PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

issued by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 97 Washington: 1947 No. 3218

NEW GENERA AND SPECIES OF ECHIUROID AND SIPUNCULOID WORMS

By Walter Kenrick Fisher

The types of the new species of worms described herein are in the collection of the United States National Museum. I am indebted to Dr. Olga Hartman for the two new echiuroids, to Prof. G. E. MacGinitie for the specimens of the remarkable *Siphonomecus ingens*, and to the Museum of Comparative Zoology for three specimens of *Sipunculus branchiatus* W. Fischer for which I have made a new genus.

Phylum ECHIUROIDEA

Genus THALASSEMA Lamarck

THALASSEMA PHILOSTRACUM, new species

Plate 8

Diagnosis.—Nephridia 4; nephrostome conspicuous, semicircular, without spirals; dorsal blood vessel posteriorly voluminous, the ring vessel at junction of fore-gut with intestine; fore-gut long, longer than the presiphonal segment of intestine; the latter of moderate length; verrucae of skin unequal, low, transversely lengthened, and serially arranged in middle region of body; setae with interbasal muscle, the hook small and sharply curved; lower lip of mouth not formed by thick margin of proboscis, which is ventrally cleft at its base; length 12 to 21 mm.

Description.—Body wall rather thin in expanded parts, slightly translucent; verrucae not prominent, arranged in transverse series in the middle region of body and there transversely elongated. In some

specimens they are larger at ends of body, in others not. Setae of largest specimen 2.75 mm. long, the hook relatively small and sharply curved. The proboscis technically forms the lower lip of mouth, but the thick border is interrupted just ventral to mouth, which is not the case in *hartmani*. There are no localized thickenings of longitudinal muscle layer; inner layer very thin, with satiny luster.

Nephridia 2 pairs, with fan-shaped nephrostome much larger than in *hartmani*. The anal vesicles are slender, about half the length of body; ciliated funnels very small.

The alimentary canal, similar to that of *T. thalassema* (Pallas), has a long fore-gut, two-thirds of which is taken up by the pharynx-esophagus. The gizzard, not well defined, is about equal to the stomach in length. The dorsal blood vessel branches to form the ring vessel exactly at the end of the fore-gut. The succeeding presiphonal portion of the intestine is much longer than in *T. steinbecki* Fisher (Gulf of California to Ecuador), as is also the fore-gut. It is also apparently larger than in *T. thalassema*, but here the difference is not so great. The precloacal intestinal coecum is rather large. The cloaca is distinctly elongate, with translucent walls. The anterior chamber, comprising about half, has a longitudinally plicated mucosa; the posterior or cloaca proper has smoother walls and is separated from the anterior by a constriction. The gland cells surrounding this part of the cloaca of *T. thalassema*, figured by Rietsch (1886, pl. 21, fig. 105) and called the perianal glandular organ by Jameson (1899, p. 555), must be absent or greatly reduced in thickness in *philostracum*, as the walls are everywhere thin and translucent.

The pellets that crowd the intestine are composed of gray mud with clear quartz sand and fragments of shells; the latter are often too large to be included in the pellets.

The vascular system conforms to the *Thalassema* pattern.

Color in life: Body deep red, proboscis white (Hartman).

Type.—U. S. N. M. No. 20802.

Type locality.—Thornton Island, near Englewood, Gulf coast of Florida. Common in muddy pockets of dead shells. Dr. Olga Hartman collector, January 15, 1938.

Specimens examined.—Thornton Island, 24; Lemon Bay Flats, Fla., January 14, 1938, 1, in tip of dead conch; Beaufort, N. C., 1.

Remarks.—This species differs from *T. steinbecki* Fisher (1946, p. 230, fig. 11) in having a much longer fore-gut and a much longer presiphonal segment of the intestine. In *steinbecki* the gizzard and stomach are very short, the nephrostome is of the same shape but smaller, and the anal vesicles longer. Both species have a small seta hook, that of *steinbecki* being more angular, as if the tip were bent at right angles to the shaft.

The ecology of *T. philostracum* is different from that of *T. thalassema*, which Lankester describes as living (on the south coast of Devonshire) in galleries excavated in the red sandstone by the lamellibranch *Gastrochaena*. There is probably some difference in the dimensions of the fore-gut, that of *philostracum* being slightly longer. Judged by Rietsch's figures (1886, pl. 21, figs. 96, 99) the nephrostome of *thalassema* is much smaller. His figures of specimens taken at Concarneau indicate that the margin of the proboscis very definitely forms the lower lip (figs. 92, 93), but Jameson (1899, p. 545) states: "The mouth lies at the base of the proboscis, the lateral margins of which meet but do not fuse ventrally. That is to say the under lip belongs to the body and not to the proboscis." The structure of the cloaca appears to differ as mentioned in the description.

There is no indication in alcoholic specimens of a division of the body into three regions, as is said to be characteristic of *thalassema* (Leigh-Sharpe, 1928, p. 499).

THALASSEMA HARTMANI, new species

PLATE 9

Diagnosis.—Nephridia 2; nephrostome pedunculate, inconspicuous, without trace of spirals; dorsal blood vessel posteriorly voluminous, encroaching upon intestine, the ring vessel being distal to junction of fore-gut with intestine; segment of intestine between end of fore-gut and beginning of siphon exceedingly long, equaling or exceeding length of extended specimen; skin papillae numerous, elongate, unequal, not obviously in serial arrangement or larger at ends of body; setae with interbasal muscle, the hook not sharply bent; lower lip of mouth formed by flange of proboscis. Type: Length 40 mm; proboscis, 8 mm.

Description.—Body wall thin in expanded specimen, slightly translucent; papillae prominent, unequal in size, the larger being swollen squamiform and bent anteriorward; no evident serial alinement; setae 3.5 mm., with broadly curved flattened, tapering ends; proboscis fleshy, forming thick under lip to mouth; no localized thickenings of longitudinal muscle layer; inner layer very thin, with satiny luster.

The single pair of nephridia are small in the type; the nephrostome is simple and represents only the slightly expanded end of its rather long peduncle, which springs from the base (anterior side) of the nephridium. The anal vesicles are relatively very small with tiny ciliated funnels.

A characteristic feature of this species is the extremely long segment of the intestine that precedes the siphon—far longer than in any known species of *Thalassema*, s. s. It is not possible to measure this accurately, but it is of the order of five times the length of fore-gut. The fore-gut seems to lack a stomach, or crop, behind the gizzard. The

latter extends to the beginning of the intestine, which is marked by the ciliated groove. The long intestine, which is filled with ellipsoidal pellets of mud, has no features characteristic of this species. The precloacal intestinal coecum is very tiny.

An unusual feature of the vascular system is the prolongation of the dorsal vessel beyond the fore-gut onto the intestine. This "heart," as it is sometimes called, passes from the dorsal side of the fore-gut to the ventral side of the intestine, which it practically envelops. As will be seen from the figure, the dorsal mesenteries (pl. 9, M^1) of the intestine actually are attached to the ventral side of the body wall near the nerve cord. This results in a twisting of the intestine whereby the dorsal blood vessel becomes ventral in position, while the ciliated groove, which should be ventral, becomes dorsal. In consequence the neurointestinal blood vessel (B^2, B^3) is dorsal in position when it leaves the intestine, instead of ventral as in most echiuroids. The ciliated groove passes through the ring vessel (B^2), a very rare occurrence. In the neurointestinal vessel is a small passage for the interbasal muscle of setae.

Color in life, reddish.

Type.—U.S.N.M. No. 20801.

Type locality.—Beaufort, N. C., June 1940. Dr. Olga Hartman collector, 2 specimens.

Remarks.—A specimen in poor state of preservation was dredged by the *Fish Hawk* in Chesapeake Bay, off Rappahannock Spit (station 8846) August 23, 1920, 12.8 fathoms.

Phylum SIPUNCULOIDEA

Genus SIPUNCULUS Linnaeus

SIPUNCULUS POLYMYOTUS, new species

PLATE 10

Diagnosis.—Differing from *S. nudus*, which it resembles in general form, in having 53–61 longitudinal muscle bands instead of 32–33, a shorter introvert, and a fasciculate cerebral organ and in lacking a conspicuous anterior lobe at base of nephridium.

Description.—Length 300 mm.; introvert 25 mm.; thickness of cylindrical body 28–38 mm.; of base of papillose introvert 15 mm. Longitudinal muscle bands of type 53 to 55; muscle annuli 200, much broader at extremities of body than at middle. The posterior extremity may be either very blunt or bluntly pointed (as in *robustus*). The introvert is relatively short and closely beset with posteriorly directed, blunt, small papillae, which decrease in size toward the mouth. The largest, on the posterior part of the introvert, are 0.5 to 0.75 mm. long. The four tentacles are relatively small, the two

dorsal larger (5 mm. much contracted) than the two ventral. They are subpalmate, the border subdivided into compound, short, grooved, bluntly pointed lobes, which fold easily when contracted. The base of the tentacles is surrounded by a narrow-margined collar free from papillae. At its anterior margin, between the bases of the two dorsal tentacles, is a small pore. The anal aperture is 28 or 29 muscle rings from base of introvert. The nephridiopores are six or seven rings in front of anus. The skin canal system is clearly apparent from the outside, as the interval between any two longitudinal and circular muscles is filled with eggs that are visible through the cuticle and in other places is occupied by air bubbles that can be forced along a continuous canal between two longitudinal muscles.[1]

Interiorly the longitudinal muscles form closely placed ridges, higher than wide, especially anteriorly, and are marked by lighter and darker transverse stripes. The stout retractor muscles, attached at about same level three muscle rings behind anus, are free from one another. The origin of the left ventral spans muscles 2–8; the right ventral, 2–7 or 3–8; the left dorsal spans 16–20 or 17–22; right dorsal, 19–24. The rectum passes mesially between these two dorsal retractors and opens just in front of their body-wall attachment; while the fan-shaped muscle of rectum is attached to the body wall ventral to and in a line with the left dorsal retractor origin and just behind the right dorsal, extending ventralward to outer edge of right ventral. Attached to the posterior face of this thin muscle sheet on each side of the rectum is a delicate linear structure made up of whitish minutely racemose elements (the "Zottenbildung" of Selenka). There is a very slender spindle muscle attached just in front of anus, which passes along the ventral side of the hind-gut, to which it is attached by numerous strands, and follows this distal portion of the intestinal U nearly to end of body, where it is attached to the intestinal wall at the third left-hand bend from the distalmost.

The alimentary canal is fastened, in an open spiral, to the body wall by numerous frenula.The descending or proximal spiral does not proceed directly, for near the anterior third or the middle of animal it bends (at *Y*, pl. 10, fig. 1) and proceeds spirally forward to *X*, then backward in a regular spiral to end of body, making about ten left-hand turns to the final distal bend into the ascending spiral. The latter makes about ten right-hand turns to rectum. A ciliated groove with thickened rims runs the length of canal from anterior end of esophagus to the small coecum, about 25 mm. posterior to anus. The mucosa of the esophagus has very fine transverse folds,

[1] Théel (1905, figs. 146, 147) shows the relation of these canals to the body musculature for *S. priapuloides*. Although Spengel (1912) was reluctant to suggest the function of the skin canals, that of respiration seems to be obvious in an animal with a thick muscular body wall.

but beginning at O^1 the lining is coarsely plicated longitudinally, and these rapidly become more strongly marked (unless wall is inflated). Toward the end of the descending spiral they gradually fade out.

The thick collapsed nephridia, about 40 mm. long, have the walls fortified by an irregular net of stout muscle bands. The intervals are inflated into shallow pockets of various sizes, having the appearance externally of miniature cauliflowers. The nephrostome, on the anterior side of base, is between muscles 11–12 (left) and 12–13 (right). In the paratype this is reversed. There is not a marked anterior lobe of nephridium projecting forward over the nephrostome as in *nudus*.

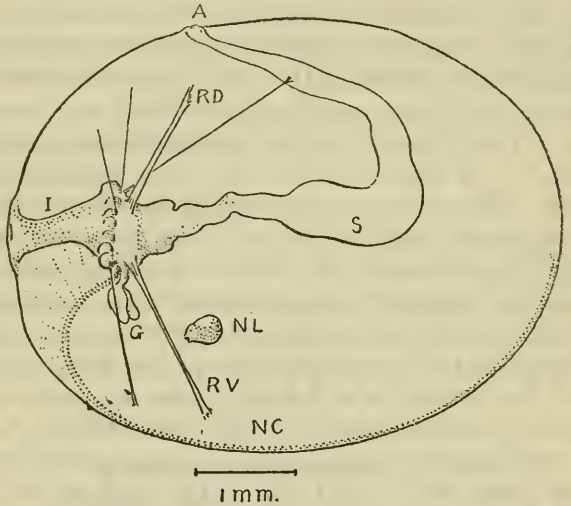

FIGURE 54.—Larva of *Sipunculus polymyotus*, new species, from left side, ×20: The retractor muscles attached to body wall and head region are of the left side only. Muscle bands of body wall omitted. (*A*, anus; *G*, glands; *I*, introvert, with nerves from nerve cord *NC; NL*, left nephridium; *RD*, dorsal retractor, *RV*, ventral retractor; *S*, stomach-intestine; the muscle strand apparently attached to it is fastened to the body wall.)

The dorsal vessel is either finely papillated or smooth and extends backward as far as the posterior edge of the mesenteries that anchor the esophagus to the ventral retractors. The ventral vessel is smaller, is not quite so long, and contains light-yellow material.

Anteriorly the nerve cord is held between two strong ventral paraneural muscles. On the anterior border of the brain is an astonishingly large, pale yellowish cerebral organ (frons), the subdivisions either very slender or flattened, thin, and digitate (pl. 10, fig. 2). The longest are 3.5 mm. In *S. nudus* the frons is a transverse pad.

Color of specimens preserved in formalin, madder brown; alcoholic specimen, faded buff ("museum color").

Larvae.—A considerable number of *Sipunculus* (*Pelagosphaera*) larvae were taken in tow nets by the *Bache*, between January 28 and March 21, 1914, in an area between the Straits of Florida, Bermuda, and the Gulf Stream off Cape Hatteras, at depths of 150 meters to surface. These larvae, in formaldehyde, are nearly transparent, are usually ellipsoidal but sometimes subspherical, and vary in size from 3 by 2.25 mm. to 6 by 4 mm. With one exception they are in about the same stage of development (fig. 54).

All the specimens have the introvert contracted. They are covered by an excessively thin iridescent cuticle, beneath which 56 longitudinal muscle bands extend from pole to pole. These bands are translucent and about twice as broad as the transparent skin between. Only one specimen was found to have developed visible ring muscles. These occur in the area posterior to anus, while the region in front is a little lengthened and constricted so that the larva has a fat vase-shaped form. There is no difference in the internal organs.

The reason for suspecting that these larvae may be *Sipunculus polymyoius* is, of course, the number of muscle bands.

The coelom is very spacious and filled with fluid. In addition to the four retractors there are eight very delicate strands arising in front of the insertion of the retractors and shown only for the left side in figure 54. The ventral retractor is attached between longitudinal muscles 5 and 6 or 6 and 7; the dorsal between 20 and 21 or 21 and 22; The strand that meets the body wall behind the dorsal retractor is attached between 21 and 22 or 22 and 23. The small nephridium opens between 11 and 12, varying to 13 and 14. The nerve cord at its anterior end, where it is free from close contact with the body wall, is already characteristically sipunculoid. The brain is well hidden.

Harold Heath (1910) has described and figured a quite different *Pelagosphaera* from Monterey Bay, Calif., which is undoubtedly a sipunculoid. It is spherical, 2.5 to 3.5 mm. in diameter.

TABLE 1.—*Localities at which larvae of* Sipunculus polymyotus *were taken by the Bache 1914*

Date	Station No.	Position	Depth	Salinity	Temperature
			Meters	*Percent*	° *C.*
Jan. 28	10161	35°27′ N., 73°14′ W	110–0	36.38	21.50
Jan. 29	10162	34°41′ N., 73°23′ W	150–0	36.44	19.30
Jan. 31 and Feb. 1	10169	32°29′ N., 71°29′ W	50–0	36.44	18.95
Feb. 5	10176	32°30′ N., 65°48′ W	50–0	36.44	19.20
Feb. 17, 18	10178	32°20′ N., 64°21′ W	50–0	36.42	18.80
Feb. 28	10195	29°00′ N., 76°23′ W	100–0	36.49	21.70
Mar. 18	10200	23°32′ N., 81°48′ W	75–0	35.93	24.78
Mar. 21	10207	27°32′ N., 79°21′ W	100–0	36.7	23.70

In the lot from *Bache* station 10200 there is a subspherical *Pelagosphaera* of a different species. The body wall is brown and opaque, the muscle bands (difficult to count) apparently not over 15.

Type.—U.S.N.M. No. 20612.

Type locality.—Key West, Fla., two specimens.

Specimens examined.—In addition to above, one from *Pelican* station 193–10, latitude 33°20′ N., longitude 78°11′05″ W., off Long Bay, S. C., 15 fathoms, March 8, 1940 (with eggs).

Remarks.—This species belongs to the *nudus-priapuloides* section of Selenka's key (1883, p. 13) except in the matter of longitudinal muscle bands, which are much more numerous than in any known species of *Sipunculus*.

The specimen from off South Carolina has 60 or 61 longitudinal muscle bands. The left ventral retractor origin spans muscle bands 1–10 from nerve cord while the right spans 2–9.

SIPUNCULUS GALAPAGENSIS, new species

PLATE 11

Diagnosis.—Size large; body wall thicker than in *S. nudus*, with 41 or 42 much stronger muscle bands; squamiform papillae of introvert *larger anteriorly than posteriorly;* papillose area not sharply demarked posteriorly; tentacular crown with very numerous small ultimate divisions, the two dorsal clusters obviously larger than the five others; longitudinal muscle bands with thin, lobate, dorsal crests adjacent to base of long slender nephridia; brain with a conspicuous cerebral organ; no spindle muscle. Related to *S. multisulcatus* W. Fischer.

Description.—Length (considerably contracted) 320 mm., introvert 30 mm.; thickness of cylindrical body, 15 to 22 mm.; of collar behind tentacles, 10 mm. Longitudinal muscle bands 41 or 42; muscle annuli about 170. Posterior extremity blunt, apparently not normal. Introvert is closely covered with posteriorly directed, blunt, leaflike papillae, which are larger anteriorly, although the reverse is commonly the case in *Sipunculus*. The longest are 1.5 mm. There are about seven primary bunches of tentacular lappets; the two dorsal, which are branched, are much larger than the two lateral and three ventral. Back of the tentacles is a narrow zone free of papillae at the anterior margin of which, between the two dorsal groups of tentacles, is a conspicuous crescentic pore with an anterior valvelike lip. The anal aperture is 25 or 26 muscle rings behind the posteriormost introvert papillae, while the nephridiopores are nine rings in front of anus. The skin-canal system is not apparent from outside as the cuticle is separated from skin owing to sojourn in a fish.

Interiorly the strong longitudinal muscles form closely placed ridges much higher (5 mm.) than thick (1 mm). The ring muscles and entrances to skin canals cannot be seen unless these are spread apart. In *S. nudus* the ring muscles and skin-canal pores are ordinarily visible when the dissection is pinned out flat. The short retractor muscles are free from one another. The origin of the ventral, slightly in advance of dorsal, is from muscle bands 2–5; and of the dorsal from 12–16. The grooves between the muscle bands continue, in shallower depth, upon the retractors. The rectum passes mesially between these two dorsal retractors and opens a short distance in front of their origin. From each side of rectum a short strong muscle (not fan-shaped as in *polymyotus*) is fastened to the longitudinal muscles at base of dorsal retractors. Selenka's "Zottenbildung" is reduced to a mere filament. No spindle muscle.

The curious posterior and anterior loops of the postesophageal intestine (a generic character) are more like those of *nudus* than of *polymyotus*. In the latter species the anterior loop (*x*) is attached to the right side of the body, not to both sides as in *nudus* and *galapagensis*. An inconspicuous ciliated groove is present in the esophagus but does not reach the coecum as in *nudus* and *polymyotus*. The intestinal spiral is too macerated for one to determine where the groove ends.

The nephridia are slender free tubes 80 mm. long. There is a slight forward diverticulum at the base above the broad nephrostome. The nephridiopore opens between the fourth and fifth muscle bands. On each side of the base of the nephridium the muscle bands have thin, lobed crests (pl. 11, fig. 2).

The dorsal and ventral blood vessels lack papillae and extend slightly beyond the mesenteries that anchor the esophagus to the dorsal retractors; the esophagus is not attached to the ventral retractors.

Anteriorly the nerve cord is held between two strong paraneural muscles, which are derived from the crest of the first longitudinals, with which the paraneurals merge behind the introvert. The brain, like that of *polymyotus* (and unlike that of *nudus*), has a large cerebral organ consisting of two very irregular, folded sheets of tissue. The brain is less conspicuous superficially than in *polymyotus*.

Color in alcohol, uniform yellowish brown.

Type.—U.S.N.M. No. 20835.

Type locality.—Indefatigable Island, Galápagos Islands, Pinchot South Seas Expedition, July 8, 1929. From stomach of fish.

Remarks.—This species has the same number of muscle bands as *S. multisulcatus* W. Fischer (1913, p. 93, Santos, Brazil), which differs in having rows of dark pigment spots in the longitudinal furrows; dorsal retractors span muscle bands 16 to 18; nephridia open six

(not nine) rings in front of anus, between the fifth and sixth muscle bands. No mention is made of the cerebral organ or of the peculiar dorsal crests of the muscle bands adjacent to the nephridia. The nephridia are described as being short and bright brown, but in *S. nudus* the color in preserved specimens varies from pale pink to deep brown and the length from short to long. In a specimen from Florida the left nephridium is 80 mm. long and the right only 15 mm. It is therefore unsafe to rely on dimensions for specific characters. A feature of *galapagensis* that may be of some systematic value is the attachment of the retractors to body wall. They do not fan out with a clear-cut posterior margin as if superimposed on the underlying muscle bands as in *nudus*. Instead, the deep grooves between the muscle bands of the body wall are continued for a varying distance upon the retractors, which are thus at their base subdivided into distinct fascicles.

XENOSIPHON, new genus

Diagnosis.—Differing from *Sipunculus* s. s. in the following particulars: An extra pair of muscles, functioning both as retractors and protractors, arising from posterior border of introvert and inserted in front of brain, rectum unusually long, the anus being in front of nephridiopores, postesophageal intestine without a long forward loop, spindle muscle arises from wall of rectum, nephridia long, slender, attached to body wall for nearly their entire length, squamiform papillae of the very short introvert increasing in size toward the tentacles, which have very many leaflets arranged in subtriangular pads surrounding the mouth, type species with papilliform dermal outgrowths.

Genotype, *Sipunculus branchiatus* Fischer.

Remarks.—This genus is instituted for the highly peculiar species described below. It cannot be determined whether the skin papillae are of generic significance since Spengel found the skin-canal system to vary considerably within the *indicus* group. The papillae may represent a further development to increase respiration surface.

XENOSIPHON BRANCHIATUM (Fischer)

PLATE 12

Sipunculus mundanus var. *branchiatus* W. FISCHER, 1895, p. 3, pl. 1, figs. 1, 1a, 2.

Sipunculus branchiatus SPENGEL, 1913, p. 74.

Description.—Length, 310 mm., introvert and tentacle crown, 20–25 mm., thickness of cylindrical body, 8, 12 mm., this varying according to constriction of ring muscles. The specimen from La Paz, 420 mm. long, is constricted in the middle of body to 8 mm. diameter. Longitudinal muscle bands 29–34 (Panama specimen, 32–34), only

rarely anastomosing. When body is fully inflated the longitudinal and circular muscles divide the surface into flat rectangular areas separated by rather inconspicuous grooves, but when constriction takes place there is apparent a series of more or less convex annuli. The middle third of body, except for a ventral zone, about six muscle bands in width, is closely covered with slender pointed papilliform outgrowths of the cuticle, 1–1.5 mm. long, which give a furry appearance to the skin. These papillae are continuous with irregularly zig-zag subcutaneous canals, above which the cuticle usually forms slight welts, which have a direction oblique to the longitudinal axis of the dermal rectangles. Each rectangle has its own canal, independent of the others (pl. 12, figs. 4, 5). Beyond the papuliferous area these canals, or more properly spaces as they are usually branched, can be traced forward half the distance to head and also posteriorly as they are often self-injected with yellowish material from the coelom. On the periphery of the papuliferous area a papilla usually appears first at the anterior end of the canal; next at posterior end; then in between, until there are four or five to each rectangle. Brown or yellow finely divided material, which is sometimes loose in the canals, is also found in the bottom of the papillae. If the top of the canal is stripped off, a pore at each end is seen to lead deeper into the tissue (arrows in pl. 12, fig. 4). If ordinary ink is forced *from the coelomic side* into the pores that exist at intersection of longitudinal and transverse muscle bands, it appears in these pores at the ends of the subcutaneous canals but is usually blocked by material already in the canal. The papillae are highly iridescent in sunlight. The area strongly reminds one of the papularium of a sea-star and the function is probably the same.

The terminal knob of the body is very short, broadly rounded to subtruncate and the slight margin is capable of disappearing under distension. There is a conspicuous terminal pore, and the skin, either smooth or longitudinally ridged, is closely beset with microscopic pores of at least two sizes.

The short introvert is covered with squamiform papillae, which increase in size toward the front, near which they decrease over a narrow zone to the bare zone behind tentacles. The largest papillae are 0.75–1 mm. in length and breadth.

The tentacles are composed of very numerous small, grooved, foliate elements in subtriangular mats or groups, radiating from the mouth, which is ventral to the center. There are seven of these from which ridges of tissue converge to the mouth, the odd one being the middorsal and much the largest, two are dorsolateral, two lateral, and two ventral. On the periphery of the crown the space between the major groups is filled in with one to three small

groups of tentacles, which probably increase in number as growth proceeds.

The anus is equivalent of about five muscle rings (not clearly differentiated) behind the posterior papillae of introvert.

Interiorly the longitudinal muscles form flat bands becoming angular in section only when the body is much constricted. The introvert and four retractors occupy about one-seventh of the body length. The retractors are free from one another and arise at approximately the same level: Both ventrals from muscles 1–4, while both dorsals arise obliquely from muscles 7–11. The two protractors arise from muscles 12–15 at the posterior border of the introvert. Before insertion, 4 mm. in front of the brain, they pass over the dorsal retractors. Their form and position when the introvert is out and in are shown in plate 12, figures 1 and 2. The rectum passes far forward and opens close behind the (dorsal) origin of the protractors. (Muscles 17 and 18 are the two middorsal in figure 1; 18 and 19 are really 17 and 16 of the left side.) The rectum lacks a thin fan-shaped muscle. A very slender spindle muscle arises from the ventral wall of rectum, 20–24 mm. behind anus, and proceeds backward following the gut; 10–12 mm. from its origin is a very small coecum to which it is attached. The rectum is fastened dorsally to the body wall by a continuous mesentery, as far back as the two lateral anchors just behind the origin of the spindle muscle. These short lateral strands of tissue fan out slightly and may be rudiments of the rectal fan-muscle. At any rate, to them is attached the ends of a delicate filament, forming a loop, which on each side passes obliquely ventralward along the origin of the dorsal retractors. Here the thread is thickly beset with delicate racemose structures (poorly preserved). These quickly thin out posterior to the muscles, and the rather long posterior loop is very delicate, translucent, and more loosely attached to the coelomic epithelium. Probably the "bandförmiges Organ" figured by Selenka (1883, p. 109, pl. 12, fig. 174 *y*) in *S. mundanus* is a fragment of a similar structure. It resembles a gonad but may be a more extensive "Zottenbildung."

The alimentary canal is macerated, but it appears to lack the forward loop which complicates the anterior end of the spiral of *S. polymyotus*. Although in plate 12, figure 1, the esophagus is drawn to the right, it naturally turns to the left, for its first attachment to the dorsal wall is by separate frenula, along muscle 9 (or 8) of the *left* side. The mesentery between the esophagus and the left dorsal retractor extends posteriorly only about half as far as the right. This shorter left mesentery allows the ventral vessel to become sinistral, while the dorsal vessel gradually becomes dextral. Both end dorsolaterally at the beginning of the dorsal frenula. From

here the canal passes backward along muscle 9 for an unknown distance before starting the spiral. The spirals are well established in the posterior half of the body

Nephridia are long, slender, and except for a short terminal portion are closely attached to muscle 5.

The nerve cord is slender, less than half the width of muscle 1. Anteriorly the rather slender paraneural muscles arise from muscle 1, 4–5 mm. behind nephrostome. The bilobed cerebral ganglion has across the front a prominent frons (cerebral organ) composed of short bushy elements, exactly resembling a very tiny cauliflower.

Color in alcohol faded yellowish; the La Paz specimen is gray varied with straw color.

Type locality.—Esmeraldas, Ecuador.

Specimens examined.—Panama (Hassler Expedition), 3 specimens. La Paz, Baja California, Lyman Belding collector, 1 specimen.

SIPHONOMECUS, new genus

Diagnosis.—Resembling *Phascolosoma* but very large, the longitudinal muscle layer divided into stout bands, either freely or rarely anastomosing; between the strong circular muscle bands there are discontinuous, transverse, coelomic lacunae, which connect with subcutaneous pockets, longitudinally oriented, one for each rectangle of the skin: retractors 2 or 4; anus a short distance behind nephridiopores; nephridia slender, free; spindle muscle strong, firmly anchored at posterior end of body; type with simple spinelets on introvert; tentacles similar to those of *Phascolosoma.*

Genotype, *Siphonomecus multicinctus,* new species.

SIPHONOMECUS MULTICINCTUS, new species

PLATE 13

Diagnosis.—Size very large; longitudinal muscles of postsiphonal region divided into anastomosing bundles; retractors 2, originating near middle of body; introvert about one-third length of body, its anterior end with about 28 circles of very small spines; tentacular crown with eight primary divisions, and numerous subdivisions; Spindle muscle strong, forked at its origin behind anus, and firmly attached to posterior end of body; anus opening far behind introvert and a very short distance behind nephridiopores. Total length 510 mm.; introvert 150 mm.; thickness of body at posterior end of retractors about 25 mm., and of the terminal 200 mm. (constricted and annulated) 10 mm.; breadth of tentacular crown, 7 mm.

Description.—The skin is pale brownish and rather closely peppered with low, brown papillae about 0.25 mm. broad. These have a circular-convex whitish center about 0.06 mm. broad. They appear to the naked eye simply as brown dots, 1 to 4 to each oblong rectangle of the skin, which is rather coriaceous but not rough. Be-

tween the skin and circular muscles is a system of parallel, longitudinal canals about 0.5 mm. in diameter in the posterior constricted region. They lie close together and apparently are not continuous between two annuli; air bubbles in the transverse, or circular, intermuscular coelomic spaces (described below) can be forced into them. They are thus a series of peripheral, longitudinally oriented, subdermal coelomic spaces, fed by the intermuscular discontinuous ring canals, which in turn open into the coelom, between the longitudinal muscle bands.

The anterior end of introvert is thin-walled and translucent. The first 20 mm. is armed with spines (pl. 13, figs. 3, 4) in about 28 circles. They decrease in size posteriorly and persist a little farther on the dorsal than on ventral side of introvert. The longest are 0.34 mm. and are nearly straight; sometimes the tip is curved slightly backward, or forward. The shorter posterior spinelets are usually curved backward (pl. 13, fig. 3).

The tentacular crown is voluminous. There are eight pinnate groups. Plate 13, figure 5, is a diagrammatic plan of the furrows leading to the mouth. These are bordered on each side by five to seven grooved pinnae. It is the swollen, raised border of these pinnae (not indicated in fig. 5) that gives the characteristic form to the tentacles of *Phascolosoma* (Théel, 1905, pl. 14), which these closely resemble. The two ventral tentacles are bifurcate. Between the two dorsal tentacles is the conspicuous nuchal organ, around the anterior border of which is a double fold of skin and a deep groove.

The inner, longitudinal muscle layer is pale pink, of a satiny luster, and smooth throughout the long introvert, although wrinkled transversely. In the succeeding *inflated* region it is divided into unequal, freely and irregularly anastomosing flat bands. The narrow spaces between these bands are crossed by slender, subequal fascicles of the adjacent circular layer. The intervals between the *circular* bands (which anastomose) are the entrances to the transverse intermuscular lacunae, or discontinuous canals, which in turn feed the subcutaneous system of lacunae. Along the fissures between the longitudinal muscles, irregularly distributed, are dark reddish, convex, ellipsoids, 1–1.5 mm. long. A few are found on the muscles.

In the constricted, annulated, posterior region, the longitudinal muscles only occasionally anastomose. They form conspicuous, narrow, closely placed ridges 18 to 22 in number. By reason of their extreme contraction the circular muscles are very much thicker than anteriorly. Each annulus, marked by deep grooves, contains half of two bundles of circular muscles, because the deep constriction divides the muscle nearly in two (pl. 13, fig. 6). In the middle of the annulus is the transverse lacuna. The connecting outlets to

general coelom, one between each pair of longitudinal bands, form regular transverse series following the lacunae between the muscle bundles of each annulus.

The retractor muscles originate close to the nerve cord, somewhat anterior to middle of postintrovert region and span three or four of the longitudinal muscle bands. Posteriorly the retractors are ventral or ventrolateral to the esophagus; anteriorly they become more and more dorsal, until in the region of the introvert hooks they cover the esophagus and fan out at the base of the tentacles.

The nephridia are slender, free, and open about 10 mm. from nerve cord, nearly midway between base of retractors and posterior margin of introvert. The nephrostome has a slightly expanded, crescentic upper lip.

The long esophagus is attached closely to retractors by lateral mesenteries as far back as the sharp bend of plate 13, figure 2. The posterior edge of the right mesentery is a muscular cord produced for a short distance posteriorly on ventral surface of esophagus, while that of left mesentry runs along dorsal side. The dorsal contractile vessel is slender, without diverticula, and ends in a small bulb, where the spindle muscle branches.

Plate 13, figure 1, shows the relations of esophagus, rectum, and spindle muscle. The last sends a branch forward on the esophagus, which ends in an attachment to body wall (*F'*), while the principal stem, turning posteriorly, lies within the coils of the gut. There is a tiny coecum where the esophagus and the rectum first cross. At this point a long slender frenulum (*F*) anchors the rectum to the body wall at midventral line. The spindle muscle is attached strongly to the posterior end of the body. If the intestinal coil had not been forced into the inflated part of the specimen, it would have extended to + in plate 13, figure 2. The free part of spindle muscle, beyond end of intestinal coil, *is as long as the constricted posterior region of plate 13, figure 2.*

The brain is very far forward, at base of the dorsal tentacles, and appears as a transversely elongate yellowish patch without obvious detail.

Color in alcohol: Anterior part of introvert grayish pink, the body bleached yellowish and pinkish brown.

Type.—U.S.N.M. No. 20911.

Type locality.—Key West, Fla., Chester Thompson collector, 1 specimen.

SIPHONOMECUS INGENS, new species

PLATES 14, 15

Diagnosis.—Size very large; body slender, either uniform in thickness, or posterior portion contracted, with an attenuate extremity; introvert long; skin smooth, with numerous tiny sunken glands

(absent from introvert); longitudinal muscle layer of postintrovert region divided into 21 to 23 muscle bands, rarely anastomosing; four retractors, the dorsals arising well in front of ventrals, which are separated from the nerve cord by two or three muscle bands; postretractor region about half body length; strong spindle muscle arising in front of the anus and attached at the posterior end of the body; intestinal spiral very long (60 to 62 coils); contractile vessel densely papillated posteriorly; nephridia free, opening a short distance in front of anus; small coelomic papillae forming a transverse zone in front of nephridia; tentacular crown capitate; tentacles arranged in 12 double meridional series, upward of 12 to a series; nuchal organ very small, at anterior end of dorsal double series. Length of type, fully relaxed, 500 mm.; diameter, 8–10 mm.; introvert about 90 mm.; distance from head to nephridiopores, 130 mm.; to anus 140 mm.; to attachment of ventral retractors 215 mm.; to end of intestinal spiral 435 mm. (unusually extended for preserved specimen).

Description.—The skin of preserved specimens is pale yellow or muddy brown. Except on the introvert it is closely beset with small, inconspicuous, roundish glands, on the order of 6 to 8 to each oblong triangle into which the skin is divided. These glands are sunken in the skin (which is smooth to touch) and are surrounded by the peripheral portion of the subdermal coelomic pockets. Coelomic fluid enters these irregular spaces by way of the narrow intervals between the circular muscle bands. Stain forced into them indicates that the space just under the epidermis is independent for each rectangle. The annular and longitudinal grooves outlining the rectangles vary in depth with the inflation of the skin. The posterior end of specimens is likely to be very attenuate and pointed and the annuli conspicuous.

The introvert is not especially well marked externally, except by the absence of the glands, and is the long portion characterized internally by the sieve-like structure of longitudinal muscle layer. There are no hooks.

None of the large specimens has the tentacle crown well enough expanded for a figure, and so it has been necessary to resort to a drawing of a small living specimen (length 70 mm.). The crown, while reminiscent of *Phascolosoma gouldii*, differs in having the tentacles of all the double rows, especially the dorsal, *close together*, with the result that the nuchal organ is almost rudimentary. There are 12 of these double rows separated by 12 grooves: A dorsal double row (not more widely separated than the rest) reaching nearest to mouth; opposite it is a midventral; on each side, five laterals. Counting clockwise from the dorsal, double rows 2, 4, 6, 8, 10, and 12

do not reach quite so near the mouth as the alternates. The mid-dorsal has seven tentacles in each series in this small specimen, the others one or two less as a rule. In large specimens the tentacles are relatively about twice as long and 10 to 12 in each series. Large specimens would therefore have about 120 tentacles altogether. In the small specimen the inner end of the dorsal group of tentacles overlies the brain, which is visible through the skin. The *very small* nuchal organ is at the inner end of this dorsal group, well hidden by the first and second tentacles, and hence is close to the brain.

The inner longitudinal muscle layer is divided into 21 to 25 bundles, which anastomose infrequently. At a distance 20 to 25 mm. in front of the anus the regular bundles cease and anastomose every few millimeters, so that this layer from here to the head appears sievelike by reason of very numerous elongate pores. The intervals between the *regular* longitudinal muscles are crossed by the circular muscle bundles (which, however, unite again under the longitudinal bands). The openings between the circular fascicles give entrance to the transverse lacunae, which in turn feed the subcutaneous spaces that surround the skin glands. The circular muscles are essentially as in *S. multicinctus*, but the annular constrictions are not so uniform and do not indent the ring muscles regularly in the middle. A constriction may divide the muscle into two unequal parts. In the posterior third of the body the longitudinal muscle bundles change from flat ribbons to ridges, which are narrower than the intervals between. The circular muscle bundles are here seen to best advantage. The transverse slits between them are virtually very numerous pockets directly beneath the thin skin to which the coelomic fluid and contents have access.

Posterior attachment of the ventral retractors is two or three muscle bundles from nerve cord; that of dorsals is well in advance of the ventrals and separated from nerve cord by usually seven bundles. Anteriorly the four retractors are in close contact forming a muscular trough in which lies the esophagus. The lateral mesenteries of esophagus are apparent for only a short distance posteriorly.

The nephridia are slender, free, brown in color, and open about four muscle bands laterally from the nerve and a short distance (varying with contraction of longitudinal muscles) in front of the anus. In one specimen they are full of eggs. In front of the simple nephrostome, and also sometimes for a short distance back of it, is an area occupied by papilliform outgrowths of the epithelium. They are either simple or branched (pl. 14, figs. 4, 5), and no opening in them is visible or likely, as they are sometimes turgid with fluid.

In the relaxed type specimen the esophagus is very long, slender, and anteriorly marked by the contractile vessel. The lateral mesen-

teries are inconspicuous, and their posterior border has a muscular strand continued upon the sides of the esophagus. The contractile vessel is posteriorly densely papillated, and its posterior end is considerably behind the point where the esophagus becomes attached to the rectum. Just back of this point the esophagus has a special muscular frenulum (*F*), which is anchored by a fork spanning the nerve cord well in front of the attachment of ventral retractors. In *S. multicinctus* this frenulum anchors the rectum. The intestinal spiral is very long and sometimes reaches nearly to end of body. There are 60 to 62 spirals of the canal counted consecutively.

Plate 14, figure 3, and plate 15, figure 3, show the relations of esophagus, rectum, and spindle muscle in the type and paratype. The spindle muscle arises in front of the anus, and after passing backward through the intestinal spiral (which in the type extends to within 65 mm. of the end of body) it sends off numerous branches, which are attached to the longitudinal bands ventrally, laterally, and dorsally, while a small strand continues to the posterior extremity. Where the esophagus joins the rectum there are two symmetrical lateral branches (*F'*) attached in front of the dorsal retractors to the first muscle bundle external to that from which the dorsal retractors arise. There is no coecum. The wing muscles are fairly conspicuous—rather better developed than in *S. multicinctus*.

At the extreme posterior end of body are four (or five) slender, terete, fusiform bodies, which open close together (around the end of spindle muscle) each on a slight pustule of the skin. They somewhat resemble a cluster of nematodes.

The brain measures about 1 mm. in length and is bilobed. It varies somewhat in appearance in different specimens by reason of being partly obscured by muscle fibers.

Type.—U.S.N.M. No. 20910.

Type locality.—Morro Bay, San Luis Obispo County, Calif., 8 specimens. G. E. MacGinitie collector, January 31 and July 18, 1931, and July 19, 1933.

Specimens examined.—Newport Bay, Orange County, Calif., 7 specimens, among *Zostera*, G. E. MacGinitie, January–February 1930 and February 14, 1932 (with eggs). Elkhorn Slough, off Monterey Bay, Calif., 1 specimen, sandy mud, low tide, G. E. MacGinitie.

Remarks.—This species and *S. multicinctus* are so different in most of the details of internal anatomy that one may question their close relationship. The muscles of the body wall and the subdermal canal system, fed by transverse lacunae in the circular layer, are essentially the same in the two species. It is curious that the muscular anchor *F* (pl. 13, fig. 1; pl. 14, fig. 3) is so similar in the two species.

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EXPLANATION OF PLATES

Plate 8

Thalassema philostracum, new species

1, A seta, 2.75 mm. long, × 20, and its hook further enlarged.

2, Dissection of anterior region of type, × 15. The fore-gut has been pulled to the right to display underlying structures. In the natural position the gizzard is on the left and ventral. Most of the radiating seta muscles have been omitted along with the mesenterics except the ventral (*VM*), which is double.

3, Sketches of four specimens to show variation in body and proboscis length due to accidents of fixation.

B^1, dorsal blood vessel; B^2, ring vessel; B^3, neurointestinal connective; B^4, ventral vessel; *C*, stomach; *CG*, ciliated groove; *G*, gizzard; *MI*, interbasal muscle; *N*, nephridia; *NC*, nerve cord; *O*, esophagus; *P*, pharynx; *Pr*, proboscis; *S*, seta; *Si1*, beginning of siphon; *VM*, ventral mesentery of pharynx.

Plate 9

Thalassema hartmani, new species: Type

1, Portion of alimentary canal to show extent of intestine (dotted) anterior to beginning of siphon, × 2. *AV*, anal vesicle; CG^1, beginning of ciliated groove.

2, Dissection of anterior end to show relations of organs. The fore-gut has been drawn to the right of natural position; × 10. *M*, M^1, mesenteries.

3, A seta, × 10, and its hook enlarged.

4, Small portion of skin, × 20 to show the papillae bent toward anterior end.

5, Ventral aspect of whole animal, × 2, with only a few papillae indicated. The dotted line indicates nerve cord visible through body wall.

Other lettering as for plate 8.

Plate 10

Sipunculus polymyotus, new species

1, Anterior region of type, introvert retracted, opened a little to left of middorsal line and spread out, so that the dorsal retractors are unnaturally divaricate and the rectum is on extreme right instead of being in middorsal line. The intestinal coil is to the right of its natural position; right nephridium omitted. Natural size.

2, Brain and cerebral body (*Fr*), × 5.

3, Left side of head region, showing the left paraneural muscle and its extensions, × 1. The left ventral retractor has a section clipped out; the nerve cord is dotted; longitudinal muscle bundles indicated on the left.

C, Intestinal coecum; *CG*, ciliated groove, which, to avoid confusion, has not been indicated on the intestine; *CV*, dorsal contractile vessel of esophagus; *Fr*, cerebral organ or frons; *I*, introvert; *N*, left nephridium (right omitted). *NC*, nerve cord; *O*, esophagus; *O'*, end of esophagus; *R*, rectum, extending to *C;* the feathered arrows indicate ascending spiral of intestine; *RD*, dorsal retractor; *RV*, ventral retractor; *W*, fan muscle of rectum; *X*, anterior bend of the forward loop of intestine; *Y*, the beginning of anterior loop, indicated by featherless arrows; *Z*, the so-called anal glands.

Plate 11

Sipunculus galapagensis, new species

1, Anterior half of type, natural size, opened a little to left of middorsal line and spread out; longitudinal muscle bundles and right nephridium omitted.
2, Proximal end of left nephridium and adjacent muscle bundles, numbered, × 5.
3, Cerebral body or frons × 10.
4, Tentacle crown, × 3.
5, Marginal elements, enlarged.

C, Coecum; *N*, left nephridium; *NC*, nerve cord; *O*, esophagus, *1* to *6* indicating position of dorsal frenula; *R*, rectum with fixing muscle on either side; *RD*, dorsal retractor, *RV*, ventral retractor; *X*, anterior bend of forward loop of intestine; *Y*, where the intestine turns to form the forward loop; *Z*, rudiments of anal glands.

Plate 12

Xenosiphon branchiatum (Fischer)

1, Anterior sixth of a specimen, with introvert extended, from Panama. It has been opened a little to the left of middorsal line and spread out so that the dorsal retractors are unnaturally spread apart and the rectum is on extreme right instead of being in middorsal line. The esophagus actually bends to left and is attached behind and in a line with the left dorsal retractor; × 2. Figures denote muscle bands to right and left of nerve cord.
2, Sketch of another specimen from Panama, in which the introvert is partly withdrawn, to show altered position of protractors (*P*), natural size.
3, Brain and the bushy frons (cerebral organ), × 10.
4, Six dermal rectangles at margin of papularium of La Paz specimen, × 10. In this specimen the cuticular welts above the canals alone show well, the detail in upper left rectangle being supplied from a Panama specimen. The next rectangle has no papillae but the irregular canal shows through the cuticle. The lower left shows at each end of canal the pores (arrows) which lead eventually to coelom.
5, A single rectangle of skin of Panama specimen about 25 mm. anterior to papularium showing a skin canal gorged with material, × 20. At either end, the dark spot marks the canal to coelom.

A, anus; *C*, intestinal coecum; *CV*, dorsal contractile vessel; *CV'*, ventral contractile vessel; *Fr*, cerebral organ or frons; *I*, introvert; *N*, nephridium; *NC*, nerve cord; *O*, esophagus, its mesenteries cross-hatched; *P*, protractors of head; *R*, rectum; *RD*, dorsal retractor; *RV*, ventral retractor; *S*, spindle muscle; *T*, tentacles; *Z*, filamentous organ described in text.

Plate 13

Siphonomecus multicinctus, new species

1, Region of origin of retractors, the end of esophagus, and rectum to show relations of the two latter to spindle muscle, × 1. The frenulum, *F'*, is a branch of the spindle muscle, *S;* its cut end is attached to body wall dorsally. Esophagus has been severed to show ascending spiral around spindle muscle.

2, Dissection of anterior portion of body, × 4/5. The posterior boundary of introvert is at *I;* frenulum *F* has been omitted; +, on constricted posterior region indicates end of intestinal spiral when in the body naturally.

3, 4, Introvert spines: 3, Curved spine from posterior part of area, × 50; 4, nearly straight spine from first three rows, 0.32 mm. long, × 100.

5, Diagram of tentacles showing the grooves, which are bordered by 5 to 7 grooved pinnae (not indicated), × 2½.

6, Longitudinal section of body wall from posteror region, × 5. The longitudinal muscle band below is not a section but a side view of the bundle.

A, anus; *C*, intestinal coecum; *CC*, circular coelomic canal with arrows in the entrance from body coelom; *CV*, dorsal contractile vessel (there is no ventral); *I*, posterior boundary of introvert; *F*, *F′*, frenula; *LC*, longitudinal canals; *N*, nephridium; *NC*, nerve cord; *NO*, nuchal organ; *O*, the dorsal, and *O′*, the ventral side of esophagus; *R*, rectum, *RV*, retractor muscles; *S*, spindle muscle; *W*, small fan muscles of rectum.

Plate 14

Siphonomecus ingens, new species

1, Head of a small specimen (Elkhorn Slough, Monterey Bay, Calif.) drawn from life, × 8.

2, Anterior end of paratype, × 1, showing the introvert partly invaginated and retractors in contracted state.

3, Portion of 2 enlarged × 2d. The left dorsal frenulum *F′* has been severed.

4, Nephrostome of a specimen from Newport Bay and associated coelomic papillae, × 10.

5, Coelomic papilla, × 30.

6, Brain of paratype, × 10.

CP, coelomic papillae; *CV*, dorsal contractile vessel; *F*, frenula or fixing muscles; *F′*, left dorsal frenulum; *F″*, right dorsal frenulum; *I*, introvert; *N*, nephridium; *NC*, nerve cord; *NO*, position of nuchal organ at anterior end of dorsal double series of tentacular lappets; *O*, esophagus; *RD*, dorsal retractors; *RV*, ventral retractors; *S*, spindle muscle; *W*, fan muscle of rectum.

Plate 15

Siphonomecus ingens, new species: Type

1, 2, Anterior half of body × 1.5. The top of fig. 2 is a continuation of the bottom of fig. 1. This specimen is unusually well relaxed. The coelomic papillae have been omitted and the muscle bands are only lightly indicated in order to avoid confusion of lines.

3, Same specimens, × 3. Point where the esophagus joins and is fastened to the ascending intestine at end of rectum, showing relations to spindle muscle (*S*) and dorsal frenula *F′* and *F″*, the ventral frenulum to esophagus is omitted.

4, Segment of the esophagus and four retractors opposite the fan muscles of rectum to show the lateral mesenteries of esophagus, × 5. *M*, right mesentery.

Other lettering as for plate 12.

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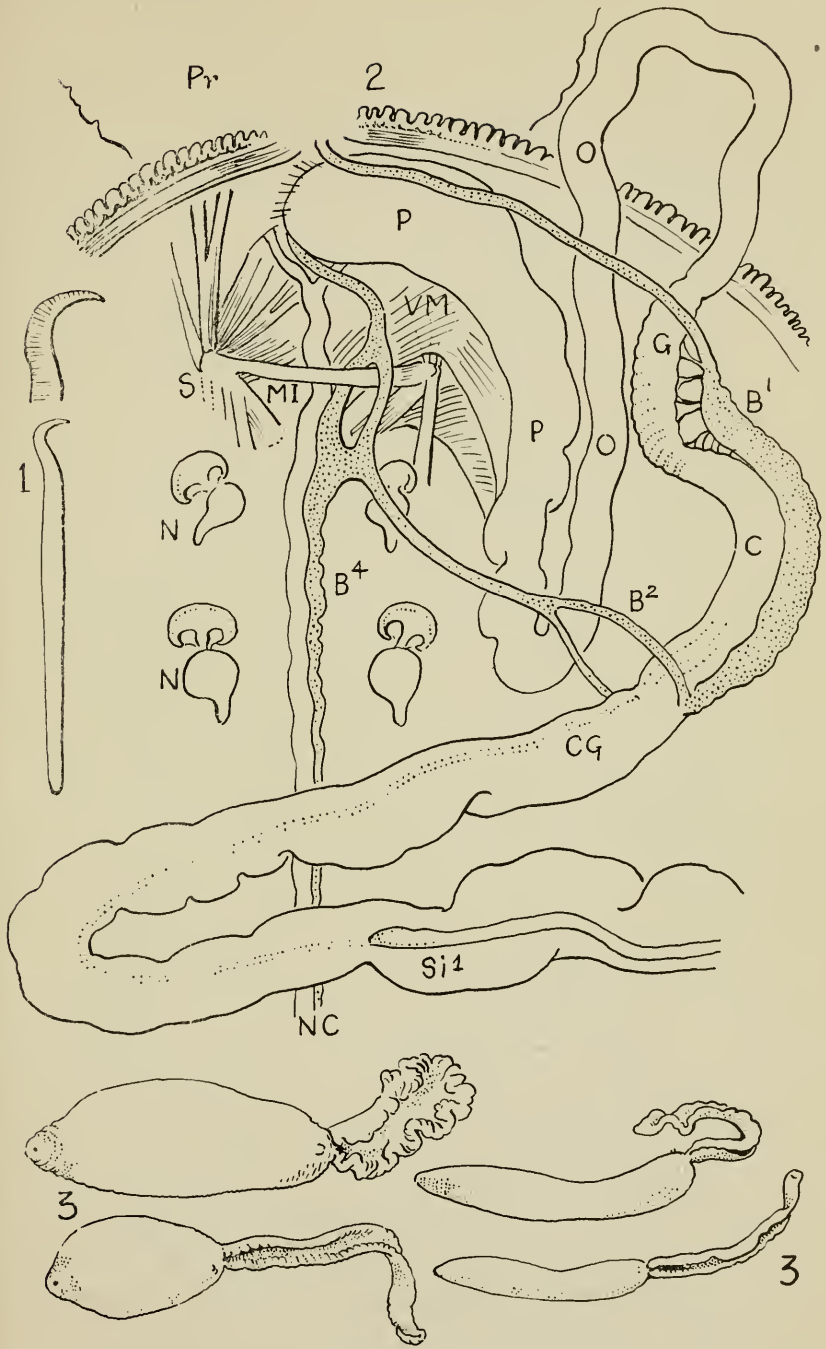

THALASSEMA PHILOSTRACUM, NEW SPECIES.

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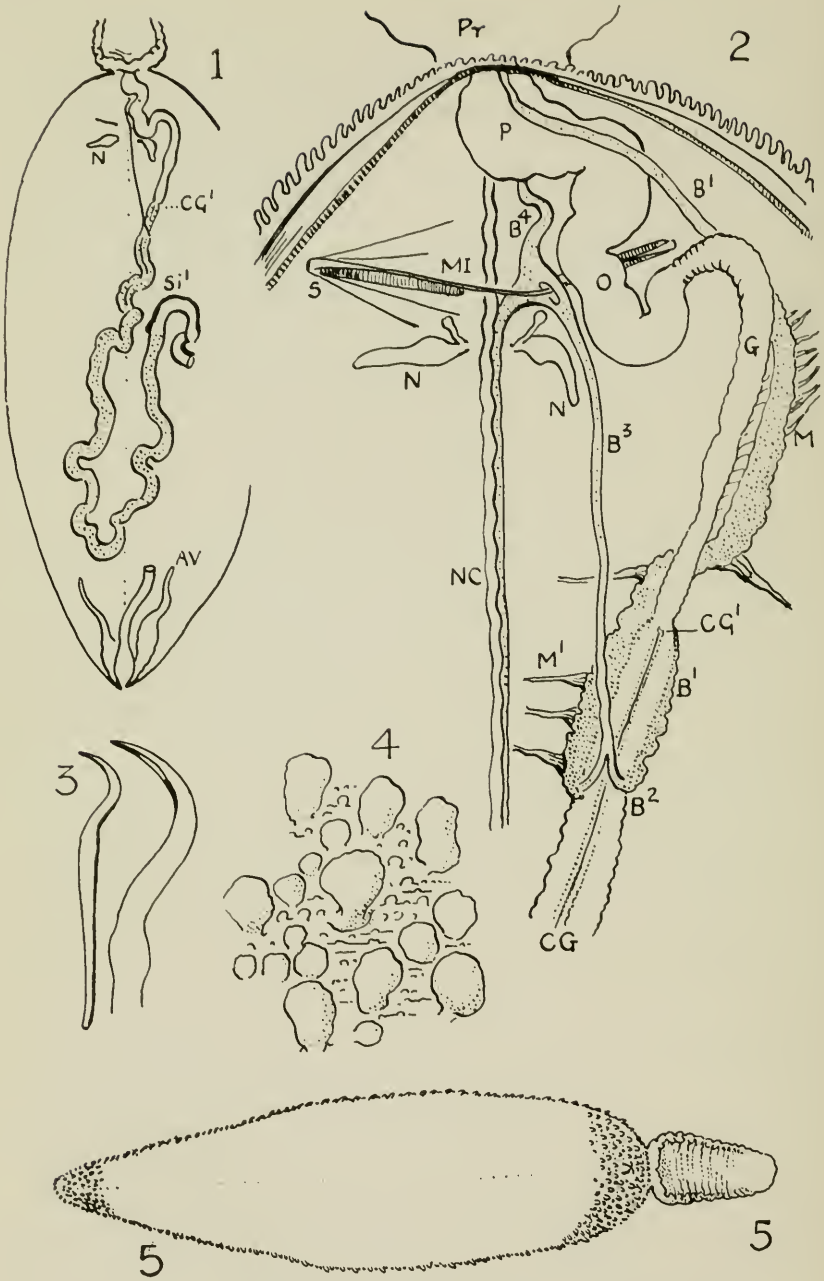

THALASSEMA HARTMANI, NEW SPECIES.

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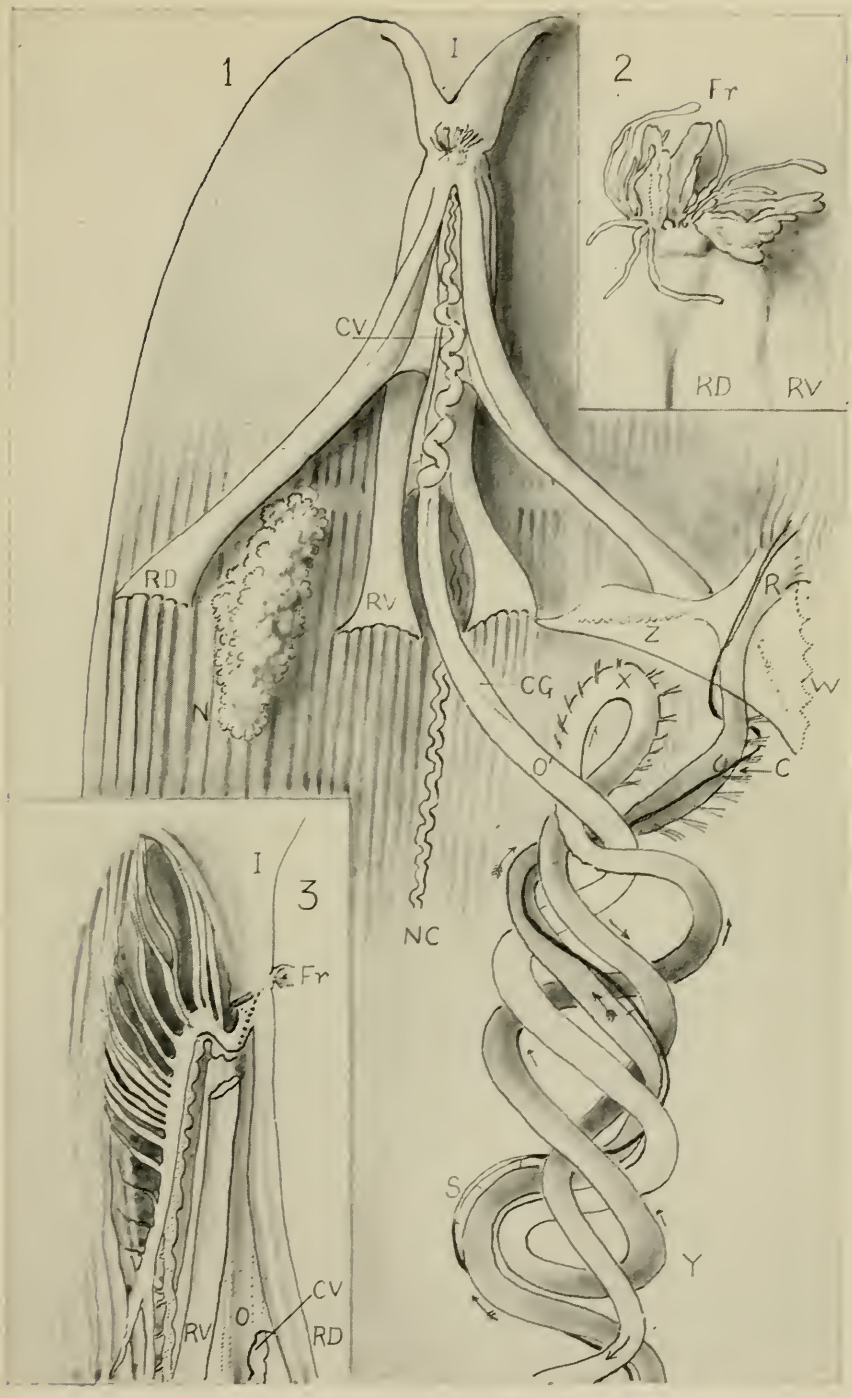

SIPUNCULUS POLYMYOTUS, NEW SPECIES

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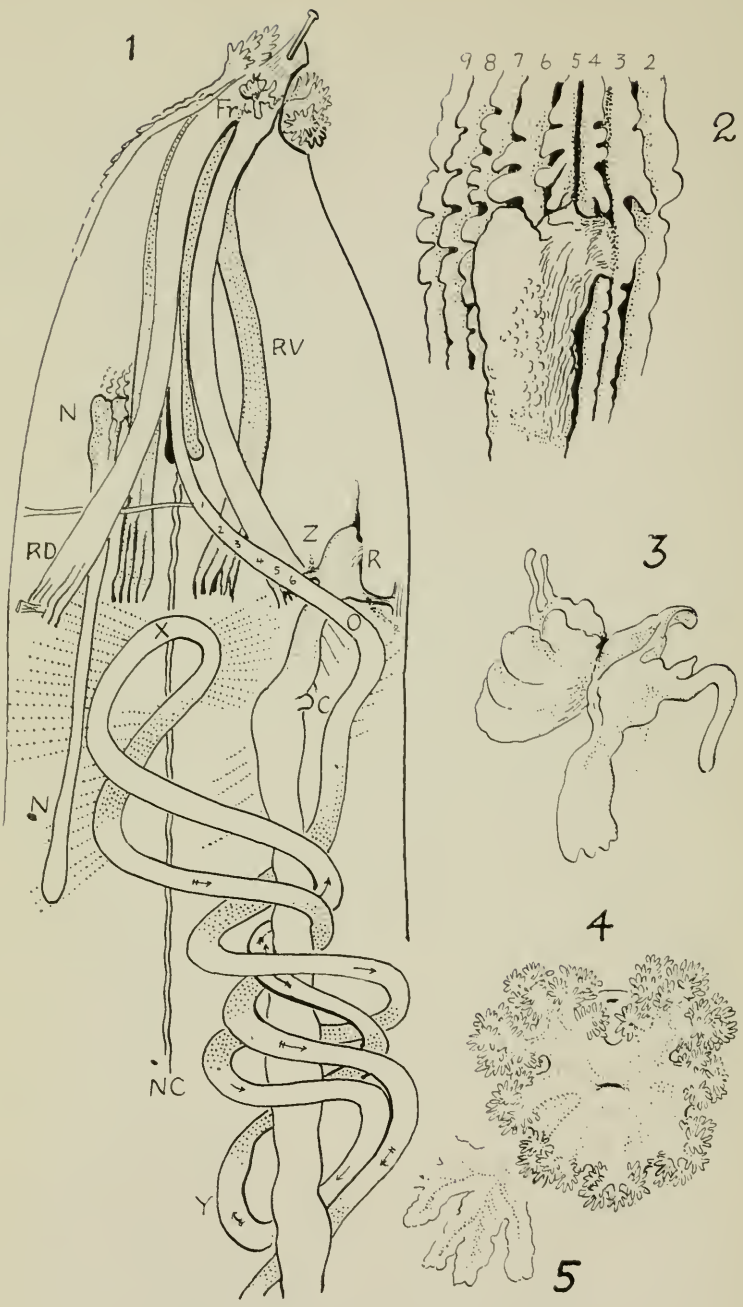

SIPUNCULUS GALAPAGENSIS, NEW SPECIES.

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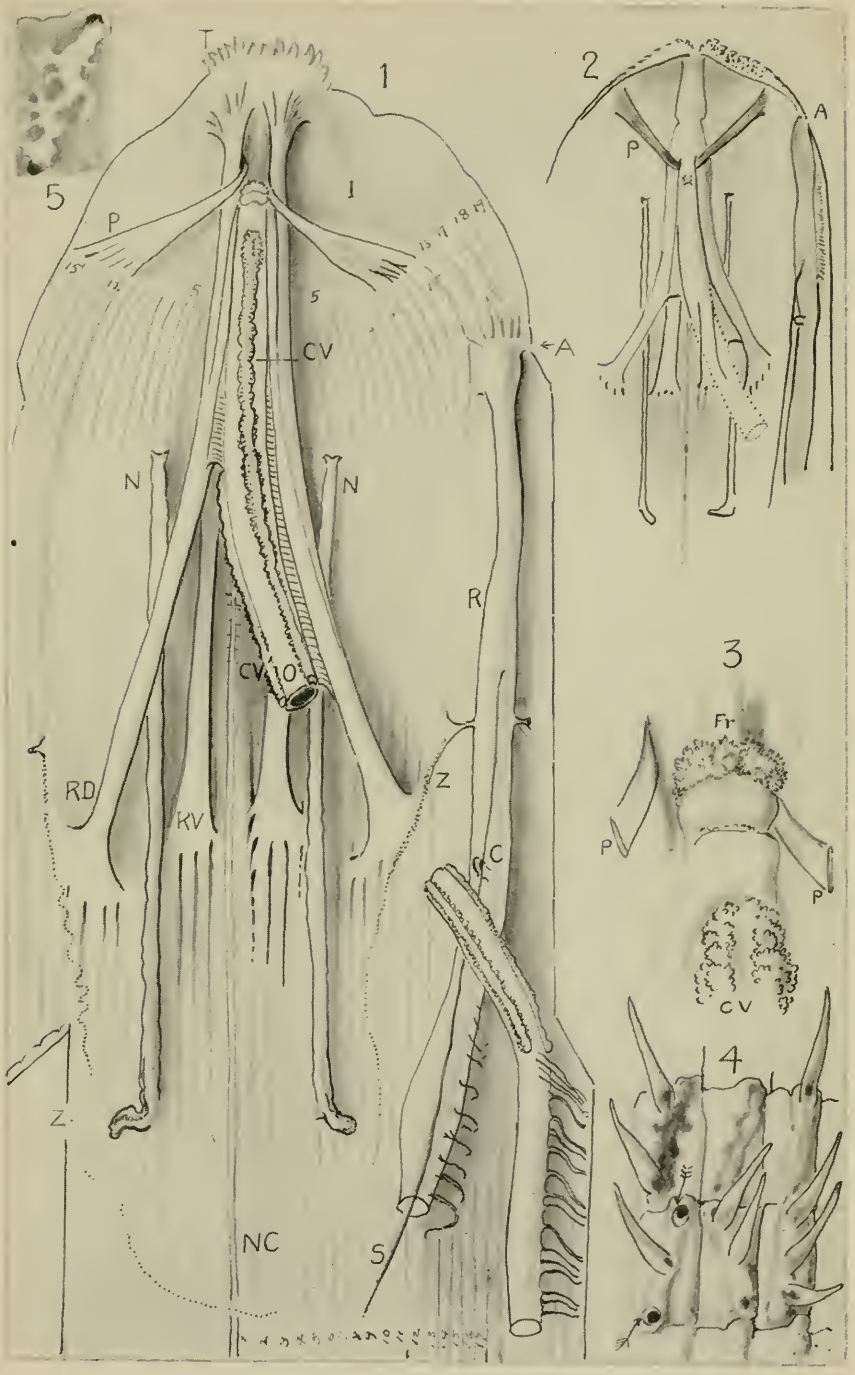

XENOSIPHON BRANCHIATUM (FISCHER)

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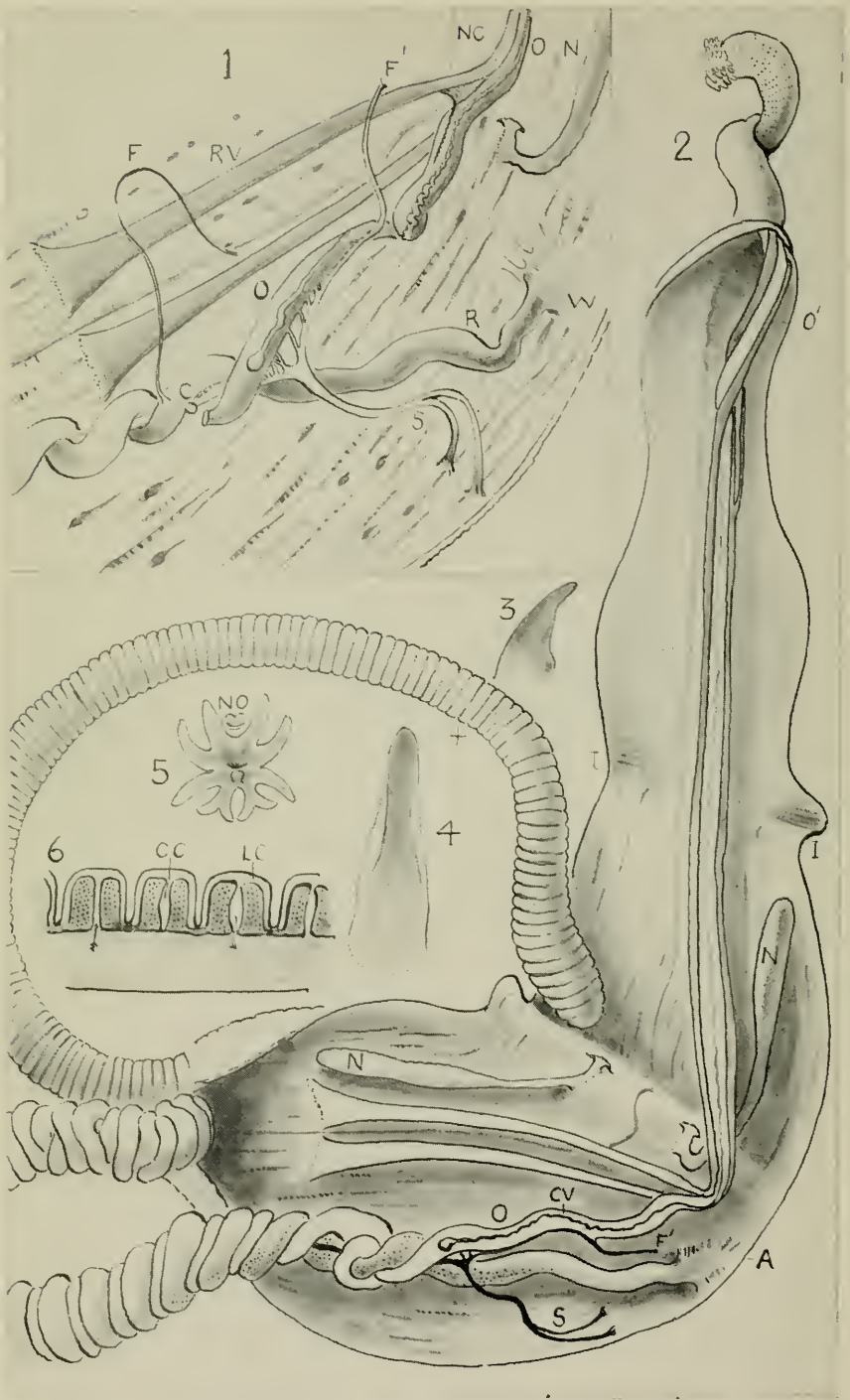
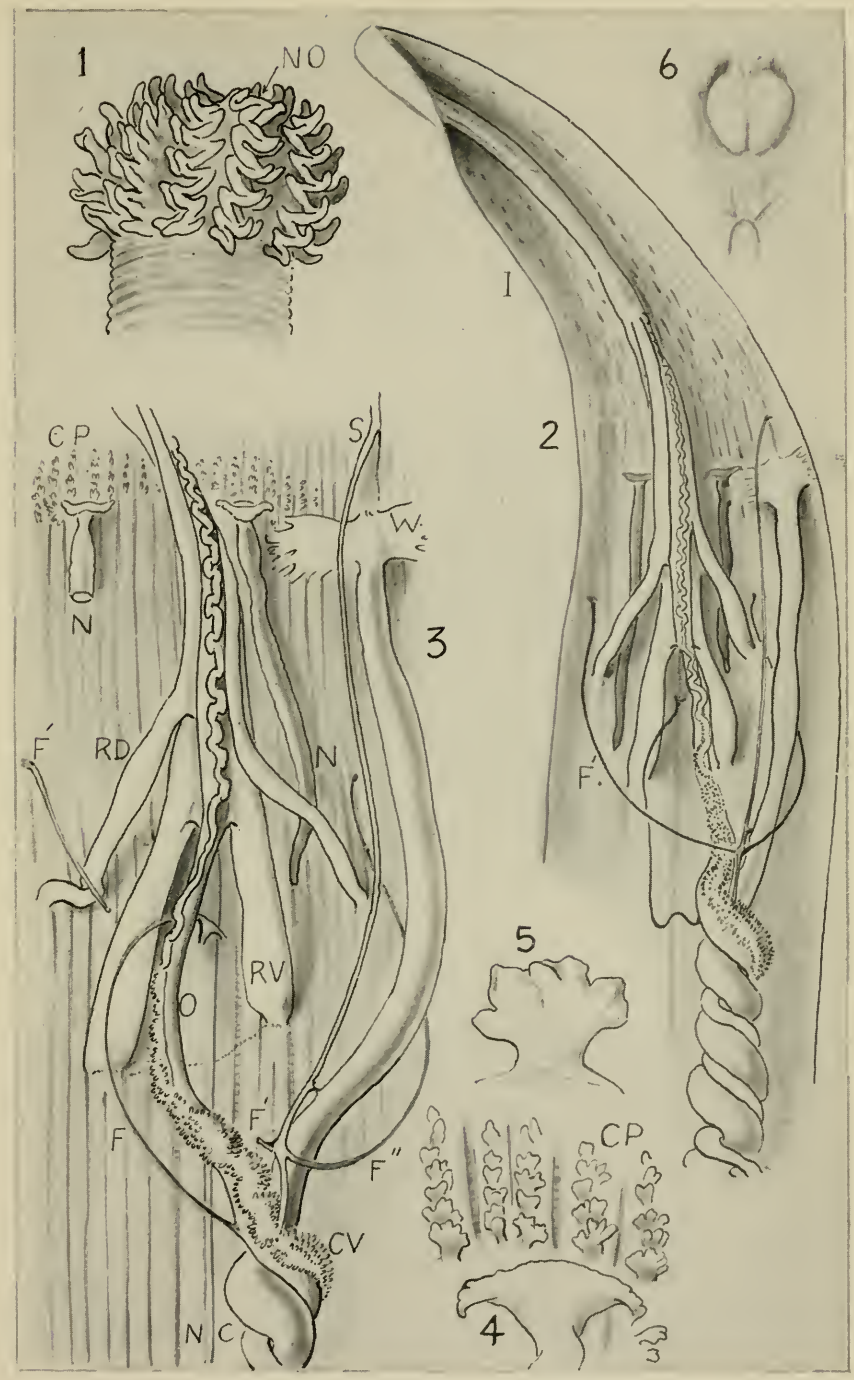


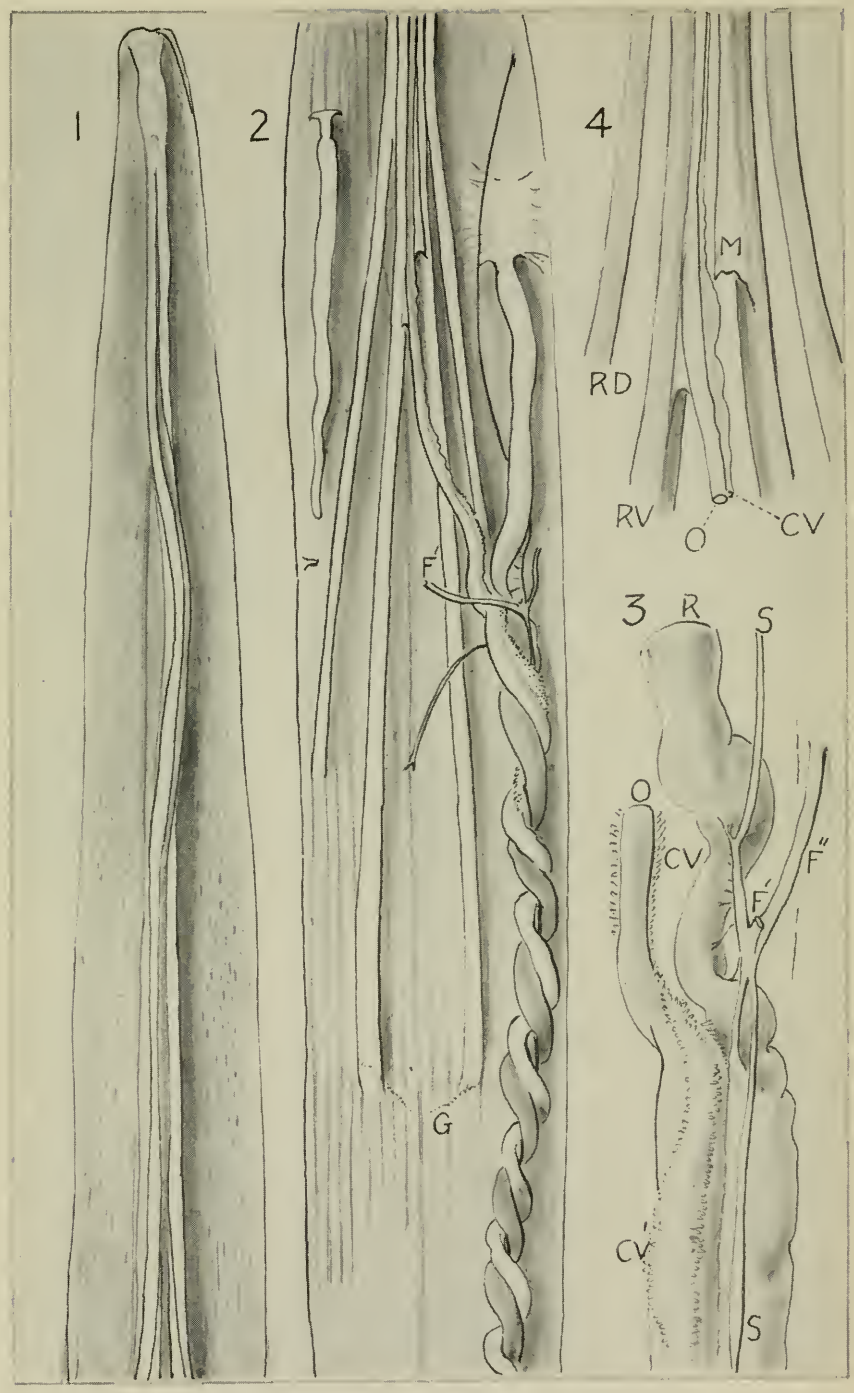
SIPHONOMECUS MULTICINCTUS, NEW SPECIES.

FOR EXPLANATION, SEE PAGES 371–372.



SIPHONOMECUS INGENS, NEW SPECIES.

FOR EXPLANATION, SEE PAGE 372.



SIPHONOMECUS INGENS, NEW SPECIES.

FOR EXPLANATION, SEE PAGE 372.