pacificola (Plehn), 1896,
new combination

Figures 87-89

Leptoplana pacificola PLEHN, 1896, p. 153, pl. 10, figs. 7-9; pl. 13, fig. 9.

Discoplana pacificola (Plehn), BOCK, 1913, p. 220.

MATERIAL: One specimen sent by the MacGinities; four specimens collected by Ricketts; two specimens sent by the Allan Hancock Foundation.

FORM: Preserved, elongate, oval, rounded at both ends (fig. 87), tapering somewhat posteriorly; available specimens 17 to 22 mm. long (preserved) by 6 to 9 mm. across the widest (anterior) region; tentacles wanting; somewhat thick.

COLOR: Not known in life; preserved specimens appear light brown.

EYES: Eyes of the Mexican specimens differ somewhat from Plehn's rather poor figure. Whereas Plehn shows the tentacular and cerebral groups as distinctly separated, in the Mexican specimens, both groups are combined in a pair of longitudinal bands. The tentacular eyes can be distinguished in this band as a close cluster of larger eyes; the cerebral eyes extend both before and behind this cluster and loosely to the outer side of it (fig. 88); anteriorly the cerebral eyes continue along the course of nerve trunks as a few scattered eyes arranged in three or four strands.

DIGESTIVE SYSTEM: The pharynx is long and narrow, with many lateral folds (fig. 87).

COPULATORY APPARATUS: The MacGinitie specimen and one of the Ricketts specimens were sectioned sagittally through the copulatory apparatus; the latter was found in the more mature condition and is the basis of figure 89 and the following description. The sperm ducts enter separately the proximal end of the curved, somewhat tubular, well-muscularized seminal vesicle. This, as diagnostic of the genus, continues directly into the ejaculatory duct that penetrates the penis papilla. The latter is a low, broad eminence projecting into the small male antrum. The male gonopore is so close to the female gonopore that they may be considered as opening into a shallow common antrum. From this a short female antrum ascends dorsally and is slightly constricted from the vagina proper which continues the dorsal ascent, slanting slightly forward. It then curves backward and after receiving the common oviduct becomes continuous with the duct of Lang's vesicle. This descends and enters the exceedingly long Lang's vesicle which is about half of the length of the pharynx. The vagina has a moderate muscular investment which decreases towards the antrum and receives shell glands along its course as far as the entrance of the oviduct. The uteri fuse around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Euplana pacificola* is differentiated from all other members of the genus by the well-developed Lang's vesicle of typical oval shape.

DISTRIBUTION: Collected by the Allan Hancock Foundation at Guaymas, Mexico, May, 1946; by the MacGinitie at Miramar Beach, Guaymas, Mexico, February 9, 1948; and by Ricketts at Point Marcial Reef, Lower California, March 24, 1940. These two localities are on opposite shores of the middle region of the Gulf of California.

SPECIMEN: One of the Ricketts' specimens, as whole mount, also one set of sagittal sections of the copulatory region (two slides) deposited in the American Museum of Natural History (A.M.N.H. No. 375).

REMARKS: Plehn had specimens of this species from two localities on the Pacific coast of South America; she spoke of them as varieties but did not give them varietal

names. The Chile specimen, taken from the bottom of a boat at Valparaíso and hence not necessarily native to the locality, differs from the present Mexican specimens in the distinctly separated gonopores, the more pointed penis papilla, and the relatively short Lang's vesicle. The other specimen, from the Peruvian coast, closely resembles the Mexican specimens in the common shallow antrum and more rounded penis papilla, but the Lang's vesicle, although longer than in the Chilean worm, is only about half as long as that of the Mexican specimens. The latter can therefore be regarded as a Mexican variant of the species. The species evidently shows considerable geographic variation but splitting it into distinct species appears unjustified.

A number of species have now been assigned to the genus *Euplana* (= *Discoplana*). Bock (1913, pp. 220-221) in creating the genus *Discoplana* assigned four species to it. Of these *subviridis* (Plehn), 1896, is declared by Stummer-Traunfels (1933) to be identical with *gigas* (Schmarda), 1859, from Ceylon, and Kato (1944) noted that his species *Susakia badiomaculata* is also identical with *gigas*. To the four species known to Bock there should be added *gracilis* (Girard), 1850, the type species of the genus. To these five species there have been added since the date of Bock's monograph the following: *takewakii* Kato, 1935; *clippertoni* Hyman, 1939b; *carolinensis*, Hyman, 1940; *longipenis* Kato, 1943; and *hymanae* Marcus, 1947. As shown in the present study, "*Leptoplana*" *inquieta* Heath and McGregor, 1912, does not belong to *Euplana*, as supposed by Marcus (1947), but is a *Notoplana*. There are consequently at present writing 10 species of *Euplana*, mostly from tropical or subtropical localities. Lang's vesicle is small, rudimentary, or wanting in all the species except *pacificola* and *gigas*: in *gigas* it has the form of a U, with the arms extending forward.

GENUS PHYLLOPLANA LAIDLAW, 1903

DEFINITION: Leptoplanidae of typical body form with or without tentacles; eyes in tentacular and cerebral groups; with strongly developed spermiducal bulbs that unite with the true seminal vesicle to form a tripartite structure; prostatic vesicle poorly differen-

tiated; penis armed or not; Lang's vesicle present or absent.

TYPE SPECIES: *Phylloplana lactea* Laidlaw, 1903.

Phylloplana viridis (Freeman), 1933,
new combination

Figures 90-92

Stylochoplana viridis FREEMAN, 1933, p. 118,
figs. 3-5.

MATERIAL: One whole mount found in the Freeman collection labeled "*S. viridis* type."

FORM: Elongate, rounded anteriorly, tapering to a blunt tail (fig. 90); thin and soft; with two short conical or cylindrical nuchal tentacles; 25 mm. long by 8 mm. through the brain region.

COLOR: Uniform light green.

EYES: In four well-separated groups; tentacular eyes form a small group of nine to 13 eyes located on the tentacles; cerebral eyes smaller than the tentacular eyes, arranged in two loose groups of 12 to 20 eyes each, extending forward from the level of the tentacles along the lateral sides of the brain and the bases of large nerve trunks. The eyes are correctly depicted by Freeman in his figure 5.

DIGESTIVE SYSTEM: Pharynx slightly anterior, long and narrow, with a number of lateral folds; mouth at about two-thirds of the pharynx length; intestinal branches radiating, not anastomosing.

COPULATORY APPARATUS: This is located a little distance behind the rear end of the pharynx (fig. 90). After the dorsal aspect of the male apparatus had been drawn (fig. 91), the specimen was dissolved from the slide, and the copulatory region was sectioned sagittally. The sperm ducts after reaching the level of the copulatory apparatus turn anteriorly and immediately enlarge into prominent muscular spermiducal bulbs of elongated oval form (fig. 91). These soon fuse and extend anteriorly, then join the proximal end of the true seminal vesicle, a straight muscular tube that proceeds backward in the median line for a length nearly double that of the spermiducal bulbs and then narrows as it enters the prostatic vesicle. Spermiducal bulbs and seminal vesicle thus form a large conspicuous tripartite seminal vesicle. In the type specimen, spermiducal bulbs, seminal

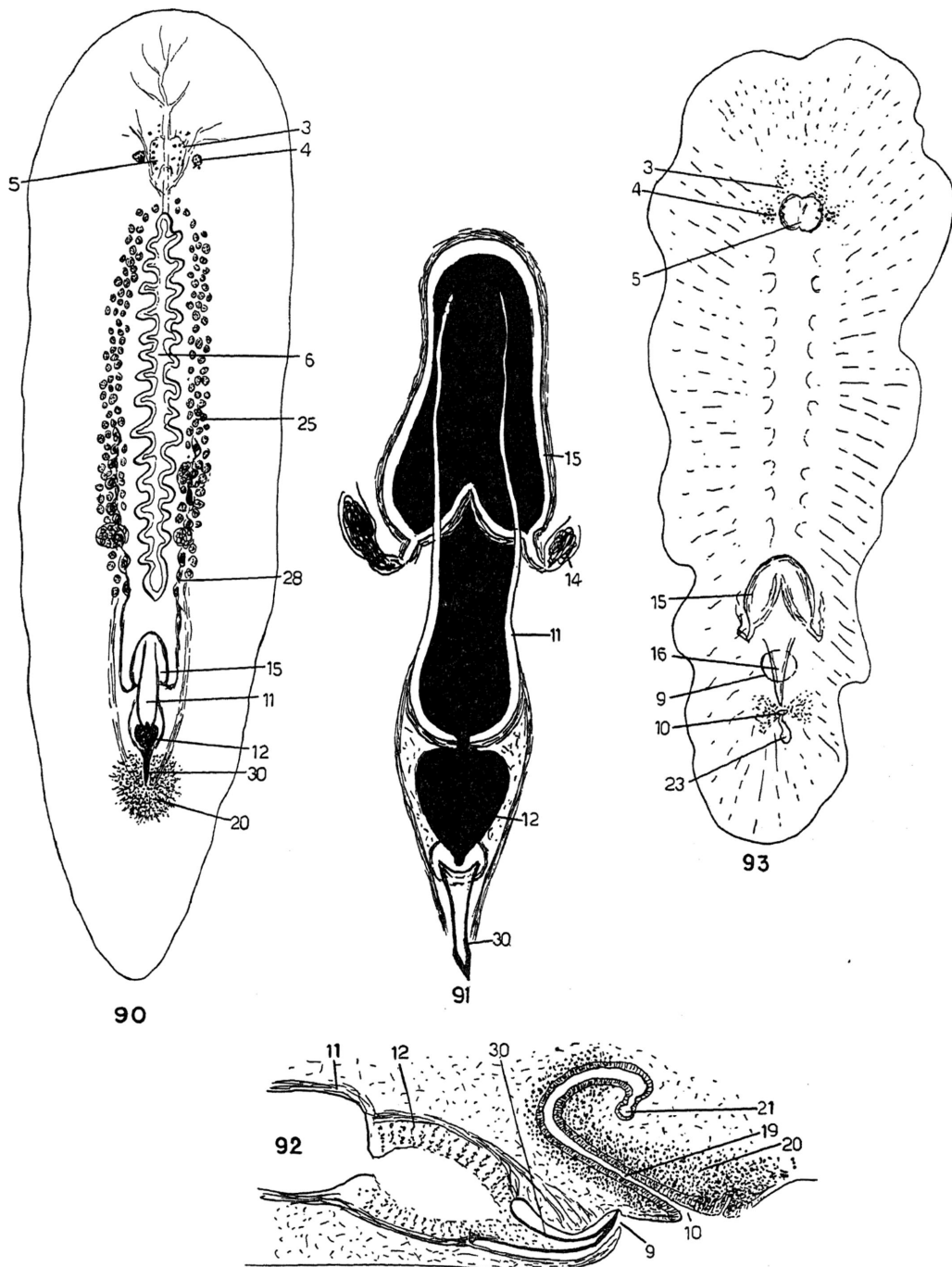
vesicle, and prostatic vesicle are packed and distended with a dense mass of sperm that clearly outlines the lumina of these organs. Sections (fig. 92) show that the cordate prostatic vesicle is a poorly differentiated organ. Its external surface is delimited by a continuation of the muscle wall of the seminal vesicle, and its interior is lined by a thick layer showing eosinophilous strands of secretion; a definite epithelial lining could not be discerned. To the distal end of the prostatic vesicle is attached the curved pointed penis stylet (fig. 92), housed in a male antrum of similar shape leading to the male gonopore. Slightly behind this lies the female gonopore from which the vagina ascends on a pronounced forward slant, then curves backward and terminates with entrance of the common oviduct, so that a Lang's vesicle is wanting. The vagina is so thickly entered throughout its course by cement glands that it was not possible to determine how much of a muscular investiture it has. Shortly behind the female gonopore was noted an epithelial invagination that serves as the outlet of a particularly dense aggregation of cement glands. As shown in figure 90, the uteri are confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Phylloplana viridis* is differentiated from other species of the genus by the combination of tentacles, penis stylet, and lack of Lang's vesicle.

DISTRIBUTION: Taken by the describer in Puget Sound, at False Bay and near Brown's Island; no other specimen has to my knowledge been collected since the original finding.

HOLOTYPE: Freeman's type specimen deposited in the American Museum of Natural History, anterior half as whole mount, posterior region as sagittal serial sections (three slides), (A.M.N.H. No. 376).

REMARKS: The present species is the third to be assigned to this genus on adequate grounds. The type species *lactea* has a penis stylet and a small Lang's vesicle. Stummer-Traunfels (1933) placed part of Schmarda's specimens labeled *Leptoplana purpurea* in the genus *Phylloplana*; *purpurea* lacks a penis stylet and has a large Lang's vesicle. The present species has a conspicuous stylet but altogether lacks a Lang's vesicle. It appears to me to fit well enough into the genus



FIGS. 90–92. *Phylloplana viridis*. 90. Type specimen, dorsal view. 91. Enlarged view of male apparatus, from above. 92. Sagittal view of copulatory apparatus, only distal end of seminal vesicle shown, anterior end to left.

FIG. 93. *Freemania litoricola*, dorsal view from life, Puget Sound.

Phylloplana and certainly is not a *Stylochoplana* as Freeman thought.

FREEMANIA, NEW GENUS

DEFINITION: Leptoplanidae of typical form and thick consistency, without tentacles; eyes in paired cerebral and tentacular clusters; with massive spermiducal vesicles; true seminal vesicle wanting; prostatic vesicle well differentiated, of the *Notoplana* type; large, unarmed penis papilla; Lang's vesicle wanting.

TYPE SPECIES: *Freemaniana litoricola* (Heath and McGregor), 1912.

Freemaniana litoricola (Heath and McGregor), 1912, new combination

Figures 93, 94

Phylloplana litoricola HEATH AND MCGREGOR, 1912, p. 472, text fig. 4; pl. 12, fig. 7; pl. 15, fig. 23; pl. 18, fig. 42.

Notoplana segnis FREEMAN, 1933, p. 130, figs. 23-25, 37.

MATERIAL: Many specimens collected personally in Puget Sound; sent by Ricketts and the United States National Museum; and found as whole mounts in the Boone, Fisher, and Freeman material, including the type specimen of *Notoplana segnis*.

FORM: Varying from elongated oval to somewhat cuneate (fig. 93, from life) as the animal creeps slowly with changing margins; to 40 mm. in length, extended, by 10 mm. across the widest region; preserved specimens are usually perfectly oval, with gaping gonopore and protruding penis papilla.

COLOR: According to my observations, mottled dark brown, with darker brown mid-dorsally.

EYES: The eye arrangement has been correctly depicted by both Heath and McGregor and Freeman. The tentacular and cerebral groups are distinctly separated. The former occupies an oval whitish slanting area and consists of a close group of about 15 eyes plus some more loosely arranged eyes before and behind this. The cerebral eyes are loosely arranged linear groups of 35 to 80 eyes each, beginning at about the level of the most posterior eyes of the tentacular groups and extending forward well beyond the anterior margin of the brain. The cerebral group

is narrow posteriorly and widens anteriorly, where some scattering occurs.

DIGESTIVE SYSTEM: The pharynx is long and narrow, with a number of lateral folds; the mouth is slightly posterior to the center of the pharynx. Contrary to Freeman's statement there is no peripheral anastomosis of the intestinal branches.

COPULATORY APPARATUS: A dorsal view of this apparatus as seen in whole mounts is given by both Heath and McGregor and Freeman. Its outstanding features are the massive spermiducal bulbs and the long conical penis papilla. The sperm ducts are connected, as often in Leptoplanidae, by a loop that passes above the female apparatus. They form the usual spermiducal vesicles beside the posterior part of the pharynx. On reaching the male apparatus these narrow and, turning forward, enter the proximal ends of the conspicuous spermiducal bulbs. These have thick muscular walls of fibers paralleling the external contours and relatively narrow lumina. They extend anteriorly, converging towards each other and fusing medially. From the fused region a narrow ejaculatory duct proceeds posteriorly and soon enters the small, narrowly oval prostatic vesicle, constructed as in the genus *Notoplana* with a central projecting ejaculatory duct encircled by longitudinal chambers. From this the ejaculatory duct continues posteriorly and with a sharp downward bend enters the base of the penis papilla. This is an unusually large, very muscular, pointed, conical projection; as it seems to exceed in length the male antrum it is nearly always found protruding from the male gonopore which in preserved specimens is often widely distended. The female gonopore lies shortly behind the male pore and leads into what seems to be a female antrum with well-muscularized walls. From the posterodorsal wall of this the vagina proper proceeds, soon making a sharp dorsal and then a forward bend. This "kink" in the vagina appears in all three sets of sections available and is also seen in Heath and McGregor's sketch, their text figure 4. The vagina makes the usual backward loop and, after receiving the common oviduct into its ventral wall, becomes continuous with the short narrow duct of Lang's vesicle, leading to the rather small, ir-

regularly rounded or oval Lang's vesicle. The uteri encircle the anterior end of the pharynx. What Heath and McGregor call uterine glands are probably masses of sperm in the uterus, as fertilization occurs in this region of the uteri. It is apparently unusual to find such sperm masses in the uteri, since no such condition is detectable in a number of available whole mounts of this species.

DIFFERENTIAL CHARACTERS: This species is readily distinguished from all other polyclads of the region by the combination of massive spermiducal bulbs and large, elongated, pointed penis papilla.

DISTRIBUTION: Monterey Bay; Puget Sound; also taken by Ricketts on the shores of Vancouver Island and Queen Charlotte Islands, British Columbia.

LECTOTYPE: One of the whole mounts in the Fisher collection labeled as identified by Heath declared a lectotype, Natural History Museum, Stanford University, No. 5627. Type of *Notoplana segnis* deposited in the American Museum of Natural History (A.M.N.H. No. 378).

REMARKS: This is one of the most common species in the region under consideration; it is found from Monterey Bay to British Columbia, and is especially abundant everywhere in Puget Sound. Heath and McGregor obviously put the species in *Phylloplana* because of its highly developed spermiducal bulbs, but the lack of a true seminal vesicle and the presence of a well-defined prostatic vesicle of the *Notoplana* type make it impossible to fit the species into *Phylloplana*. Stummer-Traunfels (1933) has also remarked that the species must be removed from *Phylloplana*. Freeman evidently regarded the chambered prostatic vesicle as sufficient ground for allocating the species to *Notoplana*, but the massive spermiducal bulbs and other details of the male copulatory apparatus are foreign to the genus. I therefore feel it necessary to create a new genus for the species and have named it after Freeman in recognition of his pioneer work on the polyclads of Puget Sound.

For a long time I was of the opinion that "*Phylloplana*" *chloranota* Boone was a not fully mature specimen of *Freemanina litoricola*, and Marcus (in correspondence) concurred in this opinion. The figures of Boone

left no other conclusion. Examination of the type specimen showed that this conclusion was altogether erroneous and that in fact the two species are altogether different. As already explained, "*Phylloplana*" *chloranota* turned out to be a species of *Leptoplana*.

MACGINITIELLA, NEW GENUS¹

DEFINITION: Leptoplanidae of elongated oval form, without tentacles; tentacular eyes present, cerebral eyes wanting; with massive spermiducal bulbs; true seminal vesicle absent; with strongly developed interpolated prostatic vesicle; penis papilla armed; ductus vaginalis present, opening posteriorly into the intestine.

TYPE SPECIES: *Macginitiella delmaris*, new species.

Macginitiella delmaris, new species

Figures 95, 96

MATERIAL: One specimen sent by the MacGinities, collected by Bland Ewing.

FORM: Elongated oval (fig. 95), rounded at both ends, broadest anteriorly, narrowing somewhat towards the posterior extremity, 29 mm. long by 9 mm. wide when alive.

COLOR: According to the collector, rose shading to rose beige at the margin; on the anterior third of the animal, halfway between the margins and the center, festoons and aggregations of dark pigment occur in bilateral curves as shown in figure 95.

EYES: This species is remarkable for the paucity of eyes. Eyes are limited to a pair of tentacular clusters, each of three or four small, closely placed eyes.

DIGESTIVE SYSTEM: Pharynx somewhat anterior, elongated, with a number of lateral folds (fig. 95); intestinal branches radiating as usual in leptoplanids.

COPULATORY APPARATUS: The copulatory region of the specimen has been sectioned and is shown in sagittal view in figure 96, which omits the spermiducal bulbs. This species has massive spermiducal bulbs that lie parallel to each other and to the median body plane, close to that plane (fig. 95). The sperm ducts descending posteriorly to a level a little behind the gonopore turn sharply anteriorly and at once enlarge to the elongated

¹ In honor of the MacGinities for their generous cooperation in the present study.

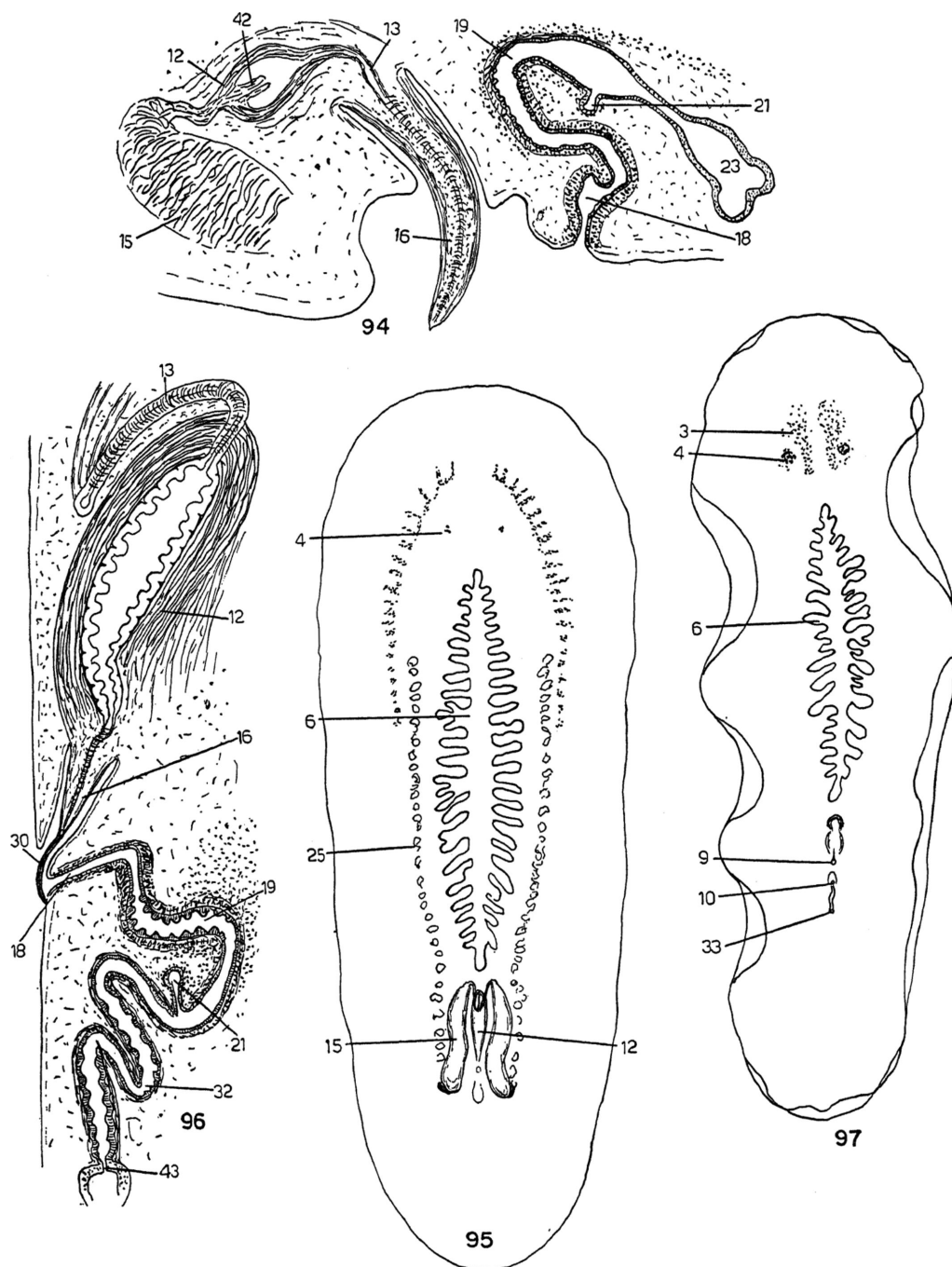


FIG. 94. *Freemania litoricola*, sagittal view of copulatory apparatus, anterior end to left.

FIGS. 95, 96. *Macginitieella delmaris*. 95. Dorsal view. 96. Sagittal view of copulatory apparatus, spermiducal bulbs omitted, anterior end above.

FIG. 97. *Copidoplana tripyla*, dorsal view.

spermiducal bulbs with a thick muscular wall and moderate-sized lumen. These bulbs extend forward to a level not far behind the pharynx, then narrow again, losing most of the muscular wall, to slightly muscularized sperm ducts that proceed obliquely posteriorly ventral to the anterior part of the prostatic vesicle. They here unite (fig. 96) to a somewhat muscularized common sperm duct; this takes a dorsal and forward course and then curves backward to enter the proximal end of the prostatic vesicle. The latter is an elongated body, similar in size and shape to the spermiducal bulbs. It has a thick muscular wall and fairly wide lumen lined with a scalloped epithelium but is not chambered. Distally it narrows and becomes continuous with the base of the penis papilla. The latter has the form of a pointed, elongated cone, lying in a male antrum of similar shape. The penis is armed with a curved stylet of moderate length. The male and female gonopores lie very close together. From the female pore, the scarcely muscularized female antrum ascends dorsally and then gives off the vagina by a sharp backward turn. The vagina has distally a thick muscular investment, possibly forming a sphincter, and is fairly muscular along its course. It curves dorsally, presenting a scalloped epithelium, then downward, and after receiving the common oviduct continues as a sinuous tube that communicates with the intestine. This sinuous tube is evidently a ductus vaginalis that forms a genitointestinal canal; it clearly represents the duct of a missing Lang's vesicle, and its epithelium is thrown into the same regular constrictions often seen in this duct. The usual cement glands enter the vagina from a point beyond the sphincter to the entrance of the oviduct. The uteri do not extend around the anterior end of the pharynx.

DISTRIBUTION: Taken on a rocky shore at Corona del Mar, California, in February, 1948.

HOLOTYPE: Anterior half as whole mount, copulatory region as sagittal sections (four slides) deposited in the American Museum of Natural History (A.M.N.H. No. 377).

REMARKS: This species appears to be rather rare. It can be recognized from all other polyclads of the region by the paucity of eyes.

The color reported is probably the result of the ingestion of some particular food item. It seems likely that the species is really white. Its relation to other leptoplanid genera is problematical, but creation of a new family to contain it appears unjustified. From Bock's (1927) discussion of the genitointestinal connection in polyclads, it appears that among Acotylea such a connection has hitherto been noted only in the family Stylochidae. The present report therefore seems to be the first finding of a genitointestinal communication in leptoplanids. One can but agree with the conclusion of Bock that among the Turbellaria the intestine tends to fuse with adjacent structures, and hence the presence of a genitointestinal duct cannot be regarded as indicative of relationship. This duct is one of several variations found in the postvaginal part of the female tract in polyclads.

GENUS COPIDOPLANA Bock, 1913

DEFINITION: Leptoplanidae of elongated form without tentacles; with tentacular and cerebral eyes; with true seminal vesicle; spermiducal bulbs wanting; prostatic vesicle interpolated, of the *Notoplana* type; penis stylet present; Lang's vesicle wanting; instead vaginal duct present opening on the ventral surface by a separate pore behind the female gonopore.

TYPE SPECIES: *Copidoplana paradoxa* Bock, 1913.

Copidoplana tripyla, new species

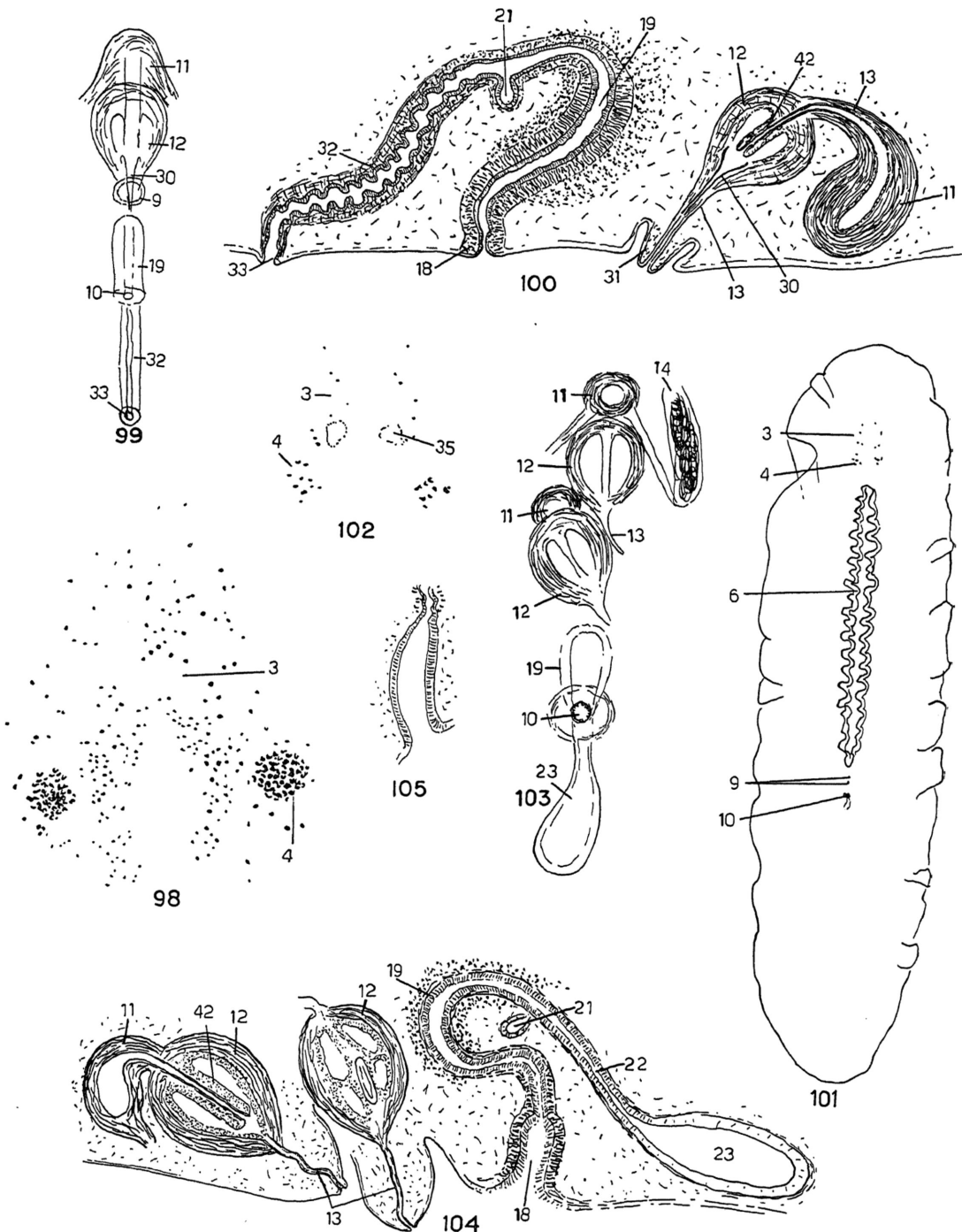
Figures 97-100

MATERIAL: One whole mount found in the Fisher collection, labeled "*L. acticola* Monterey."

FORM: Elongated, both ends rounded, width decreasing slightly posteriorly (fig. 97); 26 mm. long by 7 mm. wide across the anterior region; tentacles wanting.

COLOR: Not determinable; specimen had been stained.

EYES: In separate tentacular and cerebral groups, not superimposed as in *C. paradoxa* Bock. The tentacular eyes consist of a compact group plus a few scattered eyes to the side of and behind this group, to a total of 50 to 60 eyes. The cerebral groups, of 90 to 100 eyes each, are loose elongated groups, be-



FIGS. 98-100. *Copidoplana tripyla*. 98. Eye pattern. 99. Copulatory apparatus seen from above in whole mount. 100. Sagittal view of copulatory apparatus, anterior end to right.

FIGS. 101-105. *Diplandros singularis*. 101. Dorsal view. 102. Eye pattern. 103. Copulatory apparatus seen from above, in whole mount, Fisher specimen. 104. Sagittal view of the copulatory apparatus, Fisher specimen, anterior end to left, protruded condition. 105. Male antrum of the Ricketts specimen, retracted condition.

ginning well behind the level of the main tentacular clusters and spreading anteriorly (fig. 98).

DIGESTIVE SYSTEM: Pharynx slightly anterior, elongated, with a number of lateral folds (fig. 97); mouth central.

COPULATORY APPARATUS: Situated immediately behind the pharynx, far removed from the posterior end (fig. 97). Its main features, including the presence of a vaginal duct, could be seen in the whole mount and are sketched in figure 99. The posterior part of the worm was removed and sectioned and the copulatory apparatus is shown in sagittal view in figure 100. The sperm ducts form voluminous spermiducal vesicles; they enter separately the lateral angles of the retort-shaped seminal vesicle with thick muscular wall. This narrows to an ejaculatory duct that penetrates the muscular wall of the cordiform prostatic vesicle. The latter is constructed as in *Notoplana* of a central ejaculatory duct projecting far into the lumen and encircled by longitudinal chambers. Prostatic glands and secretory granules were not in evidence in the preparation. The wall of the prostatic vesicle, although moderately thick, is of looser construction than the wall of the seminal vesicle. The prostatic vesicle narrows distally into what appears to be a penis pocket. This contains the penis stylet which as in *C. paradoxa* seems not to be fully cuticularized. No definite penis papilla could be discerned. The tubular penis pocket proceeds ventrally, slanting posteriorly, and terminates in what at first sight might be considered a penis papilla but which in fact must be regarded as a penis sheath. A true penis papilla would necessarily be located at the base of the stylet. The penis sheath lies in a shallow male antrum. The male and female gonopores are separated by a considerable distance. The female canal is not distinctly differentiated into antrum and vagina; it ascends with the usual forward slant as a well-muscularized tube, receiving cement glands for most of the slanting region. It then curves posteriorly and after receiving the common oviduct descends as a muscularized tube with scalloped epithelial lining and opens to the exterior by a separate vaginal pore situated well behind the regular female gonopore. This descending tube constitutes a

vaginal duct and obviously corresponds to a duct of Lang's vesicle. The uteri are not fully developed but appear to be confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Copidoplana tripyla* differs from the only other species of the genus, *C. paradoxa* Bock, 1913, in the eye arrangement, presence of a penis sheath, complete separation of male and female gonopores, and greater length of the vaginal duct.

DISTRIBUTION: Monterey Bay, California.

HOLOTYPE: Anterior half as whole mount, posterior half as sagittal serial sections (two slides), deposited in the Natural History Museum, Stanford University, No. 5640.

REMARKS: The finding of a species of this genus on the California coast is very surprising, as the only other known representative came from the Gulf of Siam. It is a complete mystery how anyone could have mistaken the specimen for a *Notoplana acticola*, for the eye pattern alone differs wholly from that of the latter. Further, the vaginal duct and the vaginal pore were perfectly evident on the whole mount, also the penis stylet.

DIPLANDROS, NEW GENUS

DEFINITION: Leptoplanidae of elongated, slender form without tentacles; eyes in cerebral and tentacular groups; male copulatory apparatus double, arranged in tandem, each with its own pore; each consists of a true seminal vesicle and interpolated prostatic vesicle of the *Notoplana* type; penis wanting; Lang's vesicle present.

TYPE SPECIES: *Diplandros singularis*, new species.

Diplandros singularis, new species

Figures 101-105

MATERIAL: One specimen sent by Ricketts; one whole mount found in the Fisher collection labeled "*Leptoplana acticola* Boone La Jolla"; two specimens sent by the Allan Hancock Foundation.

FORM: Elongated, slender, of about equal width throughout, but tapering near the posterior end to a blunt extremity (fig. 101); Ricketts specimen 23 mm. long by 6 to 7 mm. wide; Fisher specimen smaller, 13 mm. long but better developed sexually; tentacles wanting.

COLOR: Not determinable; Fisher specimen had been stained.

EYES: Very scanty, hence diagnostic of the species; tentacular clusters of about 10 eyes each; cerebral groups of six or seven eyes each, lying entirely anterior to the tentacular groups (fig. 102).

DIGESTIVE SYSTEM: Pharynx somewhat anterior, elongated, narrow, with shallow lateral folds (fig. 101).

COPULATORY APPARATUS: This lies directly behind the pharynx, hence far from the posterior end (fig. 101). The copulatory region of both specimens was sectioned; that of the Fisher specimen was found in the more mature state, hence forms the chief basis of the description and drawings. The curious feature of this species is the presence of two male copulatory apparatuses in tandem arrangement. Figure 103 gives a sketch of the copulatory structures of the Fisher specimen as seen in the whole mount. The lateral displacement of the posterior male apparatus in this specimen is presumably artificial, the result of pressure put upon the specimen. In the Ricketts specimen both apparatuses are perfectly median. The two male apparatuses are identical except that it was not possible to trace sperm ducts into the posterior one. The sperm ducts form voluminous sinuous spermidical vesicles as they approach the anterior male apparatus. They then narrow and enter separately the proximal end of the anterior seminal vesicle. This is a rather small muscular body showing the usual curve. From its distal end the very short ejaculatory duct enters the proximal end of the cordate muscular prostatic vesicle into which it projects nearly to the distal end (fig. 104). The prostatic vesicle is constructed on the *Noto-plana* plan, with a central ejaculatory duct surrounded by longitudinal chambers lined with a tall glandular epithelium. Extracapsular gland cells were not detectable. From the distal end of the prostatic vesicle, a simple ejaculatory duct proceeds somewhat sinuously to the ventral surface, where it opens by a slight protrusion in the center of a rounded elevation. In the Ricketts specimen, however, the ejaculatory duct of both male apparatuses opens at the bottom of a fairly deep, narrow, male antrum (fig. 105). It therefore appears that the body region

around the ejaculatory duct can be everted as an elevation simulating a penis papilla as shown in figure 104. The posterior male apparatus is identical with the anterior one, but in the Fisher specimen, the posterior prostatic vesicle was cut somewhat transversely and hence appears somewhat smaller than the anterior prostatic vesicle in figure 104 but better illustrates the glandular chambers around the central ejaculatory duct. The ejaculatory duct from the prostatic vesicle of the posterior apparatus also traverses a rounded projection that presumably represents an everted male antrum. These elevations contain no special musculature and appear to consist chiefly of mesenchyme.

The female apparatus lies shortly behind the posterior male apparatus (figs. 103, 104). The female gonopore leads into a fair-sized female antrum provided with a thick muscular wall. From the roof of this the vagina proper springs and soon makes a pronounced forward loop (fig. 104), then descends posteriorly and, after receiving the common oviduct, becomes continuous with the duct of Lang's vesicle which opens into an oval Lang's vesicle of modest size. The vagina is somewhat muscular for a short distance after leaving the antrum, but the rest of the female apparatus has but a slight muscular investment. The usual cement glands are appended to the looped portion of the vagina.

DISTRIBUTION: Taken by Ricketts at Ensenada on the Pacific coast of Lower California near the California border, May 31, 1939; the Fisher specimen is labeled as collected at La Jolla, California; taken by the Allan Hancock Foundation at San Clemente Island, November 24, 1939. The species therefore appears limited to the warmer waters of the area under consideration and is probably not uncommon.

HOLOTYPE: Fisher specimen taken as holotype, anterior part as whole mount, posterior part as sagittal serial sections (three slides), deposited in the Natural History Museum, Stanford University, No. 5639.

REMARKS: A multiplication of male apparatuses or prostatic apparatuses is rather common among the Polycladida but does not appear to have been previously reported for the Leptoplanidae. As the male apparatus of *Diplandros* is built on the *Noto-plana* plan

apart from the absence of a definite penis papilla, the separation of the genus from the Leptoplanidae on the mere ground of the doubling of the male apparatus is clearly unwarranted. It is again incomprehensible that the Fisher specimen could have been mistaken for *Notoplana acticola*, as the eye arrangement alone should have precluded such a gross misidentification. Further, the double male apparatuses in tandem were clearly in evidence in the specimen as a whole mount.

As this species concludes the Leptoplanidae in the material, it appears appropriate to make some remarks about this family at this point. This, the largest polyclad family, was defined and limited by Bock (1913) to comprise all Schematommata with an interpolated prostatic vesicle (or none!) and a copulatory organ in the form of a penis (not a cirrus, thus differentiating the family from the Planoceridae). By virtue of this rather broad definition, the family has now come to include a rather varied assortment of genera, and attempts have not been wanting to introduce some order into the family by subdividing it into subfamilies. These older attempts have been utilized by Marcus (1947) in proposing three subfamilies based on the genera *Leptoplana*, *Notoplana*, and *Euplana*, respectively. I am not able to accept this arrangement. In the first place, one must note the several peculiarities of the genus *Leptoplana*, such as the genital pit, the lack of good differentiation of both the seminal and prostatic vesicles, and the curious diverticulum of the latter. These features might, indeed, justify the separation of *Leptoplana* into a family of its own. But if we accept a subfamily Leptoplaninae, the question next arises what genera are to be regarded as sufficiently related to *Leptoplana* to be included with it in the subfamily. Marcus, following Bresslau (1933), considers the Leptoplaninae to comprise *Leptoplana*, *Stylochoplana*, *Alloiplana*, *Leptocera*, *Ceratoplana*, *Notoplanides*, and *Digynopora*. Of these, *Alloiplana* is a planocercid, as will appear shortly, *Leptocera* is insufficiently known, and *Stylochoplana*, *Ceratoplana*, *Notoplanides* (really distinct from *Stylochoplana*?), and *Digynopora* all have well-differentiated seminal and prostatic vesicles, forming muscular bulbous enlargements well set off by narrowed regions of ejaculatory

duct. It therefore appears to me that these four genera are related to *Notoplana*, rather than to *Leptoplana*. The fact that *Leptoplana chloranota* has pronounced spermiducal bulbs suggests a relationship of *Leptoplana* to *Phylloplana* in which also the prostatic vesicle is poorly differentiated and the seminal vesicle tubular and not well demarcated from the spermiducal bulbs. Possibly *Euplana* without prostatic vesicle belongs here, possibly also *Tripylecelis*. I would therefore suggest that the subfamily Leptoplaninae center about *Leptoplana* and *Phylloplana*, and possibly also include *Euplana* and *Tripylecelis*.

The genus *Notoplana* resembles the *Stylochoplana* group mentioned above in having distinct, well-differentiated seminal and prostatic vesicles as obvious muscular bulbous enlargements. It differs in the chambered condition of the prostatic vesicle. If this character is to be regarded as of subfamilial importance, then one may suggest a subfamily Stylochoplaninae including *Stylochoplana*, *Ceratoplana*, *Zygantriplana*, *Notoplanides* (validity?), and *Digynopora*, and a subfamily Notoplaninae including all the leptoplanid genera with chambered prostatic vesicle and otherwise typical male apparatus, namely, *Notoplana*, *Copidoplana*, *Diplandros*, *Pucelis*, and presumably *Plagiotata*, although this last has some atypical features.

But we are now faced with the dilemma of what to do with such genera as: *Freemanina*, with a *Notoplana* type of prostatic vesicle but without seminal vesicle and instead with massive spermiducal bulbs; *Macginitiella*, similar to *Freemanina* but with a different type of prostatic vesicle; and *Notoplanella*, with the same kind of prostatic vesicle as *Macginitiella* but with an ordinary seminal vesicle and no spermiducal bulbs.

One is forced to conclude that a satisfactory arrangement of the genera of the Leptoplanidae into subfamilies is not feasible at present.

FAMILY HOPLOPLANIDAE STUMMER- TRAUNFELS, 1933

DEFINITION: Schematommata of rounded to broadly oval form and often translucent consistency; with tentacles and tentacular

and cerebral eye clusters; dorsal surface smooth or papillate; pharynx ruffled; with well-developed spermiducal bulbs; true seminal vesicle absent; prostatic vesicle present, interpolated, usually small, embedded in the proximal end of a muscular male antrum; penis represented by a short stylet attached directly to the prostatic vesicle; Lang's vesicle wanting.

GENUS *HOPLOPLANA* LAIDLAW, 1902

DEFINITION: With the characters of the family.

TYPE SPECIES: *Hoploplana villosa* (Lang), 1884.

Hoploplana californica, new species

Figures 106, 107

MATERIAL: Two specimens sent by the MacGinities, and two by the Allan Hancock Foundation.

FORM: Oval in life, nearly circular after preservation (fig. 106); one specimen reported to have been 8 by 7 mm. in dimensions alive; preserved, the MacGinitie specimens measure 7 by 5 and 4 by $2\frac{1}{2}$ mm., respectively; with a pair of conspicuous pointed conical nuchal tentacles; dorsal surface covered with papillae.

COLOR: One specimen stated to have been orange red, the other translucent, with dark gray and a few tan patches; presumably the orange red color resulted from ingestion of some favorite food item.

EYES: The tentacular eyes occur around the bases of the tentacles (fig. 106); there do not appear to be any eyes inside the tentacles as in some other species of the genus; the cerebral eyes are concentrated into a pair of oval groups medial and anterior to the tentacles.

DIGESTIVE SYSTEM: The pharynx was not clear on the specimens; it appears to be short, with a few narrow lateral folds.

COPULATORY APPARATUS: This lies immediately behind the pharynx (fig. 106) and is shown in sagittal view in figure 107. One of the specimens was sectioned entirely. As typical of the genus and family, there is no seminal vesicle, but the much coiled and expanded sperm ducts become spermiducal bulbs as they approach the male copulatory apparatus from the sides. The spermiducal

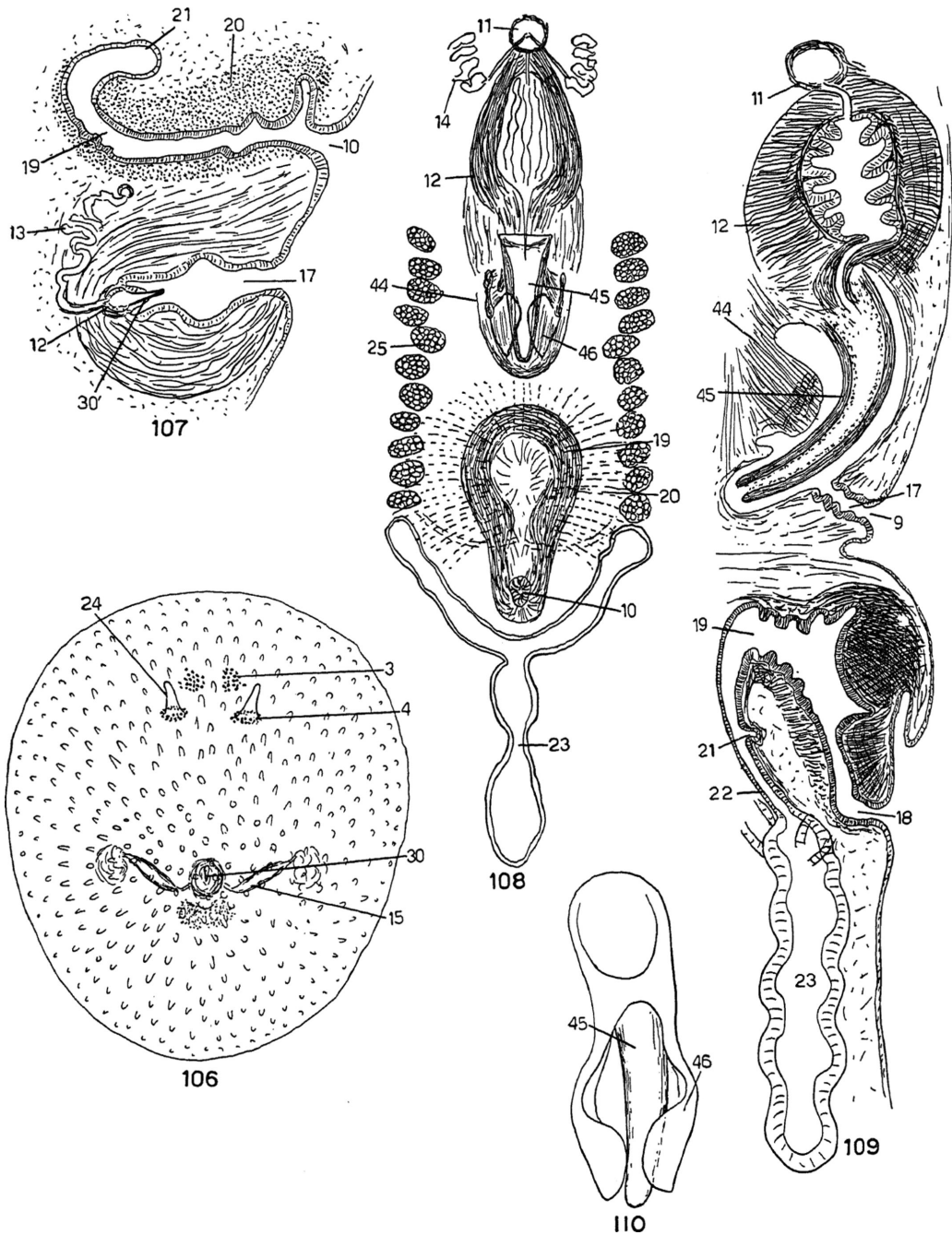
bulbs lie almost transverse to the body axis (fig. 106); they have only moderately thick muscular walls. When near the male antrum, the bulbs narrow again to slender tubes that unite in the median line to an ejaculatory duct. This is also a slender, scarcely muscularized tube; it proceeds forward in coils dorsal to the male antrum, then curves ventrally to enter the small prostatic vesicle (fig. 107). The latter lies buried in a heavy muscular wall that appears to belong to the male antrum. The latter is a conspicuous oval muscular mass with a central lumen. At the inner end of the lumen is found the short straight penis stylet springing directly from the prostatic vesicle. This is a very small rounded cellular mass that in the present specimen shows no evidence of glandularity but is obviously glandular in other species of the genus. The female gonopore lies shortly behind the male pore (fig. 107) and as usual in the genus leads into a simple ascending female canal that makes a backward curve and terminates at the entrance of the oviduct. The short distal portion of the female canal may be regarded as a female antrum and the remainder as the vagina proper; this receives cement glands along its course.

DIFFERENTIAL CHARACTERS: *Hoploplana californica* differs from all other species of the genus except *villosa* and *papillosa* in the papillate condition of the dorsal surface. In *papillosa*, the papillae are few and large, in *villosa* very numerous and slender, whereas in *californica* they are fairly numerous and larger than in *villosa*.

DISTRIBUTION: Taken by the MacGinities at Newport Bay, California, April 20, 1940, at 25 to 30 feet, and at Corona del Mar, California, July 9, 1947, at 40 to 50 feet; taken by the Allan Hancock Foundation also at Newport Harbor, March 13, 1942, in the intertidal zone.

HOLOTYPE: One whole mount, deposited in the American Museum of Natural History (A.M.N.H. No. 379).

REMARKS: In 1913 Bock assigned five species to the genus *Hoploplana*. Since then there have been described *ornata* Yeri and Kaburaki, 1918; *cupida* Kato, 1938; *deanna* Kato, 1939b; *schizoporellae* Kato, 1944; and *rubra* Kato, 1944. As noted above, three species of *Hoploplana* have a papillate dorsal sur-



FIGS. 106, 107. *Hoploplana californica*. 106. Dorsal view. 107. Sagittal view of copulatory apparatus, anterior end below.

FIGS. 108–110. *Alloioplana californica*. 108. Dorsal view of copulatory apparatus. 109. Sagittal view of copulatory apparatus, anterior end above. 110. Shape of cuticularized part of cirrus sac.

face; in *schizoporellae* and *rubra*, the dorsal surface is covered with low tubercles. The copulatory apparatus is very similar throughout the genus, and some species can scarcely be distinguished by this means, so that external characters become of considerable taxonomic importance. The extremely small size of the prostatic vesicle in the genus is curious, and one wonders if part of the heavy musculature of the male antrum should not be regarded as belonging to the prostate. In *H. inquilina* (see Hyman, 1939a), this musculature definitely surrounds the prostatic cells, but in several other species this is definitely not the case, and the whole of the musculature appears to serve the antrum wall. *H. californica* occupies an intermediate position in this regard, as the proximal part of the antrum musculature embraces the prostate (fig. 107).

FAMILY PLANOCERIDAE LANG, 1884

DEFINITION: Schematommata with rounded, oval, or cuneate bodies of translucent consistency; usually with nuchal tentacles; with tentacular and cerebral eye clusters; pharynx more or less central, ruffled; male copulatory organ consists of a cirrus sac with a cuticularized lining, usually armed with teeth, spines, or thorns, or with a long papilla; with true seminal vesicle or with spermiducal bulbs; prostatic vesicle free or interpolated, sometimes wanting; female antrum or vagina or both usually heavily muscularized; Lang's vesicle generally present.

GENUS ALLOIOPLANA PLEHN, 1896

DEFINITION: Planoceridae of oval form, with a pair of nuchal tentacles; with true seminal vesicle and interpolated prostatic vesicle; cirrus sac with a partially cuticularized lining and armed with a single large median tooth that conveys the ejaculatory duct; gonopores separate; with or without Lang's vesicle.

TYPE SPECIES: *Alloioiplana delicata* Plehn, 1896.

Alloioiplana californica (Heath and McGregor),
1912, new combination

Figures 108-110

Planocera californica HEATH AND MCGREGOR,

1912, p. 459, text fig. 1; pl. 15, fig. 24; pl. 16, fig. 32; pl. 18, fig. 39.

MATERIAL: Two specimens sent by Ricketts; one specimen sent by the United States National Museum; several specimens collected by the Allan Hancock Foundation; and one whole mount in the Fisher collection labeled "*Planocera californica* identified by Heath."

FORM: Oval or elliptical, broadest through the middle, narrowing to the ends; up to 40 mm. long according to Ricketts, largest available specimens 28 by 16 mm.; thick and firm; with a pair of nipple-like, contractile nuchal tentacles. An excellent representation of the general appearance of this species is given in "Between Pacific tides" (fig. 6).

COLOR: Transparent bluish green or light olive, with the branches of the digestive tract showing as zigzag chocolate lines radiating from the central main intestine to the periphery.

EYES: The eyes of smaller specimens are well shown by Heath and McGregor (1912, text fig. 1, p. 459). The tentacular eyes fill the tentacles and also occur diagonally before and behind the tentacle bases, making oval areas diverging anteriorly. The cerebral eyes occur in an elongated area beginning scantily at about the posterior margin of the brain and broadening forward. In the largest available specimen there is a considerable increase in the number of cerebral eyes, and these extend considerably forward in streaks along the main nerve trunks.

DIGESTIVE SYSTEM: The relatively small pharynx with a few lateral folds is situated anterior to the middle of the animal. The intestinal branches radiate to the periphery, branching extensively but do not anastomose.

COPULATORY APPARATUS: One of the Ricketts specimens was sectioned sagittally, and a sagittal view of its copulatory apparatus is given in figure 109. A dorsal view of the apparatus as seen in a whole mount is shown in figure 108. The figures in the original description give a poor idea of the details of the copulatory apparatus. The coils of the spermiducal vesicles may be seen in whole mounts beside the posterior part of the pharynx (fig. 108). They extend to a point behind the seminal vesicle, then narrow to slender, slightly muscularized, straight tubes

that proceed forward, converging to the middle of the ventral surface of the small, rounded, seminal vesicle. Here they enter the seminal vesicle separately but close together and pass through its wall in a close parallel relationship. The seminal vesicle has a moderately thick muscular wall, thickened ventrally where the sperm ducts penetrate it. It rests upon the anterior face of the conspicuous, highly muscularized prostatic vesicle and sends the ejaculatory duct through the thick muscular wall of the latter. The prostatic vesicle is thus interpolated. It is a conspicuous oval body with a very heavy muscular wall of mostly radial fibers and is lined by a wavy glandular epithelium. There appeared to be no extracapsular prostatic glands present. The prostatic vesicle is directly continuous with the cirrus sac (fig. 108), and the ejaculatory duct from the prostatic vesicle into the cirrus sac is contained within the muscular coat of the vesicle (fig. 109). The ejaculatory duct enters the base of the large curved cirrus tooth which acts as a conduit for the distal part of the ejaculatory duct (fig. 109). The cirrus sac has an irregular shape that cannot very well be represented in a sagittal view. Its proximal half is heavily muscularized by fibers continuous with those of the prostatic vesicle (fig. 108); distally it is less muscularized (fig. 109). The lining is not cuticularized except for a spoon-shaped area on each side which does not appear in sagittal section. The best view that was had of these areas in a whole mount is given in figure 110. The lumen of the cirrus sac is occupied by the large tooth that curves dorsally where its free end fits into a dorsal recess of the lumen of the cirrus sac. The cirrus tooth is smooth throughout. From the posteroventral region of the cirrus sac, a canal lined by a scalloped epithelium leads to the male gonopore (fig. 109).

The female gonopore lies a little distance behind the male pore. A short female antrum extends dorsally from it as a short vertical tube from which the vagina continues by a sharp forward bend, soon showing a widened lumen. The anterior wall of the antrum and horizontal part of the vagina is provided with an extremely heavy musculature, but the posterior wall of these parts has but a moder-

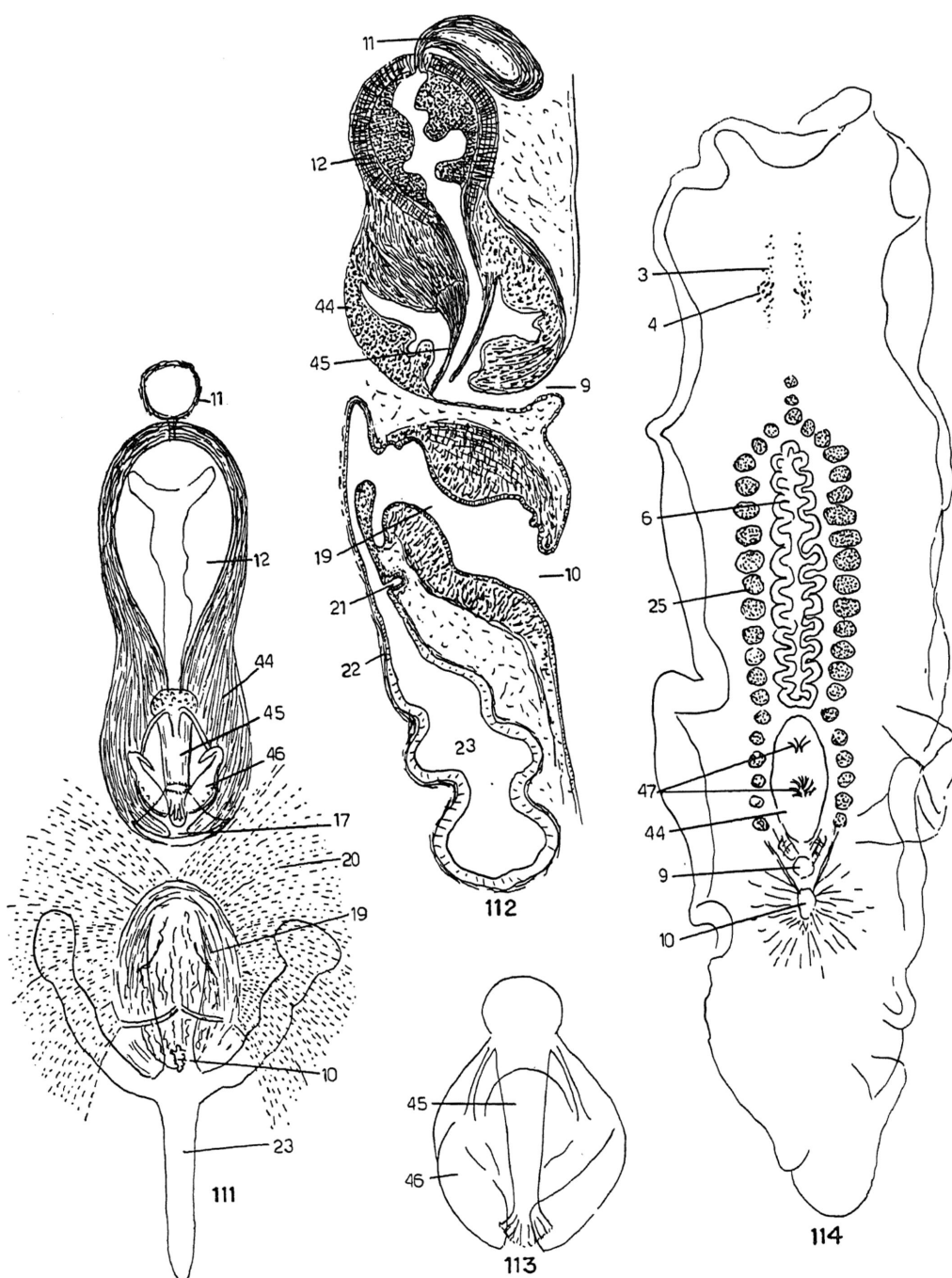
ate muscular provision (fig. 109). The vagina now proceeds dorsally with a scalloped epithelial lining and thin musculature, then turns backward and, after receiving the oviduct, continues as a short duct of Lang's vesicle. This soon enters the tripartite Lang's vesicle, the shape of which is shown in figure 108. Cement glands are not very obvious in the sections but appear in the Fisher whole mount as the usual radiations around the muscularized part of the vagina (fig. 108.) On this same mount, the uteri are conspicuous as expanded tubes along either side of the pharynx and are obviously confluent around the anterior end of the pharynx.

DIFFERENTIAL CHARACTERS: *Alloioplana californica* differs from *A. delicata*, the only previously described species of the genus, in the shorter, more muscularized prostatic vesicle, the heavily muscularized vagina, and the presence of a Lang's vesicle.

DISTRIBUTION: Taken by the original describers at Monterey Bay and "to the south for at least 34 miles"; two specimens taken at Malaga Cove, April 25, 1937, and six at San Clemente Island, in November, 1939, by the Allan Hancock Foundation; one specimen sent by the United States National Museum (No. 3946) collected at San Diego, California, December 31, 1884; reported by Ricketts in "Between Pacific tides" (p. 16), as relatively abundant near Monterey under large boulders when the tide is out. The form reported by Ricketts (*op. cit.*, p. 17) from Lower California is presumably *Alloioplana sandiegensis*, but *A. californica* does occur in the San Pedro and San Diego regions. *Alloioplana californica* may be regarded as common along the entire California coast but not as yet taken elsewhere.

LECTOTYPE: Fisher whole mount identified by Heath declared a lectotype, deposited in the Natural History Museum, Stanford University, No. 5632. This specimen is clearly the cotype mentioned by Heath and McGregor (1912, p. 460), since it contains the radula of a snail in its pharynx.

REMARKS: This and the succeeding species have been placed in the genus *Alloioplana* because the armature of their male apparatus consists, as in the type species of the genus, of a single large tooth that carries the ejaculatory duct. Inspection of Plehn's figure (her



FIGS. 111-113. *Alloioplana sandiegensis*. 111. Dorsal view of copulatory apparatus. 112. Sagittal view of copulatory apparatus, anterior end above. 113. Dorsal view of cuticularized part of cirrus sac. FIG. 114. *Spinicirrus inequalis*, dorsal view.

pl. 13, fig. 1) shows that this armature cannot be an ordinary penis stylet, although Plehn so labels it. As the remaining cuticularization of the cirrus sac is confined to the lateral walls and hence does not show in sagittal section, it is understandable that Plehn's figure of the cirrus sac might be mistaken for a male antrum containing a penis stylet. But as soon as one realizes that one is dealing with a planocericid, then it becomes evident that the structure in question is a cirrus sac armed with a tooth. I consider that Plehn was correct in placing her species in the Planocericidae and that Bock (1913) was in error in transferring her genus to the Leptoplanidae. Grounds could be found for erecting a new genus for "*Planocera*" *californica* and *sandiegensis*, but the similar construction of the cirrus appears to me sufficient justification for assigning them to *Alloioiplana*. The slightest knowledge of the Planocericidae should have told the authors of these two species that the latter are totally unlike the members of the genus *Planocera*.

Alloioiplana sandiegensis (Boone), 1929,
new combination

Figures 111-113

Planocera sandiegensis BOONE, 1929, p. 33, pl. 2, fig. 6; pl. 3, fig. 10.

MATERIAL: Type and other whole mounts found in the Boone collection, others in the Fisher and Freeman collections; specimens also sent by the United States National Museum, the Allan Hancock Foundation, Ricketts, and the MacGinities.

FORM: Oval, rounded anteriorly, slightly pointed posteriorly; to 20 mm. long by 14 mm. in width; with a pair of nuchal tentacles. Very similar in appearance to *A. californica*.

COLOR: According to Boone, light tan, with dark brown and olive green patches or brown patches only; according to the MacGinities, brownish, speckled; available specimens preserved appear similar to *A. californica*, that is, with radiating zigzag brown digestive branches on a lighter ground. The colored figure in "Seashore animals of the Pacific coast" (pl. 4, fig. 3) labeled "*Planocera burchami*," is presumably *Alloioiplana sandiegensis*.

EYES: The eyes of a specimen of moderate size have been figured by Boone (1929, pl. 2,

fig. 6). The tentacular eyes comprise eyes in and around the tentacles, plus more scattered eyes behind the tentacles, totaling 35 in the smaller to 70 in the larger specimens. The tentacular clusters thus differ from those of *A. californica* in that there are no loose eyes anterior to the tentacles. Most of the tentacular eyes are larger than those of the cerebral groups, but some very small eyes are usually present. The cerebral groups range in number in the available specimens from 27 to about 100; they begin sparsely at about the posterior border of the brain and extend forward, widening into a rather broad group anterior to the level of the tentacles. The main mass of the cerebral eyes is thus more compact than in *A. californica*, where the cerebral groups tend to extend forward in streaks along the main nerve trunks.

DIGESTIVE SYSTEM: The oval ruffled pharynx is located at about the body middle or slightly anterior and has a limited number of lateral folds. From the main intestine branches radiate to the periphery, branching extensively.

COPULATORY APPARATUS: This is similar to that of the preceding species in general layout but differs in details. A dorsal view of the apparatus as seen in a whole mount is given in figure 111 and a sagittal section in figure 112. The sperm ducts form the usual convoluted spermiducal vesicles beside the posterior part of the pharynx. They extend posteriorly to a point a little behind the seminal vesicle, then turn sharply forward, and as straight narrowed tubes with somewhat muscularized walls enter separately the proximal end of the seminal vesicle. The latter appears in dorsal view as a spherical body (fig. 111), but sections show it to have an oval form (fig. 112) and fairly thick muscular wall. It narrows to a short ejaculatory duct that immediately penetrates the anterior wall of the prostatic vesicle. This is an oval body with thick muscular wall of radial and longitudinal fibers, scalloped glandular lining, and irregular lumen that appears tripartite in whole mounts. The prostatic vesicle is directly continuous with the cirrus sac, both being enclosed in the same muscular sheath (fig. 111). The cirrus sac is a somewhat rounded mass, with heavy muscular walls and a lumen of irregular form

containing the large cirrus tooth that carries the ejaculatory duct. This tooth is shorter than in *A. californica* and differs also from that of the latter species in that its free end is fimbriated. Boone in her description claims that there are eight fimbriations, but I was not able to count the number precisely. As in *A. californica*, only the lateral walls of the cirrus sac are cuticularized, and hence no cuticularization is visible in median sagittal sections. It was difficult to make out the shape of the cuticularized areas; the best view obtained of them in whole mounts is shown in figure 113. Boone describes various teeth in the cirrus sac and on the cirrus tooth, but I was unable to see any such structures either in whole mounts or in a set of frontal sections, and believe Boone was mistaken about them. The angles of the cuticularized areas when viewed from above in whole mounts may give the illusion of teeth as in figure 111. From the posterior end of the cirrus sac a passage leads ventrally to the male gonopore.

The female gonopore is a wide opening not far behind the male gonopore (fig. 112). The female canal is not differentiated into antrum and vagina. It is a broad vertical canal with a wide lumen and with thick muscular walls around its entire circumference. Dorsally it gives off a narrowed portion that curves sharply backward and soon receives the common oviduct into its ventral wall. It then continues into the Lang's vesicle which as in the preceding species is tripartite, with one limb extending directly backward and two proceeding forward, curving around the sides of the female canal (fig. 111). The uteri take the usual course, extending anteriorly along either side of the pharynx and coalescing anterior to the latter.

DIFFERENTIAL CHARACTERS: *Alloioplana sandiegensis* differs from *A. californica*, to which it is very closely related, in the oval rather than spherical seminal vesicle, the shorter cirrus tooth, the fimbriated tip of the cirrus tooth, and the even muscularization of the female duct.

DISTRIBUTION: Collected by the MacGinities at Corona del Mar, January 20, 1934, and in San Diego Bay, December 16, 1937; taken by Boone at La Jolla, California; collected by the United States National Museum off San Diego, California, December 31,

1884; taken by the Allan Hancock Foundation in San Gabriel Bay, February 20, 1936; by Ricketts at Point Marcial Reef, March 24, 1940, and by the MacGinities at Puerto Penasco, December, 1947. The last three localities are in the Gulf of California. The species is therefore common from Corona del Mar, California, at least to the lower end of the Gulf of California. It appears more southerly in its distribution than the very similar *A. californica*, but the two species overlap in the San Diego region.

HOLOTYPE: Boone's type specimen deposited in the Natural History Museum, Stanford University, No. 5634. As this specimen is unfortunately rather small, some larger specimens are also deposited.

SPINICIRRUS, NEW GENUS

DEFINITION: Planoceridae of elongated form without tentacles; seminal vesicle wanting; cirrus sac with two vesicles, an anterior one enclosed in the muscular sheath of the cirrus sac, and a posterior prostatic vesicle opening into the cirrus sac; cirrus sac armed anteriorly with large spines in two groups, posteriorly with small spines; Lang's vesicle wanting.

TYPE SPECIES: *Spinicirrus inequalis*, new species.

Spinicirrus inequalis, new species

Figures 114-117

MATERIAL: One specimen, sent by the Allan Hancock Foundation.

FORM: Slender, elongated, anterior end rounded, body tapering posterior to a blunt end (fig. 114); tentacles wanting; 11 by 3 mm. (preserved).

COLOR: Indeterminable.

EYES: Cerebral and tentacular eyes form a continuous band on each side; in this the cerebral eyes, forming a rounded cluster of about 15 eyes, are distinguishable by their larger size (fig. 115). The small tentacular eyes, about 20 to 25 in number, extend for a short distance behind, and for a longer distance in front of, the cerebral eyes.

DIGESTIVE SYSTEM: Pharynx nearly central, long and narrow, with about 11 lateral folds (fig. 114).

COPULATORY APPARATUS: The rear half of the specimen was sectioned, and, although a

complete series of sections was obtained, the histological condition was poor, with many breaks and tears. I am therefore unable to give a complete account of the copulatory apparatus. It is shown in sagittal view in figure 117, and the cirrus sac with its two groups of large spines as seen in the whole animal before sectioning is drawn in figure 116. The sperm ducts could not be traced into the copulatory apparatus. They appeared to form coiled spermiducal vesicles along the sides of the anterior part of the cirrus sac, and a straight section was seen around the anterior end of the cirrus sac in the sections as indicated on figure 117. The cirrus sac is an oval muscular body found immediately behind the pharynx (fig. 114). Embedded in the musculature of its anterior end is a small rounded sac (figs. 116, 117). At first this was thought to be a seminal vesicle, but it lacks a definite muscular investment, is lined by a tall granular epithelium, and does not receive any ducts from without. It therefore appears to be some sort of gland but apparently not a prostate, as the granules in its epithelium do not take the eosin stain but rather seem to be basophilic. Possibly it corresponds to the gland pockets opening into the male antrum in *Paraplanocera* although differently located. The gland pocket in question opens by a broad connection into the anterior part of the cirrus sac (fig. 117). This has thick muscular walls and a rather narrow lumen of irregular shape. Anteriorly the lumen is armed with two large spines situated immediately behind the gland pocket and farther back just before the middle of the cirrus sac with a ventral group of about 15 smaller and more slender spines (fig. 116). The whole cirrus lining anterior to the supposed location of the male gonopore is devoid of any spination except the two groups of large spines just mentioned. Posteriorly the cirrus lumen curves dorsally and here is lined with small teeth (fig. 117). Into this posterior part of the cirrus sac there opens from the dorsal side another sac about twice the size of the anterior gland pocket. This is clearly a prostatic vesicle of the free type; it is enclosed in the muscle sheath of the cirrus sac and is lined by a deeply scalloped epithelium filled with eosinophilous granulations. The position of the male gonopore could not be definitely

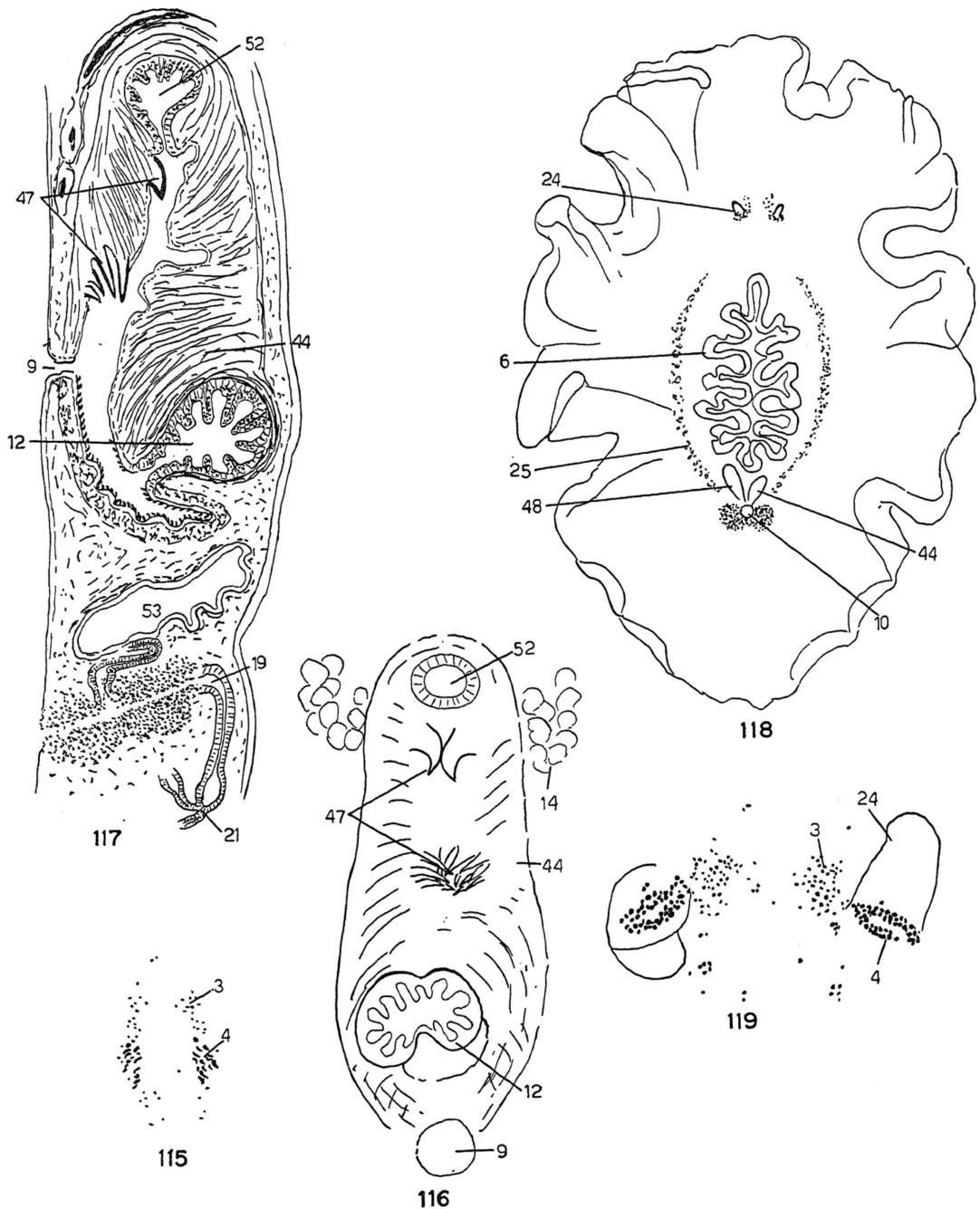
ascertained because of breakage in this region but appeared to be located as indicated in figure 117.

The female apparatus was not satisfactorily made out. Immediately behind the cirrus sac occurs a large oval cavity lined by a cuboidal epithelium that seems to be related to the female system. It does not appear to open directly to the exterior. Just behind this the vagina accompanied by a heavy mass of cement glands ascends dorsally, makes a sharp posterior bend, runs a short distance horizontally backward, and terminates with the entrance of the oviducts, which enter it separately. Lang's vesicle is wanting. The female gonopore could not be found on the sections but appeared to be located as shown in figure 117. From the anterior wall of the distal part of the vagina a duct runs anteriorly and dorsally and appears to enter the oval cavity mentioned above, but the actual entrance into the cavity was not clearly found. The uteri coalesce anterior to the pharynx.

DISTRIBUTION: Taken by the Allan Hancock Foundation off Pardita Island, near La Paz Bay, Gulf of California, May 7, 1932.

HOLOTYPE: Anterior half as whole mount, posterior half as sagittal serial sections (four slides) deposited in the Allan Hancock Foundation.

REMARKS: I had hoped to avoid creating a new genus for this species by fitting it either into *Disparoplana* Laidlaw, 1903, or *Neoplanocera* Yeri and Kaburaki, 1918. *Spinicirrus* resembles these genera in body shape, eye arrangement, and lack of Lang's vesicle. The original description of *Disparoplana* is unsatisfactory, but a sagittal view of the copulatory apparatus has been furnished by Steinböck (1937). From this it appears that the prostatic vesicle is appended to the side of the cirrus sac as in *Spinicirrus*, but *Disparoplana* has a large elongated seminal vesicle wanting in *Spinicirrus* and lacks the anterior gland pocket found in the latter. My inability to trace the sperm ducts into the male apparatus makes it impossible to decide whether or not *Spinicirrus* might be squeezed into *Disparoplana* by broadening the definition of the latter. The original description of *Neoplanocera* has been emended by Kato (1937) who finds that this genus has an inter-



FIGS. 115-117. *Spinicirrus inequalis*. 115. Eye pattern. 116. Cirrus sac seen from above. 117. Sagittal view of copulatory apparatus, anterior end above.

FIGS. 118, 119. *Paraplanocera oligoglena*. 118. Dorsal view. 119. Eye pattern.

olated prostatic vesicle, hence would not be a suitable vehicle for *Spinicirrus inequalis*. A better specimen of the latter is required before its systematic position can be stabilized. The spine arrangement in the cirrus sac certainly differs greatly from that of any other planocercid, but it is questionable whether planocercid genera should be based on this feature.

GENUS *PARAPLANOCERA* LAIDLAW, 1903

DEFINITION: Planocercidae of broadly oval form and thin consistency, with ruffled margins; with conspicuous nuchal tentacles; seminal vesicle wanting; with spermiducal bulbs; prostatic vesicle free; cirrus sac lined with spines; female apparatus provided with an oval muscular sac, the bursa copulatrix, which extends anteriorly beside the male apparatus; Lang's vesicle present.

TYPE SPECIES: *Paraplanocera langii* (Laidlaw), 1902.

Paraplanocera oligoglena (Schmarda), 1859

Figures 118-123

MATERIAL: Three specimens sent by Ricketts and three specimens from the Allan Hancock Foundation.

FORM: Broadly oval, thin, with ruffled margins, 20 to 25 mm. long by 17 to 20 mm. wide; with conspicuous stout nuchal tentacles (fig. 118).

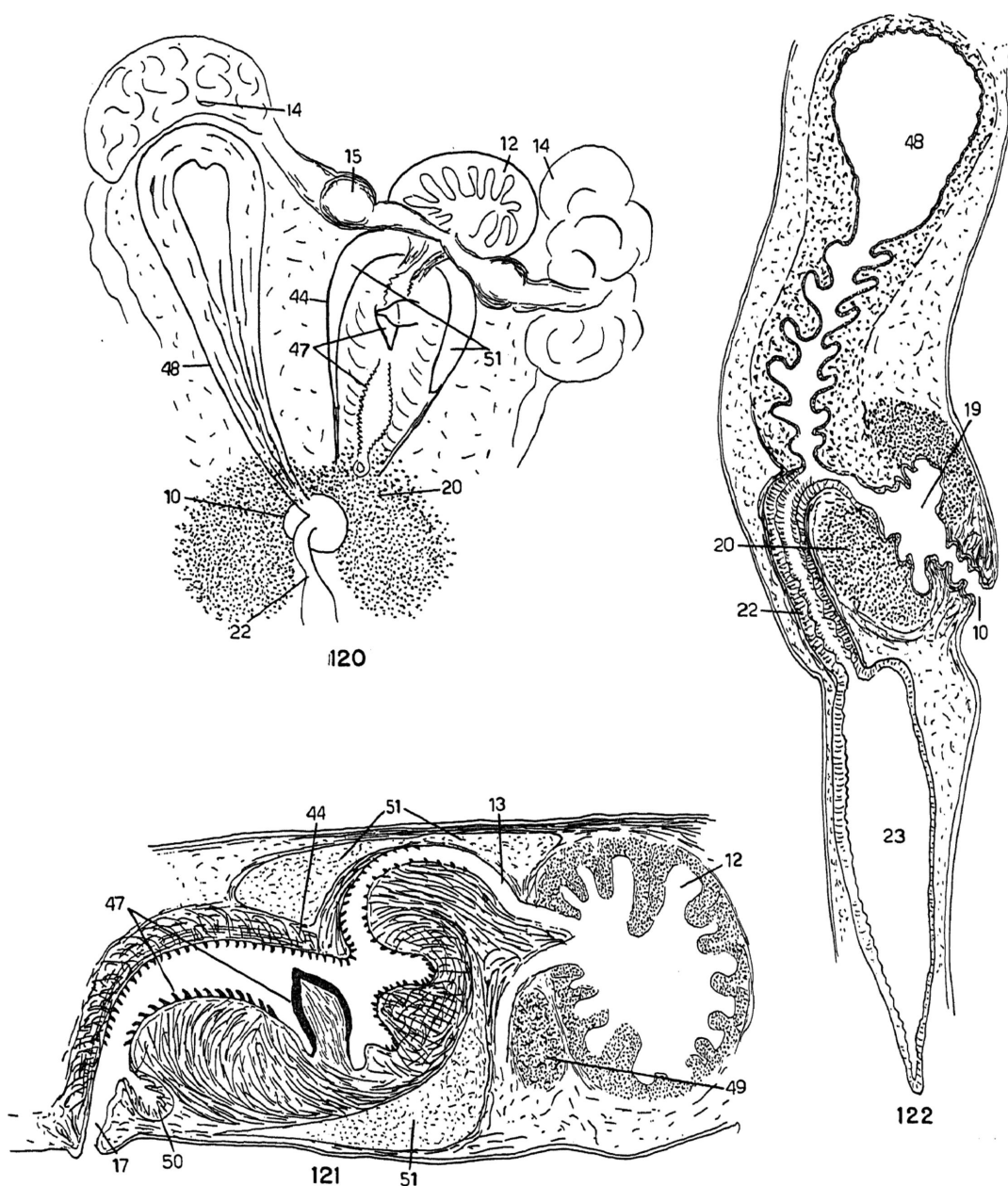
COLOR: Buff speckled with brown, according to Ricketts.

EYES: A girdle of eyes encircles the base of each tentacle (fig. 119); there appear to be no eyes inside the tentacles; the cerebral groups are rather short; they begin thinly, with scattered eyes behind the level of the tentacles, and extend forward broadening into clusters. The eye arrangement is identical with that illustrated for *P. misakiensis* by Kato (1936).

DIGESTIVE SYSTEM: The rather short broad pharynx is provided with four or five ruffled lateral branches on each side (fig. 118). In the specimen figured the mouth was somewhat posteriorly located with relation to the pharynx, being between the third pair of main lateral folds.

COPULATORY APPARATUS: The copulatory region of one of the Ricketts specimens was sectioned sagittally, that of another frontally. The copulatory apparatus of this genus

is very complicated and is represented in figure 120 as it appears in ventral view of the third specimen mounted whole. Anteriorly the copulatory apparatus consists of two parts, the male apparatus to the left, consisting of the prostatic vesicle and cirrus sac, and a part of the female apparatus called bursa copulatrix to the right. It is therefore impossible to represent the entire copulatory apparatus in one sagittal view, and hence the male apparatus is shown in figure 121 and the female apparatus in figure 122. The sperm ducts approach the male apparatus from behind and enter massive coils formed by the spermiducal vesicles (fig. 120). The right mass tops the anterior end of the bursa copulatrix; the left one lies to the left of the prostatic vesicle. These conspicuous masses do not seem to have been noticed by previous observers except Jacobowa (1906), although the right one at the anterior end of the bursa copulatrix is very obvious in all six of the available specimens. From this coiled mass a straight length of spermiducal vesicle emerges on each side and runs transversely towards the prostatic vesicle. Shortly before reaching this vesicle, it acquires muscular walls and becomes a spermiducal bulb. These are short oval bodies (fig. 123) that soon narrow to ducts that unite to a common sperm duct that enters the posterior end of the prostatic vesicle. The prostatic vesicle is therefore of the free type; it lies in contact with the anterior end of the cirrus sac as a rounded body with thin muscular coat and heavy lining epithelium thrown into numerous folds filled with eosinophilous granules. The posterior part of the prostatic vesicle is separated off as two small blind sacs that open separately into the prostatic duct. These appear histologically identical with the main part of the prostatic vesicle, so that their anatomical separation is puzzling. These sacs or accessory prostatic vesicles have been noticed by Stummer-Traunfels (1933), Kato (1936b), and Prudhoe (1945) and possibly are characteristic of the genus. The relations of prostatic vesicle, accessory prostatic vesicles, and spermiducal bulbs as seen in a frontal section are shown in figure 123. From the prostatic vesicle, the prostatic duct proceeds into the cirrus sac, receiving en route the openings of the two accessory prostatic



FIGS. 120–122. *Paraplanocera oligoglana*. 120. Dorsal view of copulatory apparatus, Lang's vesicle omitted. 121. Sagittal view of male apparatus, only one of two large teeth shown, anterior end to right. 122. Sagittal view of female apparatus.

vesicles. As shown in figure 121 the prostatic duct is independent of the common sperm duct formed by the union of the ducts from the spermiducal bulbs. It thus appears that the sperm must enter the rear part of the prostatic vesicle and must traverse the prostatic duct; nevertheless the prostatic vesicle

may be regarded as free. Prudhoe (1945) reports in specimens he identified as *P. oligoglana* the entrance of the common sperm duct into the prostatic duct, but this is definitely not the case in my specimens. My finding that the common sperm duct opens into the prostatic vesicle agrees with the

statements of Jacobowa (1906) and Stummer-Traunfels (1933). As Stummer-Traunfels had the original specimens of Schmarda, his findings must be regarded as correct for the species.

The cirrus sac is an oval muscular body apparently somewhat spirally curved, at least in its anterior part. As already noted it receives at its anterior end the prostatic duct which soon passes into the lumen of the cirrus sac. The lumen is of irregular shape and lined almost throughout with small spines which are larger ventrally than dorsally in the posterior half of the cirrus. At about the middle of the cirrus sac, two large teeth covered over with a thick cuticularized layer spring from the ventral wall of the cirrus sac. These are actually teeth, not sections of a ridge, because they are clearly seen as teeth in the whole specimen (fig. 120), and they appear the same in both sagittal and frontal sections. Posteriorly the cirrus sac narrows to a short male antrum from which there project anteriorly a pair of glandular pockets. These glandular appendages to the male antrum have been seen by other observers and are probably characteristic of the genus. The cirrus sac has a thick muscular wall, especially ventrally, and is surrounded anteriorly by what are usually called "spaces" in the literature, but in my specimens these are filled with a pale, vaguely fibrous material.

The female gonopore is distinct from but not far behind the male gonopore. A short female antrum leads into a wider vagina, with irregular outpocketed walls that receive a dense cloud of cement glands. There appear in fact to be two main pockets, one anterior and one posterior, into which the cement glands open. The vagina ascends and makes the usual backward curve; at the curve it receives the outlet of the bursa copulatrix. This is an elongated oval sac peculiar to the genus that extends anteriorly beside the male apparatus. It has a thick muscular wall and posteriorly a heavily scalloped lining. After receiving the outlet of the bursa copulatrix, the vagina descends posteriorly, with a ciliated lining, and beyond the entrance of the oviducts, separately, one on either side, continues as the duct of Lang's vesicle that soon enters the elongated Lang's vesicle (fig. 122). The uteri are apparently not confluent

anterior to the pharynx (fig. 118).

DISTRIBUTION: The Ricketts specimens were taken on Point Marcial Reef along the western shore of the Gulf of California, March 24, 1940; the Allan Hancock Foundation specimens were collected by Hubbs, November 8, 1946, at Coronados Island, Gulf of California. The two localities are close together. The species is probably cosmopolitan in tropical and subtropical waters. The Ricketts specimens are the ones mentioned in "Sea of Cortez" (p. 336), as *Stylochus* (?) sp.

SPECIMENS: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 380). The Allan Hancock Foundation specimens have been returned to that institution.

REMARKS: I have been at some pains to illustrate this species fully, because of considerable uncertainty as to synonymy that exists in the literature. I am fully confident that my specimens are identical with Schmarda's *Stylochus oligoglenus*, of which the original specimens were restudied by Stummer-Traunfels (1933). Stummer-Traunfels notes the "mächtige accessorische Samenblasen" (actually spermiducal vesicles), the entrance of the common sperm duct into the prostatic vesicle, and the pockets of the vagina that receive the cement glands. I also feel that *Paraplanocera laidlawi* Jacobowa, 1906, is a synonym of *P. oligoglana*, as Jacobowa saw the large masses formed by the spermiducal vesicles and found that the common sperm duct opens into the prostatic vesicle. As Jacobowa had Willey's specimens, which he had already named *discus*, it appears that she was in error in giving the specimens a new name, *laidlawi*. It thus seems to me clear enough that *laidlawi* and *discus* are synonyms of *oligoglana*. To this extent I am in agreement with the standpoint of Prudhoe (1945) who has published a general consideration of the genus *Paraplanocera*. But I do not agree that *P. langii* (Laidlaw), 1902, is identical with *oligoglana*, and the point is of some importance as *langii* is the type of the genus. According to the original description, the sperm ducts of *P. langii*, after forming spermiducal bulbs, enter the prostatic duct separately, and the larger armature of the cirrus sac is described as a pair of folds rather than as

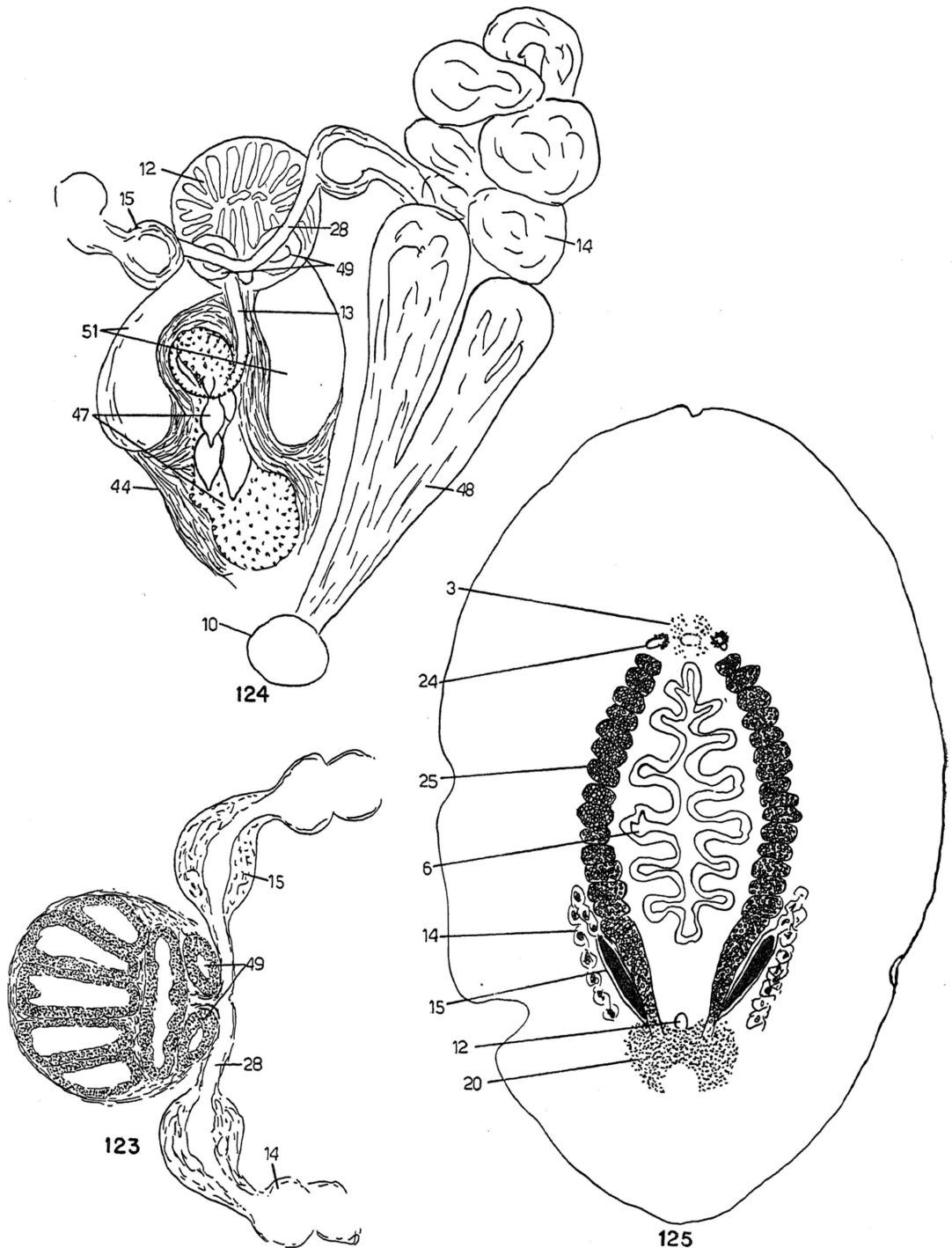


FIG. 123. *Paraplanocera oligoglana*, prostatic vesicle, accessory prostatic vesicles, and spermiducal bulbs.

FIG. 124. Aberrant specimen referred to *Paraplanocera oligoglana*, with additional teeth in cirrus sac, bifurcated bursa copulatrix, dorsal view of copulatory complex.

FIG. 125. *Pseudostylochus burchami*, dorsal view.

teeth. Further, *P. langii* is said to be transparent white, whereas *P. oligoglana* is speckled or reticulated with brown. While I agree with Prudhoe that colors are of little worth in evaluating preserved specimens, the above color descriptions are made from life and cannot be ignored. Probably *P. rotumanensis* Laidlaw, 1903, is identical with *P. langii*, as the differences between these two species recorded by their author are slight and inconsequential. Prudhoe is of the opinion that *P. misakiensis* Yeri and Kaburaki, 1918, is also identical with *P. oligoglana*, but I am unable to agree with this, either. Kato (1936b) has furnished a detailed description of *misakiensis*, well illustrated, and this account differs in many details with my findings for *oligoglana*. Thus according to Kato's account the common sperm duct enters the prostatic duct in *misakiensis*, the main armature of the cirrus consists of two long ridges rather than teeth, the distal end of the bursa copulatrix gives off a glandular sac wanting in *oligoglana*, and the course of the cement duct ("shell gland duct" of Kato) in *misakiensis* as represented by Kato is rather peculiar. Further, the masses formed by the spermiducal vesicles in *oligoglana* appear wanting in *misakiensis*. *P. misakiensis* may be identical with *langii*. The figure of the male apparatus presented by Prudhoe under the name *P. oligoglana* differs from the typical *oligoglana* as described by Stummer-Traunfels in that the common sperm duct enters the prostatic duct. In short, it appears to me impossible to reduce the described species of *Paraplanocera* to three as Prudhoe has done. Many of the available descriptions are inadequate to enable one to come to a decision regarding the synonymy, but it seems to me there are at least four species, namely, *oligoglana*, *langii*, *aurora*, and *marginata*, and possibly a fifth, *misakiensis*.

ABERRANT SPECIMEN REFERRED
TO *Paraplanocera oligoglana*

Figure 124

REMARKS: The copulatory apparatus of one of the Allan Hancock Foundation specimens differs from the others in what seems to be a partial multiplication. As seen in the cleared specimen (fig. 124), the bursa copulatrix forks

anteriorly into two sacs, in front of the proximal ends of which are seen the voluminous coils of the right spermiducal vesicle. The two spermiducal bulbs are obvious and clearly join a short common sperm duct that enters the prostatic vesicle directly. The prostatic vesicle shows the typical folded interior, and the two accessory prostatic vesicles in the posterior part of the main vesicle could be made out by focusing. The passage from the prostatic vesicle into the cirrus sac (prostatic duct) is definitely independent of the common sperm duct as in the typical specimens. The cirrus sac seems somewhat anteroposteriorly compressed but shows very well the spiral twist of its anterior half. As far as can be made out in the whole mount, it differs from the typical specimens only in that there are five, possibly six, large teeth at about its middle, that is, there are three, possibly four, smaller teeth anterior to the two large teeth typical of the species. The cirrus sac could not be traced to the male gonopore in the whole specimen. The female apparatus appears identical with the norm of the species except for the forking of the bursa copulatrix. While it is possible that this specimen is a different species of *Paraplanocera*, it appears best to regard it as an abnormal specimen of *P. oligoglana* until the finding of similar individuals justifies separating it off specifically. The specimen has been mounted whole and returned to the Allan Hancock Foundation.

FAMILY CALLIOPLANIDAE, NEW NAME

Diplosolenidae BOCK, 1913, p. 248.

DEFINITION: Schematommata of oval form and firm consistency; with or without tentacles; with cerebral and tentacular eye clusters; pharynx ruffled; with true seminal vesicle; with or without spermiducal bulbs; prostatic vesicle free; copulatory organ in the form of a penis papilla; Lang's vesicle present, single or double.

As Stummer-Traunfels (1933) has shown that *Diplosolenia Johnstoni* Haswell, 1907, is identical with *Callioplanea marginata* Stimpson, 1857, it is clearly necessary to alter the family name. The family may be regarded as a depository for Schematommata with a stylochid-like male apparatus.

GENUS *PSEUDOSTYLOCHUS* YERI AND
KABURAKI, 1918

Discosolenia FREEMAN, 1933, p. 133.

DEFINITION: Callioplanidae with single Lang's vesicle; otherwise with the characters of the family.

TYPE SPECIES: *Pseudostylochus takeshitai* Yeri and Kaburaki, 1918.

Pseudostylochus burchami (Heath and
McGregor), 1912, new combination

Figures 125, 126

Planocera burchami HEATH AND MCGREGOR,
1912, p. 461, pl. 13, fig. 9; pl. 15, fig. 27; pl. 18,
fig. 44

Discosolenia washingtoniensis FREEMAN, 1933,
p. 133, figs. 27-29, 40.

MATERIAL: A number of specimens sent by the United States National Museum, the MacGinities, and the Allan Hancock Foundation; one whole mount presented by James Lynch.

FORM: Oval, of firm texture; to 40 mm. or more long by 25 to 30 mm. wide; with prominent nuchal tentacles (fig. 125).

COLOR: Light brown, apparently speckled or reticulated.

EYES: Tentacular eyes in a dense ring of 40 or 50, up to 90, eyes around the tentacle bases; cerebral eyes few and loosely arranged behind or on the brain, then a gap and more numerous denser eyes in front of the brain between the tentacles or anterior to their level. The eye pattern is well shown in Heath and McGregor (1912, pl. 13, fig. 9) except that the eyes are rather few, belonging apparently to a small specimen.

DIGESTIVE SYSTEM: The centrally located pharynx is well ruffled, with five or six lateral branches (fig. 125); the mouth in the available whole mounts is somewhat posterior to the center of the pharynx; digestive branches radiate to the periphery. The division of the main intestine anteriorly into three branches behind the brain was easily seen in my preparations but is of no taxonomic importance as it commonly occurs in acotyleans.

COPULATORY APPARATUS: This follows the plan typical of the genus. It is located a little distance behind the posterior end of the pharynx (fig. 125). It is shown in sagittal view in figure 126. The spermiducal vesicles be-

come evident in whole mounts at about the level of the male gonopore. They then ascend anteriorly to a level of the posterior folds of the pharynx, then turn abruptly backward by a sharp angle and soon become spermiducal bulbs. These are of long tubular form with but slightly muscular walls; they parallel the spermiducal vesicles to their medial side (fig. 124). At the level of the anterior end of the prostatic vesicle they enter the proximal end of the seminal vesicle. This is a long tubular body with slightly muscular walls which extends posteriorly beneath the prostatic vesicle whose duct it joins at the base of the penis. The prostatic vesicle is an oval body with a thick wall. About half of the wall consists of a layer of eosinophilous glands; the rest is composed of a muscular network. The penis papilla is of conical shape and is protruded in the available sections as shown in figure 126. Freeman in his figure 28 indicates a shallow male antrum when the penis is at rest. Freeman is mistaken in thinking that the penis papilla is "armed with small but sharp spines." This is definitely not the case and would be foreign to the genus. The large female gonopore is shortly behind but distinct from the male gonopore. The female antrum is a wide, funnel-like opening lined by a scalloped epithelium that appears glandular at least in the posterior wall of the antrum. The glandular nature of the lining of the female antrum was first noticed by Kato (1937) for *P. okudai* and later for several other species of the genus; this author regards this glandular epithelium as serving a sucking function. From the antrum the vagina ascends with the usual forward slant and receives a great mass of cement glands along the distal part of its course. The vagina then continues, showing a scalloped epithelium, makes a sharp backward bend and, after receiving the two oviducts separately into its ventral wall, continues posteriorly as a slender duct of Lang's vesicle which slants downward and enters the small oval Lang's vesicle. The uteri extend forward along the sides of the pharynx as broad tubes stuffed with eggs (fig. 125) and terminate behind the tentacles, therefore not embracing the pharynx.

DISTRIBUTION: Taken by the original describers in Monterey Bay at 20 meters;

specimens sent by the United States National Museum were collected by the "Albatross" at Station 5705, Southampton Light, San Francisco Bay, February 6, 1912, at 18 meters, and at Station 5789, Farallones Light, outside the Golden Gate, October 21, 1912; taken by Freeman at two points in Puget Sound and by Lynch in the same region in May, 1941; collected by the MacGinities in Monterey Bay, April 12, 1931, at 20 meters; taken by the Allan Hancock Foundation at Consag Rock, Gulf of California, March 24, 1937, at 20 to 50 meters, in Sulphur Bay, Clarion Island, off Mexico, March 16, 1939, on the shore, off Anacapa Island, California, September 17, 1941, at 70 meters, and in Depoe Bay, Oregon, August, 1942, trawled. Evidently the species is distributed from Puget Sound south into Mexican waters.

NEOTYPE: One of the MacGinitie specimens from the type locality declared a neotype, A.M.N.H. No. 382.

REMARKS: For years I was of the opinion that "*Planocera*" *burchami* is wholly unrecognizable on the basis of the original description, but suddenly I realized that it is identical with "*Discosolenia*" *washingtoniensis*. I had long been aware that the latter is a species of *Pseudostylochus*. The synonymy is based not only on the agreement in the two descriptions in such characters as appear in the original account of *burchami* but more convincingly on the fact that *burchami* is the only acotylean in the Monterey Bay region that could be mistaken for a planocercid. If "*Planocera*" *burchami* really were a planocercid, then the armature of the cirrus sac would have been visible to the original describers. The specimens they had, although small, were obviously sufficiently mature, as the cement glands are well developed and the uteri are visible, hence must have contained eggs. What the "pits" anterior and posterior to the copulatory apparatus mentioned in the original description may be I cannot say, for, although some such appearance can be noticed in some of my whole mounts, sections show nothing special at these locations. Johnson and Snook in "Seashore animals of the Pacific coast" (pl. 4, fig. 3) present a colored figure that they claim to be *Planocera burchami*. No grounds are given for this identification, which is obviously false, but one

infers from the text that the authors had something they knew was not "*Planocera*" *californica* and therefore they concluded that it must be "*Planocera*" *burchami*. Johnson and Snook also state that their specimens swam about, whereas Freeman reports that "*Discosolenia*" *washingtoniensis* cannot swim. It is probable that what Johnson and Snook figure as "*Planocera*" *burchami* is really *Alloioiplana sandiegensis*. The colors of their figure entirely correspond with a color description of *A. sandiegensis* sent by the MacGinities.

The genus *Pseudostylochus* is common in Japanese waters where no fewer than 16 species have been described (summarized in Kato, 1944), but appears not to have been taken elsewhere except for the present species. All the species are very similar as to the copulatory apparatus, except that only about half of them possess a glandular female antrum. The Japanese species in general have small or poorly developed tentacles, thus contrasting with *burchami* in which the tentacles are large and conspicuous.

MONOSOLENIA, NEW GENUS

DEFINITION: Callioplanidae without tentacles; female gonopore asymmetrical, to the right of the median line; spermiducal bulbs wanting; Lang's vesicle single.

TYPE SPECIES: *Monosolenia asymmetrica*, new species.

Monosolenia asymmetrica, new species

Figures 127-129

MATERIAL: Three specimens sent by Ricketts.

FORM: Oval or oblong, about 10 mm. long by 5 mm. wide (fig. 127); without tentacles; with the general appearance of a leptoplanid.

COLOR: Not determinable.

EYES: In paired cerebral and tentacular clusters; tentacular eyes in a slanting cluster of 20 to 25 eyes; cerebral group linear, of about 20 to 26 eyes, thin posteriorly, widening anteriorly (fig. 128).

DIGESTIVE SYSTEM: Pharynx central or slightly anterior, well ruffled, with about eight lateral folds.

COPULATORY APPARATUS: The rear part of one of the specimens was sectioned. As the female gonopore is asymmetrical the two

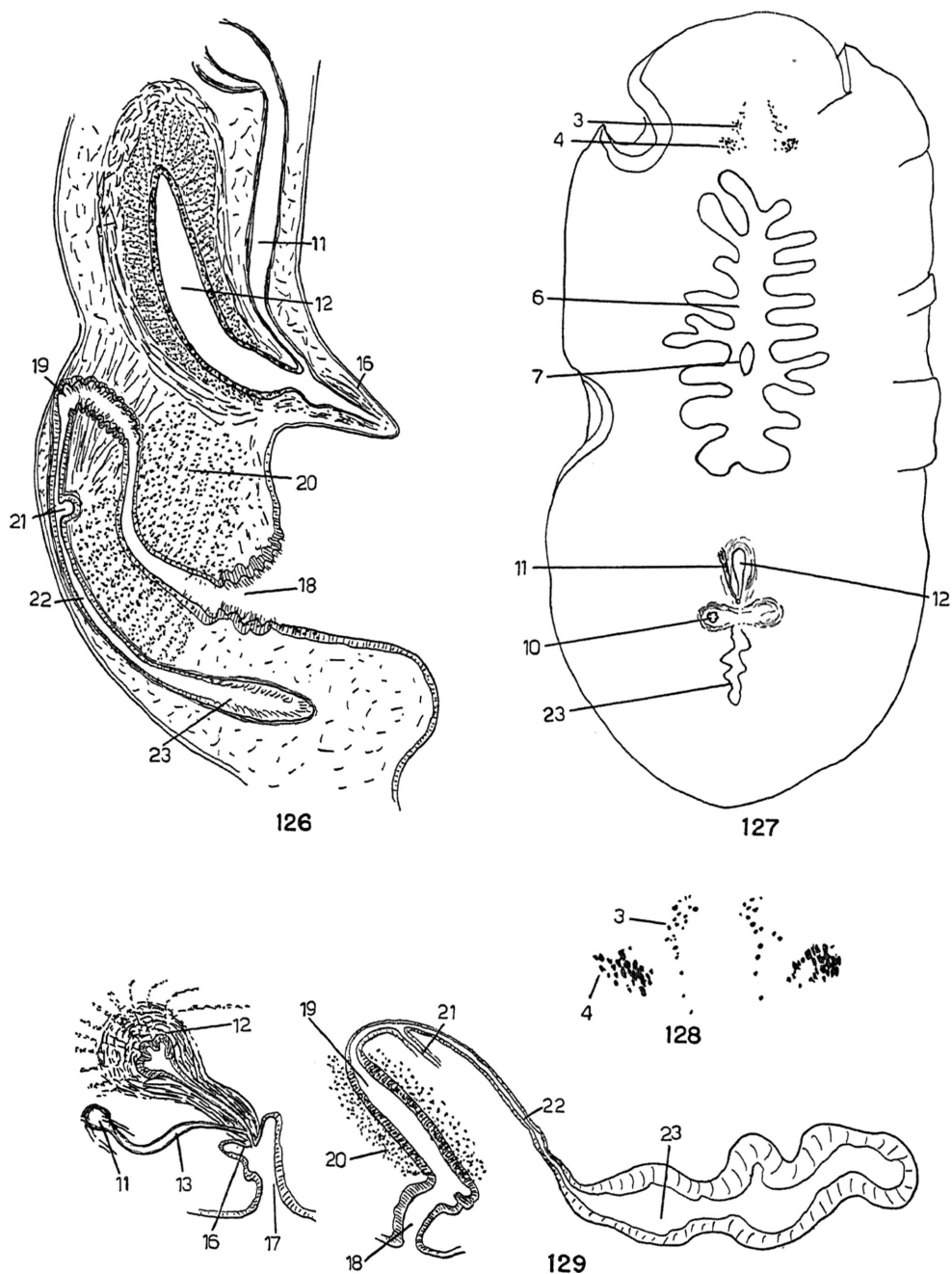


FIG. 126. *Pseudostylochus burchami*, sagittal view of the copulatory apparatus, penis protruded, anterior end above.

FIGS. 127-129. *Monosolenia asymmetrica*. 127. Dorsal view. 128. Eye pattern. 129. Male and female copulatory apparatuses, in sagittal section.

apparatuses cannot be represented in one sagittal view, hence are shown separately in figure 129. The male apparatus is typical of the family. The sperm ducts enter separately a small bulbous seminal vesicle from which the ejaculatory duct proceeds towards the penis, at the base of which it is joined by the prostatic duct. The free prostatic vesicle is pyriform, with a thick muscular wall and a tall glandular epithelium. Many extracapsular prostatic glands pierce the wall of the rounded proximal part of the vesicle. The penis is of short but broad conical form, lodged in the proximal end of a rather deep male antrum. The female gonopore lies to the right of the median line; its asymmetrical position was noticed at once on the first examination of the cleared specimens. It leads into a moderately long female antrum from which the vagina surrounded by cement glands slants forward and dorsally. Beyond the cement gland region, the vagina narrows, curves sharply backward and, after receiving the common oviduct into its ventral wall, continues as a long, slender, somewhat sinuous duct of Lang's vesicle. This enters the long, deeply lobed Lang's vesicle which is medially located. Uteri containing eggs occur beside the posterior part of the pharynx in one of the specimens; apparently the uteri do not embrace the anterior end of the pharynx.

DISTRIBUTION: Taken by Ricketts under a rock at Cape San Lucas on the tip of Lower California, March 18, 1940. Reported as Planoceridae in "Sea of Cortez" (p. 337, art. F-13).

HOLOTYPE: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 381).

REMARKS: The family Callioplanidae, hesitatingly erected by Bock under the name Diplosolenidae (should have been Diplosoleniidae), turns out to be a useful concept for leptoplanid-like acotyleans having a type of male copulatory apparatus similar to that of *Stylochus*. The curious position of the female gonopore in the present species does not appear sufficient grounds for creating a separate family for it in view of the conformity of its male apparatus with that typical of the Callioplanidae.

UNIDENTIFIABLE ACOTYLEA

The foregoing account elucidates all of the Acotylea described in the literature for the region in question except four. Two of these appear unidentifiable unless the original specimens can be recovered. They are:

Leptoplana maculosa Stimpson, 1857. The original description of this species appears in translation in Heath and McGregor (1912, p. 472). This description offers no characters of any value except the paucity of eyes. There are said to be seven eyes in the tentacular groups and four to six in the cerebral groups. My study has revealed only two leptoplanids on the California coast with eye clusters corresponding to this description, namely, *Parviplana californica* and *Diplandros singularis*. As it is unusual for leptoplanids to be provided with such a small number of eyes, it appears quite probable that Stimpson's specimen was one of these species, especially the second as its size corresponds better to Stimpson's description.

Leptoplana timida Heath and McGregor, 1912. No specimens assignable to this species have come to hand, and in fact the original description and figures offer scarcely any definite points on which to base an identification. The representation of the penis papilla in Heath and McGregor (1912, pl. 13, fig. 12) appears an anatomical impossibility. In the Fisher collection there was found a whole mount labeled "*Leptoplana timida*, Monterey Peninsula, identified by Heath." It was confidently hoped this specimen would elucidate the true nature of the species, but sections of its copulatory apparatus showed the specimen to be identical with *Notoplana acticola* (Boone). The eyes of the specimen, shown in my figure 73, also correspond with the eyes of *N. acticola*, not with those of *L. timida* as given by the original describers (their fig. 3, p. 466). It further appears impossible that *timida* can be identical with *acticola*, because *timida* is described and figured as having a spherical prostatic vesicle and a long, slender Lang's vesicle, whereas in *acticola* the prostatic vesicle is of elongate oval form and the Lang's vesicle short and plump. One is therefore forced to conclude that Heath's identification of the whole mount in question as *timida* is erroneous. If the figures and de-

scription of *L. timida* are to be taken as correct, then it appears that *timida* must belong to the genus *Stylochoplana*, for the prostatic vesicle is represented as with a simple lumen. But I find it more probable that *timida* is a species of *Notoplana*. In the original description of *timida* it is stated that *timida* shows a red saddle in the central part of the dorsal surface. This at once calls to mind *Notoplana sanguinea* Freeman, 1933, also with a red saddle. Other characters in common, as the eye arrangement, spherical prostatic vesicle, and long, slender Lang's vesicle, strongly suggest the identity of *timida* and *sanguinea*. In the absence of a specimen from the Monterey Bay region referable to *sanguinea*, I have foreborne to make the synonymy.

As already noted in earlier parts of the text, I have had no specimens referable to *Leptoplana californica* Plehn, 1896, or to *Notoplana sanpedrensis* Freeman, 1930, and believe there is something wrong and misleading in the original descriptions of these species.

SUBORDER COTYLEA

DEFINITION: Polyclads with a sucker in the midventral line at varying distances behind the female gonopore (rarely wanting?); tentacles when present of the marginal type; with cerebral and marginal eyes; marginal eyes occur in and around the tentacles when present, or as two clusters on the anterior margin at the same sites in the absence of tentacles, or as a short band along the anterior margin, or along all or part of the body margin; pharynx usually anterior, sometimes central, ruffled or tubular; when tubular directed forward; copulatory or prostatic apparatuses sometimes numerous; when single or paired in the anterior body half close to the pharynx with penis directed forward and uteri extending backward; prostatic vesicle free, rarely interpolated; Lang's vesicle almost always wanting.

FAMILY PSEUDOCERIDAE LANG, 1884

DEFINITION: Cotylea of oval or oblong shape, with smooth or papillate dorsal surface and prominent marginal tentacles, formed by the upfolding of the anterior margin; sucker centrally located; pharynx ruffled, anteriorly located; intestinal branches numerous, anas-

tomosing to a network; male copulatory apparatus single or double, close behind or partly beneath the pharynx; penis usually armed with a short pointed stylet; female copulatory apparatus single; uteri when ripe greatly branched.

GENUS THYSANOZOON GRUBE, 1840

DEFINITION: Pseudoceridae with papillate dorsal surface; an intestinal branch may or may not extend into each papilla; male apparatus double, symmetrically paired, or single.

TYPE SPECIES: *Thysanozoon brochi* (Risso), 1818.

Thysanozoon californicum, new species

Figures 130, 131

MATERIAL: One specimen sent by the MacGinities.

FORM: Large, oval, 45 mm. long by 18 mm. wide alive, 28 by 19 preserved; with the usual marginal tentacles formed by upfolding of the anterior margin; dorsal surface covered with long pointed papillae which are longer and more thickly placed centrally, declining in length and numbers laterally.

COLOR: According to notes sent by the MacGinities, the ground color is reddish gray with a mauve margin; the papillae are yellowish cream medially, reddish gray tipped with taupe more laterally, and mauve on the margins. This description is practically repeated in "Natural history of marine animals" (p. 154).

EYES: The eye pattern is typical of the genus. There are two small oval clusters of cerebral eyes; numerous tentacular eyes occur along the bases and tips of the tentacles with few in the medial regions; there are also eyes on the small area of anterior margin between the tentacles bases (fig. 131).

DIGESTIVE SYSTEM: Typical of the genus. There is an oval, well-ruffled pharynx in the anterior body third, extending from the brain to the region of the female apparatus; the mouth is a large, oval opening about centrally located in the pharynx (fig. 130). The pharynx causes a typical dorsal bulge that is nearly free of papillae. The intestinal branches are not evident but presumably follow the pattern of the genus. They do not appear to send a branch into the papillae.

REPRODUCTIVE SYSTEM: Little can be seen of this in the whole specimen, and it was thought not desirable to section the specimen as the reproductive system is very similar throughout the Pseudoceridae and offers hardly any basis for taxonomic distinctions. The male copulatory apparatus is paired, and the two male gonopores can be seen one to either side of the posterior end of the pharynx. The single median female gonopore lies shortly behind this in the midventral line as an obvious opening surrounded by the radiating cement glands. The uteri could be seen better in the uncleared or partially cleared specimen than after clearing and appeared as a branching white network to either side of the main intestine behind the level of the female gonopore. The details of the reproductive system of the genus *Thysanozoon* are given by Lang (1884, pl. 18, fig. 1).

DIFFERENTIAL CHARACTERS: *Thysanozoon californicum* is differentiated from other species of the genus mainly by color pattern.

DISTRIBUTION: Taken by the MacGinities on a rocky shore at Corona del Mar, California, May 12, 1933.

HOLOTYPE: One whole mount, A.M.N.H. No. 383.

REMARKS: According to Lang's original definition of *Thysanozoon*, the genus was characterized by the extension of digestive branches into the papillae and a double male copulatory apparatus. But Stummer-Traunfels (1895) investigated a number of species assignable to *Thysanozoon* and found none in which the papillae contain intestinal branches and some with only one male apparatus. It therefore appears that the presence of the papillae becomes the sole distinction between *Thysanozoon* and other pseudocerid genera.

There must be another species of *Thysanozoon* on the California coast, for Johnson and Snook give a colored figure (p. 118, pl. 5, fig. 1) of a *Thysanozoon* from La Jolla that appears black with light markings. The worm is stated to reach a length of an inch. Although no specimen has been received, the facts stated warrant proposing a specific name for the species, and I suggest *Thysanozoon sandiegense*.

GENUS **PSEUDOCEROS** LANG, 1884

DEFINITION: Pseudoceridae with smooth

dorsal surface; male copulatory apparatus single or paired; female apparatus single.

TYPE SPECIES: *Pseudoceros velutinus* (Blanchard), 1847.

***Pseudoceros mexicanus*, new species**

Figures 132-134

MATERIAL: Seven specimens sent by the MacGinities.

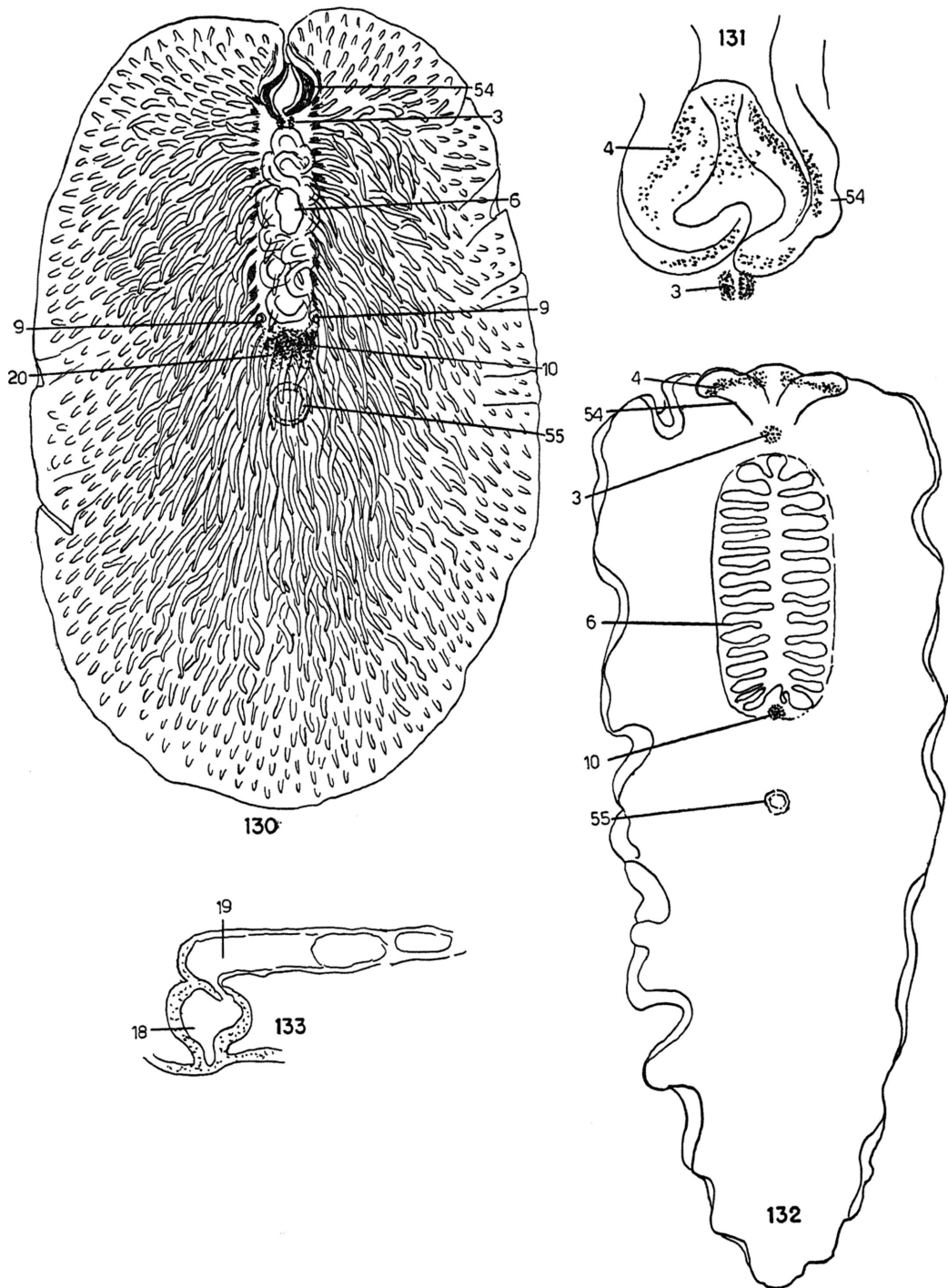
FORM: Large, obovate, broadest anteriorly, tapering to a blunt posterior end (fig. 132); thin, with ruffled margins; to 57 mm. long by 25 mm. wide, alive; with conspicuous broad marginal tentacles formed of the usual marginal folds; sucker conspicuous, elevated, about central.

COLOR: Medium brown to dark purplish brown.

EYES: Cerebral eyes of a single rounded cluster; marginal eyes occur on the anterior margin as a pair of clusters to either side of the median line, and from these the eyes continue as a band along the broad tentacles (fig. 134).

DIGESTIVE SYSTEM: The outstanding feature of this species is the large, oval, ruffled pharynx in the anterior body third with numerous narrow folds extending inward from the lateral walls (fig. 132). These folds are so conspicuous that the pharynx presents a cross-striated appearance even to the naked eye. Nothing definite could be made out of the rest of the digestive system. A network throughout the lateral body regions was evident on some of the specimens, but it was not clear that this represents the intestinal branches.

COPULATORY APPARATUS: None of the specimens seemed to be in a good sexual state. The median region of the anterior body third of one of the specimens was removed and sectioned but was found in very bad histological condition. No trace could be found of the male reproductive system. After prolonged search the terminal part of the female apparatus was located shortly behind the pharynx. What could be seen of this is shown in figure 133. The net-like uteri extend from behind and unite to a single stem that enters the dorsal side of the cement pouch characteristic of many Cotylea. This represents the vagina expanded into a pouch for receiving the cement glands. Although the latter were



FIGS. 130, 131. *Thysanozoon californicum*. 130. Dorsal view. 131. Eye pattern.

FIGS. 132, 133. *Pseudoceros mexicanus*. 132. Dorsal view. 133. Sagittal view of female apparatus.

evident in the whole specimens as radiations around the cement pouch, they were not detectable in the set of sections. The sucker was found as a prominent fleshy eminence well behind the female apparatus. The female gonopore was not demonstrable.

DIFFERENTIAL CHARACTERS: This species is distinguished by the color, broad, flap-like tentacles, and large oval pharynx with narrow folds.

DISTRIBUTION: Taken by the MacGinities beneath rocks on a rocky point at Puerto Penasco, Mexico, at the head of the Gulf of California, in December, 1947. This is the "brown flatworm, over two inches in length," mentioned in "Natural history of marine animals" (p. 151).

HOLOTYPE: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 384).

***Pseudoceros bajae*, new species**

Figures 135, 136

MATERIAL: Four specimens sent by the MacGinities, and one specimen sent by Ricketts.

FORM: Somewhat obovate, widest anteriorly, narrowing posteriorly (fig. 135); to 35 mm. long preserved by 25 mm. wide; marginal tentacles form rather narrow rounded folds.

COLOR: Black, sometimes with whitish speckles.

EYES: Because of the heavy black pigmentation, the eye arrangement could not be ascertained with certainty. There appeared to be a single median cerebral group, and eyes were seen along the tentacular folds.

DIGESTIVE SYSTEM: The ruffled pharynx forms an elongated oval area shortly behind the tentacular region. The pharynx consists of a few heavy, thick, curving folds (fig. 135). The lateral body regions show a black network which may represent the intestinal branches.

COPULATORY APPARATUS: This consists of a pair of male apparatuses and a single female apparatus. It is shown in dorsal view, as surmised from a study of a set of sagittal sections, in figure 136. The voluminous spermiducal vesicles approach the male apparatuses from behind. The two male apparatuses are located

behind and slightly beneath the posterior end of the pharynx. Each spermiducal vesicle enters a seminal vesicle which is a tubular structure bent on itself like a V. The seminal vesicle has a firm muscular wall. At its distal end it continues into a sinuous ejaculatory duct which after several coils approaches the base of the penis papilla. Here it is joined by the prostatic duct from the oval prostatic vesicle of modest size. This consists of a muscular wall and the usual glandular lining filled with eosinophilous granules. The penis papilla is a small conical eminence projecting into the proximal end of a long, rather wide male antrum that exits below by a male gonopore. The penis papilla definitely lacks the small pointed stylet characteristic of the Pseudoceridae. The female gonopore occurs in the median line shortly behind the two prostatic vesicles. It continues inward into a slender vagina that does not show any enlargement into a cement pouch. The vagina is encircled by the usual cloud of radiating cement glands, but these appear to open into it only near the gonopore. After pursuing a short posterior course, the vagina receives the two uteri that extend posteriorly.

DIFFERENTIAL CHARACTERS: This species is distinguished by the black color, ear-like tentacles, relatively few heavy pharyngeal folds, double male apparatus, lack of a penis stylet, and absence of a cement pouch.

DISTRIBUTION: Taken by the MacGinities at Puerto Penasco, Mexico, in December, 1947, and at Miramar Beach, Guaymas, Mexico, February 9, 1948, in both cases under rocks on a rocky shore; taken by Ricketts near La Paz, Mexico, March 21, 1940. The species therefore appears not uncommon in the Gulf of California, whence the trivial name.

HOLOTYPE: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 385).

REMARKS: The above study indicates that there are two species of *Pseudoceros* in the Gulf of California, a brown one of thin texture with a large pharynx appearing as if cross-barred and flap-like tentacles, *P. mexicanus*, and a thicker black one with a small pharynx of thick folds and ear-like tentacles, *P. bajae*. They should be easily recognized by external characters.

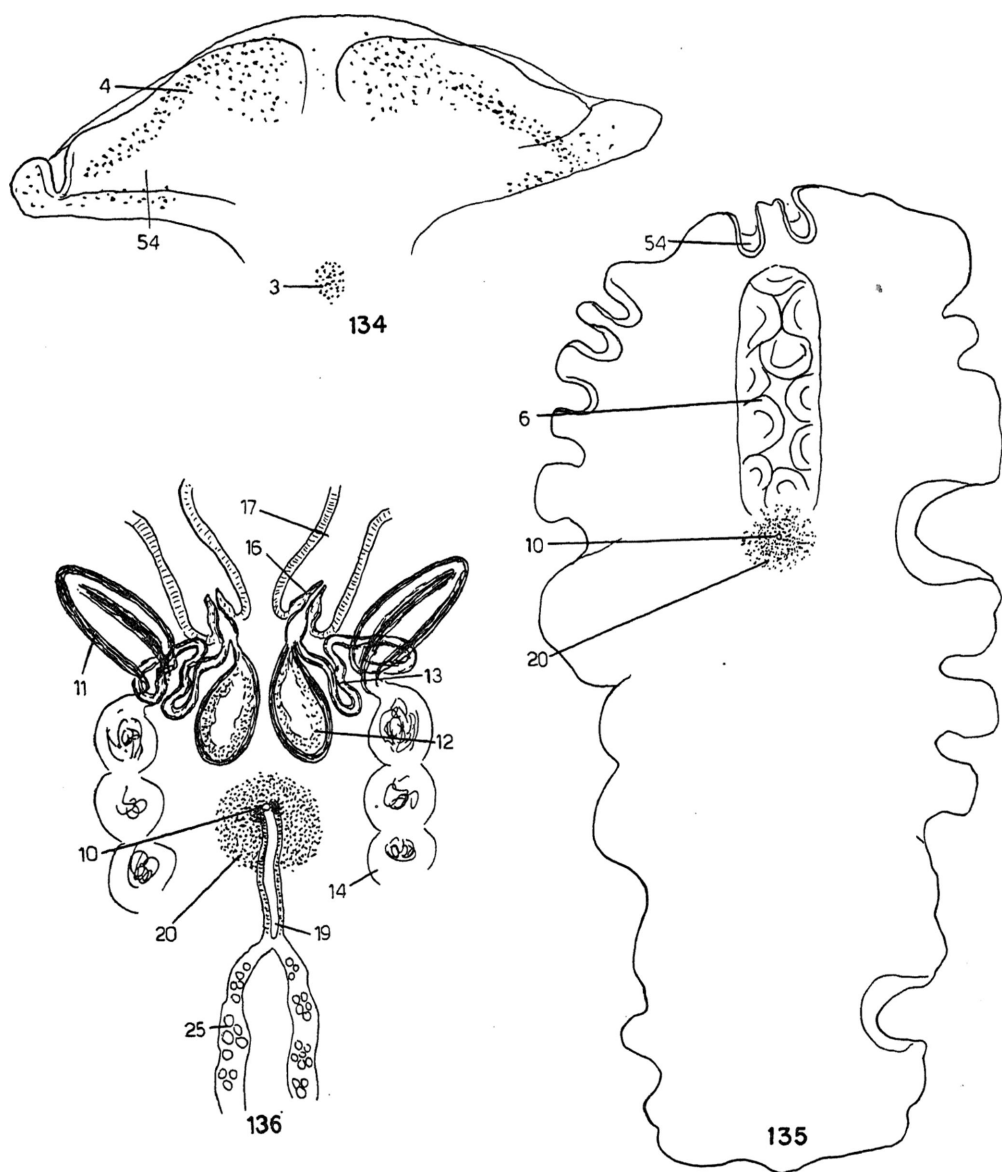


FIG. 134. *Pseudoceros mexicanus*, tentacles and eye pattern.

FIGS. 135, 136. *Pseudoceros bajae*. 135. Dorsal view. 136. Dorsal view of copulatory apparatus, with two male complexes.

***Pseudoceros luteus* (Plehn), 1898,**
new combination

Figure 137

Amblyceraeus luteus PLEHN, 1898, p. 94, pl. 5,
figs. 6-8.

MATERIAL: Three specimens sent by the
MacGinities.

FORM: Elongated oval, with rounded ends
and ruffled margins; thin, delicate; with a
pronounced middorsal ridge extending most
of the body length; tentacles broad, flap-like;
sucker well anterior to the middle. As an
excellent photograph of this species is given
in "Natural history of marine animals" (p.
154, fig. 38), it appears unnecessary to present

a drawing. According to this photograph the worm may reach a length of 50 mm.

COLOR: White with a narrow middorsal black stripe extending along the center of the ridge. Anteriorly this stripe forks between the tentacular flaps, and the forks continue to the anterior margin. In the original description the color is given as a lively brownish yellow, and a colored figure is also presented, but it is not clear from the text whether the indicated color is that of the live or the preserved animal. It seems probable that it is the result of preservation, and hence that the trivial name is a misnomer.

EYES: Plehn was unable to see any cerebral eyes in her specimen, but they show in all three of my specimens as a single cluster, shaped somewhat like an inverted V (fig. 137). The usual eyes occur along the tentacular flaps, but the distortion of these flaps makes it difficult to determine their exact arrangement. The arrangement is indicated in a general way in figure 137. There are also eyes on the anterior margin between the tentacular bases.

DIGESTIVE SYSTEM: Plehn is of the opinion that the pharynx is intermediate between the ruffled type of the *Pseudoceridae* and the funnel type of the *Euryleptidae*; consequently she created a new genus for the species and placed it in the latter family. I am unable to agree with this opinion. The pharynx is small, to be sure, but it appears to me to be a typical ruffled pharynx. I have therefore transferred the species to *Pseudoceros*. The pharynx is found inside the anterior part of the dorsal ridge; it occupies about one-fifth of the length of the animal. It is small and narrow, with a small number of rather thick folds (fig. 137). According to Plehn the main intestine extends posteriorly from the pharynx and gives off numerous branches that anastomose into a network; it also extends anteriorly above the pharynx.

COPULATORY APPARATUS: This agrees entirely with Plehn's description and figures, so that there cannot be any doubt of the identification. As Plehn has given a good sagittal view of the anterior part of the worm, including the sexual region, it appears unnecessary for me to present a similar figure. The single male apparatus occurs immediately behind or slightly beneath the rear

part of the pharynx. The two sperm ducts enter separately the proximal end of the large, inflated oval seminal vesicle, provided with the usual muscular wall. From its distal end the narrow ejaculatory duct proceeds into the penis base, where it is joined by the prostatic duct from the much smaller oval prostatic vesicle. The penis papilla is of conical form and is armed with the usual short, sharply pointed stylet. The penis papilla is encircled by the fold of the penis sheath. The female gonopore is not far behind the male pore and leads into a short female antrum expanded into a pouch. This does not receive any cement glands. From it the vagina ascends and very soon widens into a small, shallow, cement pouch (missed by Plehn) into which the halo of cement glands surrounding the vagina opens. The vagina then continues dorsally and receives the two uteri.

DISTRIBUTION: Monterey Bay and region around Corona del Mar.

SPECIMEN: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 386). As this specimen did not come from the type locality (Monterey Bay) but from Corona del Mar, it appears impermissible to declare it a neotype, although there can be no doubt of the identification.

REMARKS: As already indicated, I cannot justify Plehn's creation of a new genus for this species. It seems to me to fit well enough into *Pseudoceros*. If one were to attempt to split up the genus *Pseudoceros* on the basis of the size of the pharynx, one would soon run into difficulties, as size gradations exist. My observations also do not support Plehn's other reasons for assigning the species to the *Euryleptidae*; contrary to what she says, the main intestine does extend anteriorly above the pharynx, and the tentacles are formed by the usual upfolding of the anterior margin.

POSSIBLE COLOR VARIANT OF *Pseudoceros luteus*

REMARKS: There was sent by the MacGinities another specimen, also collected at Corona del Mar, that seems to differ from the typical *Pseudoceros luteus* only or primarily in color pattern. This specimen is mottled gray and instead of a median black stripe along the middorsal ridge, this ridge is bordered on either side by black pigment not

arranged into definite stripes. Other differences noted are the greater ruffling of the pharynx which, however, is of the same dimensions as in the typical specimens, and possibly less flap-like tentacles. It is possible that this specimen represents a different species of *Pseudoceros*, but this does not seem very likely. The point could presumably be settled by sectioning the specimen and examining the copulatory apparatus, but I have thought it preferable to keep the specimen intact. It is deposited as a whole mount in the American Museum of Natural History (A.M.N.H. No. 387). Should another specimen of similar color pattern become available, I shall section it and settle the question of its identity.

***Pseudoceros canadensis*, new species**

Figures 138, 139

MATERIAL: Two specimens sent by Ricketts.

FORM: Small, oval or rounded, of firm consistency (accompanying label reads "round, thick polyclads"); the two specimens are 13 by 7 and 12 by 9 mm. in dimensions, respectively; tentacles fairly developed, formed by the usual upturned folds of the anterior margin; sucker about central, very large, oval, much folded (fig. 138).

COLOR: Indeterminable, apparently brown or flecked with brown.

EYES: Cerebral eyes as a pair of closely placed oval clusters of about 15 eyes each; tentacular eyes form a band across the edge of the dorsal side of the tentacular folds, broader medially, narrowing laterally (fig. 138).

DIGESTIVE SYSTEM: The small oval pharynx comprises about one-fifth of the body length. Despite its small size, the pharynx is well ruffled with many much-coiled, rather narrow folds. The main intestine could be seen extending backward from the pharyngeal region and appeared to give off numerous branches, but the lateral body regions are so filled with ovaries that nothing could be seen of the digestive tract.

COPULATORY APPARATUS: The central region of one of the specimens was sectioned sagittally, and the copulatory apparatus so revealed is clearly different from that of other

Pseudoceros species of the region. It is shown in sagittal view in figure 139. The spermiducal vesicles ascend from behind and, on approaching the single male copulatory apparatus, become narrow sperm ducts that enter separately the proximal end of the seminal vesicle. The latter is a tubular, curved, muscular body with a thick muscular wall, but the ventral wall of its proximal end, into which the sperm ducts open, is very thin. At its distal end the seminal vesicle narrows to become the ejaculatory duct which curves posteriorly to one side of the prostatic vesicle and joins the prostatic duct at the base of the penis papilla. The prostatic vesicle is a small oval body with a muscular wall and glandular interior. The penis papilla is long and slender, armed distally by the usual short sharp penis stylet, and is protected by a penis sheath reaching to its tip. The whole is enclosed in a male antrum opening ventrally by a wide male gonopore. The wide female gonopore, well behind the male pore, leads into a good-sized female antrum, from the roof of which the vagina extends, curving backward through the mass of cement glands. The distal end of the vagina which receives the cement glands bulges into the roof of the female antrum. The vagina then narrows, then widens again, and finally narrows to a duct that receives the two uteri, ascending from behind to either side of the main intestine. Not far behind the female apparatus, the sucker could be seen in the series of sections as a very large, invaginated, much-folded structure.

DIFFERENTIAL CHARACTERS: *Pseudoceros canadensis* is distinguished from other *Pseudoceros* species of the region by the small size, small pharynx with many narrow folds, very large oval sucker, and details of the copulatory apparatus.

DISTRIBUTION: Taken by Ricketts at Clayoquot on the Pacific shores of British Columbia, June 7, 1945.

HOLOTYPE: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 388).

REMARKS: It is rather surprising to find a species of *Pseudoceros* in such cold northern waters, as the genus in general is restricted to the warmer seas. Perhaps the small size and lack of striking coloration are expressions of the northern habitat.

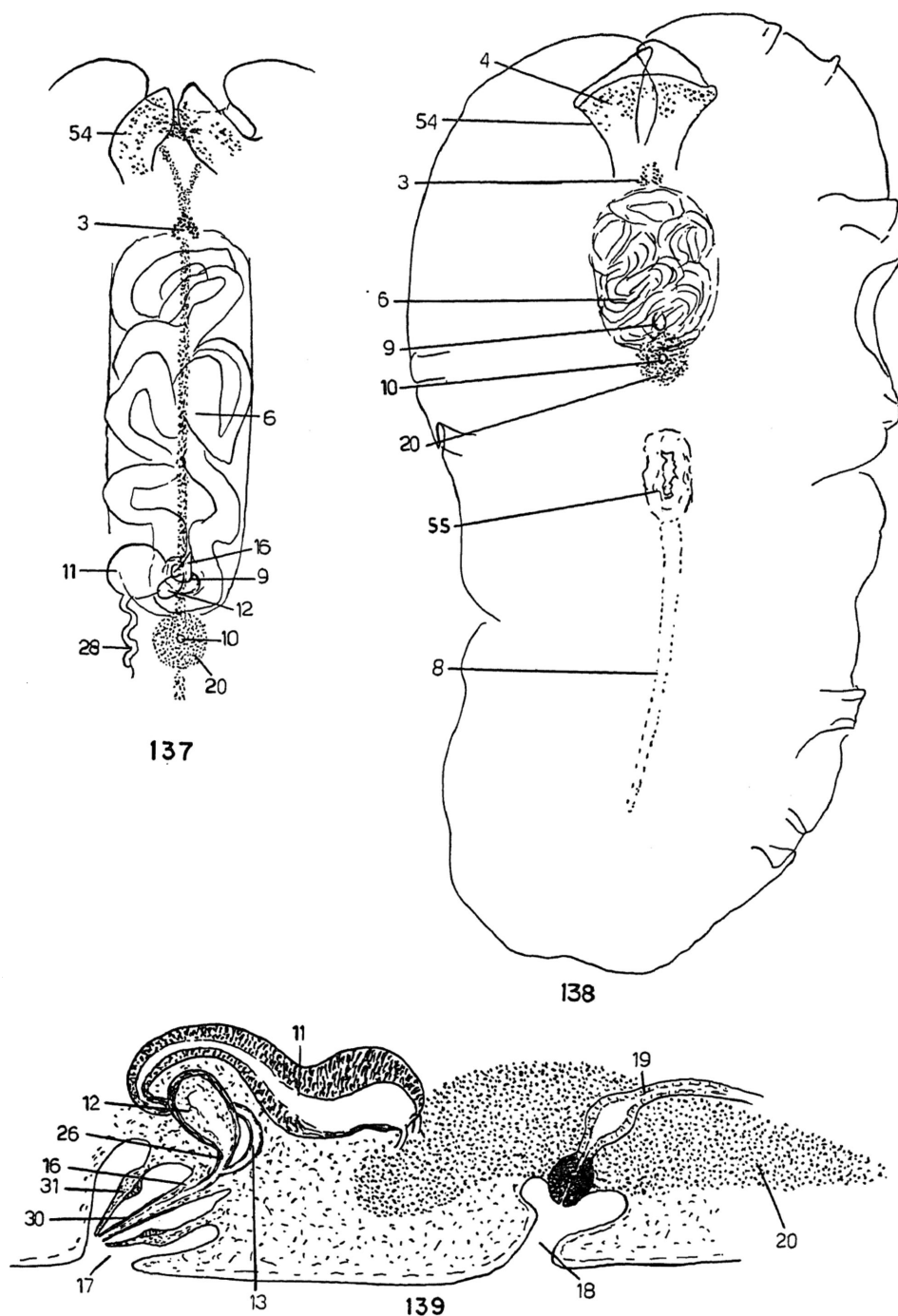


FIG. 137. *Pseudoceros luteus*, middle of anterior end, dorsal view.
 FIGS. 138, 139. *Pseudoceros canadensis*. 138. Dorsal view. 139. Sagittal view of copulatory apparatus, anterior end to left.

OTHER PSEUDOCERIDAE
IN THE REGION

Licheniplana lepida Heath and McGregor, 1912. I have had no specimens attributable to this species and therefore am not in a position to evaluate it. Possibly the presence of small dorsal papillae and the absence of eyes from the tentacles (at least I infer from the text that this is the case) do justify the creation of a distinct pseudocerid genus for this species.

NEW SPECIES OF *Pseudoceros*: In "Natural history of marine animals" (p. 153) there is given a good photograph (fig. 37) of what appears to be a species of *Pseudoceros*, clearly distinct from any others known from the California coast. The surmise of the authors that this might be *Amblyceraeus luteus* is clearly mistaken since figure 38 on the next page is obviously that species. According to the photograph and text, the polyclad in question is a large form, about 90 mm. long, white with a black border and with black spots and markings in the middorsal region. It is further stated that the worm came from tide pools at Pacific Grove. As these facts appear sufficient to enable future recognition of the form, I feel justified, despite the fact that the specimen is not available, in suggesting a name for it and propose *Pseudoceros Montereyensis*, new species.

In the same book there is a photograph (p. 151, fig. 35, left) of what seems to be still another species of *Pseudoceros*. In a letter Dr. MacGinitie has stated that this worm was taken in the vicinity of Corona del Mar, California. According to the legend of the photograph, the worm is over 70 mm. long, but as no details of the coloration are furnished I do not feel justified in proposing a name for the species.

FAMILY EURYLEPTIDAE LANG, 1884

DEFINITION: Cotylea of oval form, with smooth or papillate dorsal surface; with well-developed, slender, pointed tentacles or reduced tentacles or none; tentacles are not obviously upfoldings of the anterior margin; with cerebral eyes and marginal eyes in and around the tentacles or as a pair of clusters on the anterior margin in the absence of tentacles; pharynx of the tubular type, directed forward, often short and funnel-like, especially in preserved specimens; male copulatory

apparatus always single, behind or beneath the pharynx, directed forward, similar to that of the Pseudoceridae; uteri not branched, usually provided with uterine vesicles, often two in number; sucker median or posterior.

GENUS EURYLEPTA EHRENBERG, 1831

DEFINITION: Euryleptidae with smooth dorsal surface; tentacles well developed, long, and pointed; cerebral eye groups usually elongated; pharynx cylindrical; branches from the main intestine relatively few in number, not anastomosing; male apparatus behind the pharynx or beneath its posterior end; usually with one pair of uterine vesicles.

TYPE SPECIES: *Eurylepta cornuta* (O. F. Müller), 1776.

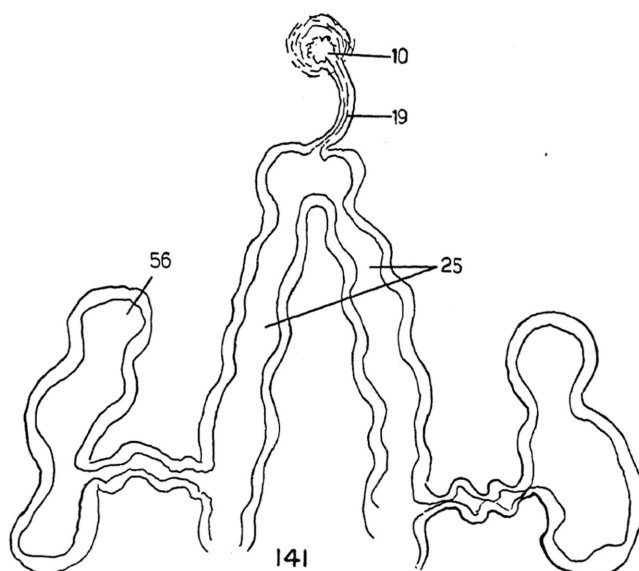
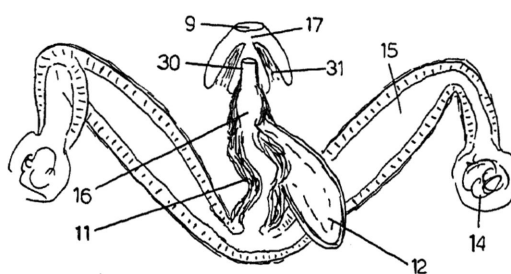
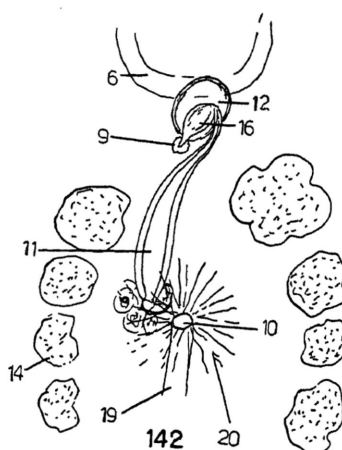
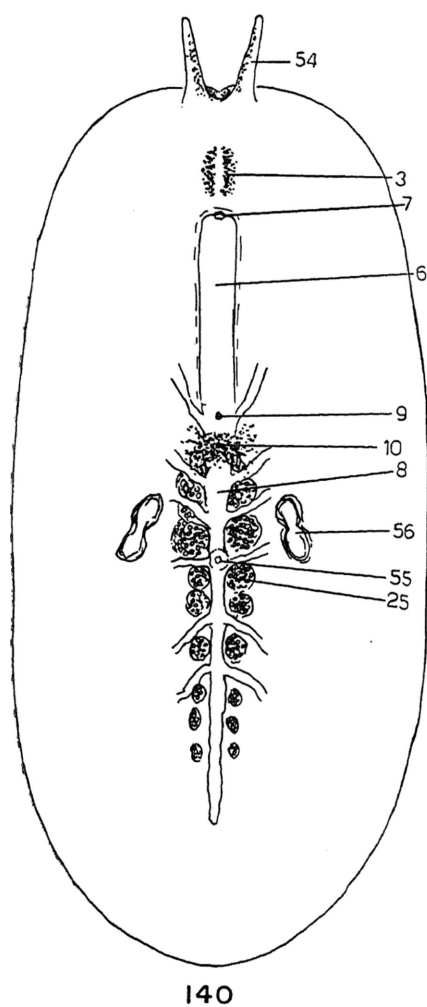
Eurylepta aurantiaca Heath and McGregor, 1912

Figures 140, 141, 143

MATERIAL: One specimen taken alive at Pacific Grove; two whole mounts found in the Fisher material labeled "*Eurylepta aurantiaca* Carmel, identified by Heath"; two whole mounts found in the Freeman collection, labeled *Eurylepta aurantiaca*; four specimens sent by Ricketts; two specimens sent by the United States National Museum.

FORM: Oval, somewhat thick, with smooth dorsal surface and a pair of slender pointed tentacles (fig. 140, drawn from life); the living specimen was 28 mm. long by 9 mm. wide when crawling, extended, but contracted to 15 mm. on fixation; the dimensions given in the original description appear to be those of preserved specimens, and the figure fails to show the true body shape or form of the tentacles. In all preserved specimens seen the tentacles are contracted to a form similar to that of the tentacles of *Stylostomum*. Sucker small, round, somewhat posterior to the middle. Johnson and Snook in "Seashore animals of the Pacific coast" (p. 118, pl. 5, fig. 3) give a colored figure of *Eurylepta aurantiaca* that agrees with my observations on the living worm, except that the tentacles seem abnormally far apart on this figure.

COLOR: Yellowish pink or salmon, according to the original description, with minute white specks; a similar coloration is presented in Johnson and Snook; some of the Ricketts specimens were labeled "red polyclads"; in



FIGS. 140, 141. *Eurylepta aurantiaca*. 140. From life, Pacific Grove. 141. Copulatory apparatus from series of frontal sections.

FIG. 142. *Eurylepta leoparda*, copulatory apparatus seen from above in whole mount of type specimen.

the living specimen that I observed the color was a uniform orange red, due to minute granulations. The MacGinities in "Natural history of marine animals" (p. 153) state that the species is gray and fragile and that the pink or coral color results from the eating of masses of similarly colored mollusk eggs.

DIGESTIVE SYSTEM: The tubular pharynx is cylindrical in life (fig. 140) but contracts to a shortened shape on fixation. The mouth occurs at the anterior end of the pharynx. The main intestine extending backward from the pharynx gives off about six to eight lateral branches on each side, the general arrangement of which is shown in my figure 140, also in figure 18 of the original description. These branches subdivide as they proceed to the periphery but the divisions do not anastomose.

COPULATORY APPARATUS: The specimen that I obtained alive was sectioned frontally, and the details of the copulatory apparatus as worked out from this set of sections are shown in my figure 141. Other specimens were sectioned sagittally, and a sagittal view of the apparatus is given in figure 143. The spermiducal vesicles enter on each side a long straight tube with a thin muscular investment and lined by a cuboidal epithelium. These tubes are termed vas deferens in the original description, but they seem to me to partake more of the nature of spermiducal bulbs. They join a median, more or less sinuous tube with a heavy muscular wall that is obviously a seminal vesicle. The statement in the original description that a seminal vesicle is wanting is clearly erroneous. The seminal vesicle leads anteriorly to the base of the penis papilla, where it is joined by the prostatic duct from the prostatic vesicle. The latter is a conspicuous oval sac, with a muscular wall and glandular lining. Its orientation with respect to the rest of the male apparatus seems to vary in different specimens; it usually extends somewhat laterally or posteriorly. In the specimen depicted in figure 143 it actually extended laterally but to avoid a foreshortened effect has been displaced somewhat anteriorly in the drawing. The penis papilla is a relatively small eminence armed with a cylindrical stylet that does not come to the sharp point usual in the *Cotylea*. Penis papilla and stylet

are housed in a cylindrical penis pocket separated by a penis sheath from the more expanded distal part of the male antrum. The male gonopore is located at the root of the pharynx. Some little distance behind the male gonopore the female gonopore leads into a small female antrum from which the vagina continues dorsally; the vagina receives the many cement glands into its distal part without any expansion into a cement pouch (fig. 143). After a short dorsal ascent, the vagina curves posteriorly and soon receives the two uteri. These proceed posteriorly as broad tubes lined with a cuboidal epithelium; each soon connects by a side branch with a large, oval, uterine vesicle, a hollow sac of uncertain function. Uterine vesicles, also called uterine glands, are of common occurrence in the *Cotylea*, but their purpose has never been elucidated. In the present species they are filled with granular material possibly indicative of secretion. The pair of uterine vesicles of *Eurylepta aurantiaca* is so large and conspicuous as to be easily noticed in whole mounts on a level with about the fourth pair of intestinal branches. The sucker appears in sections as a conspicuous muscular elevation.

DISTRIBUTION: Monterey Bay region; the United States National Museum specimens came from the San Diego region, also given as a locality by Johnson and Snook. The Ricketts specimens were collected at Clayoquot, on the Pacific shore of Vancouver Island, and at Round Island, in the same region, in June, 1945. The locality of the Freeman specimens was not stated on the slide. Evidently the species is distributed from the San Diego region northward at least as far as Vancouver Island.

LECTOTYPE: One of the Heath whole mounts declared a lectotype, deposited in the Natural History Museum, Stanford University, No. 5638.

Eurylepta leoparda Freeman, 1933

Figure 142

REMARKS: The single specimen taken by Freeman as recorded in his article was found in the Freeman collection and has been remounted on the original slide. As I felt that the specimen should be preserved as the type

of the species I have forborne to section it and hence have little to add to the original description. The general appearance of the anterior part of the mounted specimen is well shown in Freeman's figure 36, but I am not able to see in the specimen in its present condition all of the details of the copulatory apparatus depicted by Freeman in his figure 34. As this figure is very small and not very clear I have thought it best to represent what I have been able to see in figure 142. The sperm ducts apparently unite to a common duct that enters the proximal end of the seminal vesicle. This is a fusiform body labeled vas deferens in Freeman's figure 34 but called seminal vesicle in the text. It narrows distally to an ejaculatory duct that makes a curve and enters the proximal end of the penis papilla. The latter could not be clearly seen in the specimen but appeared to be a small conical body coming to a point at the male gonopore. The oval prostatic vesicle is readily seen extending anteriorly from the male gonopore and presumably has the usual relation to the rest of the male apparatus, but naturally this cannot be ascertained without the aid of sections. The male apparatus lies directly behind the root of the pharynx. The female gonopore, well behind the male pore, leads into a short straight length of vagina, apparently without any expansion into a cement pouch, and this soon receives the two uteri. A succession of dark masses occurs to either side of the copulatory complexes, extending backward from about the level of the seminal vesicle. These are regarded by Freeman as a pair of uterine vesicles and portions of the uteri. It seems to me their identity cannot be established without the aid of sections. The specimen has been deposited as a holotype in the American Museum of Natural History (A.M.N.H. No. 389).

GENUS *PROSTHECERAEUS* SCHEMADA, 1859

DEFINITION: Euryleptidae of somewhat fusiform shape and smooth dorsal surface; often strikingly colored; with well-developed pointed tentacles similar to those of *Eurylepta*; cerebral eye groups usually short; pharynx rather short, usually bell- or funnel-shaped; intestinal branches numerous, anastomosing to a network; uterine vesicles

usually equal in number to the number of intestinal branches.

TYPE SPECIES: *Prostheceraeus vittatus* (Montagu), 1815.

Prostheceraeus (?) *bellostriatus*, new species

Figures 144, 145

MATERIAL: One specimen sent by the MacGinities and one in bad condition by the United States National Museum.

FORM: Fusiform, widest across the middle, diminishing moderately towards the ends; preserved specimen was 22 mm. long by 11 mm. wide; stated by Johnson and Snook to reach a length of about 1 inch. The tentacles are well developed and pointed as in *Eurylepta* (fig. 144). As a colored figure of the species appears in Johnson and Snook (p. 118, pl. 5, fig. 4) it is unnecessary for me to illustrate the entire animal.

COLOR: The color is illustrated and described in Johnson and Snook as cited above. The coloration is striking, consisting of alternating black and white longitudinal stripes with a middorsal orange stripe and a marginal orange band. The stripes vary in width, some being very narrow, others wider; their appearance at the anterior end is shown in figure 144. A pattern of longitudinal stripes appears quite common in the genus, as may be seen by examining the colored plates in Lang (1884).

EYES: The cerebral eyes form a pair of small oval clusters; tentacular eyes occur on the margin between and on the bases of the tentacles but apparently are wanting elsewhere on the tentacles (fig. 144).

DIGESTIVE SYSTEM: The pharynx is located as usual close to the anterior end and is elongated and cylindrical (fig. 144). The MacGinities specimen was cut frontally to elucidate the digestive tract, but the sections were unsatisfactory in this respect. It was impossible to make out the intestinal branches, and it could not be determined whether they anastomose or not. As this is the main distinction between the genera *Eurylepta* and *Prostheceraeus*, the generic status of the species remains uncertain.

COPULATORY APPARATUS: Frontal sections are not very satisfactory for the study of the copulatory apparatuses, but the result of the study of the frontal series is shown in figure

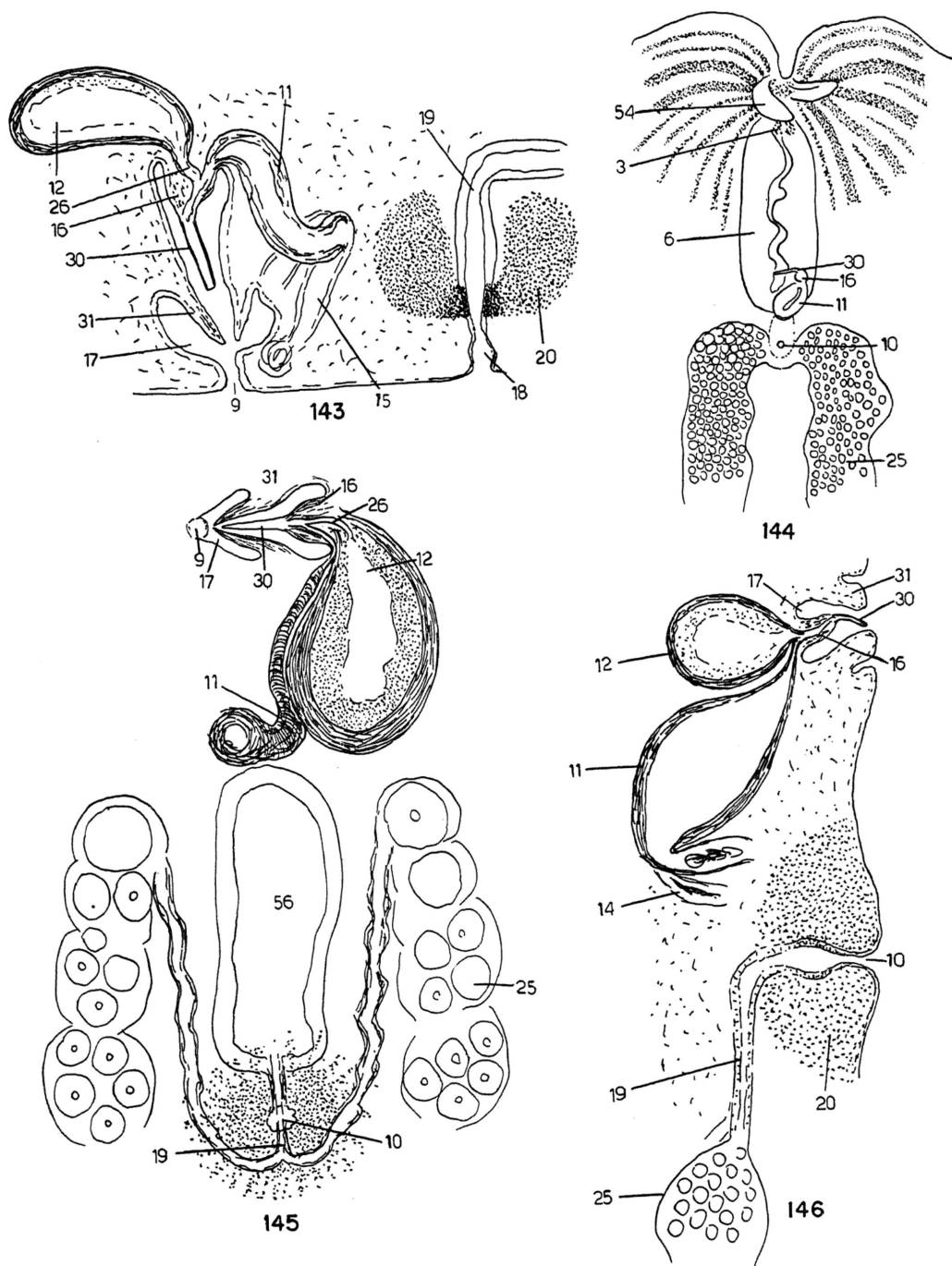


FIG. 143. *Eurylepta aurantiaca*, sagittal view of copulatory apparatus, anterior end to left.
 FIGS. 144, 145. *Prostheceraeus bellostriatus*. 144. Middle of anterior part, seen from above. 145. Copulatory apparatus as worked out from series of frontal sections.
 FIG. 146. *Euryleptodes insularis*, sagittal view of copulatory apparatus, anterior end above.

145. There is a tubular, somewhat sinuous seminal vesicle with a muscular wall that continues distally as an ejaculatory duct, joined as usual in the Cotylea by the prostatic duct from the free prostatic vesicle. The latter is a large oval body with the usual muscular wall and glandular lining; it extends backward from the penis, fitting into the curve of the seminal vesicle. The conical penis papilla bears the usual pointed stylet; both are enclosed in a well-developed penis pocket separated from the distal part of the male antrum by a penis sheath. The male apparatus is located beneath the posterior end of the pharynx. The female gonopore, some little distance behind the male gonopore, leads into the vagina encircled by the usual mass of cement glands. The vagina soon forks into an anterior and a posterior branch. The anterior branch leads into a large oval sac that extends forward up to the proximal end of the seminal vesicle (fig. 154). The nature of this sac is puzzling, and sagittal sections are needed to elucidate fully the anatomy of this region. The sac seems to be a single median uterine vesicle, but I know of no such condition in other Cotylea. It is filled with an eosinophilous granular material. The posterior branch of the vagina soon forks, and each fork extends anteriorly to enter the anterior end of the uterus of that side. The uteri extend posteriorly to either side of the main intestine; no uterine vesicles were found, but the sections are not satisfactory for this purpose. The sucker appears as a rounded muscular mass at about the body middle.

DIFFERENTIAL DIAGNOSIS: This species is differentiated from related forms by the distinctive color pattern.

DISTRIBUTION: Taken by the MacGinities in May, 1938, in a tank at the Kerckhoff Marine Laboratory at Corona del Mar, California; taken by the United States National Museum at Laguna Beach, California. The specimen illustrated in the Johnson and Snook book is stated to have been collected under a stone at La Jolla, California. The species appears limited to the southern part of the California coast.

SPECIMEN: The set of frontal sections has been deposited in the American Museum of Natural History (A.M.N.H. No. 368), but it

does not seem desirable to declare them a holotype. It is hoped that a good specimen will eventually become available.

REMARKS: This species has been doubtfully placed in the genus *Prostheceraeus* on the grounds of external resemblance, as the available material does not suffice to enable me to determine the characters necessary for generic placement. If the median sac extending anteriorly from the vagina is in fact a uterine vesicle, a new genus may be necessary for the species.

GENUS *EURYLEPTODES* HEATH AND
MCGREGOR, 1912

DEFINITION: Euryleptidae of oval or obovate form with well-developed tentacles; sucker well posterior to the middle; pharynx short; intestinal branches anastomosing to a network; male apparatus behind the pharynx, typically cotylean, with sacciform seminal vesicle; uteri forming networks; uterine vesicles wanting.

TYPE SPECIES: *Euryleptodes cavicola* Heath and McGregor, 1912.

Euryleptodes insularis, new species

Figures 146, 147

MATERIAL: Three specimens sent by the Allan Hancock Foundation, one large, two small.

FORM: Somewhat obovate, expanded anteriorly, diminishing somewhat posteriorly (fig. 147, somewhat distorted by preservation); with well-developed conical pointed tentacles; sucker somewhat posterior to the middle; largest specimen is about 20 mm. long, but its dimensions are difficult to determine because of distortion.

COLOR: Indeterminable, apparently brown with dark spots.

EYES: There are the usual two elongated cerebral clusters (fig. 147); two groups of marginal eyes occur on the anterior margin at the base of and between the two tentacles, but there appear to be no eyes in the tentacles, except possibly on their bases.

DIGESTIVE SYSTEM: The pharynx has the usual oval shape common in preserved specimens and resulting from contraction of the tubular pharynx. The intestine could not be seen in the whole mount, made from the large specimen (fig. 147), but sections of one

of the small specimens indicate about seven pairs of lateral branches, which probably anastomose to a network.

COPULATORY APPARATUS: The male apparatus is readily seen in the whole specimens lying behind the pharynx, and its parts are more or less discernible. One of the small specimens has been sectioned sagittally, and the copulatory apparatuses are shown in sagittal view in figure 146. An outstanding feature of the male system is the enormous spermiducal vesicles that ascend lateral to the mass of cement glands; their coils are intermingled with the uterine network (fig. 147). Anterior to the cement mass the spermiducal vesicles narrow to a pair of tubes with thin walls, and these enter separately the proximal end of the seminal vesicle. This is an expanded body with a fair muscular wall that narrows distally to a short ejaculatory duct that soon joins the very short prostatic duct coming from the broadly oval but rather small prostatic vesicle. The two ducts unite inside the small penis papilla which bears a short stylet. The penis papilla is housed in a male antrum of fair size embraced by the thick short folds of the penis sheath. The female gonopore lies well behind the male pore; from it the vagina without any expansion into a cement pouch ascends through the dense mass of cement glands, turns posteriorly, and soon forks to connect with the two uteri. The uteri form extensive networks through the lateral body region; this network was evident in some lateral regions of the specimen shown in figure 147 but not everywhere. The canals of this network are full of eggs and connect with the ovaries everywhere. Uterine vesicles are wanting.

DIFFERENTIAL CHARACTERS: *Euryleptodes insularis* differs from other described species of the genus in the eye arrangement and the very short ejaculatory duct.

DISTRIBUTION: Taken by the Allan Hancock Foundation at 20 meters off Santa Rosa Island, August 10, 1939.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: The validity of the genus *Euryleptodes* is open to doubt, but at present the genus appears to furnish a convenient receptacle for well-tentacled euryleptids de-

void of uterine vesicles and provided with extensive uterine networks as in the Pseudoceridae. A somewhat posteriorly located sucker and an expanded seminal vesicle also appear characteristic of the genus. Heath and McGregor list three species of this genus, but I am not able to assign the present species to any of them. *E. cavicola* has a long narrow ejaculatory duct contrasting with the short duct of *insularis*. The systematic position of *E. pannulus* is doubtful, as the anterior margin is damaged. The description indicates that the large spermiducal vesicles characteristic of *insularis* are also present in *pannulus*, but the uteri do not seem to form networks, and therefore *pannulus* is more likely a *Prostheceraeus*. Uterine networks also appear absent in the third species, *E. phyllulus*, which in any case is rather poorly described. The absence of color notes from two of the three species adds to the difficulty of future recognition of them. I have had no specimens attributable to any of the three Heath and McGregor species placed in *Euryleptodes*.

GENUS *STYLOSTOMUM* LANG, 1884

DEFINITION: Euryleptidae of small to moderate size and oval form with smooth dorsal surface; tentacles reduced to small stumps or wanting; with cerebral and marginal eye clusters, often few in number; pharynx cylindrical; intestinal branches relatively few, not anastomosing; male apparatus beneath the anterior part of the pharynx, opening in common with the mouth; usually with a pair of uterine vesicles.

TYPE SPECIES: *Stylostomum ellipse* (Dalyell), 1853.

Stylostomum lentum Heath and McGregor, 1912

REMARKS: I have had no specimens referable to this species, but the original description and figures are adequate to identify it, and undoubtedly it has been correctly placed generically. I therefore list it among the valid cotyleans of the region under study. There have been described to date only four other valid species of the genus, namely: *ellipse* (Dalyell), 1853 (= *roseum* Sars, 1878, *variabile* Lang, 1884); *frigidum* Bock, 1931; *hozawai* Kato, 1939b; and *maculatum* Kato, 1944. The first two, together with *lentum*, are provided

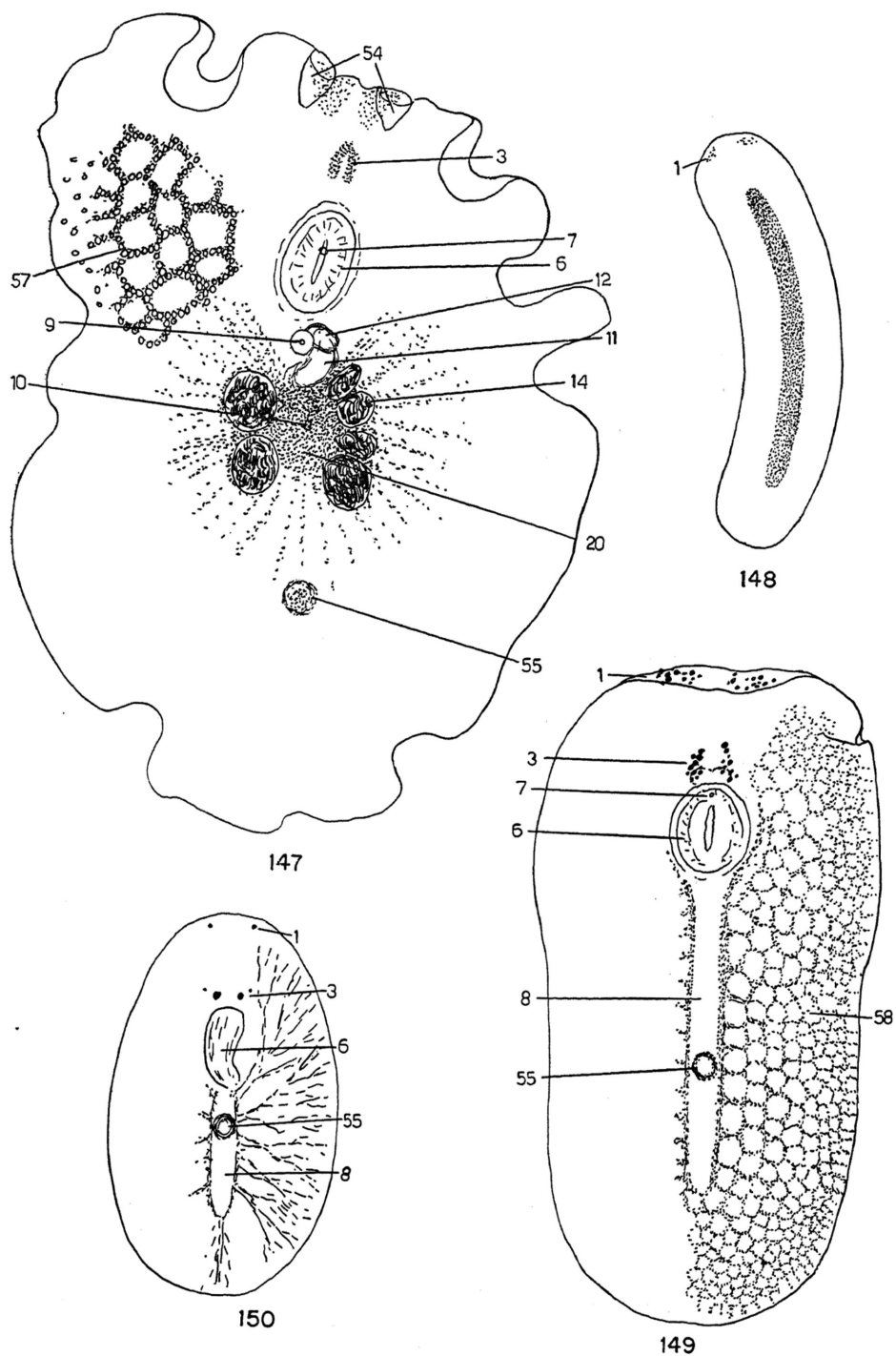


FIG. 147. *Euryleptodes insularis*, dorsal view.

FIGS. 148, 149. *Acerotisa archica*. 148. Appearance in life as sketched from color photograph furnished by MacGinitie. 149. Dorsal view.

FIG. 150. *Acerotisa californica*, young specimen.

with small stumpy tentacles, but the two Japanese species lack tentacles, and, as they also have very few eyes, they present a marked resemblance to members of the genus *Acerotisa*. The eyes are also reduced in number in *Stylostomum ellipse*, but both *lentum* and *frigidum* are provided with numerous cerebral and marginal eyes.

GENUS *ACEROTISA* STRAND, 1928

Aceros LANG, 1884, p. 589.

DEFINITION: Euryleptidae of small size and oval form without tentacles; dorsal surface smooth; eyes relatively few in number, in a pair of cerebral groups and a pair of marginal groups at the sites of the missing tentacles (one species lacks eyes); pharynx short, cylindrical; intestinal branches few, without anastomoses or numerous and anastomosing to a network; male apparatus beneath the pharynx; usually with a pair of uterine vesicles.

TYPE SPECIES: *Acerotisa inconspicua* (Lang), 1884.

Acerotisa alba (Freeman), 1933, new combination
Figure 151

Oligocladus albus FREEMAN, 1933, p. 140, fig. 21.

MATERIAL: Type specimen of *Oligocladus albus* found in the Freeman collection.

FORM: Oval or pyriform, 5 mm. long by 3 mm. wide while alive, extended; nearly 3 mm. long by less than 2 mm. wide preserved; anterior margin incurved at center; tentacles wanting; sucker about central (fig. 151).

COLOR: White according to the original description, with some yellowish markings mid-dorsally; specimen had been stained.

EYES: The eyes are typical of the genus *Acerotisa* (fig. 151). The cerebral eyes consist on each side of a large mass composed of three eyes, with about three eyes anterior to this mass; the marginal group consists of six eyes on one side and about eight on the other.

DIGESTIVE SYSTEM: This system offers several peculiarities. The mouth is stated by Freeman to be located in the center of the anterior margin, and I can see an appearance there that is probably the mouth. I am not able to discern any tubular "prepharynx" leading from the mouth to the pharynx. The

pharynx has such a remarkable location that I am constrained to believe it has been torn loose from its normal position and pushed backward during fixation. It lies in the present specimen in the posterior body half, entirely behind the male apparatus and above the female apparatus and the sucker. What Freeman regards as folds in the pharynx appear to me to be longitudinal muscle fibers. The main intestine extends backward from the pharynx and gives off a few conspicuous lateral branches. I am not able to trace these farther; according to Freeman the intestinal branches anastomose.

COPULATORY APPARATUS: The specimen appears to be mature as regards the male system, but the female system is not fully developed, as no eggs can be seen anywhere. Instead the whole lateral body regions are filled with deeply stained oval bodies that appear to be immature ovaries. The male system is fairly determinable on the whole mount and is typically euryleptid. It is situated in the anterior body half a little distance behind the brain and in front of the pharynx. There are visible an inflated seminal vesicle filled with sperm and narrowing to an ejaculatory duct leading to the penis, an oval prostatic vesicle anterior to the seminal vesicle, and a small penis papilla bearing the usual stylet and embraced by a penis sheath. The female gonopore encircled by a modest amount of shell glands occurs below the anterior end of the pharynx. To either side of this region are seen two darkly staining masses, one large, one small. The smaller ones appear to be coils of the spermiducal vesicles, and similar coils occur between the seminal vesicle and the female gonopore. The two larger masses may be a pair of uterine vesicles as believed by Freeman, but I find no indication of the connecting ducts that Freeman shows in his figure 21. An elongated yellowish body lies to either side of the pharynx: these are regarded as uteri by Freeman, but I find this rather doubtful.

DISTRIBUTION: Puget Sound on hydroids at the old marine station.

HOLOTYPE: Original specimen deposited in the American Museum of Natural History (A.M.N.H. No. 391).

REMARKS: The specimen has the general appearance of the genus *Acerotisa* and fits

well enough into this genus except for two points: the far anterior position of the mouth and the far posterior position of the pharynx. The latter I believe to be a displacement due to fixation. If it is real, then the species would certainly require a new genus, possibly even a new family, of the Cotylea. The specimen cannot be fully elucidated without sections, and I felt that it should be preserved intact. It is hoped that other specimens may be forthcoming that will enable one to place the worm properly. My transferring it to *Acerotisa* must be regarded as tentative.

Acerotisa arctica, new species

Figures 148, 149

MATERIAL: One good specimen and two fragments sent by the United States National Museum, collected by MacGinitie.

FORM: Elongated with rounded ends when crawling alive, extended (fig. 148); to 6 mm. long; preserved specimen is oval or slightly obovate, 4 mm. long by 2 mm. wide (fig. 149); without tentacles; sucker posterior to the middle.

COLOR: According to color photographs sent by MacGinitie, the worm is pale or translucent, with a reddish brown middorsal longitudinal stripe (fig. 148). Reddish yellow tints in the digestive tract presumably represent ingested food.

EYES: Fairly numerous for the genus; cerebral groups consist of 11 eyes on each side over the brain; one of the marginal groups comprises about 13 eyes, the other 15 (fig. 149).

DIGESTIVE SYSTEM: The pharynx, found anteriorly just behind the brain, is contracted as usual in preserved animals to an oval shape. The main intestine proceeds posteriorly from it, terminating well anterior to the posterior margin. It gives off a number of lateral branches that immediately anastomose to an extensive network filling the entire periphery. This is very obvious in the one good specimen (fig. 149). Although Lang defined the genus as without intestinal anastomoses, an intestinal network was previously recorded for *A. meridiana* (Ritter-Zahony), 1907, and for *A. typhla* (Bock), 1913. The mouth is located near the anterior end of the pharyngeal cavity.

COPULATORY APPARATUS: There are no

signs of the reproductive system in the one good specimen that has been mounted whole. One of the fragments contained the pharynx and a small area behind it. This has been sectioned sagittally, but no trace of any copulatory apparatus has been found. It therefore appears that the specimens are not in a sexual state.

DIFFERENTIAL CHARACTERS: *Acerotisa arctica* differs from the other known species of the genus except *typhla* and *meridiana* by the presence of an intestinal network; *typhla* lacks eyes and in *meridiana* there are only four pairs of intestinal branches springing from the sides of the main intestine.

DISTRIBUTION: Taken by G. E. MacGinitie in the vicinity of Point Barrow, Alaska, at about latitude 72° N., on rocky and gravelly bottom, at depths of 295 to 453 feet, during September and October, 1949.

HOLOTYPE: One whole mount deposited in the United States National Museum (U.S.N.M. No. 23785).

REMARKS: The locality of this species is the northernmost recorded for the genus. *A. typhla* is also a northern species, having been taken on the Norwegian coast at a latitude of about 65° N., but the other species come for the most part from tropical and subtropical waters.

Acerotisa californica, new species

Figures 150, 152-154

MATERIAL: A number of specimens, mostly juveniles, sent by D. Reish of the Allan Hancock Foundation.

FORM: Small, oval, reaching a length of nearly 3 mm. preserved (figs. 150, 152), without tentacles; sucker about central, shortly behind the female gonopore.

COLOR: Indeterminable, specimens appear flecked with brown or black.

EYES: Few; in young specimens each cerebral group consists of one large eye flanked by a small eye (fig. 150). In mature specimens (fig. 152) the large eye of the cerebral groups is usually found to have divided into two eyes, and these are accompanied by one to four small eyes. The marginal groups may consist of a single eye each in young specimens, of four to five eyes paralleling the margin in mature ones.

DIGESTIVE SYSTEM: The pharynx is of the

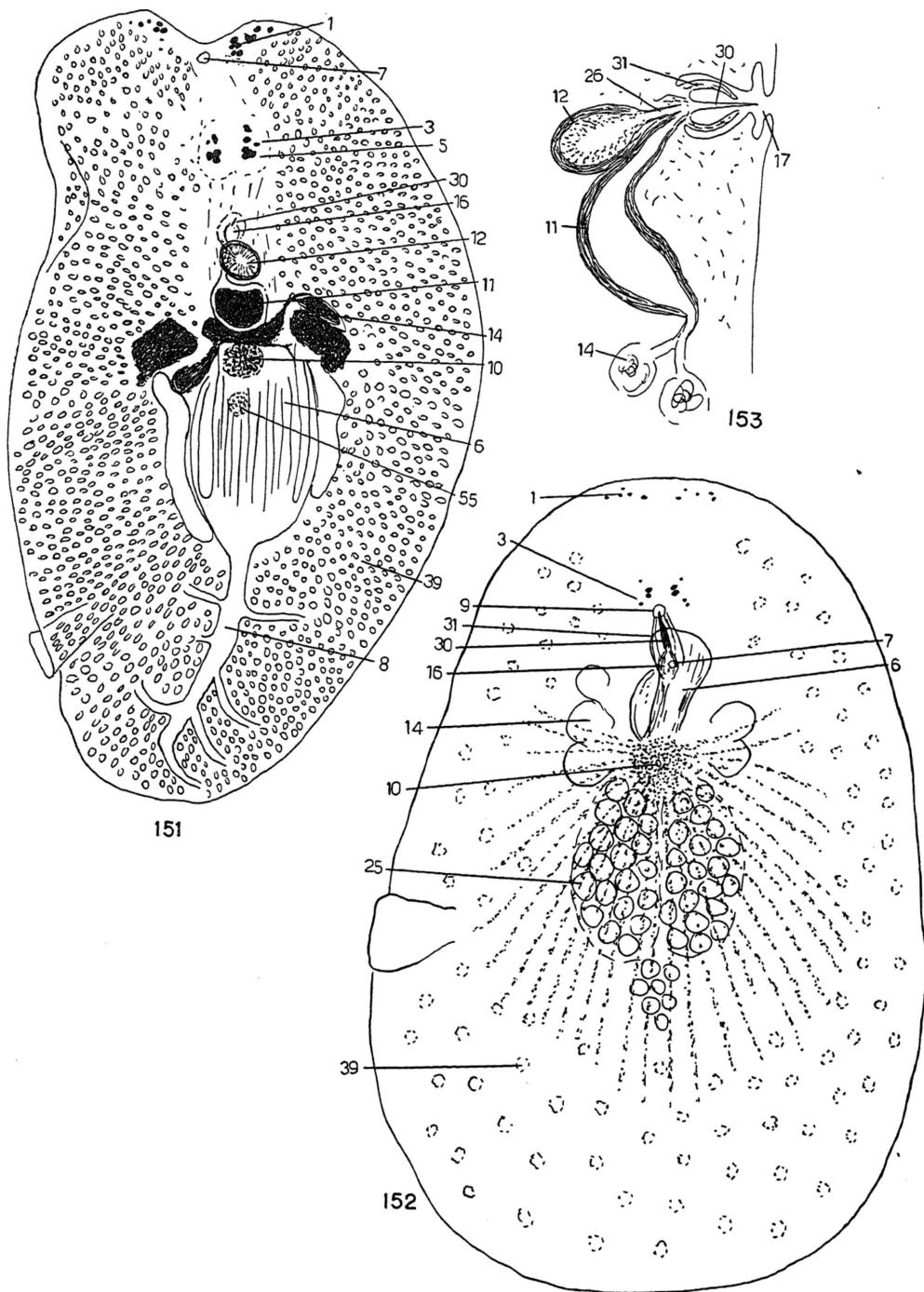


FIG. 151. *Acerotisa alba*, dorsal view of Freeman type specimen.

FIGS. 152, 153. *Acerotisa californica*. 152. Ventral view of mature specimen. 153. Sagittal view of male apparatus, anterior end above.

usual short bell type (fig. 150); from it the main intestine proceeds backward and gives rise to about five pairs of lateral branches that branch to the periphery without anastomosing. The mouth is found beneath the anterior part of the pharynx (fig. 152).

COPULATORY APPARATUS: The outstanding feature of this species is the anterior position of the male copulatory apparatus. This apparatus was readily seen in the whole mounts made of the two best specimens. The male gonopore is directly behind the brain in front of the anterior end of the pharynx (fig. 152). The male apparatus, located slightly to one side of the median line, is typically euryleptid in construction. Because of the asymmetrical position of the male apparatus, the one available set of serial sections is not altogether satisfactory, since the penis is cut at an angle. Figure 153 gives a sagittal view of the male apparatus, with some details supplied from the whole mounts. There are voluminous spermiducal vesicles that approach the male apparatus from behind. Shortly before reaching the seminal vesicle, they narrow to tubes that at once unite and enter the proximal end of the vesicle. The latter is a fusiform body with a muscular wall that narrows distally as it enters the penis base and there unites with the prostatic duct from the small oval prostatic vesicle. The penis papilla is the usual small eminence, bearing a long stylet that is enclosed by the penis sheath. There is a short but laterally expanded male antrum leading to the male gonopore located shortly behind the brain. The female apparatus, shown in sagittal view in figure 154, also offers no special features. The female gonopore, located behind the root of the pharynx, leads into an expanded female antrum. The narrow vagina ascending from the roof of this immediately widens into a cement pouch into which pour the secretions of the great mass of cement glands surrounding the female apparatus. From the roof of the cement pouch, the vagina continues, making the usual backward bend, and soon receives the two uteri. The sucker is a conspicuous projection located shortly behind the anterior ends of the uteri. In the best whole mount (fig. 152) there are seen to either side of the posterior part of the pharynx elongated sacs that may be the pair of uterine vesicles expected in

Acerotisa. However, uterine vesicles could not be identified in sections, and the sacs in question might be coils of the spermiducal vesicles.

DIFFERENTIAL CHARACTERS: *Acerotisa californica* is distinguished from other species of the genus by the anterior position of the male gonopore.

LOCALITY: Taken by Reish in Los Angeles Harbor on wooden blocks that had been suspended in the water at various levels for study of the fauna settling on such blocks.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: Marcus (1947), in adding three new species to the genus, considered that there were previously described seven valid species, so that with the three added in the present study there seem to be 13 good species of *Acerotisa*. To the four species with five or more eyes in each cerebral group is to be added *arctica*; whereas *alba* and *californica* increase the forms with very few cerebral eyes to a total of seven; and one species, *typhla*, is devoid of eyes. Heath and McGregor (1912) gave the name *Aceros langi* to a single worm taken in Monterey Bay. As the anterior margin so important in assigning Cotylea to genera is missing from the specimen and as the number of cerebral eyes surpasses that usual to the genus, it seems very doubtful that the worm can belong to *Acerotisa*. The authors failed to see any prostatic vesicle, but reliance on whole-mount study no doubt accounts for this failure. Altogether it appears impossible to evaluate *Aceros langi* on the basis of the original description.

OTHER EURYLEPTIDAE IN THE LITERATURE

As already indicated, it has been impossible to elucidate most of the euryleptids described in the Heath and McGregor article. I have had no material assignable to the following species and as the original specimens cannot be found and the original descriptions are inadequate, I am not able to pass on their validity: *Anciliplana graffi*, *Aceros langi*, *Euryleptodes cavicola*, *E. pannulus*, and *E. phyllulus*. The genus *Anciliplana* seems to differ from *Euryleptodes* only in the absence of tentacular and marginal eyes. It seems very odd indeed for a cotylean to lack margin-

al eyes, and one is inclined to suspect an error of observation. *Aceros langi* cannot be placed generically, because the specimen lacks the anterior margin, and it is further very doubtful that it can be an *Acerotisa*. Although I feel that the genus *Euryleptodes* fills a niche in the Euryleptidae and have therefore acknowledged it, Heath and McGregor seem to use this genus as a receptacle for *Cotylea* they were unable to understand. The three species they placed in this genus do not seem to have much in common, and one of them again lacks part of the anterior margin.

FAMILY PROSTHIOSTOMIDAE LANG, 1884

DEFINITION: *Cotylea* of long slender form, with smooth dorsal surface and rounded anterior end; without any trace of tentacles; with paired cerebral eye clusters and with marginal eyes usually in a band along the anterior margin or encircling the entire margin; pharynx tubular, long and cylindrical; mouth at the anterior end of the pharynx; main intestine wholly behind pharynx, extending to the posterior end and giving off numerous lateral branches that do not anastomose; copulatory complexes immediately behind the root of the pharynx; male complex with two spherical accessory vesicles opening into the ejaculatory duct by way of sinuous narrow tubes; accessory vesicles separate or bound within a common muscle sheath; typical prostatic vesicle wanting; penis armed with a stylet; uterine vesicles absent; sucker at varying distances behind the female gonopore.

GENUS PROSTHIOSTOMUM QUATREFAGES, 1845

DEFINITION: Prosthiostomidae with marginal eyes limited to varying lengths of the anterior margin; accessory vesicles usually separate but sometimes bound within a common muscle sheath; sucker not far behind the female gonopore.

TYPE SPECIES: *Prosthiostomum siphunculus* (Della Chiaje), 1828.

Prosthiostomum latocelis, new species

Figures 155-157

MATERIAL: Several specimens sent by the Allan Hancock Foundation; one specimen sent by de Laubenfels.

FORM: Typical of the genus, long and slender, broadest anteriorly, gradually tapering to a bluntly rounded posterior end (fig. 155); largest available specimen 17 mm. long, preserved, by 4.5 mm. across the anterior region.

COLOR: Yellow, according to de Laubenfels.

EYES: Shown in enlarged view in figure 156; cerebral clusters form wedge-shaped groups of about 50 eyes each, beginning behind the brain and narrowing anteriorly to a point about equally far anterior to the brain. Marginal eyes consist of a short band along the anterior margin, somewhat scattered on the inner side from which eyes extend back on either side to meet the cerebral groups.

DIGESTIVE SYSTEM: Typical of the family. The long tubular pharynx extends from the brain to about the posterior end of the anterior body third (fig. 155). Behind this the main intestine proceeds posteriorly; lateral branches were not evident in the available specimens but presumably follow the pattern usual in the genus.

COPULATORY APPARATUS: This is also typical of the genus and presents very little variation among the numerous species. The male apparatus is situated directly behind the root of the pharynx (fig. 155). It is shown in sagittal view in figure 157. The spermiducal vesicles approach the seminal vesicle from each side; as they reach the vesicle each narrows to a slender straight duct that enters the seminal vesicle at about the middle of its side but then slants backward to the proximal end of the seminal vesicle where it opens into the lumen of the latter. Only one of the two spermiducal vesicles and sperm ducts is shown in figure 157. The seminal vesicle has an elongated oval shape; it narrows distally to a sinuous ejaculatory duct that proceeds to the penis. To the sides of the anterior part of the seminal vesicle are seen the two spherical accessory vesicles characteristic of the family. These are round bodies with a thick muscular wall of circular fibers and a glandular interior. From each a very slender sinuous duct proceeds to the base of the penis papilla where it joins the ejaculatory duct. The nature of these accessory vesicles is unclear, but probably they cor-

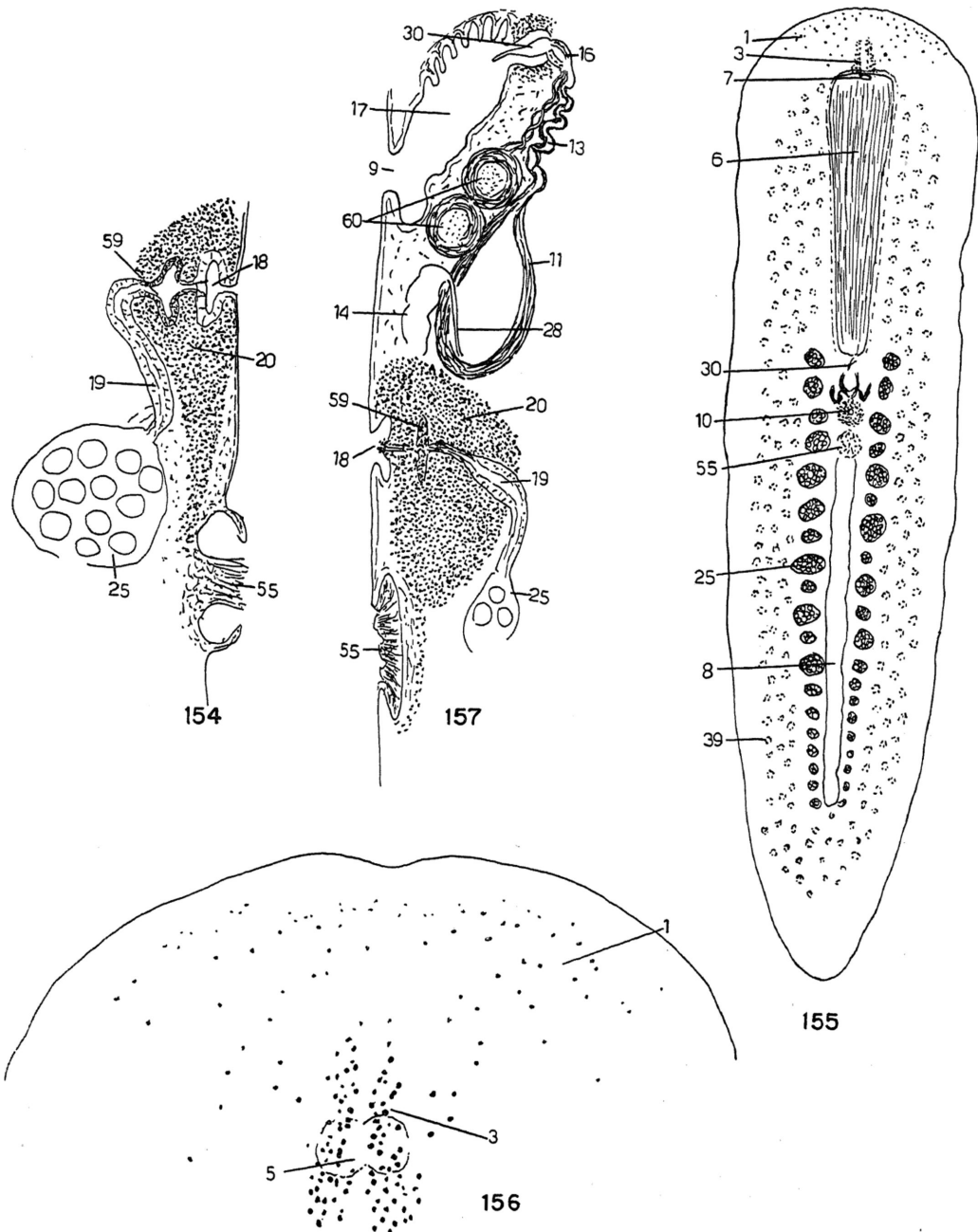


FIG. 154. *Acerotisa californica*, sagittal view of female apparatus, anterior end above.

FIGS. 155-157. *Prosthlostomum latocelis*. 155. Dorsal view. 156. Eye pattern. 157. Sagittal view of copulatory apparatus, anterior end above.

respond to prostatic vesicles. The penis papilla is a small eminence bearing a stylet of characteristic shape. The walls of the cavity that house the papilla and stylet are glandular, receiving the outlets of numerous prostatic glands which here do not enter a definite prostatic vesicle. Distal to the penis is a large male antrum that slants backward to open by the male gonopore; its anterior wall is much folded, but conditions here may depend on the state of contraction of the animal. The female gonopore occurs shortly behind the male pore and leads into a vagina surrounded by the usual great mass of cement glands that extend anteriorly to the seminal vesicle. There is a shallow but expanded female antrum from which the narrow vagina leads dorsally, soon expanding into a flattened cement pouch from which the narrow vagina continues dorsally, then widens and turns backward to receive the uteri. The latter course beside the main intestine. The sucker is found directly behind the female gonopore.

DIFFERENTIAL CHARACTERS: This species is distinguished mainly by the pattern of the marginal eyes, especially their junction on each side with the cerebral eyes.

DISTRIBUTION: Taken by de Laubenfels at Laguna Beach, November 27, 1939; taken by the Allan Hancock Foundation off Catalina Island July 5, 1940, July 19, 1941, and September 14, 1941, off Anacapa Island March 16, 1941, San Clemente Island June 10, 1941, and Santa Barbara Island September 14, 1941, at depths varying from 30 to 90 meters. The species appears common on the southern part of the California coast and around the adjacent islands.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: This species appears similar to *Prosthiostomum parvicelis*, which I described in 1939 from the Galápagos Islands, and for some time I believed it identical with the latter. Decision is hampered by the fact that the Galápagos specimen was very small, and hence the eyes may not be fully developed. The manner of entrance of the sperm ducts into the seminal vesicle is also similar, if not identical, between the two species. However, it finally seemed to me that the eye pattern of the two species cannot be reconciled.

Nevertheless, the possibility of identity remains.

***Prosthiostomum multiceles*, new species**

Figures 158-159

MATERIAL: Three specimens sent by the Allan Hancock Foundation.

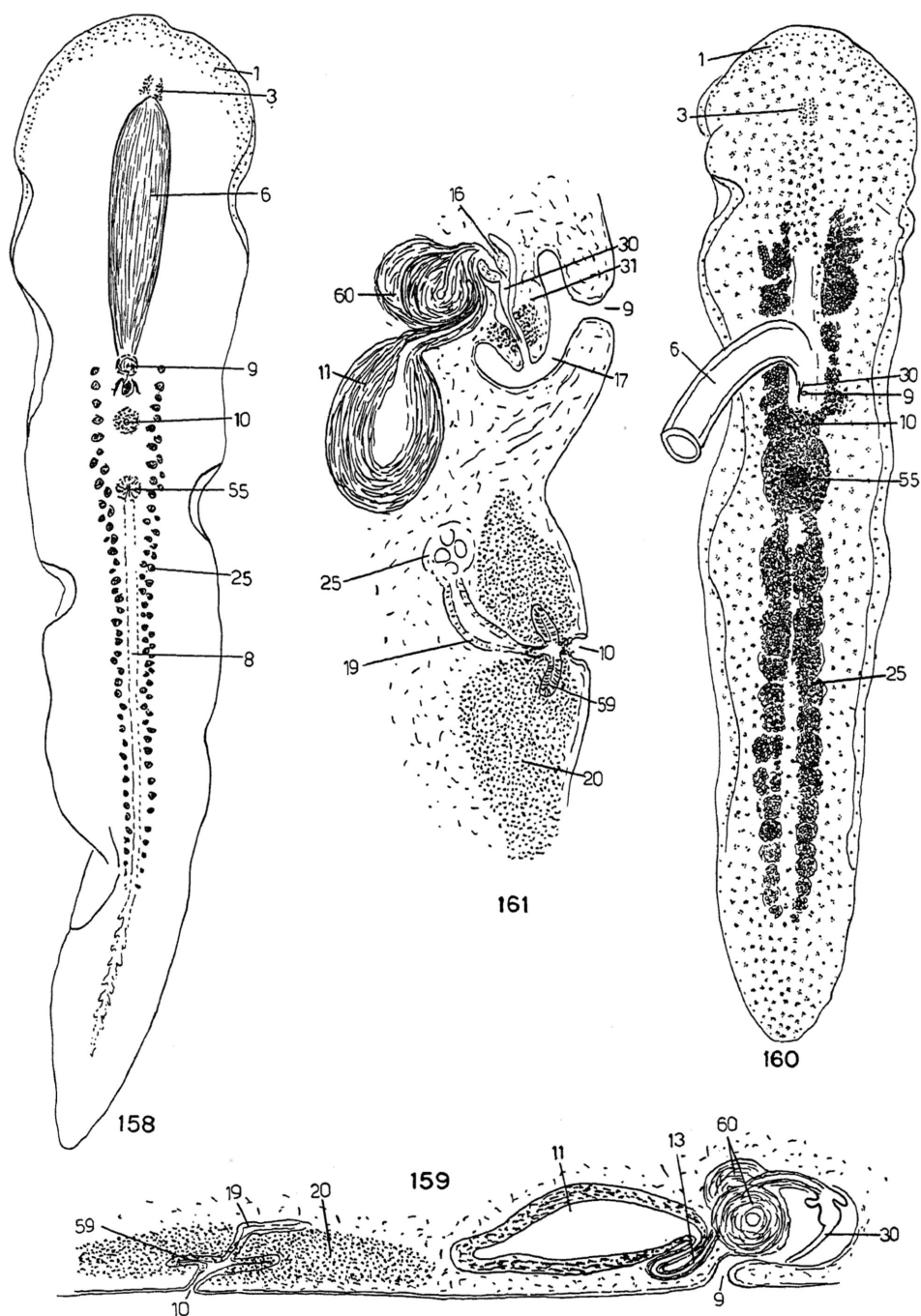
FORM: Typical of the genus, long and slender, to 22 mm. long, preserved, by 4.5 mm. across the anterior end; rounded anteriorly, gradually tapering to a blunt tail (fig. 158).

COLOR: Indeterminable.

EYES: There are the usual two elongated groups of cerebral eyes, over the brain, of about 28 eyes each. The arrangement of the marginal eyes is distinctive of the species. The marginal eyes are numerous, extending in a band along the anterior margin as far back as nearly the middle of the pharynx; band rather broad anteriorly, diminishing posteriorly.

DIGESTIVE SYSTEM: This is typical of the genus; there is the usual long tubular pharynx, anteriorly located, reaching a length of about one-fourth of that of the worm; it leads posteriorly into the long main intestine extending almost to the posterior end.

COPULATORY APPARATUS: The male apparatus is located as usual just behind the root of the pharynx; the female apparatus occurs shortly behind this, and the sucker is found not far behind the female apparatus (fig. 158) but farther than in the preceding species. A set of sagittal sections was prepared, but these were not very satisfactory, especially in the region of the penis. What could be seen of the male apparatus is shown in figure 159. There are as usual conspicuous spermiducal vesicles, of which the coils are seen to either side of the male apparatus. They appear to enter the distal part of the seminal vesicle. The latter is of elongated oval shape; from its distal end the narrow ejaculatory duct continues and, after making a ventral loop, proceeds above the region occupied by the accessory vesicles and enters the base of the penis. The accessory vesicles are the usual spherical muscular bodies; they are located between the seminal vesicle and the male antrum, to either side of the ejaculatory duct. Their ducts into the penis base could not be followed. There is a large male



FIGS. 158, 159. *Prosthiostomum multiceles*. 158. Dorsal view. 159. Sagittal view of copulatory apparatus, anterior end to right.

FIGS. 160, 161. *Enchiridium punctatum*. 160. Dorsal view, pharynx ruptured from normal position. 161. Sagittal view of copulatory apparatus, anterior end above.

antrum which slants backward to exit by the male gonopore. The antrum contains the penis stylet, which seems to be of somewhat unusual shape basally. There appeared to be a muscular mass around the penis papilla, but this region could not be clearly made out in the available sections. The female gonopore, well behind the male pore, leads into a narrow antrum from which the vagina proceeds, widening at once into the usual flat but laterally expanded cement pouch which receives the mass of cement glands. From the roof of the pouch the vagina proceeds dorsally, then slants forward to be entered by the uteri. The sucker was conspicuous on the sections, a little farther behind the female gonopore than the distance between the two sex pores.

DIFFERENTIAL CHARACTERS: This species is readily distinguished by the unusual length of the band of marginal eyes, also by the elongated seminal vesicle and the ventral loop of the ejaculatory duct.

DISTRIBUTION: Taken by the Allan Hancock Foundation in San Gabriel Bay, Gulf of California, March 14, 1949, at Puerto Refugio, Angel de la Guardia Island, Gulf of California, January 27, 1940, and off Santa Catalina Island, California, August 4, 1941, in all cases in shore collecting. The species is evidently distributed in the southern part of the California region and in the Gulf of California.

HOLOTYPE: One whole mount deposited in the Allan Hancock Foundation.

REMARKS: Marcus (1949) has recently reviewed the genus *Prosthiostomum*, listing a total of 40 species, one of which, however, appears to belong to *Euprosthiostomum*. Kato in 1944 added six more species, so that with Marcus' species and the two described in the present study the genus appears to contain 48 valid species. In very few of these does the marginal band of eyes extend posteriorly as far as in *multicelis*, for a short marginal band is in general typical of the genus. Great reduction of both cerebral and marginal eyes is seen in *P. gabriellae* Marcus, 1949, and of the marginal eyes in *P. komaii* Kato, 1944, and in both species the four anterior eyes are far back from the anterior margin, hence should probably be considered frontal eyes. The two accessory vesicles are completely separate in

all but five of the 48 species and, as Marcus remarks, this might be considered grounds for separating these five species, in which the accessory vesicles are bound in a common muscle sheath, into a separate genus.

GENUS EUPROSTHIOSTOMUM Bock, 1925

DEFINITION: Prosthiostomidae in which the sucker is located near the posterior end of the body; otherwise as in *Prosthiostomum*.

TYPE SPECIES: *Euprosthiostomum adhaerens* Bock, 1925.

Euprosthiostomum molle (Freeman),
1930, new combination

Prosthiostomum molle FREEMAN, 1929, p. 334, fig. 1.

REMARKS: I have had no specimens assignable to this species, but it seems to me proper to transfer it to *Euprosthiostomum*. It is readily distinguished from the three other species of the genus (*adhaerens* Bock, 1925; *viscosum* Palombi, 1936; and *mortenseni* Marcus, 1948) by the great length of the marginal band of eyes.

GENUS ENCHIRIDIUM Bock, 1913

DEFINITION: Prosthiostomidae in which the marginal eyes completely encircle the margin; accessory vesicles bound within a common muscle sheath; otherwise as in *Prosthiostomum*.

TYPE SPECIES: *Enchiridium periommatum* Bock, 1913.

Enchiridium punctatum, new species

Figures 160, 161

MATERIAL: Two specimens sent by the MacGinities, one by de Laubenfels, five by the Allan Hancock Foundation, and one by the United States National Museum.

FORM: Typical of the family, to 40 or more mm. long, alive, extended, by 8 to 10 mm. wide.

COLOR: White or cream covered with brown to black spots. It seems probable that the right-hand photograph in figure 35 (p. 151) of "Natural history of marine animals" is a contracted specimen of *Enchiridium punctatum*, but as the specimen was not received this cannot be asserted with certainty.

EYES: There are the usual two groups of cerebral eyes; the marginal eyes completely encircle the margin as diagnostic of the genus.

This marginal band is wide along the anterior margin, but at about the level of the brain becomes reduced to a single row of small eyes well spaced.

DIGESTIVE SYSTEM: This offers nothing different from other members of the family.

COPULATORY APPARATUS: This is shown in sagittal view in figure 161. It is typical of the genus. The coiled spermiducal vesicles approach the male apparatus from either side and open into the seminal vesicle near its distal end to either side of the exit of the ejaculatory duct. The seminal vesicle is of oval shape, with a very thick muscular wall; it narrows abruptly at its anterior end into a curved ejaculatory duct. This passes anteriorly beneath the two accessory vesicles. The latter are spherical bodies with very thick muscular walls and small lumina; they are bound within a common muscle sheath. Their small ducts are very short and soon join the ejaculatory duct in the base of the penis papilla. The latter is a small projection armed with the usual stylet projecting into the cavity enclosed by the penis sheath. The walls of the latter are provided with the usual prostatic glands, and it is enclosed in a fairly large male antrum. The female apparatus offers nothing distinctive. A small antrum leads to a narrow vagina that at once expands into the usual flattened cement pouch; from this the vagina ascends again and turning forward receives the uteri. The uteri course in conspicuous coils beside the main intestine, as usual in the family. The sucker is located a short distance behind the female gonopore.

DIFFERENTIAL CHARACTERS: This species is distinguished from *E. evelinae* Marcus,

1949, by the oval shape of the seminal vesicle but seems very similar to *E. periommatum* Bock, 1913. The color of the latter is not known, and hence recourse must be had to internal structures. The male apparatus seems to offer no definite points of difference between the two species, but the shape of the cement pouch of *E. punctatum* differs greatly from that of *E. periommatum* while closely resembling that of *E. evelinae*. *E. japonicum* Kato, 1943a, differs from the three other species of the genus in color pattern and the close proximity of the sucker to the female gonopore.

DISTRIBUTION: Taken by de Laubenfels at Laguna Beach, California, November 27, 1939, by the MacGinities at 8 to 15 meters in Newport Bay, April 20, 1940, and July 9, 1947, by the Allan Hancock Foundation on rocky shores at Redondo, California, November 18, 1941, at Point Arguello, California, February 14, 1942, and at Corona del Mar, June 2, 1942, and by the United States National Museum at Espiritu Santo Island in the Gulf of California, March 30, 1934. The species therefore appears distributed along the southern part of the California coast and in the Gulf of Mexico.

HOLOTYPE: One whole mount deposited in the American Museum of Natural History (A.M.N.H. No. 390).

REMARKS: This genus is easily distinguished from other Prosthiostomidae by the eye arrangement, but the sexual anatomy appears very similar throughout the species. It further seems that all of them have dark dots on a white or light ground, so that specific distinctions, other than those of geographical location, present difficulties.

REMARKS ON GEOGRAPHICAL DISTRIBUTION

It is obvious that the species discussed in this study are definitely related to latitude in their distribution. Some are limited to small areas, at least as judged by the available data, whereas others extend along a wide range of coast. Freeman (1933) remarks of Puget Sound polyclads that none is known to occur in any other place. Actually three of his species are identical with California species of Heath and McGregor and Boone and two others that he missed also occur on

the California coast. The species herein described may be tabulated as follows with respect to latitude:

Far northern species limited to the Point Barrow, Alaska, region: *Notoplana atomata*, *Acerotisa arctica*. *Notoplana atomata* is also common along the northern shores of the North Atlantic from Maine to Scandinavia. It is the only species found in common between the Atlantic and Pacific shores of North America.

Northern species occurring from Puget Sound

to varying points northward: *Kaburakia excelsa*, *Notoplana longastyleta*, *Notoplana sanjuania*.

Northern species so far found only on the shores of British Columbia: *Pseudoceros canadensis*.

Northern species limited to Puget Sound: *Leptoplana vesiculata*, *Phylloplana viridis*, *Notoplana natans*, *Notoplana sanguinea*, *Notoplana celeris*, *Eurylepta leoparda*, *Acerotisa alba*.

Species ranging from California to Puget Sound or even British Columbia: *Leptoplana chloranota*, *Notoplana inquietata*, *Freemania litoricola*, *Pseudostylochus burchami*, *Eurylepta aurantiaca*.

Species common to the California and Oregon coasts: *Stylochus atentaculatus*, *Stylochus tripartitus*, *Notoplana rupicola*.

Species limited to the California coast: *Plehnia caeca*, *Stylochus franciscanus*, *Stylochus californicus*, *Stylochus exiguus*, *Stylochus insolitus*, *Stylochoplana gracilis*, *Leptoplana limnoriae*, *Notoplana saxicola*, *Notoplana acticola*, *Macginitia delmaris*, *Copidoplana tripyla*, *Hoploplana californica*, *Alloioiplana californica*, *Thysanozoon californicum*, *Pseudoceros luteus*, *Pseudoceros montereyensis*, *Protheceraeus bellostriatus*, *Stylostomum lentum*.

Species limited to the southern part of the California coast: *Plehnia caeca* var. *oculifera*, *Cryptocelis occidentalis*, *Notoplana sciophila*, *Stylochoplana hancocki*, *Monosolenia asymmetrica*,

Acerotisa californica, *Euryleptodes insularis*, *Euprosthiostomum molle*, *Prosthiostomum latocelis*, *Thysanozoon sandiegeense*.

Species distributed along southern California and the shores of Lower California and the Gulf of California: *Phaenocelis mexicanus*, *Stylochoplana longipenis*, *Parviplana californica*, *Alloioiplana sandiegensis*, *Diplandros singularis*, *Prosthiostomum multiceles*, *Enchiridium punctatum*.

Species limited to the Gulf of California: *Alleena mexicana*, *Mexistylolochus tuberculatus*, *Mexistylolochus laevis*, *Marcusia ernesti*, *Longiprostatum rickettsi*, *Zygantoplana styliifera*, *Pseudoceros mexicanus*, *Pseudoceros bajae*, *Spinicirrus inequalis*.

Species extending from California southward beyond the limits of North America: *Euplana pacificola*, *Stylochoplana panamensis*.

Species cosmopolitan in warm waters: *Paraplanocera oligoglena*.

Inspection of the foregoing tabulation reveals that the majority of the species (nearly 69 per cent) are limited to the warmer waters of the region or at least to the southern half of the Pacific coast. This percentage would be increased if the several unidentifiable species of Heath and McGregor were added to the list.

SUMMARY

1. THE AREA UNDER STUDY extends from the Aleutian Islands to the southern end of Lower California and is limited to the littoral zone, chiefly the intertidal zone.

2. In this area there have been described or listed as valid, recognizable species of polyclads 67 species, comprising 48 Acotylea and 19 Cotylea as follows:

Suborder Acotylea

Section Craspedommata

Family Latocestidae

Alleena mexicana, new species

Family Plehniidae

Plehnia caeca, new species

Plehnia caeca variety *oculifera*, new variety

Family Stylochidae

Stylochus franciscanus, new species

Stylochus tripartitus, new species

Stylochus atentaculatus, new species

Stylochus californicus, new species

Stylochus exiguus, new species

Stylochus insolitus, new species

Kaburakia excelsa Bock, 1925

Mexistylochus tuberculatus, new genus, new species

Mexistylochus laevis, new species

Family Cryptocelidae

Cryptocelis occidentalis, new species

Marcusia ernesti, new genus, new species

Phaenocelis mexicana, new species

Longiprostatum rickettsi, new genus, new species

Section Schematommata

Family Leptoplanidae

Stylochoplana panamensis (Plehn), 1896

Stylochoplana gracilis Heath and McGregor, 1912

Stylochoplana longipenis, new species

Stylochoplana hancocki, new species

Zygantroplana styliifera, new species

Leptoplana chloranota (Boone), 1929, new combination

Leptoplana vesiculata Hyman, 1939

Leptoplana limnoriae, new species

Parviplana californica (Woodworth), 1894, new genus, new combination

Notoplana atomata (O. F. Müller), 1776

Notoplana rupicola (Heath and McGregor), 1912, new combination

Notoplana saxicola (Heath and McGregor), 1912, new combination

Notoplana inquieta (Heath and McGregor), 1912, new combination

Notoplana acticola (Boone), 1929, new combination

Notoplana sciophila (Boone), 1929, new combination

Notoplana longastyletta (Freeman), 1933, new combination

Notoplana sanguinea Freeman, 1933

Notoplana natans Freeman, 1933

Notoplana celeris Freeman, 1933

Notoplana sanjuania Freeman, 1933

Euplana pacificola (Plehn), 1896, new combination

Phylloplana viridis (Freeman), 1933, new combination

Freemania litoricola (Heath and McGregor), 1912, new genus, new combination

Macginitiiella delmaris, new genus, new species

Copidoplana tripyla, new species

Diplandros singularis, new genus, new species

Family Hoploplanidae

Hoploplana californica, new species

Family Planoceridae

Alloioplana californica (Heath and McGregor), 1912, new combination

Alloioplana sandiegensis (Boone), 1929, new combination

Spinicirrus inequalis, new genus, new species

Paraplanocera oligoglana (Schmarda), 1859

Family Callioplanidae, new name

Pseudostylochus burchami (Heath and McGregor), 1912, new combination

Monosolenia asymmetrica, new genus, new species

Suborder Cotylea

Family Pseudoceridae

Thysanozoon californicum, new species

Thysanozoon sandiegense, new species

Pseudoceros luteus (Plehn), 1898, new combination

Pseudoceros mexicanus, new species

Pseudoceros bajae, new species

Pseudoceros canadensis, new species

Pseudoceros montereyensis, new species

Family Euryleptidae

Eurylepta aurantiaca Heath and McGregor, 1912

Eurylepta leoparda Freeman, 1933

Prostheceraeus bellostriatus, new species

Euryleptodes insularis, new species

Stylostomum lentum Heath and McGregor, 1912

Acerotisa alba (Freeman), 1933, new combination

Acerotisa archica, new species

- Acerotisa californica*, new species
 Family Prosthlostomidae
Prosthlostomum latocelis, new species
Prosthlostomum multiceles, new species
Euprosthlostomum molle (Freeman), 1930,
 new combination
Enchiridium punctatum, new species

3. This list shows that there have been found nine new genera, 36 new species, and one new variety.

4. Because of lack of material and inadequacies of the original descriptions it has been impossible to elucidate or to assign taxonomically the following species in the literature: *Leptoplana maculosa* Stimpson, 1857; *Leptoplana californica* Plehn, 1898; *Notoplana sanpedrensis* Freeman, 1930; and Heath and McGregor's (1912) species *Leptoplana timida*, *Lichenoplana lepida*, *Acerosangi*, *Ancilioplana graffi*, *Euryleptodes cavicola*, *Euryleptodes pannulus*, and *Euryleptodes phyllulus*.

5. Attention is called to the following synonyms, all of which except the first have been discovered in the present study:

Cryptophallus magnus Freeman, 1933, is identical with *Kaburakia excelsa* Bock, 1925, and takes the latter name.

Notoplana inquieta Freeman, 1933, is identical with *Phylloplana chloranota* Boone, 1929, which belongs to the genus *Leptoplana*; hence both names become *Leptoplana chloranota*.

Notoplana segnis Freeman, 1933, is identical with *Phylloplana litoricola* Heath and McGregor, 1912, for which a new genus *Freemaniana* has been created, so that both names become *Freemaniana litoricola*.

Discosolenia washingtoniensis Freeman, 1933, is identical with *Planocera burchami* Heath and McGregor, 1912, which belongs to the genus *Pseudostylochus*, so that both names become *Pseudostylochus burchami*.

Stylochoplana heathi Boone, 1929, is identical with *Leptoplana inquieta* Heath and McGregor, 1912, which belongs to the genus *Notoplana*, so that both names become *Notoplana inquieta*.

6. The species of the area under consideration are zoned with respect to latitude; this relationship has been tabulated on pages 387 and 388.

7. The distribution of Pacific coast polyclads does not appear very definitely related to Point Conception, as a number of species occur both south and north of this point. Probably the strictly southern species will not be found north of the Point Conception region.

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