

DESCRIPTION OF A WOOD DWELLING SIPUNCULAN,
PHASCOLOSOMA TURNERAE, NEW SPECIES

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Abstract.—*Phascolosoma turnerae*, a new species of the phylum Sipuncula, is described from 104 specimens collected at depths of 1,135–1,184 meters in the Straits of Florida, south of Key West and from 366–412 meters in the northern Gulf of Mexico, south of Mobile, Alabama. The specimens were found in association with submerged wood, occupying burrows in the wood. In the sample from the Straits of Florida, pogonophoran tubes had penetrated the wood and were frequently entwined around the bodies of the sipunculans.

Phascolosoma turnerae, new species

Fig. 1-4

Material examined.—85 specimens, 2 with extended tentacles (20 dissected, 1 prepared for scanning electron microscopy). *Gerda* Station 448, Rosenstiel School of Marine and Atmospheric Science, University of Miami; 1 Dec 1964; 620–647 fathoms; 23°54'N, 82°21'W.

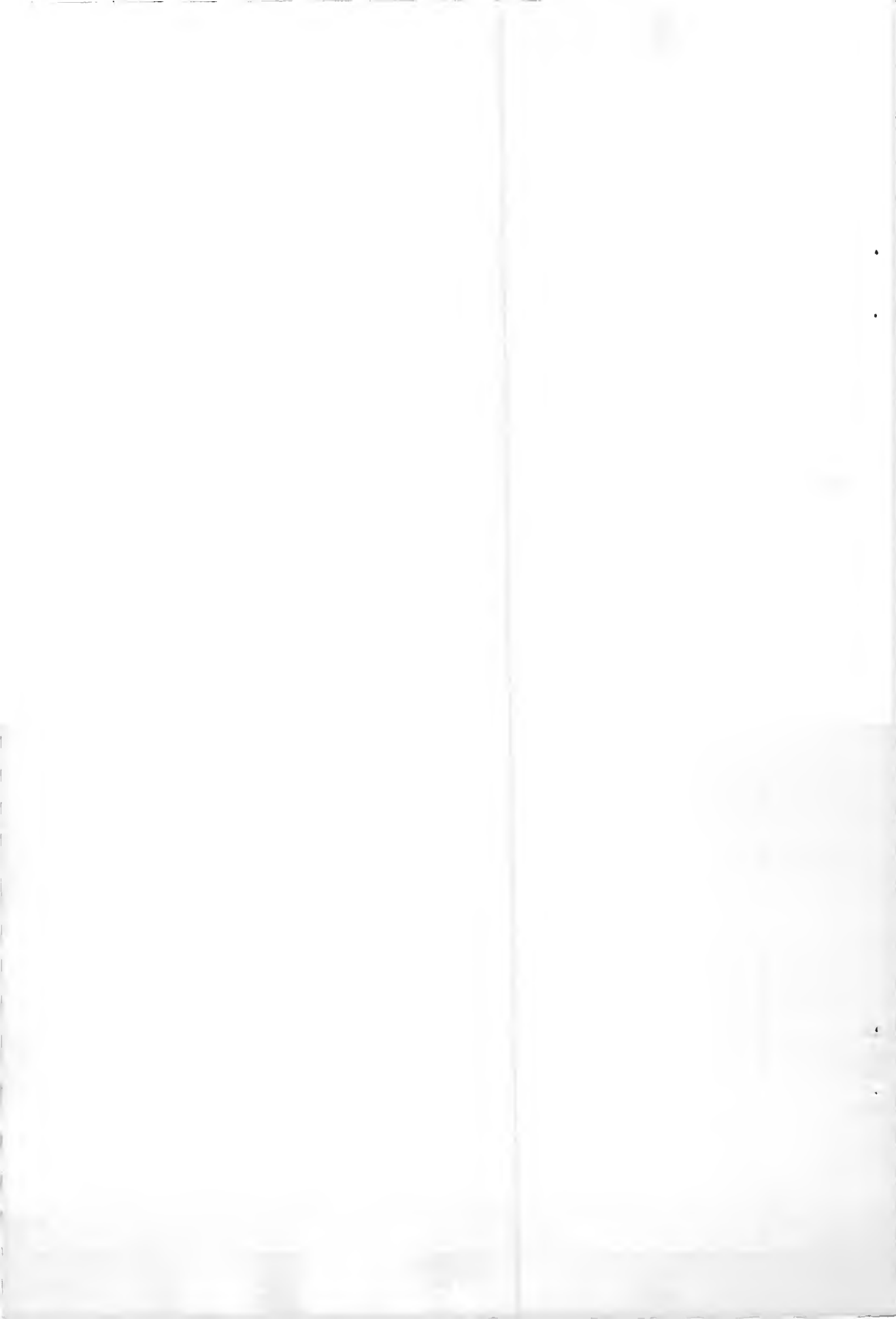
19 specimens (5 dissected) M/V *Oregon* Station 3753, Bureau of Commercial Fisheries, United States Fish and Wildlife Service, Pascagoula, Mississippi; 28 Aug 1962; 200–225 fathoms; 29°13.5'N, 87°58.5'W.

Holotype: USNM 96687 (dissected), from *Gerda* Station 448. Fig. 1a, b, c, d.

Paratypes: USNM 96688 (Fig. 1f, dissected), 96689 (Fig. 1g), 96690 (Fig. 1e) from *Gerda* station 448.

Diagnosis.—Introvert nearly equal in length to trunk; approximately 50 rows of closely apposed hooks on anteriormost introvert followed posteriorly by rows of more widely spaced hooks; most posterior rows incomplete dorsally. Tentacular crown dorsal to mouth, larger in proportion to body size than usual for *Phascolosoma*; 14–22 digitiform tentacles. Exceptionally large mammillate papillae with prominent apical protuberances; papillae largest and most numerous at base of introvert and posterior trunk. Surface of papillae covered with small, granular platelets, also scattered on non-papillary body surface. Longitudinal body wall musculature separated into anastomosing bundles. Four retractor muscles, dorsals arising in middle third of trunk, ventrals in posterior third; retractor muscles separate for most of length. Spindle muscle attached posteriorly at extremity of trunk and anteriorly immediately above anus. One fixing muscle, attaching lower esophagus to body wall in mid-trunk to left of ventral nerve cord. Intestinal coil with approximately 15 single coils. Contractile vessel simple. Nephridia attached nearly entire length to body wall; nephridiopores at approximate level of anus. Hooks sharply bent distally with clear streak close to convex surface; relatively narrow at base with basal rootlets on concave side.

Description.—Trunk measurements average 6.7 mm ($n = 80$) in length for specimens from the *Gerda* collections and 12.8 mm ($n = 14$) for those from the M/V *Oregon*. The ranges for the two groups are, respectively, 3.5–11.4 mm and 7.4–17.3 mm. In two specimens, both from the *Gerda* collections, the introvert and tentacles are fully extended; in others the introvert is in varying states of con-



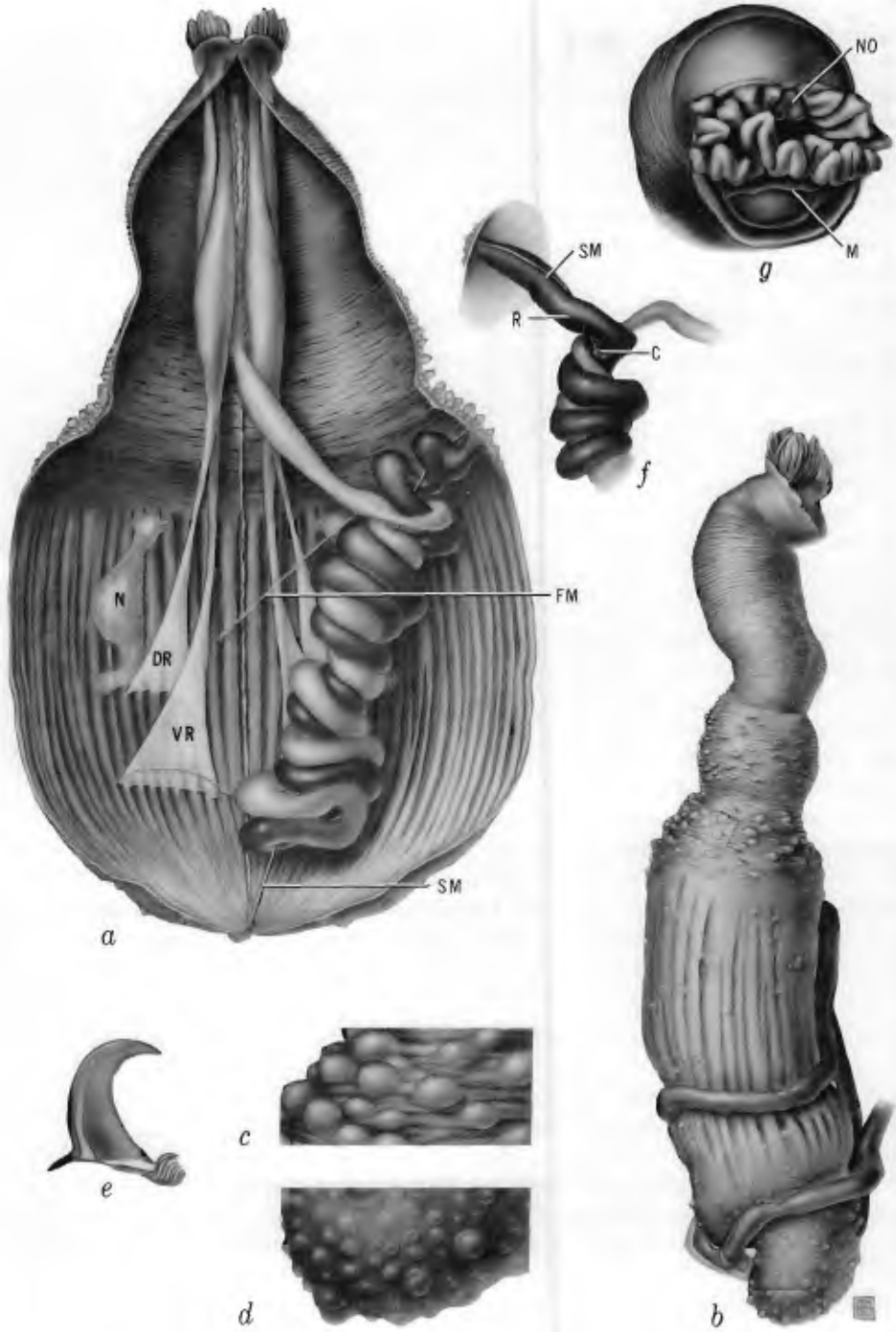
traction. One of the extended specimens has a total length of 12 mm (Holotype USNM 96687) and the other (Paratype USNM 96689) a total length of 17 mm. In the former the ratio of introvert to trunk is 1:1.4 and in the latter 1:1.1. In both specimens the relatively stout introvert is about one-half the maximum width of the trunk. The introvert is approximately one-third as wide as long; proportions are the same for the trunk. The short, thick, digitiform tentacles number 14 in the holotype and 22 in the paratype. They are arranged dorsal to the mouth in a circle that is interrupted at the mid-dorsal line by a heart-shaped nuchal organ. The color of the body of these preserved specimens is generally a pale grayish yellow, the posterior and anterior trunk being somewhat darker than the middle. The anterior introvert has a brownish appearance because of its dark-colored hooks.

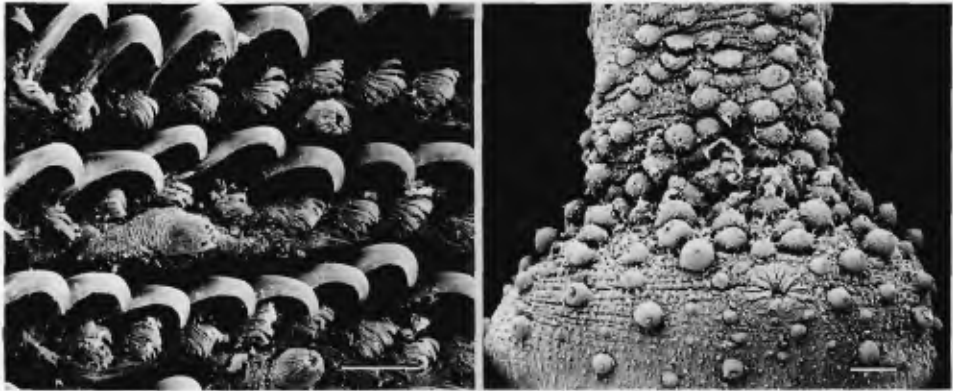
On the extended introvert of the holotype there are 70 rows of hooks. The first 25 rows are completely formed whereas those following may be incomplete dorsally (especially noticeable in rows 25 to 45). Following the first 52 rows in which the hooks are closely apposed, the individual hooks are more widely set apart. Scattered hooks are present after row 70, but no longer is there an obvious arrangement in rows. Hooks in the first 5 to 6 rows are light tannish yellow, whereas the remainder are dark brown. The most anterior 5 rows are smaller than those that follow, except for the farthest posterior ones which become increasingly smaller toward the posterior introvert.

The form of the hook is simple (Figs. 1e, 2). The end is sharply curved, and, within the hook near the convex curvature a clear streak runs from base to apex gradually decreasing in width toward the apex. The hooks are best developed in rows 6 to 50. Measurements of hooks from rows 5 to 19 in paratype USNM 96690 show an average basal width of 0.044 mm and an average height of 0.051 mm. The basal processes number about 10 on each hook. Introvert papillae appear at regular intervals between the rows of hooks (Fig. 2).

The body wall is rather thin, particularly in the mid-trunk region where the longitudinal muscle bands are visible through the integument. The most distinctive features of this species are the size and shape of the papillae at the anterior and posterior trunk (Figs. 1b, c, d; 3). In these regions the papillae are numerous, concentrated, and mammillate in shape, each with a central protuberance bearing a pore. Most commonly the width and height are approximately equal although either one may exceed the other slightly. The largest papillae measure 0.16×0.16 mm in width and height in specimens from the *Gerda* collections which range in trunk length from 7 to 10 mm. Papillae of the somewhat larger specimens from the M/V *Oregon* collections, which range in trunk length from 17 to 18 mm, show a maximum width and height of 0.24×0.30 mm. In contracted specimens the base of the papillae may be constricted to form a narrow stalk. Papillae in the midtrunk region are few, scattered and much flattened. The largest among them are the same diameter as the largest of the anterior and posterior papillae, but they have little or no elevation. Embedded in the integument of the papillae are small, well-separated platelets, ranging from colorless to light brown. Similar platelets are found scattered throughout the skin, although they are more concentrated on the papillae. The central protuberance of the papilla frequently appears brown.

The bundles of the longitudinal musculature undergo considerable splitting and





Figs. 2-3, *Phascolosoma turnerae*: 2, (left) Rows of hooks from the anterior introvert (scanning electron micrograph, scale = 20 μm); 3, (right) Papillae of anterior trunk and posterior introvert (scanning electron micrograph, scale = 200 μm).

anastomosis; therefore any counts of the bundles show great variability (Fig. 1a). Two counts were made on 10 dissected specimens: one anteriorly near the level of the nephridiopores and a second more posteriorly near the level of the attachment of the ventral retractors. Anteriorly the average was 25, ranging from 20 to 32, whereas posteriorly it was 33, with a range from 28 to 38. In the holotype the anterior and posterior counts are 25 and 35 respectively and in the paratype USNM 96688, 20 and 38.

The nephridia are single-lobed and vary considerably in their state of distension. In specimens from the *Gerda* collections, lengths of nephridia are 24 to 37% of the length of the trunk; whereas in specimens from the *Oregon* collections, nephridial lengths are about 50% the length of the trunk. Nephridia are attached by mesenteries to the body wall for at least 75% of their length in most specimens, the percentage depending on the degree of nephridial distension. Nephridiopores open to the exterior at the same level as or slightly anterior to the anus.

There are 4 separate retractor muscles that unite far anteriorly near the brain. The 2 dorsals attach to the body wall in the mid-trunk region and the ventrals attach in the most posterior one-third of the trunk, usually at a distance of about one-third the trunk length from the posterior end. A gonad extends as a thin band of tissue along the base of the ventral retractor muscles and continues between them, running under the ventral nerve cord.

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Fig. 1. *Phascolosoma turnerae*: a, Dissected specimen showing dorsal retractor muscles (DR), ventral retractor muscles (VR), gonad at base of ventral retractors, anastomosing longitudinal muscle bundles, intestinal coil, spindle muscle (SM), fixing muscle (FM), nephridia (N), and ventral nerve cord (Holotype USNM 96687); b, External view of entire specimen showing entwining pogonophoran (Holotype USNM 96687); c, Enlargement of papillae from anterior trunk near region of anus; d, Enlargement of papillae from the posterior end of the body; e, Hook from anterior introvert (Paratype USNM 96690); f, Anterior intestinal coil from different specimen to show anterior attachment of spindle muscle (SM), caecum (C), and rectum (R) (Paratype USNM 96688); g, Apical view of tentacular crown, nuchal organ (NO), and mouth (M) (Paratype USNM 96689).

In specimens from the *Gerda* collection the number of single coils in the intestine ranges from 13 to 19. In specimens from the M/V *Oregon* the number is 10. The holotype and dissected paratype USNM 96688 each has 15. One fixing muscle attaches the posterior esophagus near its entry to the intestinal coil to the body wall left of the ventral nerve cord in the mid-trunk region. In some specimens the fixing muscle splits, the second branch attaching to the last ascending coil of the intestine. A small caecum is located where the last ascending intestinal coil joins the rectum. A spindle muscle, running through the center of the intestinal coil, attaches to the body wall posteriorly at the tip of the animal and anteriorly just above the anus.

Remarks.—*Phascolosoma turnerae* clearly belongs to the group within the genus *Phascolosoma* recognized by Stephen and Edmonds (1972) as the subgenus *Phascolosoma*. This taxon is diagnosed to include species having two pairs of retractor muscles, simple contractile vessel, and spindle muscle fastened posteriorly. Of the 39 species listed by Stephen and Edmonds only three lack hooks and the remaining 36, along with *Phascolosoma turnerae*, possess hooks on the introvert which serve as diagnostic taxonomic characters. These species with hooks are very similar in general body form and structure and are most easily distinguished by form and structure of hooks and papillae.

The hook of *Phascolosoma turnerae* is simple and readily distinguished from that of other species of *Phascolosoma*. The clear streak follows the curvature of the hook along the convex side. It remains near the convex side of the base of the hook, and does not bisect the base as in some other species. Complexities such as expansions of the clear streak, clear basal triangular areas and accessory teeth, characteristic of hooks of many species of sipunculans, are lacking in *P. turnerae*.

Other characteristic features of *Phascolosoma turnerae*, in combination with the form of the hook, serve to distinguish this species from other hooked species in the subgenus *Phascolosoma*. These features are the conspicuous mammillate papillae concentrated at the anterior and posterior trunk and the proportionately large tentacular crown.

Species of *Phascolosoma* are commonly found in shallow waters, but collections of *P. turnerae* were from 366 to 1184 meters in depth. Another *Phascolosoma* known from deep waters is *P. abyssorum*, found off the coast of southwest Ireland at 1096 meters (Southern 1913). This species is readily distinguished from *P. turnerae* by the manner in which its retractor muscles unite. In the former species, four retractor muscles, which are distinguishable in the esophageal region, are reduced to two near the level of the beginning of the intestine by the union of the dorsal and ventral muscles on each side. The single pair of muscles thus formed continues posteriorly to an attachment to the body wall in the mid-trunk. The four retractor muscles of *P. turnerae*, on the other hand, are completely separate for their entire lengths; the two dorsals attach to the body wall in the mid-trunk and the two ventrals in the posterior one-third of the trunk.

Phascolosoma turnerae has been found only in association with submerged wood. In the samples from the Straits of Florida (*Gerda* station) the sipunculans were present in great densities in the wood (Fig. 4). The sipunculans fit tightly within their burrows and each burrow resembles the outline of its occupant in size and shape. The anterior end of the sipunculan is directed toward the opening

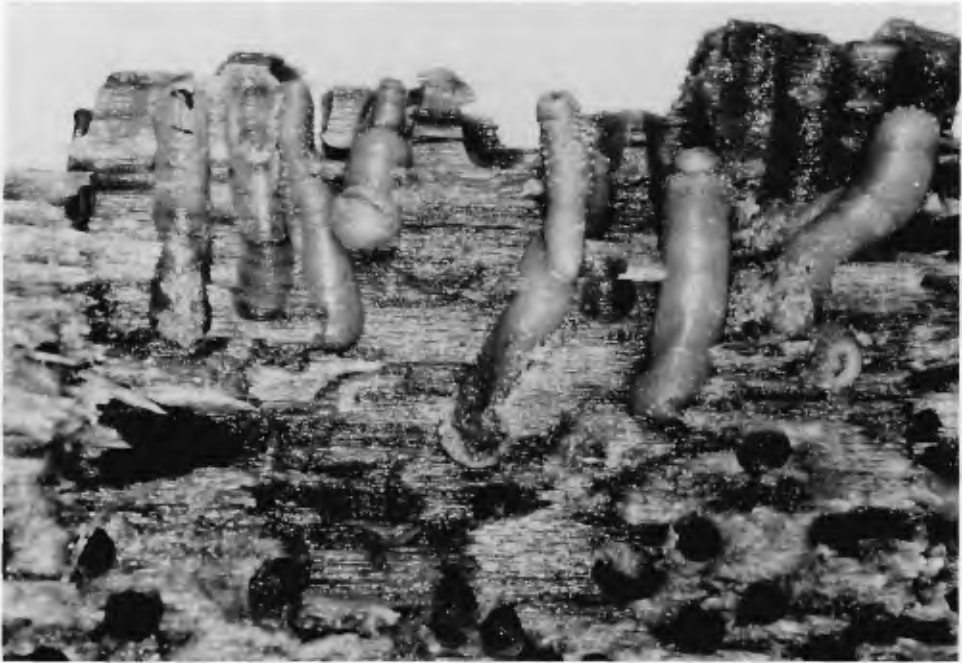


Fig. 4. Photograph of wood sample containing sipunculans. From *Gerda* Cruise 448. Photograph courtesy of Ruth Turner.

of the burrow. These burrows are not lined with a calcareous layer as are those of teredinids. Whether the sipunculans make their own burrows, as they are known to do in calcareous substrata (Rice 1969, 1976) or whether they enter empty teredinid burrows and dissolve the calcareous lining is not known. As pointed out by Dr. Ruth Turner, who provided the specimens from the *Gerda* material, the burrows of the sipunculans are generally at right angles to the grain of the wood whereas those of the teredinids are not thus restricted. Sipunculans possess no known mechanisms for burrowing into wood. However, if the wood were softened by the activity of bacteria or fungi, it seems feasible that a sipunculan, entering a small hole or crevice as a juvenile, might enlarge the cavity as it grows by movements of the body against the surrounding wood to form a burrow.

Wolff (1979) reports finding three specimens of the wide-spread deep-sea species *Golfingia (Phascoloides) shuttei* in mud-filled cavities in wood or in a crevice of wood. He assumed that the specimens were using the wood for shelter, but he was unable to determine whether they were feeding on it. In the case of *P. turnerae*, the sipunculans are undoubtedly utilizing the wood for shelter. Because their introverts are directed toward the outside of the burrow, it is unlikely that they are using the wood as a major source of food. Examination of the gut contents of a few specimens showed that they were packed with a whitish gray fine particulate matter believed to be a fine sediment. A few fragments of calcareous material, foraminiferans, and a few wood fibers were found among the particulate matter and could have originated from within the sediment surrounding the submerged wood or from the surface of the wood itself.

The sipunculans from the *M/V Oregon* collection were in a bottle along with a piece of wood which was riddled with empty burrows. Because of the presence of the wood with the sample, it is assumed that the sipunculans were in some way associated with it, although no such notations were made in the station records.

An interesting association is found between the sipunculans in the wood and wood-inhabiting pogonophorans. In the sample from the *Gerda* cruise, pogonophoran tubes penetrated throughout the wood and were entwined around the bodies of many of the sipunculans (Fig. 1b). The pogonophorans have been identified by Dr. Eve Southward as belonging to the genus *Sclerolinum*. The material available was insufficient for specific identification.

Etymology.—The species is named for Dr. Ruth Turner, Museum of Comparative Zoology, Harvard University, who first recognized these wood-dwelling sipunculans and provided the material from the *Gerda* cruise.

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