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A Preliminary Account of the Marine  
Annelids of the Pacific Coast, with  
Descriptions of New Species.


BY

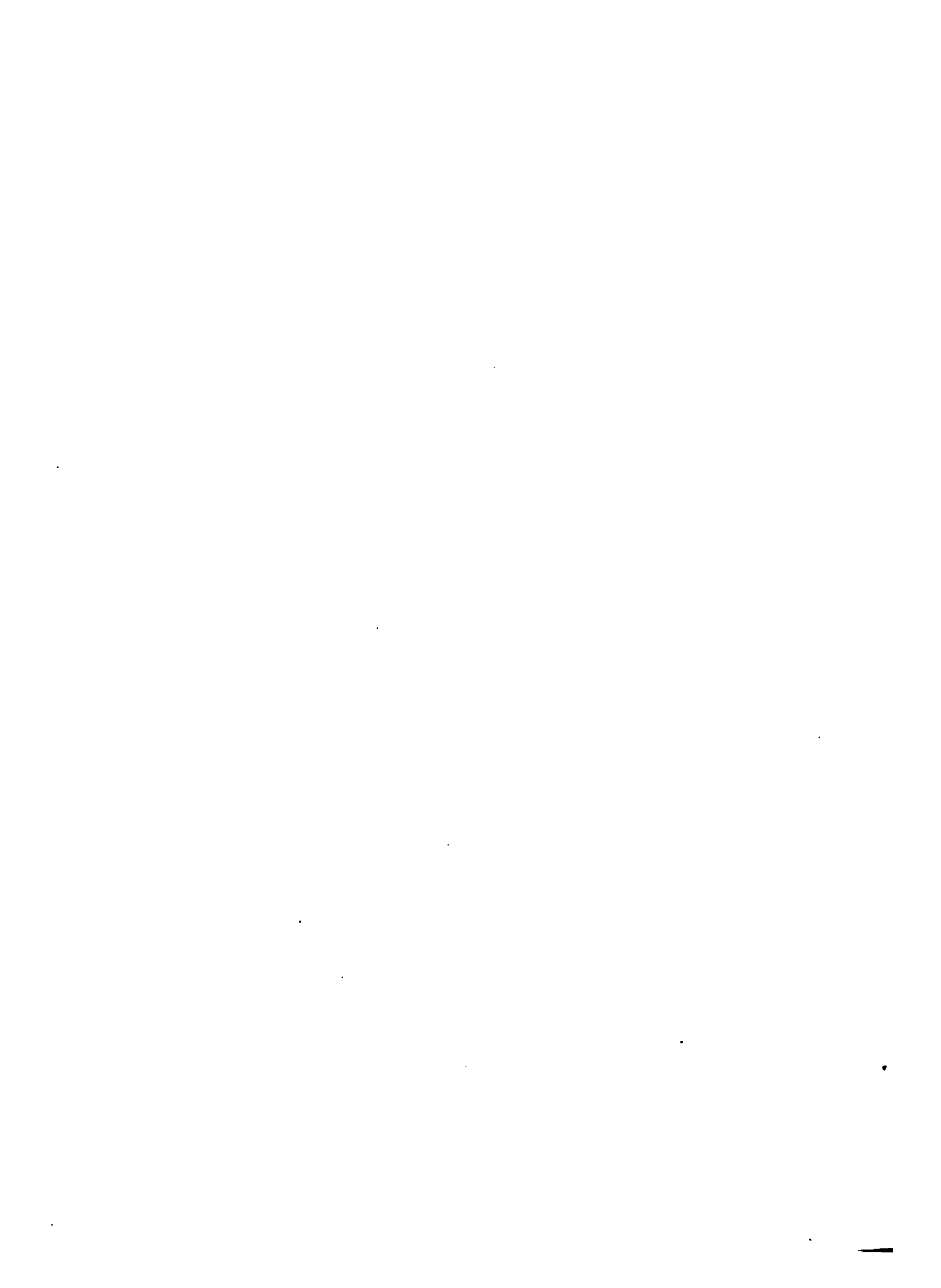
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PLATES V-X.

PART I. THE EUPHROSYNIDÆ, AMPHINOMIDÆ, PALMY-  
RIDÆ, POLYNOIDÆ, AND SIGALIONIDÆ.

THE marine Annelids of the western sea-board of our country have received but little attention, and by far the greater number of the species remain unknown to science. Any work done upon this group in this region, even at this late day, must necessarily have the character and limitations of pioneer work. It is certainly an interesting revelation of the haphazard nature of zoological exploration to find that much more is known about the Polychæta in the most remote regions of the earth, in the farthest north and the farthest south, in the East Indies and the South Seas, than along the easily accessible shore of a great civilized nation. No apology, therefore, need be offered for the preponderance of attention here given to such preliminary matters as descriptions of new species, distribution, habits, and other details of the natural history of the group. It is the writer's intention to present the entire order Polychæta, as represented on our shores, thus in outline, and concurrently or subsequently to fill in the picture with as much of embryological and histological detail as possible. The present publication is in every sense a *prodromus* of a more extensive work, which will require many years to complete.

Notices of marine Annelids of the Pacific Coast have been few and meager. The earliest collection of Annelids

from California was that of Kinberg<sup>1</sup>, who, sometime between 1851 and 1853, obtained a few specimens in the vicinity of San Francisco. Three species were described by Kinberg: *Halosydna brevisetosa* (which I have found in great abundance), *Mastigonereis spinosa*, and *Syllis californica*.

A much larger collection was gathered in 1859-60 by Alexander Agassiz, at several points along this coast between Panama and the Gulf of Georgia. Several new species were described from this material by Ernst Ehlers in his fine monograph "Die Borstenwürmer" (1864-67). This collection has never been entirely worked up.<sup>2</sup> It is worthy of note that three Atlantic species are enumerated in the list of Agassiz's Annelids—*Polynoë* (*Lepidonotus*) *squamata*, *Harmothoë imbricata*, and *Arenicola antillensis*. The occurrence of the two former on our coast I can verify from personal observation.

In 1863<sup>3</sup> and again in 1865<sup>4</sup> William Baird of the British Museum described seven species of Polychæta collected by J. K. Lord at Esquimalt, Vancouver Island. Four of these I have been able to identify with reasonable certainty: *Halosydna insignis*, *H. grubei* (both of them varieties of *H. brevisetosa* Kinberg), *H. lordi*, and *H. fragilis*,—and I strongly suspect that his *Harmothoë unicolor* is none other than the ubiquitous and highly variable *Harmothoë imbricata*. Baird's descriptions are lacking in precision, and are unaccompanied by figures.

Three species of Polychæta from our coast were described in 1889 by J. Walter Fewkes.<sup>5</sup> Two of these, *Sabellaria californica* and *Sabella pacifica* are very common colony-forming species along the California coast.

<sup>1</sup> J. G. H. Kinberg: Nya Slågten och arter af Annelider. Öfversigt K. Vetensk.-Akad. Förh., Bd. XII, 1855; also in: Ibid, Bd. XXII, 1866 (Annulata Nova); also in: Friggatten Rugenies Resa omkring jorden, Zoölogi, 1858.

<sup>2</sup> I am indebted to my friend, Dr. Wm. M. Woodworth, for opportunity to copy that portion of his MS. catalogue of the Vermes of the Museum of Comparative Zoology which includes Prof. Agassiz's collection.

<sup>3</sup> Proc. Zool. Soc. (London) for Apr., 1863, pp. 106-110.

<sup>4</sup> Journal Linnæan Soc. (London), Vol. VIII, pp. 188-192, 196.

<sup>5</sup> "New Invertebrata from the Coast of California," Bull. Essex Institute, Vol. XXI, pp. 99-146, 7 Pls.

The material upon which my own study of the Polychæta is based has been gathered almost entirely from the California coast, and for the most part within the littoral zone. A few species not found within the area left bare by the tides have been dredged from very moderate depths (down to twenty or twenty-five fathoms), and a yet smaller number have been taken from stones brought up on fish-hooks from a greater depth in Monterey Bay.<sup>1</sup> The Polychæta now deposited in the Museum of the University of California have been collected by my colleague, Prof. Wm. E. Ritter, by students in the University (particularly Messrs. F. W. Bancroft and H. B. Torrey), and by myself. The localities where the most extensive and thorough collecting has been done are San Pedro (summer and winter of 1895, summer of 1896), Pacific Grove (1894, 1896, 1897), and the vicinity of San Francisco. Collecting has been done, besides, at a number of other points—San Diego, San Clemente and Santa Catalina Islands, Bodega Bay, Point Arena, Point Mendocino, Humboldt Bay, Shelter Cove, Trinidad, and Patrick's Point. A few species from Puget Sound have been recently added to the collection.<sup>2</sup>

A word should perhaps be said in regard to terminology. I have employed the old terms "dorsal" and "ventral" instead of the more modern "hæmal" and "neural." Consequently the uppermost branch or division of the parapodium is the "dorsal ramus," and the lower the "ventral ramus." The setæ borne by these two portions are respectively the "dorsal setæ" and the "ventral setæ." The appendages of the prostomium are the "tentacle" (median and unpaired), the "antennæ" (paired and adjacent to the tentacle) and the "palpi" (paired organs of touch, very contractile in Polynoidæ, springing from the ventral side of the prostomium). The somite immediately back of the prostomium is the "peristomium," and is the

<sup>1</sup> For these specimens I am indebted to Dr. Bashford Dean of Columbia University. He was informed by Ah Tak, the Chinese fisherman from whom he obtained them, that the depth was 90 to 100 fathoms.

<sup>2</sup> For these I am indebted to Miss Alice Robertson, student in Natural Science at this University, and to Master John Dewhurst of Seattle, Washington.

first counted in an enumeration of the somites. Next to the prostomium, this somite is the most modified. Its cirri are the "peristomial" cirri, and are two, four, or eight in number. When two only are present, as in *Heteropale bellis*, they are the dorsal. A dorsal and ventral peristomial cirrus is present on each side in the Polynoidæ. In *Chrysopetalum*, where two pairs are present on each side, the duplication probably does not indicate the fusion of two peristomial somites, but a sort of chorisism or division of an original single pair. The "buccal" cirri are the much-enlarged ventral cirri of the second somite. The "anal" cirri are always a single pair belonging to the terminal or anal somite, which is invariably postanal in Euphrosynidæ, Aphroditidæ and Polynoidæ. The "nephridial papillæ" of the Polynoidæ and Sigalionidæ are the little protuberances on the ventral side, one at the base of each parapod for the greater portion of the animal's length. At their distal ends the nephridia open.

Descriptions and measurements have been based almost entirely upon specimens carefully preserved either in alcohol or formalin. Only in respect to color have I found any advantage in drawing up descriptions from living specimens; and there are positive objections to taking measurements from the living worms. While I have constantly endeavored to preserve specimens in a straight and extended condition, I am bound to say that my efforts have been only partially successful. No matter how gradual or prolonged the narcosis, very few species fail to undergo more or less contraction when placed in the fixing fluid. Since measurements taken from straight and moderately contracted specimens give quite as accurate an idea of the true dimensions of the species as if obtained from living worms, exhibiting as they usually do every gradation of extension and flexion; and since, furthermore, nearly all Annelid measurements extant have been made upon alcoholic material, I have seldom taken the trouble to get the dimensions of living specimens.

I gladly avail myself of this opportunity to express my

sincere and heartfelt thanks for the many courtesies extended to me by the directors of the Hopkins Seaside Laboratory at Pacific Grove, where I have on several occasions occupied an investigator's room, and enjoyed conveniences and advantages for marine zoological work elsewhere unknown on our coast.

## Family I. EUPHROSYNIDÆ.

### *Euphrosyne aurantiaca*, sp. nov.

PLATE V, FIGS. 1-4.

Form elongate-elliptical, slightly tapering at both ends, which are very uniform. Dorsal and ventral contours both convex, the ventral more so than the dorsal. Medio-dorsal bare stripe very narrow (1-1.5 mm.), not more than one-fifth the width of the body.<sup>1</sup>

Number of somites, 30-37. Buccal somites, first to fifth inclusive. Width of middle somites,  $5\frac{1}{2}$  times their length.

Caruncle bilobed dorsoventrally. Lobes coalesced the whole length of the shorter, inferior lobe, which reaches the anterior border of the fifth somite. The free posterior tip of the superior lobe extends back of this point about one-half the width of the fifth somite. The anterior edge of the caruncle carries a short, stumpy tentacle, at the base of which are located the single pair of dorsal eye-spots.

Prostomium not distinct from the caruncle, deeply sunken between the forwardly directed parapodia of the first somite. Ventrally, close to its anterior border, are the ventral eye-spots, flanked on each side by a minute antenna, which springs from the lateral edge of the prostomium.

Parapodia with three cirri, two dorsal, one ventral, and seven ramose "gills." Ventral cirrus inserted among the ventral setæ, gradually and evenly tapered from its base, about one-half the length of the ventral setæ. Lateral cirrus similar in form, placed between the third and fourth gills (counting from the dorsal extremity of the series). Dorsal cirrus stout, slightly swollen near base, evenly tapered, acute at tip, bent towards the median line. In contracted condition, none of the cirri are longer than the setæ among which they are placed.

"Branchiæ" bifid nearly to base; each branch carries 6 or 7 branchlets (fig. 1).

Setæ numerous on all the parapodia; those of the ventral series simply forked near tip; those of dorsal series deeply incised and curved at tip (figs. 2, 4), serrated on both sides of incision. All setæ are hollow to tip and impregnated with calcic carbonate, which gives them a glistening white appearance.

Color in life orange, darkest along mid-ventral line.

*Measurements*.—Length of average specimen, 21 mm; greatest breadth,

<sup>1</sup>"Width of body" or transverse diameter in every case includes the parapodia, but not the setæ.

5.5 mm; length of caruncle, 2.5 mm. Length of largest specimen, 26 mm.; greatest breadth of same, 5.5 mm.

This species is common at San Pedro, from low-water mark to three or four fathoms, and probably to greater depths. It frequents shelly and stony bottoms. The enormous, matted rootstocks of the bladder kelp (*Macrocystis pyrifera*) afford it a welcome shelter. Many specimens were obtained from these rootstocks in July, 1895, when they washed ashore from San Pedro Bay, where the kelp grows to a depth of eight or nine fathoms.

The number of somites is variable, ranging, among twelve specimens, from 30 to 37<sup>1</sup>. The largest, measuring 26 mm. in length, had the largest number of somites, and the smallest, 16 mm. in length, had the least; but an increase in the number of somites as the size increases is by no means the rule.

All my specimens (with the exception of a single one dredged near Monterey from 12 fathoms) were obtained at San Pedro in July and August, 1895. None were taken there in December, 1895, although the same ground was dredged carefully. The larger individuals were sexually mature in July.

*E. aurantiaca* is most nearly allied to *E. myrtosa* Savigny, and to *E. mediterranea* Grube. It agrees with these in having: (1) seven pairs of gill-trunks, which are not extensively branched and have no end buds; (2) the caruncle extending to the fifth somite; (3) the number of segments. It differs in having: (1) setæ of two kinds; (2) the lateral-dorsal cirrus between the third and fourth gill-trunks, instead of between the second and third.

<sup>1</sup>The number of somites ran as follows.

37 somites . . . . .	2 specimens
36 " . . . . .	1 "
35 " . . . . .	1 "
34 " . . . . .	3 "
33 " . . . . .	1 "
32 " . . . . .	2 "
31 " . . . . .	1 "
30 " . . . . .	1 "

Average, 33 $\frac{1}{2}$ .



**Euphrosyne arctia**, sp. nov.

PLATE V, FIGS. 5-7.

Smaller than the preceding; diminishing slightly at posterior extremity, nearly as broad at anterior end as at middle somite. Median bare stripe about one-fourth width of body.

Caruncle proportionally large and high, reaching posterior edge of fifth somite; slightly bilobed dorsoventrally, the two lobes of equal length. Median tentacle short, less than one-half the length of the caruncle, with filiform tip. Two eye-spots at its base.

Preoral pads large, completely fused, and in preserved specimen covering the ventral eye-spots. Mouth set far back, its posterior border formed by fifth somite. The prostomium bears near its ventro-anterior edge the two small tentacles, which are probably homologous with the antennæ of related forms.

Setæ of dorsal rami of two kinds: simple bifid and ringent (fig. 6); the latter longer and stouter than those of *E. aurantiaca*.

Ventral setæ more slender than first type of dorsal, which they resemble; dorsal with a smaller, more divergent spike (fig. 7. two sizes).

Five "branchiæ" on each side, dichotomously branched four times (fig. 5). Latero-dorsal cirrus between second and third branchial trunks.

Number of somites 22. Buccal somites 1-5. Colors in life ochraceous; rose-red on bare dorsal stripe; the setæ, as usual in this genus, silvery white.

A single specimen of this pretty little Annelid was brought up on a stone from a depth of about 100 fathoms in Monterey Bay, in July, 1896. This individual proved to be a female, and its body-cavity was crowded with nearly mature eggs.

This form comes nearest to *Euphrosyne armadillo* Sars. From Ehlers' brief diagnosis of *E. armadillo*, in the "Borstenwürmer," I am unable to determine whether the Californian species is identical with the Norwegian. I have not seen Sars' description of the latter and must therefore defer passing judgment upon the specific distinctness of *E. arctia*.

## Family II. AMPHINOMIDÆ.

**Eurythoë californica**, sp. nov.

PLATE V, FIGS. 8-14.

Body long and rather slender, gradually tapered in its posterior third. Anterior end very slightly tapered; head about one-half the greatest diameter of the body. Cross-section of body squarish, dorsum nearly flat (except when distended with the genital products); ventral contour decidedly convex, sides between the rami flat and vertical.

Segmentation strongly accentuated, breadth of segments (in alcoholic specimens) from two to three times their length.

Head abruptly narrowed to the hoof-shaped prostomium, which is convex above, but nearly flat beneath. On its ventral aspect is a slight longitudinal groove which extends backward to the mouth. The prostomium bears two pairs of cirri, a median cirrus or "tentacle," and two pairs of eyes; the dorsal pair in front of the anterior pair of eyes, and same distance apart as the latter; the ventral cirri further apart and in the same vertical plane as the anterior pair of eyes. There is little or no difference in the length of the paired cirri.

Eyes four, the anterior pair considerably larger and a little nearer together than the posterior; anterior pair placed in a transverse sulcus that divides the dorsal side of the prostomium into anterior and posterior portions. The posterior portion carries not only the four eyes, but also the tentacle, and extends caudad as the caruncle. Tentacle decidedly shorter than the paired cirri, tapered uniformly from the base, and very acutely pointed at tip.

Caruncle slender, cylindrical, flexuous, reaching anterior border of third somite.

Mouth triangular, the apex running forward as the median groove in the ventral side of prostomium; bordered posteriorly by the fourth somite, which forms a crenated and somewhat tumid lip.

Anus terminal, minute.

Parapodia (fig. 9) composed of two widely separated rami. The ventral ramus with a fascicle of long, slender setæ, of varying lengths, and a few short hastate ones (figs. 12-14). The long setæ have a slight lateral prong near tip; they are silvery white by reflected light. The dorsal setæ shorter than the longest of the ventral fascicle, and of various lengths and sizes. They fall under three types: (1) long, very slender, bifid setæ, almost precisely similar to the corresponding type of the ventral ramus (fig. 12); (2) long, stout, serrated setæ (fig. 10); and (3) short and very stout, smooth setæ (fig. 11), which probably correspond to the hastate setæ of the ventral ramus, but are much more numerous.

The dorsal ramus of every parapod, except the first, carries a ramose gill. The number of branches in each gill increases backward; the gills of the second somite are very simple, having only two or three branches. The maximum complexity is attained at about the twelfth somite.

Dorsal and ventral cirri present on all the somites, very similar in form, smooth, terete, jointed near base, evenly tapered to the small, rounded tip; shorter than the longest setæ of both fascicles; dorsal cirrus considerably longer than the gills.

Number of somites, 60-93.

Living color variable, flesh to dark brown. When sexually mature the eggs shine through the body-wall and give the female a decided purple tinge, while the ripe males are red. A beautiful purple and green iridescence on ventral side.

*Measurements.*—Length of full-grown specimen, 106 mm.; width, 5 mm.; dorsoventral thickness, 3 mm. Length of smallest specimen (60 somites), 22 mm.; caruncle, 1 mm. long; average length of middle somites, 1.5 mm.

*Habitat.*—San Pedro sand-flats, between tide-marks, (July and December). Rocky shores at Pacific Grove, near low-water mark (December).

This species differs from *Eurythoë pacifica* Kinberg and from its variety *levukaënsis* M'Intosh in the following points:

(1) The body is more slender; (2) the tentacle is placed between the posterior instead of the anterior pair of eyes; (3) the caruncle is much narrower, and extends only to the third somite, instead of to the fourth. The bifid setæ are likewise different in lacking the serrations near the tip.

It is evidently distinct from *Eurythoë complanata* Pallas which, as its name indicates, is much flattened dorsoventrally, while in *E. californica* the vertical and horizontal diameters are nearly equal. A further distinction is seen in the tentacle, which is much shorter in *E. complanata* than in *E. californica*.

### Family III. PALMYRIDÆ.

#### *Chrysopetalum occidentale*, sp. nov.

PLATE V, FIGS. 15, 16; PLATE VI, FIGS 17-19.

Form elongate, scarcely tapered anteriorly, and but little posteriorly, slightly flattened dorsoventrally; segmentation clearly marked, prostomium and parapodia prominent and distinct. Mouth set far back, bordered posteriorly by fifth somite.

Prostomium rounded above, its breadth greater than its length, bearing the four eyes, of which the anterior pair are nearer together than the posterior, and are sometimes fused into a large black patch. On its antero-ventral aspect the prostomium carries the median cirrus, two antennæ, and the palpi (fig. 15). The median cirrus is less than half the length of the antennæ, stout, conical, indistinctly jointed near its base. Antennæ swollen in their proximal half, contracted at point of attachment, gradually tapered, their distal half, like that of all the cirri, roughened with scattered spinulations. Palpi short, decidedly less than antennæ, thick, very slightly tapered, bluntly rounded at tips, constricted at base.

First somite bears on each side two pairs of peristomial cirri, not essentially different from the rest of the dorsal and ventral cirri, each two jointed; three on each side nearly equal in length, but ventral cirrus of posterior pair decidedly shorter (Pl. V, fig. 16).

Second somite setigerous, with distinct, anteriorly directed parapodia, extending in front of prostomium. Dorsal setæ, like those of all succeeding

somites, in the exceedingly modified form of paleæ. Ventral setæ about thirty in each fascicle, compound, with cultrate appendage (Pl. VI, figs. 17, 19), the latter hooked at tip, finely spinulose on its straight border. Medulla of shaft cross-striated, forked at point of articulation with appendage.

Paleæ on all somites except peristomial and anal; they are of two sizes: (1) a lateral group of three to five narrow ones, extending at right angles to long axis of body; (2) a circlet of twenty or more, considerably broader and longer (Pl. VI, fig. 18), lying dorsally, and covering the succeeding somite like a thatch of palm leaves. Paleæ of different somites vary in width. Those of the second much narrower than the rest, and like the lateral groups. All, however, are constructed after one pattern. An average one is shown in fig. 18. It is curved in two planes; upper surface concave, the upcurved edges serrate and slightly involute, tip curved towards median line of animal, acute. Seven to eight longitudinal ribs, and numerous, fine, parallel, transverse striations. All paleæ have a golden-brown luster.

Parapodia with dorsal and ventral aciculæ (fig. 17), the ventral nearly three times the length of the dorsal. Ventral ramus long and slender; dorsal ramus a slight, rounded, broad protuberance. Both dorsal and ventral cirri jointed, terminal portions very similar in form, subulate.

Approximate number of somites in two specimens, 55 and 41. Buccal somites, first to fifth.

*Measurements.*—Length, 4.57 mm.; width across broadest part of body, .79 mm.

*Habitat.*—San Pedro Harbor, California (15 feet).

This little Palmyrid was found but once, in small numbers, in December, 1895. Like the type species, *C. fragile* Ehlers, it is notable for the readiness with which it breaks transversely. In a preserved specimen the individual somites may be readily detached, one after the other, from the trunk. The related species of our coast, *Heteropale bellis*, has the same characteristic.

This form shows numerous points of difference from *C. fragile* in the shape of the paleæ, of the setæ, of the dorsal cirri, and of the eyes. I have had no opportunity to compare it with the description of *C. debile* (Grube) Ehlers.

### Heteropale, gen. nov.<sup>1</sup>

Preoral lobe not distinct externally from peristomium. Palpi present. Eyes four, tetragonal in arrangement. Tentacle unjointed, about equal to antennæ. Antennæ two, each composed of a long basal piece and a small terminal segment. Dorsal peristomial cirri two, similar to antennæ. No

<sup>1</sup> From ζτερος, varied, and παλή, palea.

ventral peristomial cirri. Parapodia biramous. Dorsal ramus with two kinds of paleæ: (1) a group of small, narrow ones projecting laterally (figs. 21, 22a); and (2) a crown of broad, oblanceolate ones on the dorsum. Aciculæ two. Dorsal cirri present on all somites, three to many-jointed, proximal joint much the largest. Ventral cirri very short, inserted above the level of lowest ventral setæ.

### **Heteropale bellis, sp. nov.**

PLATE VI, FIGS. 20-23.

Body elongate-elliptical, slightly and about equally tapered at each end, its length less than six times its width.

Prostomium rounded, coalesced with first somite. Eyes four, forming a square on top of head; the anterior pair considerably larger, crescent-shaped. Median cirrus or "tentacle" unjointed, up-curved in a hook-like fashion, in length equal to the antennæ.

Two globular palpi, somewhat constricted at base. Antennæ two, two-jointed; tentacular cirri two, three-jointed, about equal to the antennæ, short and stumpy, the proximal joint about equal to the two terminal ones. Dorsal cirri present on all the somites, increasing in length and number of joints caudal until in the ultimate segments they reach nearly to the tips of the setæ. In the anterior somites they do not reach the tip of the neuropodium and have only three joints. Ventral cirri likewise increase in length and number of joints caudal, but in less degree.

First pair of parapodia directed forward, armed with a small fascicle of setæ and three or four paleæ. No obvious dorsal ramus. Succeeding parapodia with a two-parted dorsal ramus. Its lateral division, nearly as long as the ventral ramus, carries three or four paleæ much narrower, smaller, and straighter than the rest; these point laterally in line with the ventral rami (fig. 21). The acicula extends into this division. Dorsal portion of notopodium with a semicircle of paleæ, thirteen or fourteen in number, the largest external, and diminishing towards the median line. Oblanceolate, acuminate; tip directed obliquely, mediad or laterad (fig. 22); convex border of palea and seven or eight of its ribs elegantly adorned with minute, rounded embossments. Other ornamentation in form of longitudinal ribs and fine transverse striations. The paleæ of each somite overlap those of the succeeding somite, and over- or underlap the tips of their fellows on the foot of the opposite side.

Somites, 27 to 39. Terminal somite destitute of paleæ and setæ, but with two anal cirri.

*Measurements.*—Length of small specimen, 2.75 mm.; greatest transverse diameter of same, .44 mm.

Two specimens found among tunicates, sea-weeds, and *débris* on the piles of the wharf at Monterey, December 23, 1896.

Not without reluctance I have made this beautiful little Annelid the type of a new genus. It differs strikingly from all

known Palmyrids in the heterogeneous character of its paleæ, and in the possession of only one tentacular cirrus (the dorsal) on each side. Minor points of difference from *Chrysopetalum* are the multi-segmented, almost moniliform character of the cirri, and the unusual position of the ventral cirrus (fig. 21). The ventral setæ are very similar to those of *C. occidentale* (cf. figs. 19a, b, and 23a, b.)

The golden luster which is so beautiful a feature of the paleæ in most Palmyrids is not conspicuous in this species.

#### Family IV. POLYNOIDÆ.

At least twelve representatives of this large family have been obtained from our western coast, between Bering Straits and the Mexican boundary line. Ten species have been collected by me and are here described. The remaining two, *Polynoë vittata* and *P. tuta*, were described by Grube<sup>1</sup> in 1855 from material obtained at Sitka. I have not seen his descriptions. *Halosydna insignis* and *H. grubei* described by Baird in 1863<sup>2</sup> and again in 1865<sup>3</sup> from specimens collected by J. K. Lord at Esquimalt, Vancouver Island, are merely varieties of one species and identical with *Halosydna brevisetosa*, described by Kinberg<sup>4</sup> eight years previously. *Harmothoë unicolor*, described by Baird from the same locality as the two preceding, is probably a variety of *H. imbricata*.

The classification of the Polynoids is in a most unsatisfactory state, and much in need of thorough revision. The great multiplication of genera, nearly all of them founded upon variable, non-essential, or even accidental characters, and none of them clearly and fully defined, has been a serious drawback to the study of these interesting forms. Hence the more conservative students of the group, recognizing the instability of the numerous genera

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<sup>1</sup>Beschreibung neuer oder wenig gekannter Anneliden. Arch. für Naturgesch., Bd. XXXI, 1855, p. 1.

<sup>2</sup>l. c., p. 106, 107.

<sup>3</sup>l. c., p. 188, 189.

<sup>4</sup>l. c., p. 385.

founded by Kinberg, Malmgren, M'Intosh, and others, have been content to place all new Polynoids under the type genus, *Polynoë*. This prudent course I have been strongly inclined to follow, fully realizing the rashness of attempting to revise a classification without access to the amplest material. But after a careful study of the few species at my command, and of the best part of the Annelid literature, I have become strongly convinced of the practicability of ranging nearly all the known Polynoids under two genera. Following are diagnoses of these genera. I would have it clearly understood, however, that I do not consider this anything more than a provisional attempt to improve and make manageable a classification which is a positive hindrance to the study of this group.

#### *Polynoë Savigny (Sens. ext.).*

Prostomium bilobed, the anterior tips of the lobes produced to form basal joints of the antennæ, which are on the same level as the basal joint of the tentacle. Dorsal rami of the parapodia decidedly smaller than the ventral, often minute, bearing setæ more slender than the ventral setæ, sometimes very minute, few, or even wanting. Ventral ramus much the larger and longer, bearing a moderate number of setæ, which are stouter and usually longer than those of dorsal ramus. The dorsal and ventral rami not prolonged in a finger-like process beyond the insertion of the setæ. Elytra from 12 to over 50 pairs. Body sometimes excessively long; somites 27 to 100 or more.

In this genus I include *Lepidonotus* Leach, *Polynoë* Savigny, and *Halosydna* Kinberg.

#### *Harmothoë Kinberg (Sens. ext.).*

Prostomium bilobed, prolonged in front in two acuminate or rounded peaks. Antennæ inserted below level of tentacle. Both rami of parapodia prolonged in a finger-like process beyond the insertion of the setæ. Dorsal setæ as large or larger than the ventral setæ, never extremely short, often longer than the ventral. Both dorsal and ventral setæ serrated for more than half their exposed length. Body never excessively long; somites not exceeding forty; elytra, twelve to fifteen pairs.

Under this genus I would place the following: *Antinoë*, *Harmothoë*, *Hermadion*, Kinberg; *Eucrante*, *Eunoa*,

*Evarne*, *Lænilla*, *Lagisca*, *Melænis*, *Nychia*, Malmgren;  
*Polyeunoa* M'Intosh.

Owing to lack of full and accurate descriptions, and especially figures, of the remaining genera of the family, I am unable to state how many more can be consistently characterized as *Polynoë* or *Harmothoë* in the wide sense.

*Polynoë squamata* (L.) Aud. et M.-Edw.

PLATE VII, FIG. 30.

The occurrence of this North Atlantic and Arctic species on this coast was quite unexpected, inasmuch as it does not appear to be so widely distributed, or to occur in such high latitudes as the ubiquitous *Harmothoë imbricata*. I believe it has not hitherto been reported from the Pacific, or indeed from the western portions of the Arctic.<sup>1</sup>

It is by no means a common species on the California coast, and, as far as my observation goes, does not occur within the littoral zone. The nine specimens at my command were all obtained in Monterey Bay; some dredged in twelve fathoms on stony ground, others brought up on stones by a Chinese fisherman from a depth of 90 to 100 fathoms.

I find nothing in the external anatomy of these specimens that would justify specific distinction from *P. squamata*. They are all much smaller than the general run of Atlantic specimens (the largest measure only 16 mm. in length), but otherwise it is difficult to find even varietal difference between them and specimens of typical *P. squamata* from the New England coast.

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<sup>1</sup>This species is entered in Dr. Woodworth's catalogue of Prof. Alex. Agassiz's collection from this coast, as having been obtained from the Gulf of Georgia. Nothing has been published concerning it.



*Polynoë brevisetosa* (Kinberg).

PLATE VI, FIG. 24; PLATE VII, FIGS. 31, 40, 40a; PLATE VIII, FIGS. 46, 46a.

*Halosydna brevisetosa* KINBERG. Ofversigt K. Vetenskaps Akad.

Förh., Bd. XII, 1855, p. 385.

Ibid, Fregatten Eugénies Resa, Zoologi, 1858, p. 18, Taf. V, figs. 25 a-h.

*Lepidonotus insignis* BAIRD. Proc. Zool. Soc. (London), Apr., 1863, p. 106.*Lepidonotus grubei*. Ibid, p. 107.*Halosydna insignis* BAIRD. Journ. Linn. Soc. (London), Zool., Vol. VIII, 1865, p. 188.*Halosydna grubei*. Ibid, p. 189.

Form variable, from short and robust to rather long and slender (the latter always commensal in tubes of Annelids), about equally rounded at both ends. Somites 37; elytra, 18 pairs, borne on somites 2, 4, 5, 7 . . . 27, 28, 30, 31, 33. Elytra seldom covering the entire dorsum, frequently many of them not in contact with one another. Anus exposed, dorsal, in somite 35, or between 35 and 36.

Prostomium (fig. 31) as broad as long, slightly constricted at base, broadest a little back of anterior pair of eyes, slightly fissured longitudinally at insertion of basal joint of tentacle. Eyes four, far back, and distant transversely, anterior pair slightly farther apart than the posterior.

Antennæ, tentacle, peristomial, dorsal, and anal cirri all of moderate length, smooth, cylindrical, slightly bulbous near tip, abruptly tapered to a filamentous point. All these cirri characterised by a dark subterminal band, just below bulbous enlargement, strongly contrasting with the white apex; and a dusky area, above the joint. (This coloration of the cirri holds for all color-varieties of the species, except in case of the antennæ and tentacle, which are frequently dusky for their entire length as far as the subterminal band.)

Palpi whitish, unpigmented, except in very dark specimens, thickest near base, very gradually tapering to a fine point, beset with minute papillæ, extremely contractile, being about thrice the length of the tentacle when fully extended, but contracting to about one and a half times its length.

Parapodia (fig. 46) stout, short, scarcely biramous; dorsal ramus very small, provided with short, minute, serrated setæ, not reaching beyond tip of ventral ramus. Ventral ramus obliquely truncated, robust, armed with about sixteen setæ in two groups, six above the acicula, ten below. Setæ rather short and stout, slightly hooked at tip, which is blunt, with about ten "frills" on their posterior aspect, largest distally (figs. 46, 46a). Ventral cirri on all the parapodia subulate, pointed, of same color as general ventral surface. Anal cirri not longer than average dorsal cirri.

Nephridial papillæ cylindrical, slightly fluted, begin at eighth somite, cease at thirty-fifth or thirty-sixth—28-29 pairs.

Elytra extremely varied, broadly reniform to elliptical, first pair nearly orbicular, with a few small, short "cilia" on external border (fig. 40); the first three or four pairs with large, rounded chitinous tubercles, the remainder with minute ones (figs. 40, 40a). Each elytron with an ocella consisting of a

white spot just over the elytophore, with a black, gray, brown, or orange fleck in front; remainder of elytron more or less densely mottled with spots of the same color as the general pigmentation.

Coloration highly variable, but in all cases the fundamental or ground color is white. This is overlaid by pigmented areas of iron-gray, tawny, brown, yellow, or orange. Melanistic specimens are common, in which the iron-gray is intensified to almost jet black, and even the ventral side is dark.

Each somite marked dorsally with a transverse dark bar, in front of which is a lighter bar of the same color, broadly interrupted in the median line, and often broken transversely by a fine white stripe midway of its width. Ventral side either unpigmented or washed with ashy in melanistic individuals; this dark tint accentuated by a narrow, white, mid-ventral line.

*Measurements.*—Length of large commensals, 75 mm.; width across middle of body, 11 mm.; length of full-grown non-commensals, 57 mm.; width across middle of body, 9 mm.

This fine Polynoid is the commonest of its family along a large portion of our coast. I have obtained it in abundance between tide-marks at Pacific Grove and in the vicinity of San Francisco, both in the bay (at Lime Point and Point Cavallo on the northern side of the Golden Gate) and along the outer shore. I have also numerous specimens from localities further north—Point Arena, Cape Mendocino, Humboldt Bay, Trinidad, and Puget Sound. How much further north and south it extends I am unable to say, but have never found it at San Pedro or San Diego.<sup>1</sup> Undoubtedly it ranges much further northward than Puget Sound. I am confident that the species collected by J. K. Lord at Esquimalt and described by Baird under the names *Halosydna insignis* and *H. grubei* are varieties of this form.

I have never dredged this species, and am ignorant of its bathymetrical range. Northward, at any rate, it extends a good deal below low-water mark. I have specimens taken from the buoy at Point Arena, for which a depth of 15 fathoms is recorded; and others from Humboldt Bay, taken at a depth of 9½ fathoms.<sup>2</sup>

*Halosydna brevisetosa* is probably entitled to the distinction

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<sup>1</sup>A single specimen was collected by Mr. F. W. Bancroft at Avalon, Santa Catalina Island, in August, 1893. Avalon lies south of San Pedro about 25 miles from the mainland.

<sup>2</sup>These specimens were kindly presented to the University by Capt. Frank Curtis, United States Light House Inspector, along with other Invertebrata from the buoy-chains.

of being the first marine Annelid from the California coast described in any scientific work. A brief Latin diagnosis of the species was given by Kinberg in 1855<sup>1</sup> and a more ample description, with several fairly good figures, in the "Eugenies Resa" in 1858<sup>2</sup>.

In this second account Kinberg states that his specimens were obtained at "Sausalito Bay, near San Francisco, California, on the shore and at a depth of eight to ten fathoms."

Probably no species of this great family, noted for the morphologic plasticity of many of its members<sup>3</sup>, is more variable than this. The variation it exhibits is unquestionably due to differences in its environment. It is not only free-living under a variety of conditions (under stones, among tunicates, mussels, sea-weeds, etc.), but is also a common commensal in the tubes of species of *Amphitrite* and *Thelepus*. Like another tube-commensal of our coast, *Polynoë reticulata*, it attains a larger size in this mode of existence than when free-living, but not unless it lives in a tube of liberal dimensions, so that both the rightful occupant and its messmate have ample space. As with other species of the genus, there is a strong tendency for the commensal to attain a great length, and but slight proportionate diameter. This condition is probably seen at its maximum in *Polynoë ocellata* of Japan (commensal with the narrow-tubed *Spiochætopterus challengerix*), which, according to M'Intosh<sup>4</sup>, has over 100 somites, more than 50 pairs of elytra, measures 60 mm. in length, and only 2.5 mm. in width, including the setæ. Not alone are the commensal individuals of the present species longer and proportionately narrower than the free-living ones, but they exhibit other peculiarities. The elytra are thinner, smoother, sometimes destitute of any except microscopic tubercles, with few or no marginal "cilia," and not so likely to extend to the extreme posterior end of the body, reaching usually not further back than the anus. There is a marked tendency to develop a

<sup>1</sup> l. c., p. 385.

<sup>2</sup> l. c., p. 18, Taf. V, figs. 25 & A.

<sup>3</sup> For an excellent account of the variability of *Polynoid squamata* and *P. clava*, see Bourne "Certain Points in the Anatomy of the Polynoidia", Trans. Linn. Soc. (London) 2nd Ser., Zoology, Vol. II, pp. 347-356, Pls. XXXIV-XXXVI.

<sup>4</sup> Challenger Reports, Zoology, Vol. XII, p. 126, Pl. XII, fig. 3.

strong upper bristle in the ventral series—a characteristic very apparent, in *P. gigas*, even to the naked eye, and probably of advantage in crawling within the tube. An unlooked-for characteristic is the heavier pigmentation of commensals, and the more uniform distribution of pigment over the body. I have one specimen from Humboldt Bay which is almost entirely black, and has the largest and thinnest elytra I have ever observed in this species.

I have not detected a tendency in northern specimens to be larger than those from near the southern limit. Two specimens from Puget Sound, while of generous dimensions, do not equal the largest obtained at Pacific Grove.

### *Polynoë reticulata*, sp. nov.

PLATE VII, FIGS. 32, 41, 41a; PLATE VIII, FIGS. 47, 47a, 47b.

General aspect very nearly like *P. brevisetosa*. Form oblong-linear, tapering gradually and about equally at both extremities, broadest midway of its length. Somites 37; pairs of elytra 18, on somites 2, 4, 5, 7....27, 28, 30, 31, 33.

Prostomium (fig. 32) slightly longer than wide, deeply and broadly fissured longitudinally, globose, constricted at base; the basal joint of tentacle set into this fissure. Eyes four, anterior pair considerably wider apart than the posterior, just in front of widest region of prostomium, laterally directed. Posterior pair slightly smaller, near base of prostomium, dorsally placed.

Anus dorsal, in somite 35.

Elytra large, thin, orbicular (first pair) to irregularly reniform (fig. 41); all smooth except first two or three pairs, which have small conical tubercles (rarely these are present on all the elytra); sparingly ciliate on external margin. The elytra increase gradually in size from the first pair backward, and attain their maximum about the twelfth pair. The first pair are often scarcely half the diameter of the broadest. The upper surface of the elytron is closely punctate or pitted with little rounded or irregular cavities, between the orifices of which lie the epithelial cells, the latter forming a sort of reticulation or network (fig. 41a).

Parapodia (fig. 47) robust, biramous; dorsal ramus very small, with setæ of two sorts (fig. 47b): short, strongly curved ones, which are uppermost, and a small fascicle of long, slender, gently curving ones, which reach beyond the tip of the ventral ramus.

Ventral setæ toothed at tip (fig. 47a), serrated for a short distance below the point, rather short and stout.

Cirri smooth, slightly thickened below the point, gradually tapering. Anal cirri short, almost conical, not longer than posterior dorsal cirri. Antennæ inserted at level of base of tentacle, shorter than tentacle. Peristomial cirri not different from average dorsal setæ.

Palpi slightly thickened near the point, which is fine and filamentous; mi-

nutely papillated, pigmented nearly their entire length, darkest adjacent to the white tip.

Nephridial papillæ begin usually at eighth somite; sometimes as far back as the twelfth; end at thirty-fifth or thirty-sixth.

Colors never strong or bright, varying from reddish brown to ashy, gray, or drab, sometimes very pale. A small, darker spot on each elytron, frequently accompanied and accentuated by a light spot, as in *P. brevisetosa*. A double row of rectangular dark spots, often present on ventral side, segmentally arranged. Each dorsal cirrus, also tentacle, antennæ, peristomial cirri, and anal cirri, ringed with a dark band at or about the level of the thickened area. Dorsum transversely barred with alternate dark and light bands.

*Measurements.*—Large specimen: length, 48 mm.; greatest breadth, 7.25 mm.

The present species is distinctly southern in its range, occurring abundantly at San Pedro and at San Diego. I have found a few individuals at Pacific Grove, but invariably in the tubes of *Amphitrite* or *Thelepus*—never free-living. I have not found it further north.

The commensal habit is no more established in this species than in *P. brevisetosa*; both are facultative commensals, as far as the *species* is concerned, but probably not entirely so as regards *individuals*. The constancy of the commensalistic life throughout an individual existence is evinced both by the invariable commensalism of *P. reticulata* at the northern limit of its distribution, where it comes into competition with *P. brevisetosa*, and by the thorough-going modifications caused by this mode of life in the latter species.

Ecologically, *P. reticulata* almost exactly replaces *P. brevisetosa* beyond the southern limit of the latter, and the superficial resemblance of the two species is very strong. It fills the same place in nature, crawling over stones, nestling under them, or in the countless crevices among the multifarious vegetable and animal growths of the "littoral belt." Further than this, not a few individuals are found in the tubes—whether occupied by the rightful owner or not—of Terebellid worms, mainly species of *Amphitrite*, *Terebella*, and *Thelepus*. The commensal habit has by no means brought about such modifications in the present species as in *P. brevisetosa*. I have not found it easy to

make out just what the peculiarities of commensals are, they are so slight and indeterminate. Commensals are not, as in *P. brevisetosa*, decidedly more pigmented; but, on the contrary, are usually somewhat paler than the free-living individuals. The elytra are a trifle thinner and smoother. There is no special modification of the setæ, or of the body-form.

The largest and finest specimens have been collected at San Pedro, where the species is very abundant on rocky shores near low-water mark. It is probable that this portion of the California coast is its "metropolis," for the individuals obtained in San Diego Bay (where it occurs in some abundance on the piles) and at Pacific Grove are very much smaller than the general run of specimens from San Pedro. It should, however, be stated that most<sup>1</sup>, if not all, of the very large individuals collected at San Pedro were commensalistic in the tubes of a huge *Amphitrite* common in that region, but not found, so far as present knowledge goes, at San Diego or at Pacific Grove.

In addition to the localities above mentioned, this species has been collected by Mr. H. B. Torrey at Avalon, Santa Catalina Island, and on San Clemente Island.

At Pacific Grove the breeding season is evidently in the summer. A female collected there in July shed ripe eggs.

### **Polynoë gigas, sp. nov.**

PLATE VII, FIGS. 33, 42, 42a; PLATE VIII, FIGS. 48, 48a, 48b, 49.

Form much elongated, robust when fully grown, obtusely rounded at both ends. Young much more slender proportionally and gradually tapering from the middle to the posterior extremity.

Somites variable in number, usually between eighty and ninety; elytra likewise variable, forty to fifty pairs. Elytra not extending to posterior extremity. Anus conspicuous, at anterior edge of penultimate somite.

Prostomium (fig. 33) very broad, globose, median fissure slight, reaching not over half-way to base of prostomium. Eyes four, anterior pair situated at widest part of prostomium, much larger than posterior pair, which are nearer together. Antennæ attached at level of tentacle, articulated on anterior prolongations of cephalic lobe.

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<sup>1</sup> My notes are unfortunately defective on this point; but certainly a considerable proportion of the largest individuals were commensal with *Amphitrite*.

Cephalic cirri and dorsal cirri smooth, slightly thickened below the apex (the tentacle being the most so), ringed with black at the thickened place. The antennæ are decidedly shorter than the tentacle and peristomial cirri and about equal to the buccal cirri. Dorsal cirri, except the most posterior, of about equal length throughout, scarcely if at all surpassing the ventral setæ. Ventral cirri short, fusiform. Palpi very large, white or grayish, gradually and uniformly tapered from a thickened region near the base to the fine, filamentous tip. Minutely papillated all over, except at extreme base. Anal cirri extremely short, fusiform.

Parapodia very stout (fig. 48), much wrinkled near base. Dorsal ramus conical, diminutive, usually achætous, or with one or two minute setæ. One or two of the parapodia in posterior part of body usually asymmetrical, having an elytron on one side and a dorsal cirrus on the other (fig. 49).

Ventral setæ (fig. 48a) very large and stout, toothed near extremity, serrated for a short distance below the apex. Uppermost much the thickest, dark amber color (fig. 48b).

Elytra varying from irregularly reniform (fig. 42) anteriorly, to nearly orbicular along all the middle and posterior portions of the body. Smooth and entirely destitute of papillæ or tubercles. Ocellate, and mottled with blotches of iron-gray pigment, which is distributed in the epithelium of both sides of the elytron, as appears very distinctly when the elytron is viewed by transmitted light (fig. 42a).

Nephridial papillæ about twice as long as thick, enlarged at extremity, ringed with black. They extend from the eighth somite to the pygidial.

Colors dark-reddish on dorsum, iron-gray on elytra; each elytron with an imperfect ocellate spot; below, unpigmented. A dark spot at base of each dorsal cirrus; dorsal ramus dark.

A considerable portion of the dorsum is usually exposed in both young and old specimens.

*Measurements.*—Length, 165 mm.; width, 12 mm.

*Habitat.*—San Pedro, San Diego (Pt. Loma)<sup>1</sup>, commensal with large *Amphitrite*.

This magnificent Polynoid has been found only as a tube-commensal with a large species of *Amphitrite*, and is southern in its distribution. The dimensions above given are taken from alcoholic specimens which have undergone the usual amount of contraction. A fully extended, living specimen of the largest size would measure not less than 23 cm. Thus the present species ranks among the largest of its family and of its class.

It is worthy of note that the Polynoidæ of excessive

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<sup>1</sup> We have obtained no specimens from San Diego Bay; but recently two were kindly collected for me (together with several other Polychætes from that region) by my friend Prof. Wm. M. Wheeler, at Point Loma, near the entrance to the Bay.

length are variable as to the number of somites, while those which have few somites are remarkably constant in this particular. I have never examined a specimen of *Polynoë brevisetosa* or *P. reticulata* that did not have 37 somites and 18 pairs of elytra; nor have I any specimen of *P. squamata* with more or less than 27 somites and 12 pairs of elytra<sup>1</sup>. It is very different with Polynoids possessing many somites; these follow the law of all elongated Annelids in having no fixed number of somites.

In the present species, for example, the number of somites in nine specimens of various sizes ranges from 81 to 86. The number of pairs of elytra in the same nine specimens varies from 41 to 47. But the most astonishing fact in regard to the elytra is the prevailing asymmetry of their arrangement. Out of the nine specimens examined, only three had the same number of elytra on the right and left sides, and, even among these three, two had each two asymmetrical somites, one elytriphorus on the right, the other on the left; so that even here the general symmetry was not real, but the simple result of balancing two asymmetrical somites. A dorsal cirrus is invariably present on the opposite side of the somite or somites bearing an extra elytron (fig. 49).

I can offer no explanation for this curious asymmetry<sup>2</sup>. Its very frequent, almost universal, occurrence precludes considering it a monstrosity. It is worthy of note, although not an explanation of the anomaly, that the extra elytron always occurs in the posterior region, where the arrangement of elytra is very different from that found further cephalad. As far as the thirty-third somite the sequence of the elytra is absolutely the same as in *P. brevisetosa*, *P. re-*

<sup>1</sup> The only exception I have noticed is *Harmothoe hirsuta*, which has 37 to 40 somites.

<sup>2</sup> The only other instance of such asymmetry among the Polynoidea (or in fact among the Polychæta generally) that I have found any record of is *Lepidametria commensalis* Webster (H. E. Webster: "Annelida Chætopoda of the Virginian Coast," Trans. Albany Inst., Vol. IX, pp. 210, 211, 1879). This Polynoid is commensal with *Amphitrite ornata*; hence its mode of life is precisely like that of *P. gigas*. It is stated by Webster to have 38-50 elytra on a side, which "cannot be enumerated in pairs, since sides of the same segment may bear, one, an elytron, the other a dorsal cirrus. For the first 32 segments the arrangement is uniform. After the thirty-second segment, no two specimens present the same arrangement."



*ticulata*, and most, if not all, species having 18 pairs. Between the thirty-third and forty-ninth somites, the elytriphorous and cirriferous somites alternate regularly. On somites 49 and 50 elytra are borne. From this point onward the arrangement differs in different individuals, but long series of elytriphorous somites are the rule, alternating with pairs and trios of cirriferous somites. In one example the groups of elytriphorous somites run as follows<sup>1</sup>:

Three.....	Somites 56-58
Five.....	" 61-65
Eight.....	" 68-75

In every instance I have found two long series of elytra-bearing somites at the posterior end; and it is in one or the other of these series that the extra elytron is found.

The replacement of an elytron by a dorsal cirrus on the opposite side of one and the same somite is no argument for the homology of these organs, as might at first seem to be the case. It is obvious that the mere *absence* of the elytron may be the determining factor leading to the development of the dorsal cirrus.

### Polynoë lordi (Baird).

PLATE VII, FIGS. 35, 44; PLATE VIII, FIGS. 51, 51a, 51b.

*Lepidomotus lordi* BAIRD. Proc. Zool. Soc. (London), April, 1863, p. 107.

*Halosydna lordi* BAIRD. Jour. Linn. Soc. (London), Vol. VIII, 1865, p. 190.

Body long and tapering gradually to the attenuated posterior extremity, thickest in anterior third from eighth to twentieth somite, slightly diminishing towards the head.

Prostomium (fig. 35) broader than long, bilobed, widest across posterior portion at level of anterior pair of eyes. Eyes four, of about equal size, posterior pair at extreme base of prostomium, nearer together than the anterior. Antennæ with joint at base, inserted slightly below level of basal joint of tentacle. Antennæ and tentacle short and stumpy, but with long filiform tips; slightly longer than prostomium.

Peristomial and dorsal cirri (fig. 51) short, fleshy, club-shaped, with long

<sup>1</sup> This specimen has 45 elytra on the right side, 44 on the left. The extra elytron of the right side occurs on somite 69. The enumeration above given is for the right side.

filiform tip; not longer than ventral rami with their setæ. Palpi in preserved specimens short, conical, pointed, with subterminal black zone.

Dorsum very broadly exposed between the elytra, which are unusually small, broadly reniform or orbicular, and either entirely immaculate or more rarely with a central black spot and flecks of black, or with a black border on posterior edge. Dorsum marked with numerous irregular, transverse bands, lines, and streaks of burnt sienna; the pigment massed in a broad, solid fillet on somites eight and nine. The rest of the body unpigmented.

Parapodia (fig. 51) small and numerous, short; dorsal ramus rudimentary, achætos (or rarely with a few small setæ); ventral ramus stout, bearing two kinds of setæ: (1) a supra-acicular fascicle of blunt, slightly curved ones (fig. 51*b*); and (2) an infra-acicular series of hooked setæ (fig. 51*a*), similar to those of *P. pulchra* and *P. fragilis*; about 20 setæ in all. Ventral cirrus present, small and fusiform.

Number of somites, 67 to 74; elytra 31 to 35 pairs, extending to extreme posterior end of body.

*Measurements.*—Length of full grown specimen, 57 mm.; greatest width, 7 mm.

*Habitat.*—Northern portion of California Coast to Puget Sound. Commensal with *Glyphis aspera* and probably other Fissurellidæ, nestling under the mantle. Also with *Cryptochiton stelleri*, in the branchial groove.

I have a little hesitation in referring the species above-described to Baird's *Halosydna lordi*, although his description of the latter, based upon abundant material collected by J. K. Lord at Macaulay's Point, Vancouver Island, does not in all respects agree with the specimens at my command. For example, he describes the dorsal setæ as "stout, smooth, somewhat curved as they approach the point, enlarged and flattened and uncinatè at the point; those of ventral or lower division a little more slender, slightly enlarged near the point, which is straight, blunt, and striated across." My specimens are for the most part destitute of dorsal setæ, and have two different forms of setæ in the ventral ramus, neither of which agrees with Baird's description. The host mentioned by Baird is *Fissurella cratitia*. All my specimens from the Puget Sound region were in the mantle cavity of *Glyphis aspera*; those from Cape Mendocino are stated on the label to occur under the mantle of "*Fissurella*," but what species I do not know. Very probably these came from *Glyphis aspera*

also, as that is by far the commonest Fissurellid on that portion of the coast. I have collected a single specimen from the gill-groove of *Cryptochiton stelleri*, at Bolinas, Marin County, California. This is the only individual I have seen with black pigmentation on the elytra similar to *P. pulchra*.

*Polynoë pulchra*, sp. nov.

PLATE VII, FIGS. 34, 43, 43a; PLATE VIII, FIGS. 50, 50a, 50b.

Form attenuated posteriorly, like *P. Lordi*, which this species closely resembles. Greatest width in anterior third, thence tapering gradually to slender posterior end.

Prostomium (fig. 34) broader than long, with two peculiar lateral expansions adjacent to peristomial somite. Eyes four, placed far back, those of each pair far apart, the anterior pair more distant than the posterior; posterior and anterior pairs of about equal size. The tentacle inserted about half the length of its basal segment into front edge of prostomium; slightly longer than prostomium. Antennæ prolonged from anterior tips of lateral lobes of prostomium, with distinct basal joints, about equal in total length to the tentacle. Palpi thick and fleshy, slightly tapered from base, abruptly at tip, ringed with black near their distal ends. Filamentous tips of all dorsal cirri protrude abruptly from the slightly thickened terminal portion.

Parapodia (fig. 50) long, dorsal ramus rather slender, enlarged distally, frequently achæitous, or bearing a few serrated and notched setæ (fig. 50b). Ventral ramus with a few (6-12) strong, amber-colored, hooked setæ (fig. 50a), which have a few very minute serrations on the thickened portion near the tip.

Dorsum usually exposed (but not broadly, as in *P. Lordi*) between the rows of elytra; transversely marked with brown bands, two to each somite. Elytra (fig. 43) slightly undulate at margin, broadly reniform, adorned with a black or dark brown spot over the elyrophore, and a narrow posterior border of the same color, or else immaculate; very smooth. Epithelial cells small (fig. 43a). Young specimens from *Holothuria californica* are amber-color, very translucent, and entirely unspotted. Older ones from the same host are suffused with Indian-red, often with a tinge of purple, and have a large central spot of brown on each elytron.

Number of somites, 48-64; pairs of elytra, 20-33. Elytra are borne on somites 2, 4, 5, 7....23, 26, 28, 29, 31....51.

*Measurements*.—Length, 51 mm.; greatest width, 10 mm.

This beautiful Polynoid occurs at Pacific Grove as a common messmate (or possibly parasite) of two animals wide apart in the organic scale: *Holothuria californica*

and the great key-hole limpet, *Lucapina crenulata*. In case of *Lucapina crenulata*, *Polynoë pulchra* nestles in the cavity between the mantle-flap and the foot; but in case of the holothurian, it clings to the surface of its host, and even at times crawls into its mouth. The hooked ventral setæ serve admirably to enable the animal to maintain its hold. In fact, it clings so closely one has to exercise care in removing a specimen or it will be ruptured. The animal will live a long time—how long I have not ascertained, but at least two weeks—after separation from its host, if the water be kept pure.

The astonishing variation of color which this species exhibits is in exact agreement with its varied mode of life. Under the mantle of *Lucapina* it is securely hidden from the observation of any inquisitive fish, and almost excluded from the light. In this situation it may either be destitute of pigment, or possess a color-pattern that would render it exceedingly conspicuous in almost any external environment. Nothing could be more chastely beautiful than the translucent cream-color, accentuated in the purity of its tint by the rich velvety brown of the dorsum and the jet-black of the elytra; and nothing could be more fatal to the creature if it were exposed to the attacks of predatory animals. It is not surprising, therefore, to find a different coloration in case of individuals that lead an exposed existence on the bodies of holothurians. In this instance the color of the parasite mimics that of its host. It is further interesting to note how slight a change is necessary in the pattern-coloration to render the animal inconspicuous. It is merely a washing over of the surface with reddish or brownish—the color of the holothurian. Then the spots are toned down to a lighter shade of brown, or from intense black to dark brown. The result is a very good color-mimicry of the holothurian.

The structure of the setæ in this species, in *P. lordi* and *P. fragilis*, is a beautiful adaptation to their ectoparasitic habit. The serrations are few and very diminutive; the tip is decidedly hooked, the number of setæ is reduced,

but they are increased in size; the dorsal setæ are frequently absent. The adaptation to the clinging function is closest where the animal is obliged to maintain its hold on the exterior of its host. So we find in *P. fragilis* and *P. pulchra* that the setæ are renewed as often as the tips become at all blunted; in these two species the nascent setæ can generally be seen after clearing with oil, within the ventral ramus of the foot (fig. 52). The setæ of *P. lordi*, on the contrary, are generally rather blunt at the tip. They may become so in this species without danger, inasmuch as the animal could maintain its place without clinging to its host.

*P. pulchra* has the habit of suddenly and forcibly extending the proboscis, which is sufficiently prehensile to enable the animal to lay hold of its host. When two or three of the worms are placed in the same dish they will often seize hold of one another with such violence as to detach one or more elytra from the region struck by the tip of the proboscis.

### *Polynoë fragilis* (Baird).

PLATE VII, FIGS. 36, 45; PLATE VIII, FIGS. 52, 52a, 52b.

*Lepidonotus fragilis* BAIRD. Proc. Zool. Soc. (London), April, 1863, p. 108.

*Halosydna fragilis* BAIRD. Journ. Linn. Soc. (London), Vol. VIII, 1865, p. 191.

Form of body almost precisely like that of *P. lordi*, but a trifle broader proportionately in the anterior third, and not so thick dorsoventrally. Elytra continuing to extreme posterior end, which is much attenuated. Segmentation strongly marked, elythrohores and pseudo-elythrohores (on cirrus-bearing somites) very prominent.

Prostomium (fig. 36) short, rounded, broader than long; longitudinal fissure continued to base; tentacle inserted in a deep notch anteriorly. All cirri thick and fleshy, much clubbed at ends, very abruptly reduced to a terminal filament. Antennæ very short, not exceeding length of prostomium, two-jointed, joints of nearly equal length. Palpi short, acutely pointed, with subterminal dark ring. Eyes four, small, placed back of median transverse line.

Parapodia (fig. 52) rather long, dorsal ramus setigerous, ventral cirrus rudimentary or wanting. Dorsal setæ few, serrated, notched at extremity (fig. 52b). Ventral setæ only seven or eight, stout, hooked (52a), serrations almost obsolete.

Elytra (fig. 45) with inner margin curled up to form two funnels, the anterior ear-shaped, the posterior crescentic. Elytra thin and membranaceous, very slightly marked with yellow or pale green pigment; 29 to 34 pairs, borne on somites 2, 4, 5, 7, 9 . . . 23, 26, 28, 29, 31 . . . 57. Elytra do not cover dorsum.

Commensal (?) in ambulacral groove of *Asterias ochracea* and *A. troschelii*.

*Measurements*.—Length, 41 mm.; greatest width, 7 mm.; somites (in specimens of above dimensions) 60-70; the terminal ones very diminutive and difficult to count.<sup>1</sup>

With some hesitation I have identified the curious Polynoid above described as the *Halosydna fragilis* of Baird. His description is so defective, having been made from specimens which reached him in a fragmentary condition, that it would be quite impossible to recognize the species, were it not for its very peculiar habitat and abortive ventral cirri. The identity of the California specimens with material recently received from Puget Sound I have made out to my satisfaction; and this circumstance heightens the probability to a reasonable certainty that Baird's specimens and mine belong to one and the same species.

This species is very scarce in the neighborhood of San Francisco, and I have never found it south of this point. It occurs chiefly on *Asterias ochracea*; but even of this common species hardly one in fifty will be found to harbor a *Polynoë fragilis*. Northward, it is evidently far more abundant. Seven young specimens from vicinity of Seattle are stated by the youthful collector, John Dewhurst, to whom I am indebted for them, to have come from no more than a dozen starfish.

The parasite (or commensal) does not remain constantly in the ambulacral groove; sometimes it crawls upon the aboral side, where its peculiar coloration harmonizes so well with the colors of the starfish that it is by no means conspicuous. I have once found it on *Asterias troschelii*. Probably it occurs on all our larger species of *Asterias*. Whether the "parasitic worm" mentioned by Fewkes<sup>2</sup>

<sup>1</sup>In young specimens from Puget Sound (15-18 mm. long) the number of somites is 37-40.

<sup>2</sup>l. c. p. 129.

as infesting *Asterina mineata* is this species I have no means of knowing.

***Harmothoë imbricata* (L.) Malmgren.**

PLATE VII, FIG. 37.

This interesting species occurs all along our coast as far south at least as San Diego. The specimens from the southern parts of its range are small and few. Northward it increases in size. None of the numerous examples I have taken at Pacific Grove are so large as some from Humboldt Bay and from Puget Sound. Again, all the west coast specimens are dwarfs in comparison with Arctic examples.

At Pacific Grove it occurs under stones and among eelgrass, near low-water mark. It is extremely varied in its coloration, the tints ranging from pink to dark iron-gray. The first pair of elytra are very frequently a dull, opaque white, contrasting strongly with the general dark coloration, and giving the animal a very bizarre appearance, as having two great dull-white eyes.

I have no hesitation in placing my specimens under the name *Harmothoë imbricata*, although I have only figures and descriptions of the latter for comparison. The setæ correspond exactly; the prostomium (fig. 37) has the peculiar location of the eyes noted in *H. imbricata*—the anterior pair being placed laterally and actually under the bulging lobes of the prostomium. The relative length of tentacle and antennæ is almost precisely what it is in von Marenzeller's<sup>1</sup> figure of a specimen from Japan; but the difference in their lengths is not nearly so great as in Malmgren's<sup>2</sup> figure of the Skandinavian variety.

<sup>1</sup>Südjapanische Anneliden I. Denkschr. d. Wiener Akad. Math. Naturwiss., Classe, Bd. XII, p. 117, Taf. II, fig. 1.

<sup>2</sup>Nordiska Hafs-Annulater; Ofversigt K. Vetensk-Akad. Förhandl., Bd. XXII (1866), Taf. ix, fig. 8a.

**Harmothoë hirsuta, sp. nov.**

PLATE VI, FIGS. 27, 28, 29; PLATE VII, FIG. 38; PLATE VIII, FIGS. 53, 53*a*, 53*b*, 53*c*.

Form short and broad, rather thin dorsoventrally, and only slightly tapered at posterior end; elytra not covering last four or five somites.

Prostomium typical for the genus, broader than long, with two well defined acuminate "peaks" (fig. 38); deeply incised for insertion of base of tentacle, which is distinctly at a higher level than the antennæ. Basal joint of tentacle thickened. Eyes four, anterior pair slightly the larger, laterally placed about half-way the length of prostomium, where it is widest. Posterior pair set far back, close to base of prostomium.

Antennæ less than one-third the length of the tentacle, and about one-half its thickness; their basal joints short, and not much thicker than the terminal joint, heavily pigmented. Terminal joints of all the cirri, both dorsal and ventral, more or less thickly beset with long, villous papillæ, among which extraneous matter has usually gathered in abundance. All dorsal cirri, including tentacle (but not the antennæ), with a broad zone of dark pigment at or near the proximal end of the distal segment. Palpi longer than any of the cirri, gently tapering to a fine point; minutely papillated, terete.

Parapodia (fig. 53) with large, bristling fascicles of setæ, those of dorsal ramus usually loaded with fine sediment. Dorsal ramus of medium size, but its setæ very numerous, long, and stouter than those of ventral fascicle, with long series of serrations (fig. 53*c*). Ventral setæ (fig. 53*a*) long, slender, numerous, toothed at tip, serrated for a considerable portion of their length; decreasing in length and size ventralward (figs. 53*a*, *b*). Both dorsal and ventral ramus with a finger-like terminal process.

Elytra (figs. 27-29) curiously ornamented with 4-6-pronged tubercles, these scattered over the whole surface in young elytra, but in old ones (except first pair) limited mainly to posterior and lateral margin, where they attain a very large size. Elsewhere they are much smaller. Each tubercle arises from a "space," which is bounded by thickened walls (fig. 29). Elytra also fringed and partly clothed with long filiform papillæ, or "cilia," like those of dorsal cirri.

Number of somites, 37 to 40. Pairs of elytra, 15, borne on somites 2, 4, 5, 7 . . . 23, 26, 29, 32.

*Measurements.*—Length of large specimen, 23 mm.; width of same, 6 mm.

Found at San Pedro in considerable abundance crawling on under side of stones at low-water mark and at moderate depths (3-4 fathoms). Its setæ, cirri, and curiously tuberculated elytra are usually coated with minute sediment.

This species bears a very close resemblance to *Polynoë polytricha* of the Caribbean region, first described by



Schmarda<sup>1</sup> and subsequently by Ehlers<sup>2</sup>. I have not had access to Schmarda's original description, but Ehlers' figures and diagnosis of *P. polytricha* show that that species differs in two or three important points from the present form. The palpi of *Harmothoë hirsuta* are terete, not angular; the eyes are four instead of two (Ehlers possibly overlooked the anterior pair, however), and the foot is shorter. Notwithstanding these differences, the two forms are exceedingly alike in a number of important characters, and may yet prove to be merely varieties of a single species.

### *Harmothoë crassicirrata*, sp. nov.

PLATE VI, FIGS. 25, 26; PLATE VII, FIG. 39; PLATE VIII, FIGS. 54, 55*a, b, c*.

Form rather stout and thick, tapered considerably towards the head; (posterior somites back of twenty-fifth wanting).

Prostomium (fig. 39) with lateral lobes well defined, anterior peaks prominent, acute, median fissure broad, reaching back about one-half the length of prostomium. Tentacle with broad, conical, basal segment, reaching a little beyond tips of prostomial lobes. Tentacle shorter than peristomial cirri, but nearly twice the length of the antennæ. The latter inserted below the level of the tentacle, their basal segments enormously thick and in all respects resembling the basal piece of tentacle. Flagellum of antennæ nearly equal in length to all the rest of the antenna. Eyes four, anterior pair much the larger, lateral, protuberant, placed about midway of length of prostomium and in its widest region. Posterior pair about one-half the diameter of the anterior ones, placed far back near base of prostomium.

Peristomial cirri very similar to tentacle, but considerably longer and thicker. The basal joints of dorsal and ventral cirri are fused for nearly their whole length. The dorsal cirri (fig. 25) clavate, and much thickened. All cirri, except ventral, papillate to some extent, the dorsal the least so.

Parapodia (figs. 25, 26) divided into very unequal rami, both with a long, cylindrical, finger-like, terminal process. Setæ of dorsal ramus very few (8-16), but enormously stout (figs. 55*a, b*), dark, minutely serrated their whole exposed length. Ventral setæ much more slender and numerous (fig. 55*c*), toothed at tip. Elytra probably 15 pairs, borne on somites 2, 4, 5, 7.... 23, 26?, 29?, 32?; thin, very broadly reniform (fig. 54), very smooth, and minutely flecked with brown pigment.

*Measurements*.—Greatest width of body, 7.5 mm.; length of 25 somites, 20 mm.

<sup>1</sup> Neue wirbellose Thiere, i, ii, p. 156.

<sup>2</sup> The "Blake" Annelids, Mem. Mus. Comp. Zool. Harvard College, Vol. XV, p. 49, Pl. X, figs. 9, 10, Pl. XI, fig. 1.

Unfortunately this interesting species is known from a single imperfect specimen, brought up on a stone from about 100 fathoms in Monterey Bay. The posterior segments back of the twenty-fifth are wanting, also the palpi, and one dorsal and one ventral peristomial cirrus. The striking differences in size between the head cirri and the dorsal cirri, between the dorsal and ventral setæ, are the notable points in the external structure of this form. The cirri and elytra are very readily detached.

### Family V. SIGALIONIDÆ.

#### *Peisidice*, gen. nov.

Body short, tentacle and the single pair of peristomial cirri identical in size and shape, large and conspicuous, longer than prostomium. Palpi short, not reaching beyond tips of peristomial cirri; no antennæ; no dorsal cirri. Dorsal rami of parapodia very small, bearing slender, fine-pointed, serrulate setæ. Ventral rami with much longer, stouter, compound setæ. Elytra not meeting across dorsum; exposed portion of latter, and upper surfaces of elytra coated with minute sand grains. Elytra borne on alternate somites, papillated on their external and posterior margins. Anal cirri two.

This genus, of which only a single species is known, differs from *Pholoë* and *Psammolyce*, to which it is evidently near akin, in the possession of only a single pair of peristomial cirri, and in the regularly alternating sequence of the elytra, whereas in *Pholoë* and *Psammolyce* they are borne on every somite after the twenty-third and twenty-seventh respectively. The body is likewise shorter, and the somites few (not over forty in known species).

#### *Peisidice aspera*, sp. nov.

PLATE IX, FIGS. 56-59; PLATE X, FIGS. 63, a-d.

Body elongate-elliptical, semiterete, equally and evenly rounded at both ends, its contour determined all around by the elytra, which cover over both head and parapodia. Wide median stripe of dorsum bare for nearly entire length; like the upper surface of elytra coated with sand grains.

Prostomium globular, bearing in front a large papillate tentacle (fig. 56), enlarged at the base, considerably swollen distally, and ending in a filiform tip. Single pair of peristomial cirri extremely similar to tentacle. Palpi short, stout, evenly tapered to a fine point, annulately grooved. Eyes

four, black, the two on each side closely approximated. No dorsal cirri; anal cirri similar in shape and length to the cephalic cirri.

Elytra, 17-19 pairs, borne on somites 2, 4, 5, 7...33. Elytra varying from trigonal to uncinata, the point of the "claw" toward the median line (fig. 56); they show distinct concentric growth-lines, and have a deep fringe of knobbed filaments on their posterior and external borders (figs. 56 and 59); the whole exposed upper surface of elytron with minute adherent sand grains. A varying number of elytra, beginning with the second pair, have a central dark spot.

Peristomial parapodia forwardly directed, with only a single pair of long, curved aciculæ and minute, simple, capillary setæ like those of all the dorsal rami (figs. 58, 63*d*). Ventral rami with a fascicle of much stouter, longer setæ, with falcate appendages (fig. 63*a, b, c*). Ventral cirri short, papillated, knobbed at tip, more or less coiled (fig. 58).

Jaws (fig. 57) double, strongly hooked at apex, horizontal in position, as seen *in situ* when retracted.

Somites 35 to 38 in number, all setigerous except the pygidial.

*Measurements.*—Length, 7 mm.; width 2 mm.

This curious little Sigalionid occurs in Monterey Bay, where I have dredged it in twelve fathoms on a stony bottom. They are found crawling over the stones and hiding in crevices. The body is closely incased laterally by the elytra, and further protected by the adherent sand particles, which render it rough to the touch. This singular mode of protection has been adopted, as is well known, in the allied genus *Psammolyce*. How the sand is held so firmly in place, and how the grains are so accurately selected as regards size and kind, is not apparent. Probably a secretion is produced by the dorsal surface and elytra, which hardens very firmly and effectively.

### *Sthenelais fusca*, sp. nov.

PLATE IX, FIGS. 60, 61, 61*a-b*; PLATE X, FIGS. 64, 64*a-g*.

Form elongated, tapered at posterior end, somites very numerous (138 or more); general color above, rusty brown, mottled with black, pale below. Elytra, over 100 pairs (112 in one specimen), entirely covering the back and the sides as far down as the parapodia.

Prostomium (fig. 60) rounded, eyes four, anterior pair placed far forward, nearly concealed under antennæ (?) as viewed from above. Tentacle short, slightly moniliform towards tip; antennæ (?) very short, flattened, and foliate.

Peristomial somite with a pair of forwardly directed setigerous parapodia, each bearing two cirri, similar in shape to tentacle and the dorsal one about

same length; the ventral much shorter. Palpi long, terete, smooth, usually twisted and coiled in preserved specimens. Spoon-shaped organs<sup>1</sup> small, somewhat shorter than ventral peristomial cirrus.

First pair of elytra whitish, rhomboidal; all the rest (fig. 61) reniform, broader on somites 2-27, narrower back of this point; papillate (fig. 61*a*) on ventrolateral margin; with minute, transparent tubercles (fig. 61*b*), and with two kinds of pigment—intra-cellular and cuticular (fig. 61*b*). Elytra borne on somites 2, 4, 5, 7...27, 28, 29, and on every succeeding somite.

Parapodia (fig. 64) elongated, strongly biramous at tip, all furnished with a terete, slightly tapering, branchial appendage, arising from external edge of elyptophore, constricted at its base, its tip usually in contact with the dorsal side of the parapod; fringed with long cilia on one side. Each branchia, beginning with the twenty-fifth, has a black pigment spot on its upper side, nearer the base in the anterior, but nearer the tip in the posterior branchiæ. This spot disappears on the most posterior branchiæ. Between the base of the branchia and the point where the parapod divides occur three ciliated cushions (fig. 64), of which the middle is twice the width of the other two. Tip of anterior ventral rami with several finger-like processes. Dorsal setæ very long, capillary, dorsally curved, serrulate on two borders (figs. 64, 64*f*, 64*g*). Ventral setæ (figs. 64, 64*a-e*) of four kinds: (1) a small fascicle of simple, spirally frilled setæ, projecting in the fissure between the rami (fig. 64*e*); (2) next to these three or four very stout, jointed setæ with moderately long, toothed appendage (fig. 64*c*, *d*); (3) stout, jointed setæ with very short appendages (fig. 64*b*); (4) slender, articulated setæ in lowest portion of series (fig. 64*a*). Ventral cirrus not reaching tip of parapod; with wing-like expansion on dorsal aspect, and slightly moniliform near tip.

*Measurements.*—Length of full-grown specimen, 95 mm.; width., 7 mm.

*Sthenelais fusca* frequents crevices under stones and among the rhizomes of the "eel-grass" (*Phyllospadix*), along a large portion of the California coast. It is apparently a rare species, for we have found thus far only four specimens: two in the vicinity of San Pedro, and two in the vicinity of San Francisco (at Pillar Point, San Mateo County, and at Bolinas, Marin County). All the specimens were taken at low-water mark during a run of low tides, so it is probable that beyond the littoral zone it occurs much more abundantly.

Three of the specimens are females, turgid with nearly ripe eggs of a bluish gray color. They were collected in June, July, and November.

<sup>1</sup> These are described at length by Claperède (Ann. Chaet. du Golfe de Naples, 1867, p. 399).

**Sthenelais verruculosa, sp. nov.**

PLATE IX, FIGS. 62, 62a; PLATE X, FIGS. 65, 65a-d.

Body subcylindrical, slightly flattened on ventral side, entirely covered dorsally and laterally, as low as the parapodia, by the strongly imbricating elytra. Not tapered toward the head. Color of alcoholic specimen fulvous; a median dark band on each elytron, just meeting the overlapping edge of the preceding elytron.

Prostomium rounded, broader than long. Eyes four, black; the larger, posterior pair on dorsal side of prostomium, near insertion of basal joint of tentacle. The smaller, anterior, forwardly directed pair under the bases of the antennæ. Tentacle smooth, two-jointed, terete, tapering gradually and evenly to the point; about three times the length of the prostomium. Antennæ (?) broad, expanded laterally at tips, hardly reaching beyond distal end of basal joint of tentacle. Palpi elongated, smooth, terete, evenly tapered from the thick base to the attenuated tip; when folded back reaching to the tenth somite.

Peristomial somite pushed far forward, concrescent around bases of palpi, which appear to grow out from it. Its setæ capillary, unjointed, much finer than those of dorsal rami. Peristomial cirri four, dorsal pair much the longer, reaching to tip of tentacle. Spoon-shaped organs present, their tips reaching beyond the ends of the forwardly directed peristomial parapodia.

Elytra (Pl. IX, figs. 62, 62a) reniform, closely beset on dorsal surface with numerous, minute, wart-like tubercles. Outer margin of elytra with a single row of short, blunt, cylindrical papillæ (fig. 62a). Elytra bent in a semicircle around body; borne on alternate somites to twenty-seventh, thereafter on every somite; the latter group of elytra narrower and more curved than the former.

Parapodia (Pl. X, fig. 65) similar to those of *S. fusca* in general aspect; branchiæ arising from ventral edge of elytraphore, depressed, their tips touching the dorsal ramus, constricted at base. Tips of ventral rami prolonged in ramose structures, largest on second and third pairs, gradually reduced on succeeding parapodia. Ventral cirri elongated on three most anterior parapodia; the rest reaching to tip of ventral ramus, winged on side next the ramus, slightly moniliform toward the point. Dorsal setæ (fig. 65d) very similar to those of preceding species. Ventral setæ of three kinds: (1) slender, articulated setæ (fig. 65a), occupying the lowest place in the fascicle; (2) stout articulated setæ (fig. 65b), inserted above the former; and (3) simple, frilled setæ (fig. 65c), gathered in a small fascicle on dorsal aspect of ventral ramus. Three ciliated cushions, extremely like those of *S. fusca*.

*Measurements.*—Length, unknown; width, 3.3 mm.

A single imperfect specimen was dredged on a sandy bottom in ten fathoms off White's Point near San Pedro. The fragment, which is well preserved, consists of about forty somites of the anterior end.

## EXPLANATION OF THE PLATES.

Unless otherwise stated, all the figures have been outlined with camera lucida and the details filled in free-hand. The fine structure of setæ, paleæ, and elytra has in every instance been studied with a much higher power than the magnification of the figures would indicate.

## EXPLANATION OF PLATE V.

Figs. 1-7 illustrate *Euphrosyne*.

Fig. 1. "Gill" of *Euphrosyne aurantiaca*, sp. nov. The darker lines indicate the more refractive axial substance (blood-vessels?). In glycerine;  $\times 36$ .

Fig. 2. Tip of simple, bifid, dorsal seta, *E. aurantiaca*. In glycerine;  $\times 300$ .

Fig. 3. Tip of ringent, serrated, dorsal seta of the same. In glycerine;  $\times 300$ .

Fig. 4. Tip of one of the stouter, bifid, ventral setæ of the same. In water;  $\times 300$ .

Fig. 5. "Gill" of *Euphrosyne arctia*, sp. nov. In glycerine;  $\times 36$ .

Fig. 6. Tip of ringent, serrated, dorsal seta, *E. arctia*. The stippling indicates particles of calcic carbonate, with which all the setæ of *Euphrosyne* are impregnated. In water;  $\times 300$ .

Fig. 7. Tips of ventral setæ, large and small, of the same. In water;  $\times 300$ .

Figs. 8-14 illustrate *Eurythoë californica*, sp. nov.

Fig. 8. Anterior end of *Eurythoë californica*, from San Pedro, California. Alcoholic specimen;  $\times 19$ .

Fig. 9. Posterior aspect of a middle parapod of female specimen from Pacific Grove, California. In glycerine;  $\times 19$ .

Fig. 10. Tip of serrated, dorsal seta. Cleared in glycerine;  $\times 300$ .

Fig. 11. Tips of smooth, dorsal setæ, slender and stout;  $\times 300$ .

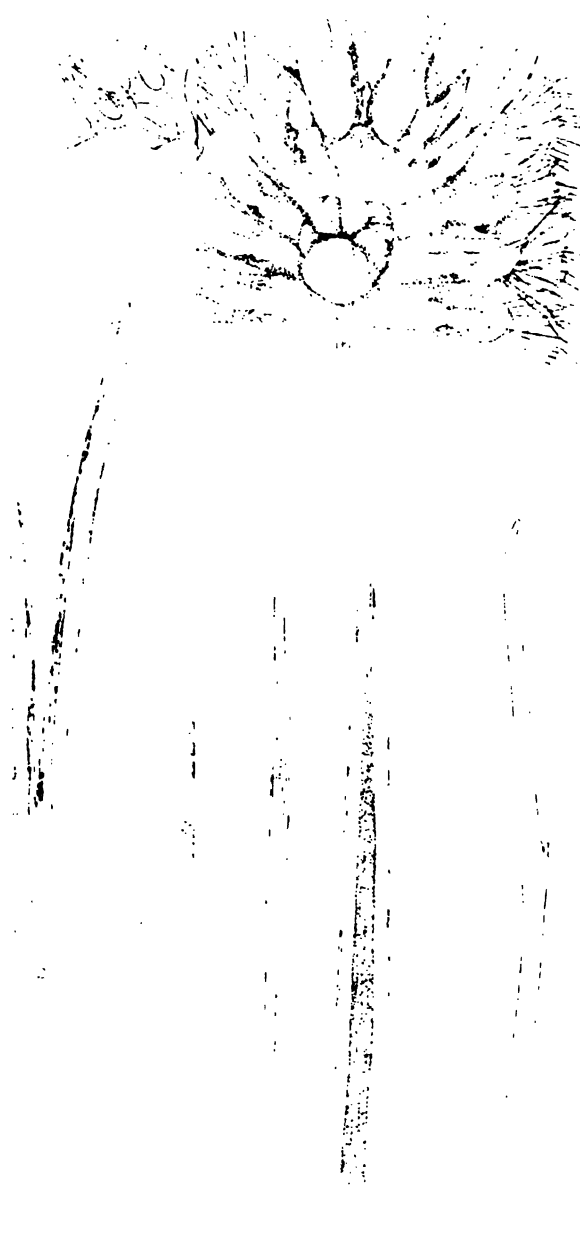
Fig. 12. Tip of long, slender, bifid seta from upper portion of the ventral series;  $\times 300$ .

Fig. 13. Tip of short, stout, bifid seta from lower portion of ventral fascicle;  $\times 300$ .

Fig. 14. Greater portion of one of the short, hastate setæ of the ventral fascicle. In glycerine;  $\times 300$ .

Fig. 15. Cephalic lobe of *Chrysopetalum occidentale*, sp. nov., with tentacle and antennæ;  $\times 86$ .

Fig. 16. Ventral aspect of anterior end of *C. occidentale*. Proboscis partially everted;  $\times 86$ .









## EXPLANATION OF PLATE VI.

Figs. 17-23 illustrate Palmyridæ.

Fig. 17. A middle parapod of *Chrysopetalum occidentale* as seen in profile under pressure of cover glass, which brings the cirlet of paleæ nearly into one plane;  $\times 78.75$ .

Fig. 18. Palea of the same;  $\times 300$ .

Fig. 19. Setæ from ventral fascicle of the same; *a*, one of the uppermost; *b*, one of the lowest of the series;  $\times 510$ .

Fig. 20. *Heteropale bellis*, gen. et sp. nov. Anterior extremity, including head and first four setigerous somites. The paleæ of the third parapod on the right side, and of the fourth somite, are omitted. In glycerine;  $\times 82.5$ .

Fig. 21. A middle parapod of the foregoing; posterior aspect. In glycerine;  $\times 97.5$ .

Fig. 22. One of the largest and most external of the broad paleæ of the same. In glycerine;  $\times 300$ .

Fig. 22a. Narrow, lateral palea of the same;  $\times 300$ .

Fig. 23. Setæ from ventral fascicle of *H. bellis*; *a* one of the highest; *b* one of the lowest of the series. In glycerine;  $\times 510$ .

Figs. 24-29 illustrate Polynoidæ.

Fig. 24. *Polynoë (Halosydna) brevisetosa* (KINBERG). Dorsal aspect of anterior and posterior extremities of a young specimen 27 mm. long. As often happens, the elytra are lax, leaving the head and part of the back uncovered;  $\times 3$ . (Drawn without camera from a specimen preserved in formalin.)

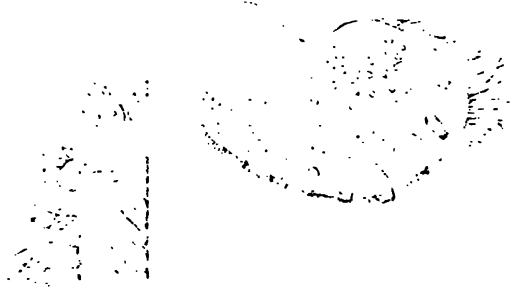
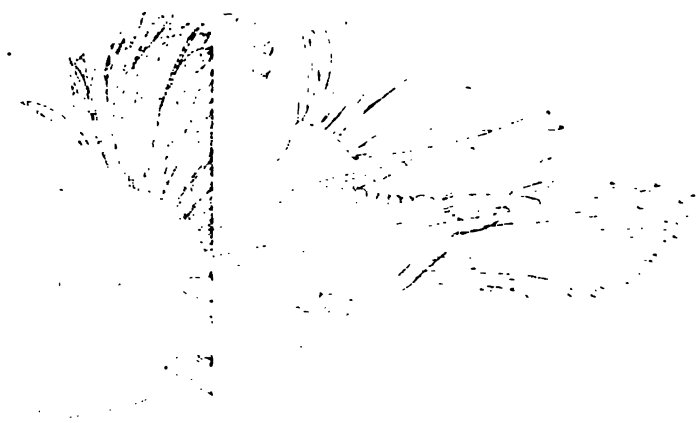
Fig. 25. Dorsal aspect of seventeenth parapod of *Harmothoë crassicirrata*, sp. nov., right side;  $\times$  circa 18. (Drawn from life without camera lucida, but accurately as possible.)

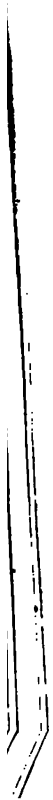
Fig. 26. Posterior aspect of twenty-second (elytrophorous) parapod of the same, formalin specimen. Position of aciculæ indicated as seen after clearing and mounting in balsam;  $\times 19.5$ .

Fig. 27. Elytron from right side, second pair, of *Harmothoë hirsuta*, sp. nov. The elytron has a fringe of "cilia" on two-thirds of its periphery (external and posterior borders). The denticulate tubercles are enormously large along posterior margin, each arising from a "space";  $\times 12.75$ .

Fig. 28. The same. A small portion of elytron, more magnified. From the antero-lateral border, where the "cilia" begin, and where the spaces, each with its tubercle, are most distinct. One "space" filled in with the pigmented cells; the others left blank. Transmitted light; glycerine;  $\times 110$ .

Fig. 29. A single "space" near margin of same elytron, with a large tubercle. Transmitted light; glycerine;  $\times 82.5$ .







## EXPLANATION OF PLATE VII.

Figs. 30-39 represent prostomia of different species of Polynoidæ, all magnified 19.5 diameters.

Fig. 30. *Polynoë (Lepidonotus) squamata* (L.) AUD. ET M.-EDW.

Fig. 31. *Polynoë (Halosydna) brevisetosa* (KINBERG).

Fig. 32. *Polynoë reticulata*, sp. nov.

Fig. 33. *Polynoë gigas*, sp. nov.

Fig. 34. *Polynoë pulchra*, sp. nov. With tentacle and antennæ.

Fig. 35. *Polynoë (Halosydna) lordi* (BAIRD). With tentacle and antennæ.

Fig. 36. *Polynoë (Halosydna) fragilis* (BAIRD). Broken base of tentacle in end view.

Fig. 37. *Harmothoë imbricata* (L.) MALMGREN. The position of the anterior pair of eyes, which are invisible from above, is indicated by dotted areas.

Fig. 38. *Harmothoë hirsuta*, sp. nov.

Fig. 39. *Harmothoë crassicirrata*, sp. nov.

Fig. 40. Second elytron from right side of *Polynoë brevisetosa*, in its normal position. Lightly pigmented; young specimen;  $\times 12.75$ .

Fig. 40a. More magnified area of foregoing, showing cells, both pigmented and unpigmented, and one of the smaller mammilliform tubercles. In glycerine. Viewed as a translucent object by transmitted light;  $\times 300$ .

Fig. 41. Second elytron from right side of *Polynoë reticulata*. Young specimen;  $\times 17$ .

Fig. 41a. More highly magnified area of the same, showing reticulate and pitted upper surface. Most of the epithelial cells pigmented;  $\times 300$ .

Fig. 42. Second elytron from left side of *Polynoë gigas*, in its normal position. Epithelium of both sides pigmented; pigment of under side duller;  $\times 12.75$ .

Fig. 42a. Highly magnified portion of upper surface of elytron of *Polynoë gigas*, showing two pigment spots and epithelial cells. A few stomata (?) between the latter;  $\times 300$ .

Fig. 43. Second elytron from left side of *Polynoë pulchra*. Adult specimen from mantle cavity of *Lucapina crenulata*;  $\times 12.75$ .

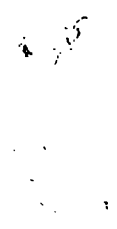
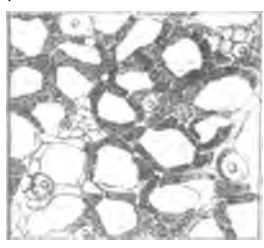
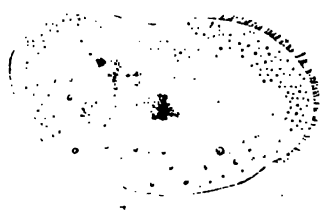
Fig. 43a. A few epithelial cells from pigmented, posterior border of the same;  $\times 300$ .

Fig. 44. Second elytron of *Polynoë lordi* (BAIRD). A nerve is clearly indicated. Immaculate;  $\times 12.75$ .

Fig. 45. Second elytron from right side of *Polynoë fragilis* (BAIRD), in its normal position; nerves from the elythrofore indicated;  $\times 19.5$ .

Plant Kingdom

Animal Kingdom



Plant Kingdom

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## EXPLANATION OF PLATE VIII.

Fig. 46. Anterior aspect of twentieth left parapod of *Polynoë brevisetosa* (KINBERG). Viewed as an opaque object, but the position of the aciculæ indicated by dotted lines. Dorsal setæ short and small;  $\times 14.8$ .

Fig. 46a. Tip of seta from the ventral fascicle of the same;  $\times 228$ .

Fig. 47. Anterior aspect of twenty-second parapod of *Polynoë reticulata*;  $\times 14.8$ .

Fig. 47a. Tip of ventral seta of *Polynoë reticulata*, from about the middle of the series;  $\times 228$ .

Fig. 47b. A group of one long and two short setæ *in situ* in dorsal ramus of thirteenth foot of the same;  $\times 228$ .

Fig. 48. Posterior aspect of forty-fifth foot of *Polynoë gigas*;  $\times 14.8$ .

Fig. 48a. Seta-tip from about the middle of the ventral fascicle, thirty-second foot, of the foregoing;  $\times 228$ .

Fig. 48b. Tip of stout, uppermost seta of ventral fascicle of the same. Dark brown and nearly opaque. The tooth is worn off;  $\times 228$ .

Fig. 49. Sixty-ninth and seventieth somites of *Polynoë gigas*. The sixty-ninth has an elyrophore on the right, a dorsal cirrus on the left;  $\times 1.8$ .

Fig. 50. Anterior aspect of twenty-fourth foot of *Polynoë pulchra*. The dorsal ramus has only a single seta (often achætous);  $\times 14.8$ .

Fig. 50a. Tip of a ventral seta of the same; moderately hooked;  $\times 228$ .

Fig. 50b. Tip of a dorsal seta of the same;  $\times 228$ .

Fig. 51. Anterior aspect of eighth parapod of *Polynoë (Halosydna) lordi* (BAIRD). Dorsal ramus achætous; ventral ramus with five blunt, slightly curved setæ above the acicula, and a fascicle of hooked setæ below;  $\times 14.8$ .

Fig. 51a. Tip of a hooked seta from lower portion of ventral series;  $\times 228$ .

Fig. 51b. Tip of a blunt seta from upper portion of ventral series;  $\times 228$ .

Fig. 52. Profile view of fifteenth foot of *Polynoë (Halosydna) fragilis* (BAIRD). Dorsal setæ present, seven or eight in number. Nascent seta imbedded within the ventral ramus represented by dotted lines;  $\times 14.8$ .

Fig. 52a. Ventral seta-tip from seventeenth parapod of *Polynoë fragilis*. In glycerine;  $\times 228$ .

Fig. 52b. Tip of seta from dorsal ramus of the same;  $\times 228$ .

Fig. 53. Anterior profile view of tenth foot of *Harmothoë hirsuta*. Balsam preparation;  $\times 14.8$ .

Figs. 53a, b. Tips of one of the longest and one of the shortest of the ventral setæ of the preceding. The difference in number of the serrations is striking;  $\times 228$ .

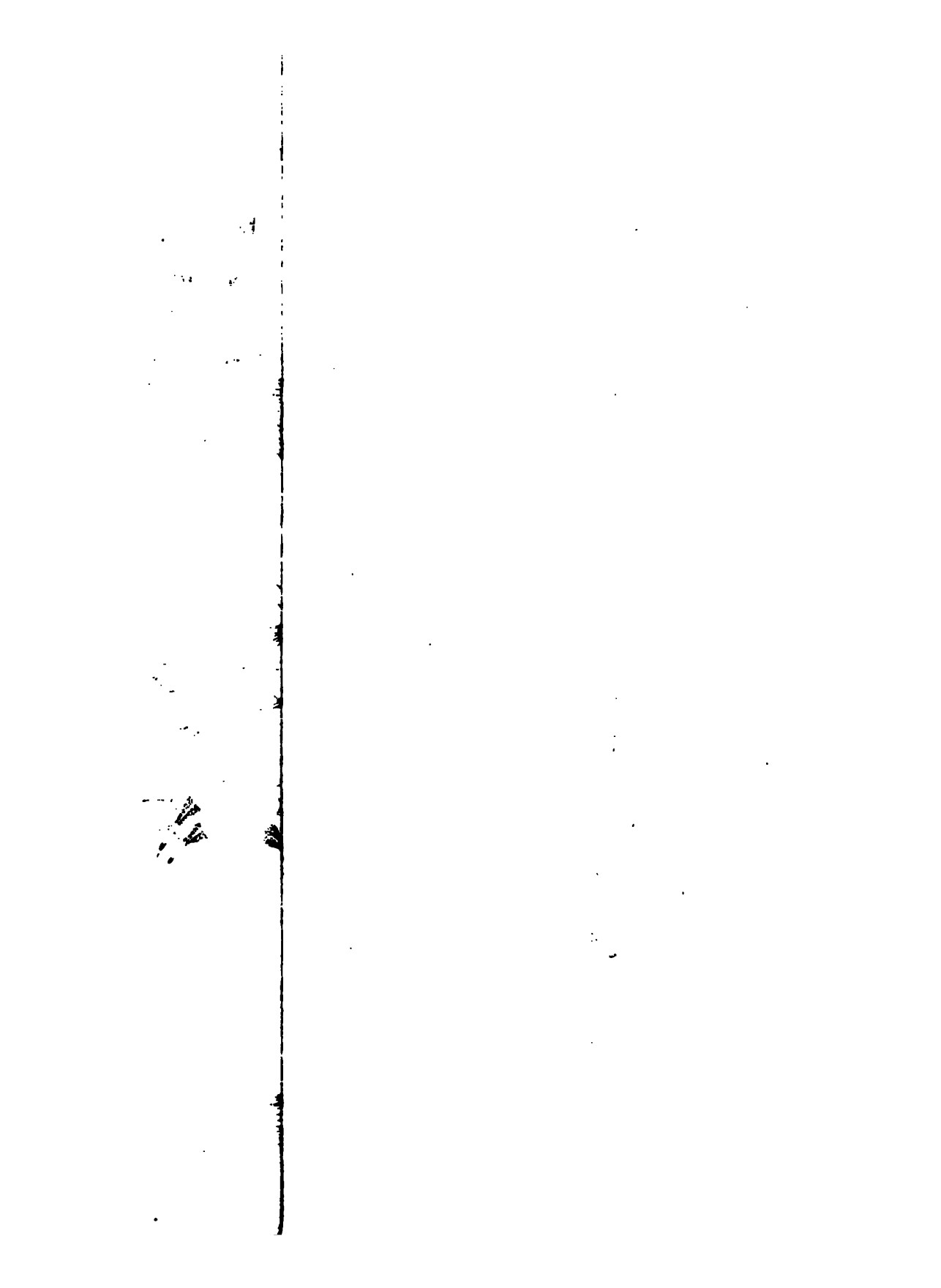
Fig. 53c. Seta-tip from the dorsal ramus of the same;  $\times 228$ .

Fig. 54. Elytron of *Harmothoë crassicirrata*. Glycerine preparation, seen by transmitted light;  $\times 7.23$ .

Fig. 55a. Entire dorsal seta from twenty-third foot of *H. crassicirrata*;  $\times 60$ .

Fig. 55b. Tip of the same, more magnified (the serrations are represented rather too distinctly);  $\times 228$ .

Fig. 55c. An average seta-tip from ventral fascicle of the foregoing;  $\times 228$ .









## EXPLANATION OF PLATE IX.

Fig. 56. Anterior region of *Peisidice aspera*, gen. et sp. nov. Drawn from life without camera lucida, but accurately as possible;  $\times 20.25$ .

Fig. 57. Jaws of the same. Seen *in situ* from ventral side, proboscis retracted. Balsam preparation of entire worm;  $\times 52.5$ .

Fig. 58. Profile view, posterior aspect of a foot from middle of body of the foregoing. In cedar oil;  $\times 78.75$ .

Fig. 59. A small portion of lateral margin of one of the fifth pair of elytra, with six marginal "cilia." Glycerine preparation; transmitted light;  $\times 300$ .

Fig. 60. Anterior end of *Sthenelais fusca*, sp. nov., after removal of first two pairs of elytra. The anterior pair of eyes are minute and forwardly directed. Alcoholic specimen; about one-half grown;  $\times 12.75$ .

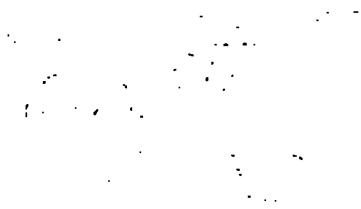
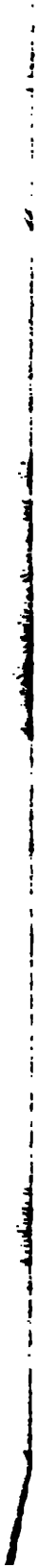
Fig. 61. Elytron from posterior region of body of *Sthenelais fusca*, left side. The nerves in the unpigmented portion of elytron are very distinct. Papillated on ventro-lateral region and margin. Glycerine preparation; transmitted light;  $\times 19.5$ .

Fig. 61a. A small portion of margin of same elytron, showing fusiform papillæ. The nerves can be traced into some of these papillæ;  $\times 225$ .

Fig. 61b. A small portion of upper surface of thirteenth elytron of the foregoing, including one of the minute non-pigmented areas. The cuticular pigment appears as rounded, amorphous masses. Glycerine; transmitted light;  $\times 225$ .

Fig. 62. Right elytron of eighth pair of *Sthenelais verruculosa*, sp. nov., showing the very numerous, small tubercles;  $\times 12.75$ .

Fig. 62a. A small portion of ventro-lateral margin of same elytron, showing tubercles and marginal "cilia";  $\times 300$ .









## EXPLANATION OF PLATE X.

Fig. 63. Seta-tips of *Peisidice aspera* from a middle parapod; *a* the lowest, *b* average, *c* the highest of ventral series; *d*, tip of dorsal seta;  $\times 228$ .

Fig. 64. Posterior aspect of twenty-sixth foot of *Sthenelais fusca*. In glycerine;  $\times 19.5$ .

Fig. 64*a*. Tip of slender, articulated seta from ventral series of a middle parapod of the preceding. Lowest in the series. Glycerine preparation;  $\times 228$ .

Fig. 64*b*. One of the medium, stout, jointed setæ of ventral ramus of the same. Glycerine;  $\times 228$ .

Fig. 64*c, d*. Tips of two of the strongest and uppermost of the ventral fascicle of the same. They are adjacent and the one to the left is the lower;  $\times 228$ .

Fig. 64*e*. Tip of one of the fascicle of frilled setæ from the ventral ramus of the same;  $\times 228$ .

Fig. 64*f*. Basal portion of one of the long, slender, serrated, dorsal setæ of the preceding; profile view. In glycerine;  $\times 228$ .

Fig. 64*g*. Frontal view of a small portion of one of the dorsal setæ;  $\times 228$ .

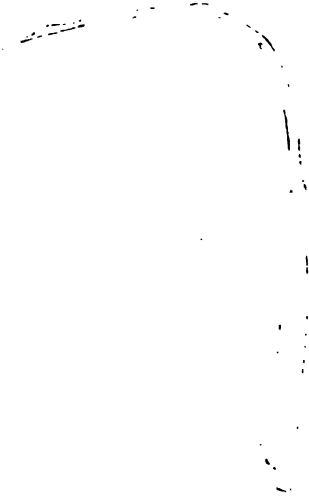
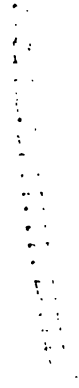
Fig. 65. Posterior aspect of fifteenth parapod of *Sthenelais verruculosa*. In glycerine;  $\times 19.5$ .

Fig. 65*a*. Tip of one of the slender, articulated, ventral setæ of the foregoing; from the lowest part of the fascicle;  $\times 228$ .

Fig. 65*b*. Tip of one of the stouter, articulated setæ of ventral fascicle of the same;  $\times 228$ .

Fig. 65*c*. Tip of one of the fascicle of simple, frilled setæ;  $\times 228$ .

Fig. 65*d*. Profile view of a portion of one of the long, curved, dorsal setæ. In glycerine;  $\times 228$ .



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Type of a Distinct Family of  
Lamnoid Sharks.

BY

DAVID STARR JORDAN.

WITH TWO PLATES.

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