

NEW SPECIES AND NEW RECORDS OF SCALED  
POLYCHAETES (POLYCHAETA: POLYNOIDAE)  
FROM HYDROTHERMAL VENTS OF THE  
NORTHEAST PACIFIC EXPLORER AND  
JUAN DE FUCA RIDGES

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*Abstract.* — The joint Canadian-American Seamount Expedition in the Northeast Pacific uncovered additional polynoid polychaetes associated with hydrothermal vents of the Explorer and Juan de Fuca Ridges. They included five species, two new, in three subfamilies of Polynoidae: Lepidonotopodinae: *Lepidonotopodium piscesae*, new species; Macellicephalinae: *Levensteiniella kincaidi* Pettibone; Branchinotogluminae: *Branchinotogluma grasslei* Pettibone, *P. sandersi* Pettibone, *Opisthotrochopodus tunnicliffeae*, new species. The diagnosis of *Opisthotrochopodus* is emended. Habitats of some species are discussed.

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Among the unusual marine life discovered in August 1983 by the joint Canadian American Seamount Expedition (CASM) in the Northeast Pacific (Tunnicliffe & Juniper 1983, Harman 1984, Canadian American Seamount Expedition 1985) and later studies on the Axial Seamount of the Juan de Fuca Ridge (Tunnicliffe et al. 1985) and the Explorer Ridge (Tunnicliffe et al. 1986), were five species of polychaete worms belonging to three subfamilies of Polynoidae. The subfamilies were described earlier by me from hydrothermal vents of the Tropical East Pacific: the Galapagos Rift and 21°N (Pettibone 1983, 1984, 1985a, b), and three of the five species were previously described from these areas: *Levensteiniella kincaidi*, Macellicephalinae; *Branchinotogluma grasslei* and *B. sandersi*, Branchinotogluminae. The remaining two are new species: *Lepidonotopodium piscesae*, Lepidonotopodinae, and *Opisthotrochopodus tunnicliffeae*, Branchinotogluminae.

The polynoids were collected by the Canadian submersible DSRV *Pisces IV* in 1983, 1984, and 1986, and by DSRV *Alvin* in 1984, and sent to me for study by Verena

Tunnicliffe. Additional specimens collected by DSRV *Alvin* in 1984 were provided by Meredith L. Jones. The specimens were obtained from four vent areas: Explorer Ridge (50°N); Endeavour segment of the Juan de Fuca Ridge (48°N); Axial Seamount of the Juan de Fuca Ridge (46°N); and Southern Juan de Fuca Ridge (45°N).

The Axial Seamount of the Juan de Fuca Ridge was described by Tunnicliffe & Juniper (1983), Harmon (1984), Canadian American Seamount Expedition (1985), and Tunnicliffe, Juniper, & de Burgh (1985). Axial Seamount is a volcanic feature formed by hydrothermal activity, 46° off the U.S.-Canadian border. The seamount is crossed by a fissure of about 1510 meters, within which is a system of vents with water temperatures up to 35°C. Dense thickets of vestimentiferan tubes overgrow the major vents and consist of deposits of sulfide-forming chimneys. Large quantities of mucus bind the tubes together and provide habitats for many organisms. Chemosynthetic bacteria are found in the mucous strands. The vents vary from diffuse flow through bacterial mats to large structures (over 2 meters high) built

by the vestimentiferan tube worms. The minor vents are surrounded by bacterial mats, small prone vestimentiferans, and limpets. Colonial protozoans (folliculine ciliates) and bacterial mats cover most surfaces of the active fissures.

Associated animals of the Axial Seamount, in addition to the vestimentiferan *Ridgeia piscesae* Jones, with its large, soft collared tubes, were two species of alvinellid polychaetes: *Paralvinella palmiformis* Desbruyères & Laubier, the large "palm-worm" that wraps the caudal end around the *Ridgeia* tubes with the anterior end held upright; and *P. pandorae* Desbruyères & Laubier, the smaller "pandora-worm," that forms mucus-lined tubes on the bases of the vestimentiferans. The ampharetid *Amphisamytha galapagensis* Zottoli was also found living in small tubes of mineral fragments on the periphery of the vents. Two new polynoid polychaetes were tentatively identified as species A and B by D. Weston; they were examined and referred herein to *Lepidonotopodium piscesae*, n. sp. (species A) and *Branchinotogluma grasslei* Pettibone, 1985 (species B). The larger white polynoids (= *L. piscesae*) were observed crawling on vestimentiferan tubes and rocks and grazing on bacterial and protozoan mats; its white coloration was due to the filamentous bacteria attached to the elytra. The smaller red polynoids (= *B. grasslei*) were found closer to the water flow than the larger white species.

The extensive hydrothermal vents of the Explorer Ridge (50°N, 130°W, 1820 m) were described by Tunnicliffe et al. (1986). This is the most northern of the recently explored vent areas of the eastern Pacific. The vents are formed of large sulfide mounds projecting 2 to 20 meters in height through thick grey hydrothermal sediment. The mounds are covered with active chimneys and vent grey 'smoke' which is a fluid rich in hydrogen-sulfide and of a high temperature (25–310°C). Vestimentiferan tubes were the major habitat for other species; limpets were

particularly abundant. Three polynoid species were listed (Pettibone, personal communication): *Branchinotogluma* sp. (= *B. grasslei*, *B. sandersi* Pettibone, 1985), *Lepidonotopodium* sp. (= *L. piscesae*, n. sp.), and *Levensteiniella* sp. (= *L. kincaidi* Pettibone, 1985).

Holotype, paratypes, and additional specimens are deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Paratypes and representative specimens are deposited in the National Museum of Natural Sciences, Ottawa, Canada (NMCA).

#### Family Polynoidae

##### Subfamily Lepidonotopodiinae

Pettibone, 1983

##### *Lepidonotopodium* Pettibone, 1983

The genus includes three previously described species: *L. fimbriatum* Pettibone, 1983, from off western Mexico at 21°N; *L. riftense* Pettibone, 1984, and *L. williamsae* Pettibone, 1984, both from the Galapagos Rift. A new species from the Explorer and Juan de Fuca Ridge systems is added.

##### *Lepidonotopodium piscesae*, new species

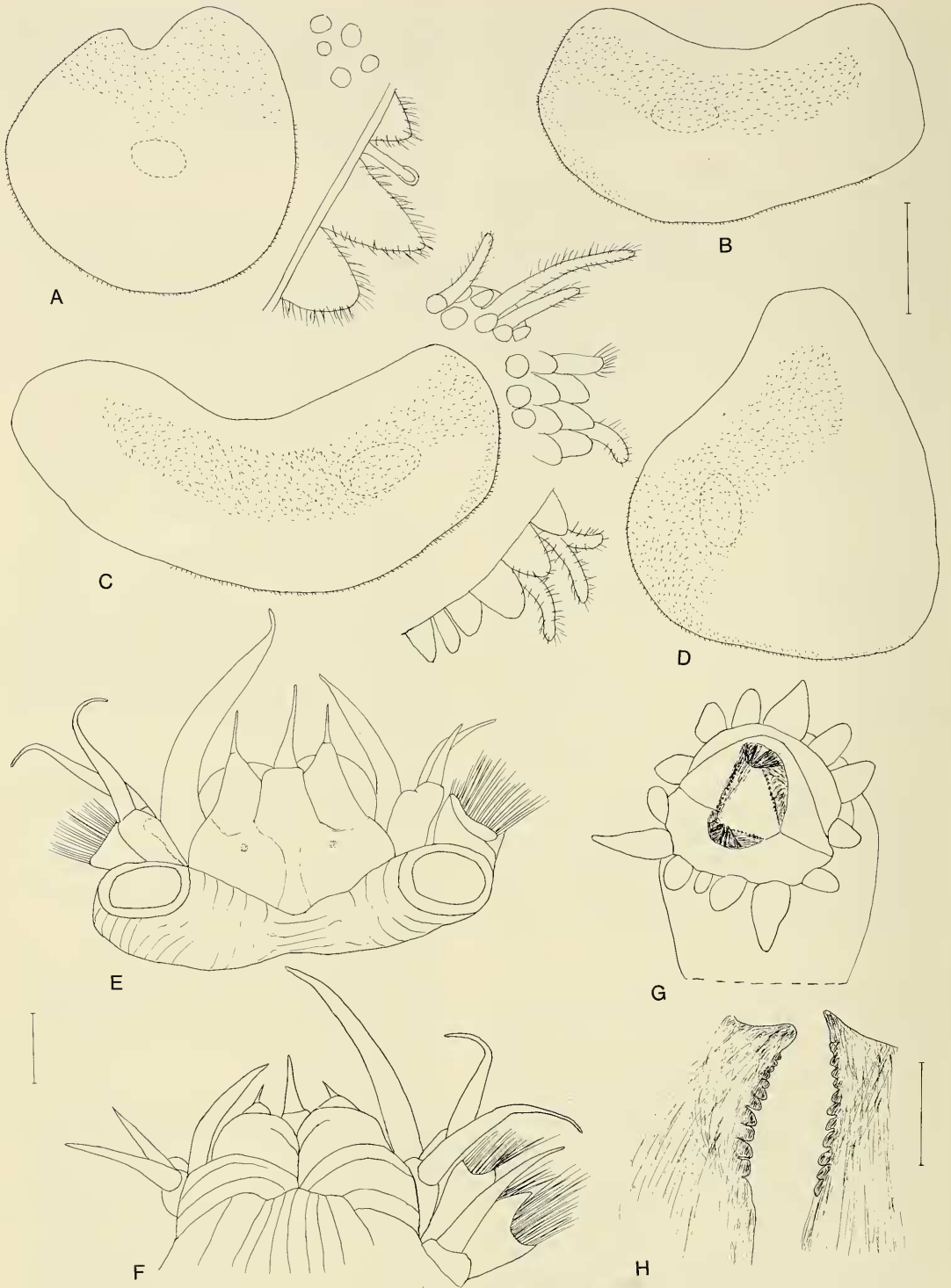
Figs. 1–4

Large white polynoid, Tunnicliffe, Juniper, & de Burgh, 1985:454, 455, 459, fig. 4 (bottom left). [Axial Seamount]

*Lepidonotopodium* sp., Tunnicliffe et al., 1986:407. [Explorer Ridge]

*Lepidonotopodium*, n. sp. (A), Desbruyères et al., 1985:114. [Juan de Fuca, sulfide rocks]

*Material.* — Hydrothermal vents of Northeast Pacific, dives by DSRV *Pisces IV* (P) and DSRV *Alvin* (A): EXPLORER RIDGE, 49°45'N, 130°16'W, 1812–1823 m: P1494-600/605, Gulati and Gusher vents, 1 Jul 1984, 14 paratypes (8 small) (USNM 102883); P1497-611, Crab vent, 4 Jul 1984, 7 paratypes (USNM 102886); P1505-617, Buster Thruster vent, 19 Aug 1984, 8 para-



types (USNM 102888).—ENDEAVOUR SEGMENT, JUAN DE FUCA RIDGE, 47°57'N, 129°06'W, 2208 m, A1452-621/641, 7 Sep 1984, 7 paratypes (USNM 102889).—AXIAL SEAMOUNT, JUAN DE FUCA RIDGE, 45°56–59'N, 130°01–03'W, 1546–1592 m: A1411, 16 Jul 1984, 2 young paratypes (USNM 102882); A1413, 18 Jul 1984, holotype (USNM 102878), 3 paratypes (USNM 102881), 23 paratypes (USNM 102887), 3 paratypes (NMCA1987-0449); P1327-639, 17 Aug 1983, Taylor's vent, paratype (USNM 102884); P1721-628, 17 Jul 1986, Embley's Inferno, 3 paratypes (USNM 102879); P1728-632, 29 Jul 1986, Demon vent, 3 small paratypes (USNM 102880).—SOUTHERN JUAN DE FUCA RIDGE, 24 Oct 1984, 44°39'N, 130°22'W, 2200 m: A1455-1B-616, 4 paratypes (USNM 102890); A1463-7B-615, paratype (USNM 102885).

*Measurements.*—Holotype from Endeavour Segment, Juan de Fuca Ridge, 28 mm long, 13 wide with setae, with 26 segments, last one small; additional paratypes 13–29 mm long, 8–12 mm wide, with 24–26 segments. Adult paratypes from Explorer Ridge 10–23 mm long, 6–11 mm wide, with 24–26 segments: young paratype 4 mm long, 3 mm wide, with 18 segments, last one small. Adult paratypes from Axial Seamount, Juan de Fuca Ridge, 11–28 mm long, 6–14 mm wide, with 24–28 segments, last one minute; young paratype 9 mm long, 7 mm wide, with 22 segments. Paratypes from Southern Juan de Fuca vent 19–29 mm long, 9–13 mm wide, with 25–26 segments.

*Description.*—Body sturdy, elongate-oval, rounded anteriorly and posteriorly, flat-

tened ventrally and arched dorsally; color brownish to tan. Elytra 11 pairs, on segments 2, 4, 5, alternate segments to 21; with dorsal cirri on posterior segments. Elytra large, overlapping, covering dorsum, thick, stiff, opaque, attached eccentrically on prominent elytophores. First pair oval, with anterolateral notch (for passage of dorsal tentacular cirrus), following ones subreniform, posterior pair (11th) subtriangular (Fig. 1A–D). Elytral surface thickly covered with opaque, rounded to conical microtubercles, especially thick on somewhat raised transverse areas in middle of elytra and along posterior and lateral borders, and with scattered globular and filiform micropapillae; both tubercles and papillae with bacterial “hairs” attached (Fig. 1A–D). Dorsal cirri on segments lacking elytra with large cylindrical cirrophores on posterior sides of notopodia, with styles long, tapered, extending beyond tips of neurosetae; dorsal tubercles on cirriferous segment elongate, inflated (Fig. 2C). Surfaces of elytophores, dorsal tubercles, and anterior sides of parapodia with numerous ciliated ridges (Figs. 1E, 2A–C).

Prostomium bilobed, with anterior lobes prominent, tapered, with rather long frontal filaments; wider on posterior half, whitish, with pair of tannish or dark spots, appearing as “eyes”; median antenna with large cylindrical ceratophore in anterior notch with style short tapered, about length of ceratophore; palps stout, smooth, tapering, about 1½ time length of prostomium (Fig. 1E). First or tentacular segment fused to prostomium, not visible dorsally; tentaculophores lateral to prostomium, without setae, each

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 Fig. 1. *Lepidonotopodium piscesae*, A–F, holotype; G, H, paratype, USNM 102890: A, Left 1st elytron, segment 2, with detail of microtubercles, micropapillae, and bacterial “hairs”; B, Left 2nd elytron, segment 4; C, Right middle elytron, with detail of A; D, Left 11th elytron, segment 21; E, Anterior end, dorsal view, palp, dorsal and ventral tentacular cirri of right side smaller, regenerating; F, Same, ventral view, right parapodium of segment 2 not shown; G, Extended pharynx, frontal view, showing border papillae and dark red jaws; H, Dorsal jaws removed. Scales = 2.0 mm for A–D; 1.0 mm for E–G; 0.5 mm for H.

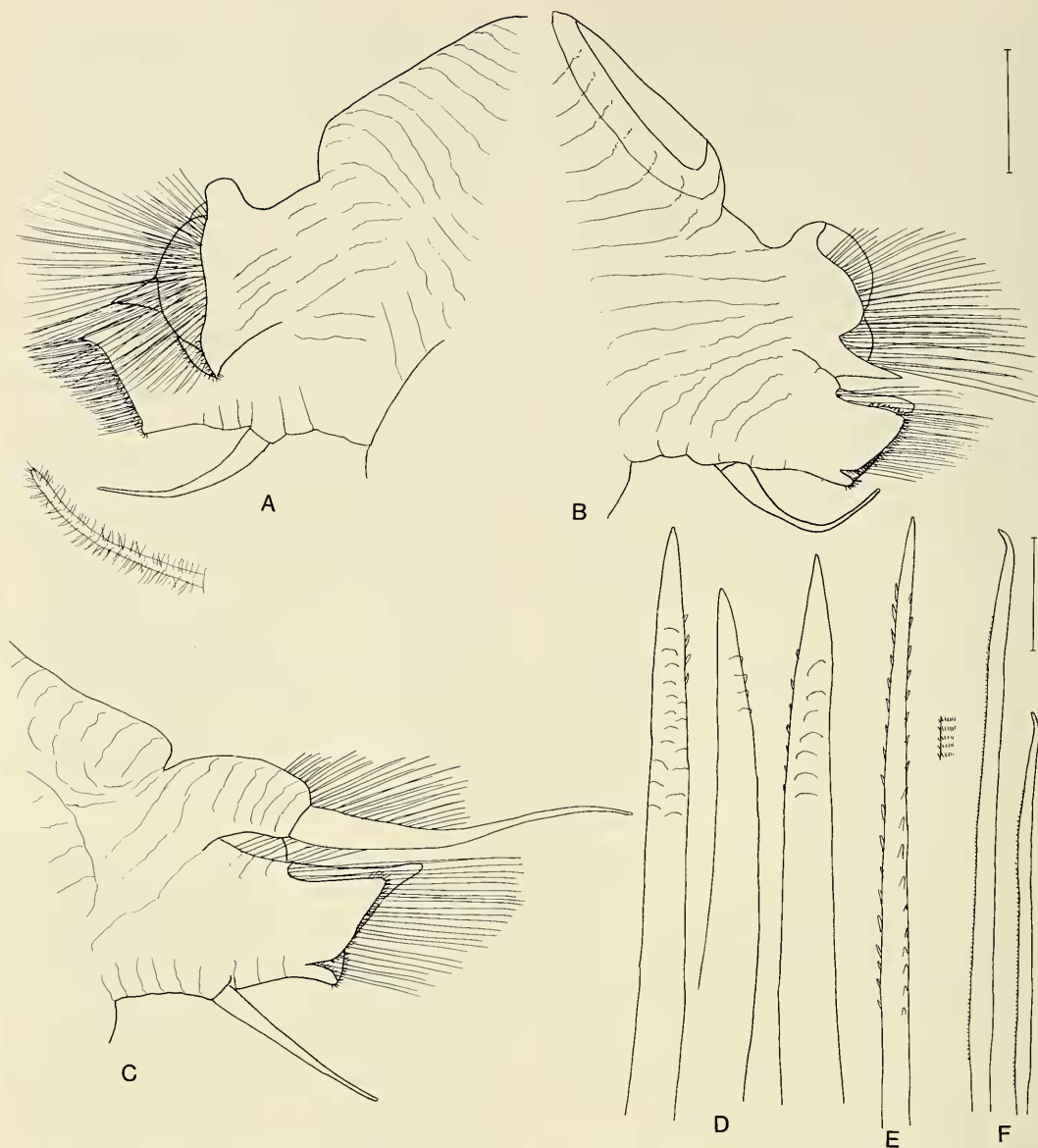


Fig. 2. *Lepidonotopodium piscisae*, holotype: A, right middle elytragerous parapodium, anterior view, with detail of neuropodial papillae with bacterial "hairs"; B, Same, posterior view; C, Right middle cirriferous parapodium, posterior view; D, Notosetae; E, Supraacicular neuroseta; F, Upper and lower subacicular neurosetae, with detail of spinous rows. Scales = 1.0 mm for A-C; 0.1 mm for D-F.

with pair of tentacular cirri, subequal in length, slightly shorter than palps; without distinct facial tubercle (Fig. 1E, F).

Second or buccal segment with first pair of large elytraphores, biramous parapodia, and ventral buccal cirri attached basally on

prominent cirrophores lateral to ventral mouth, with styles similar to tentacular cirri, larger than following ventral cirri (Fig. 1E, F). Ventral mouth enclosed in fleshy upper, lateral and posterior lips medial to parapodia of segments 1 and 2 (Fig. 1F).

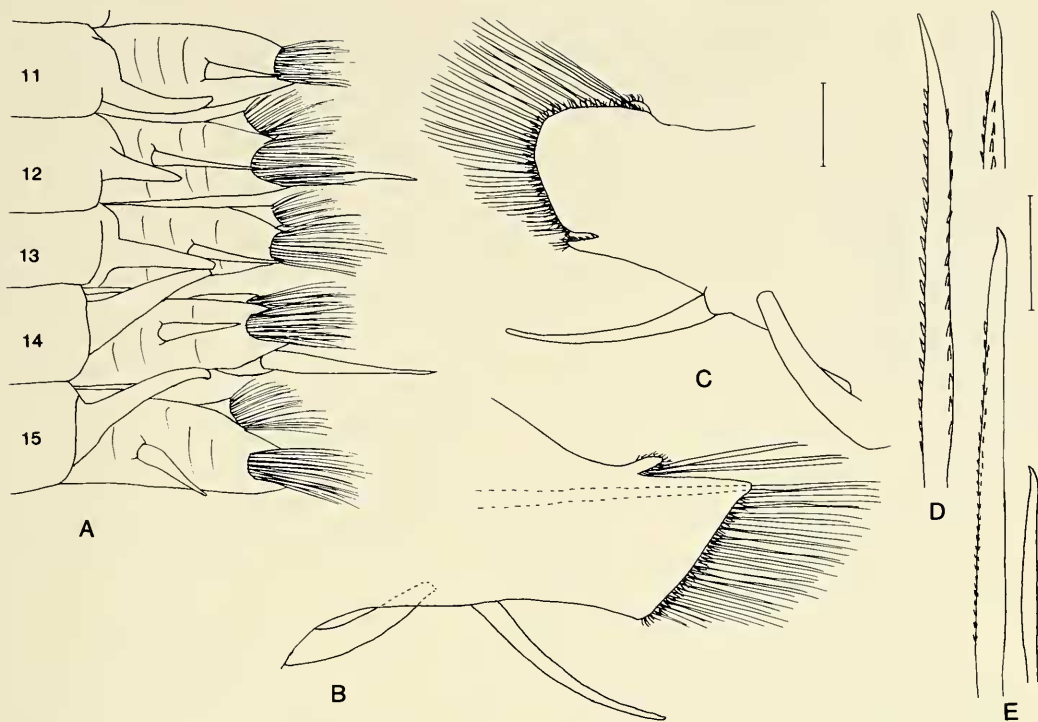


Fig. 3. *Lepidonotopodium pisceseae*, paratypes, A, USNM 102887; B-E, USNM 102889: A, Ventral view of left side of segments 11-15, showing segmental papillae; B, Left neuropodium from segment 12, anterior view, separated from notopodium, neuroaciculum dotted; C, Same, posterior view; D, Supraacicular neurosetae from same; E, Upper and lower subacicular neurosetae from same. Scales = 1.0 mm for A; 0.5 mm for B, C; 0.1 mm for D, E.

Large muscular eversible pharynx with 7 pairs of border papillae and 2 pairs of strong, hooked, dark red jaws; dorsal row of papillae subequal in size, with middle one only slightly larger; ventral row with lateral pair and 3 medial papillae smaller, with next to lateral pair elongate and tapered (Fig. 1G). Jaws serrated on cutting edge, with up to 12 or so teeth (Fig. 1G, H).

Biramous parapodia with shorter notopodia on anterodorsal sides of longer neuropodia (Fig. 2A-C). Notopodium large, rounded, with projecting acicular lobe on posterior side, hidden by very numerous notosetae, and nearly enclosed by well-developed, large, flaring bract, attached to acicular lobe on posterior side; lower thinner part of bract bordered with papillae with attached bacterial "hairs" (Figs. 2A, B, 4A).

Neuropodium diagonally truncate, with shallow notch on posterior lower side and deep notch on posterior upper side; upper part of presetal acicular lobe projecting beyond shorter postsetal lobe; distal borders of neuropodial lobes papillate with attached bacterial "hairs" (Figs. 2A-C, 3B, C). Notosetae very numerous, forming radiating bundles, varying in length from short to long, much stouter than neurosetae, distal part with 2 rows of spines and blunt tapered tips, most with numerous attached bacterial "hairs" (Figs. 2D, 4B). Neurosetae numerous, forming fan-shaped bundles. Upper, supraacicular neurosetae few (4 or so) emanating from upper posterior notch of neuropodium, stouter than lower neurosetae, with 2 rows of prominent, lateral spines and bare tapered tips (Figs. 2E, 3D). Very nu-

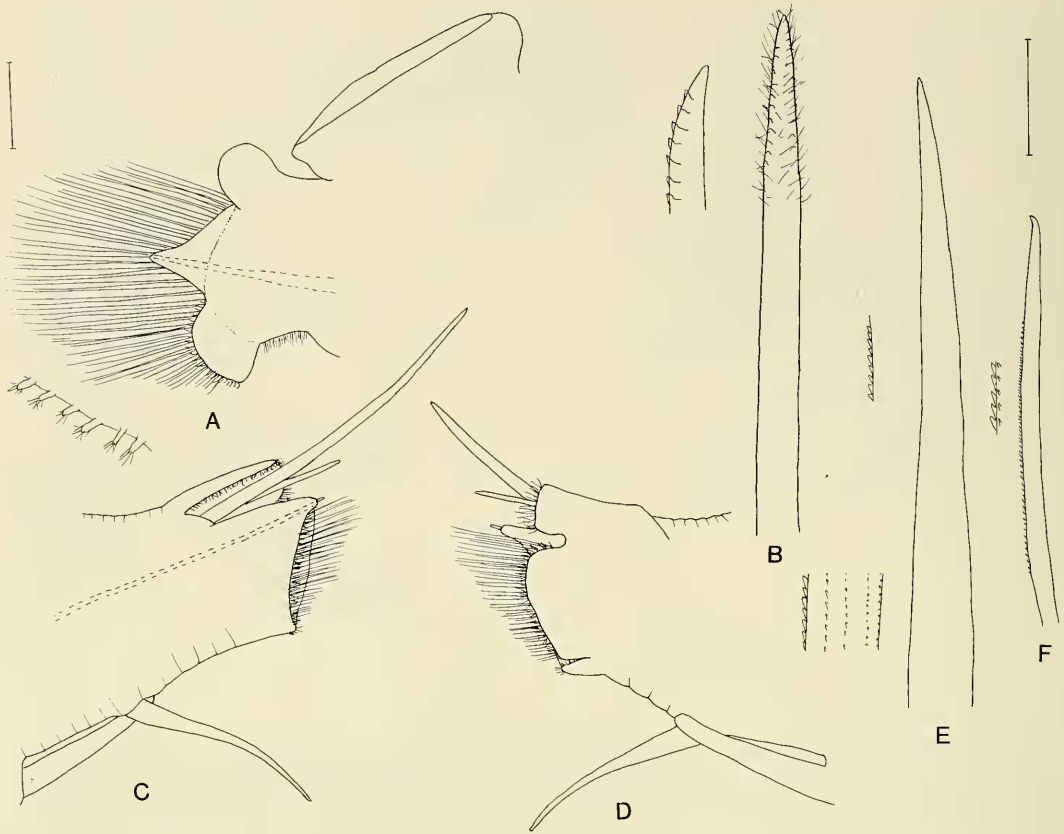


Fig. 4. *Lepidonotopodium piscisae*, paratype, USNM 102889: A, Left notopodium and elyrophore from segment 13, separated from neuropodium, posterior view, notoaciculum dotted, with detail of papillae on ventral part of bract; B, Short (left) and long (right) notosetae from same, with bacterial "hairs"; C, Left neuropodium from segment 13 anterior view, neuroaciculum dotted; D, Same, posterior view; E, Supraacicular neuroseta from same, with detail of fine spinous rows; F, Subacicular neuroseta from same, with detail of spinous rows. Scales = 0.5 mm for A, C, D; 0.1 mm for B, E, F.

merous subacicular neurosetae with slightly hooked tips and fine spinous rows on cutting edge (Figs. 2F, 3E, 4F). On 7 paratypes, neuropodia of segment 13 differing by presence of only 1–2 long, stout, reddish sabre-like supraacicular neurosetae, appearing smooth but with longitudinal rows of fine spines (Fig. 4C–E), with greater development of upper fimbriated bract (compare Figs. 3B–D and 4C–E). Ventral cirri attached on middle of neuropodia, tapering to slender tips, and extending to tips of neuropodia (Figs. 2A–C, 3B, C).

About half of adult paratypes with 5 pairs

of elongate ventral papillae on segments 11 to 15, attached on middle bases of neuropodia, and extending to near bases of ventral cirri or beyond (Figs. 3A–C, 4C, D). Pygidium bulbous dorsal lobe between parapodia of posterior few smaller segments, with or without pair of anal cirri.

*Etymology.* — The species is named for the Canadian submersible DSRV *Pisces IV*.

*Distribution.* — Hydrothermal vents of Northeast Pacific, in 1546 to 2208 meters.

*Biology.* — *Lepidonotopodium piscisae* lives on the periphery of the vents, crawling on rocks and vestimentiferan tubes, grazing

on protozoan and bacterial mats. One specimen was observed on time-lapse photography crawling to the top of a tube and groping around inside (V. Tunnicliffe, in litt.). The elytra are often coated with bacterial filaments, giving them a white color.

*Lepidonotopodium piscisae* is most closely related to *L. williamsae* from the Galapagos Rift. The two species differ from one another as follows: *L. piscisae* has 5 pairs of elongate segmental papillae on segments 11–15, instead of 4 pairs on segments 12–15; a pharynx with 7 pairs of unequal-sized border papillae, instead of subequal papillae, jaws with up to 12 basal teeth, instead of 7, and has 1–2 elongate sabre-like supraacicular neurosetae on segment 13 of a few specimens, instead of lacking them entirely.

#### Subfamily Macellicephalinae

Hartmann-Schroder, 1971,

emended Pettibone, 1976

Genus *Levensteiniella* Pettibone, 1985

*Levensteiniella kincaidi* Pettibone

Fig. 5

*Levensteiniella kincaidi* Pettibone, 1985b:  
741, figs. 1–3.

*Levensteiniella* sp. Tunnicliffe et al., 1986:  
407. [Explorer Ridge]

*Material.* — Hydrothermal vents of Northeast Pacific, dives by DSRV *Pisces IV* (P) and DSRV *Alvin* (A): EXPLORER RIDGE, 49°45'N, 130°16'W, 1818–1823 m: P1494-604/605, 1 Jul 1984, 5 specimens (USNM 102869), 1 specimen (NMCA 1987-0451); P1505-602, 19 Aug 1984, Busted Thruster vent, 1 specimen (USNM 102867). — ENDEAVOUR SEGMENT, JUAN DE FUCA RIDGE, 47°57'N, 129°04–06'W, 2208–2213 m A1418, 24 Jul 1984, 1 specimen (USNM 102868); A1447-614, 3 Sep 1984, 2 specimens (USNM 102870); A1452-621, 7 Sep 1984, Lt. Obo vent, 1 specimen (USNM 102871). — AXIAL SEAMOUNT, JUAN DE FUCA RIDGE, 45°56–57'N, 130°01'W, 1546–1553 m; A1411, 16 Jul 1984, residue from animal

container, young specimen (USNM 102866); A1413, 18 Jul 1984, young specimen (USNM 102872).

*Remarks.* — The 12 specimens agree with previously described specimens from the Galapagos Rift and 21°N vent sites. Some specimens are larger than previously reported (12 mm long, 6 mm wide, with 25 segments). The largest specimen from Explorer Ridge is 16 mm long, 9 mm wide, for 25 segments, with the last one small; additional adult specimens are 12–15 mm long, 7–9 mm wide, for 25 segments; a small specimen is 7 mm long, 4 mm wide, for 23 segments, with the last 3 small. The largest specimen from the Endeavour Segment is 16 mm long, 9 mm wide, for 25 segments; a small specimen is 6 mm long, 5 mm wide, for 22 segments. Two young specimens from Axial Seamount are 1.2 mm long, 1.2 mm wide, for 11 segments.

Most of the elytra were missing. On a small specimen from Endeavour Segment, Juan de Fuca Ridge, three pairs of elytra remained on segments 2, 4, and 5; in addition to the usual filiform papillae on the surface, some papillae on the posterior and lateral borders were enlarged basally (Fig. 5A, B). Four of the larger specimens had long ventral papillae on segments 11 and 12, sometimes directed dorsally between the parapodia.

*Distribution.* — Hydrothermal vents of Tropical East Pacific: Galapagos Rift and East Pacific Rise at 21°N, in 2457–2633 m; Northeast Pacific: Explorer Ridge, Endeavour Segment and Axial Seamount, Juan de Fuca Ridge, in 1546–2213 m.

#### Subfamily Branchinotogluminae

Pettibone, 1985

*Branchinotogluma* Pettibone, 1985

*Branchinotogluma grasslei* Pettibone

Red polynoid polychaete, Tunnicliffe & Juniper, 1983:966. [Axial Seamount, Juan de Fuca Ridge]

*Branchinotogluma grasslei* Pettibone,



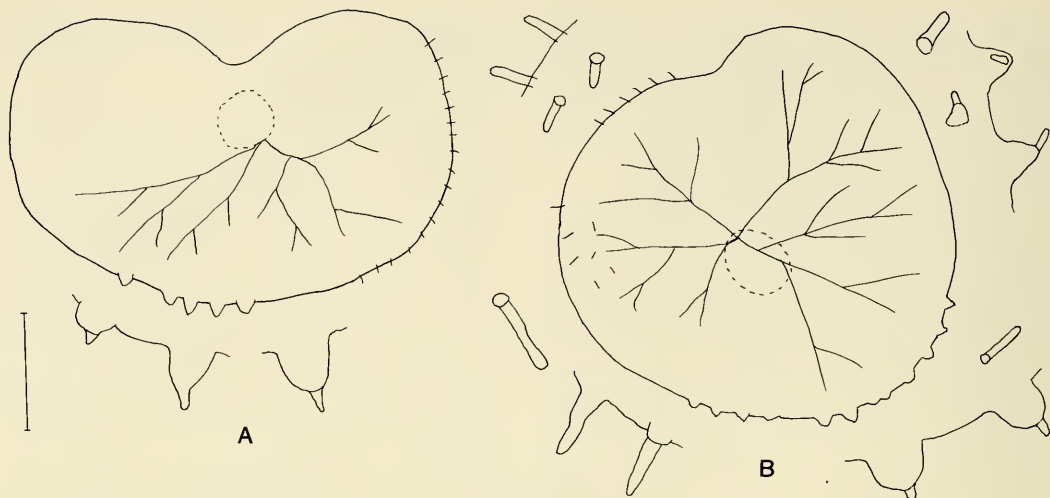


Fig. 5. *Levensteiniella kincaidi*, small specimen (6 × 5 mm, with 22 segments), USNM 102870: A, Left 1st elytron, segment 2, with detail of border papillae; B, Right 2nd elytron, segment 4, with detail of border and surface papillae. Scale = 0.5 mm.

1985a:457, figs. 5, 6.—Newman, 1985 (list).

*Branchinotogluma* sp., Tunnicliffe et al., 1986:407. [Explorer Ridge]

**Material.**—Hydrothermal vents of Northeast Pacific, dives by DSRV *Pisces IV* (P) and DSRV *Alvin* (A): EXPLORER RIDGE, 49°45'N, 130°16'W, 1818 m: P1494, 1 Jul 1984, 1 specimen (USNM 102864); P1495-606, 2 Jul 1984, Lunch Hour vent, 2 specimens (USNM 102861).—ENDEAVOUR SEGMENT, JUAN DE FUCA RIDGE, 47°57'N, 129°04–06'W, 2208 m: A1419, 25 Jul 1984, 13 specimens (USNM 102859), 2 specimens (NMCA 1987-0452); A1452.-21, Lt. Obo vent, 7 Sep 1984, 4 specimens (USNM 102865).—AXIAL SEAMOUNT, JUAN DE FUCA RIDGE, 45°59'N, 130°03'W, 1592 m: P1327, 17 Aug 1983, Taylor's vent, 2 specimens (USNM 102860); P1728-634, 29 Jul 1986, Demon vent no. 1, 6 specimens (USNM 102863).—SOUTHERN JUAN DE FUCA RIDGE, A1410, 15 Jul 1984, 45°13'N, 130°09'W, 2380 m, on chalcopyrite and sphalerite, 1 specimen (USNM 102862).

**Remarks.**—The 31 specimens from the four vent areas agree with the specimens previously described from the Galapagos Rift and 21°N vent sites. Specimens from the Explorer Ridge are 14–23 mm long, 7–10 mm wide with setae and have 21 segments. From Endeavour Segment, larger specimens are 13–31 mm long, 6–12 mm wide, and have 21 segments; small specimens are 5–7 mm long, 3–4 mm wide, and have 18–20 segments. From Axial Seamount, the larger specimens are 12–26 mm long, 6–11 mm wide and have 21 segments; the small specimen is 5 mm long, 3 mm wide, with 19 segments. Specimen from Southern Juan de Fuca Ridge is 25 mm long, 12 mm wide, and has 21 segments.

**Distribution.**—Hydrothermal vents of Tropical East Pacific: Galapagos Rift and East Pacific Rise at 21°N, in 2482–2633 m; Northeast Pacific: Explorer Ridge, Endeavour Segment and Axial Seamount, Juan de Fuca Ridge, and Southern Juan de Fuca Ridge, in 1495–2380 m.

**Biology.**—*Branchinotogluma grasslei* has been found living on rocks and the soft vestimentiferan tubes of *Ridgeia piscesae* Jones in the vicinity of very hot vents and high

hydrogen-sulfide levels. They are bright red and very difficult to see in the shimmering hot water of the vents (V. Tunnicliffe, in litt.).

*Branchinotogluma sandersi* Pettibone

*Branchinotogluma sandersi* Pettibone, 1985a:453, figs. 3, 4.—Newman, 1985: 232 (list).

*Branchinotogluma* sp., Tunnicliffe et al., 1986:407. [Explorer Ridge]

*Material.*—Hydrothermal vents of Northeast Pacific, dives by DSRV *Pisces IV* (P) and DSRV *Alvin* (A): EXPLORER RIDGE, 49°45'N, 130°16'W, 1818 m, P1494, 1 Jul 1984, 2 specimens (USNM 102857).—ENDEAVOUR SEGMENT, JUAN DE FUCA RIDGE, 47°57'N, 129°04–06'W, 2208 m: A1419, 25 Jul 1984, 3 specimens (USNM 102853), 1 specimen (NMCA 1987-0453); A1452-621, Lt. Obo vent, 7 Sep 1984, 3 specimens (USNM 102856).—AXIAL SEAMOUNT, JUAN DE FUCA RIDGE, 45°59'N, 130°03'W, 1592 m: P1327-640, 17 Aug 1983, Taylor's vent, 1 specimen (USNM 102854); P1728-634, 29 Jul 1986, Demon vent no. 1 specimen (USNM 102855).

*Remarks.*—The 11 specimens from three vent areas agree with the previously described specimens from the Galapagos Rift and 21°N vent sites. Two specimens from Explorer Ridge are 8–12 mm long, 4–6 mm wide with setae, for 21 segments. Larger specimens from Endeavour Segment measure 12–15 mm long, 6–8 mm wide, for 21 segments; smaller specimens are 8–9 mm long, 5–6 mm wide, for 21 segments, with the posterior 3 segments not fully developed. A large specimen from Axial Seamount is 21 mm long, 11 mm wide, for 21 segments.

One specimen from Endeavour Segment (USNM 102856) was observed with groups of very long white filaments emerging from the body on the left side between parapodia

of segments 12–13 and 13–14, possibly indicative of a parasite.

*Distribution.*—Hydrothermal vents of Tropical East Pacific: Galapagos Rift and East Pacific Rise at 21°N, in 2451–2633 m; Northeast Pacific: Explorer Ridge, Endeavour Segment and Axial Seamount, Juan de Fuca Ridge, in 1592–2208 m.

*Branchinotogluma* sp. B

*Branchinotogluma* sp. B, Pettibone, 1985a: 466.

*Material.*—Explorer Ridge, 49°45.6'N, 130°16.1'W, 1818 m, P1494, 1 Jul 1984, 2 young specimens (USNM 102858).

*Remarks.*—The two young specimens, 4–6 mm long, 2–3 mm wide with setae, and having 16–17 segments, may be juveniles of *B. grasslei*, *B. sandersi*, or *Opisthotrochopodus tunnicliffeae*; all three species were found at the same station.

*Opisthotrochopodus* Pettibone, 1985, emended

*Type species.*—*Opisthotrochopodus alvinus* Pettibone, 1985a; by original designation. Gender: masculine.

*Opisthotrochopodus* is emended to include the new species *O. tunnicliffeae*.

*Diagnosis.*—Body short, with 21 segments, first achaetous. Elytra 10 pairs, on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, and 19. Dorsal cirri with short cirrophores and long styles, and dorsal tubercles, in line with elytraphores, on segments 3, 6, 8, 10, 12, 14, 16, 18, 20, and 21. Arborescent branchiae 4 per segment, attached to lateral sides of elytraphores, dorsal tubercles, and dorsal sides of notopodia, beginning on segment 3 and continuing to segment 17 or 18. Prostomium bilobed with triangular anterior lobes bearing frontal filaments, with ceratophore of median antenna in anterior notch, with paired ventral palps, without lateral antennae or eyes. First or tentacular segment not visible dorsally; tentaculophores

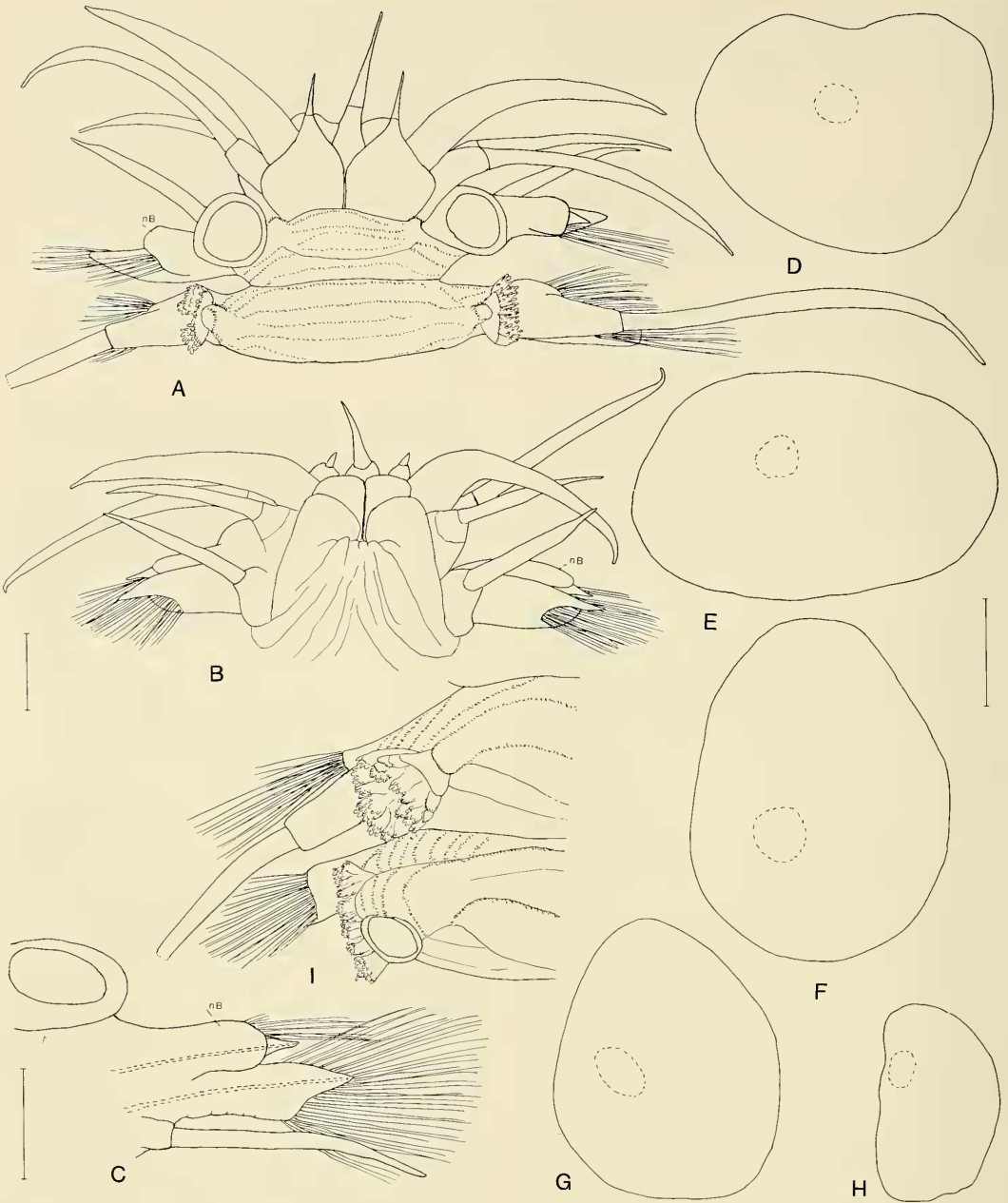


Fig. 6. *Opisthotrochopodus tunicliffae*, A–H, holotype; I, paratype, USNM 102874: A, Anterior end, dorsal view; B, Same, ventral view; C, Left elytragerous parapodium of segment 2, anterior view, acicula dotted; D, Left 1st elytron, segment 2; E, Left 2nd elytron, segment 4; F, Left 8th elytron, segment 15; G, Left 9th elytron, segment 17; H, Left 10th elytron, segment 19; I, Dorsal view left side of segments 8 (cirriferous) and 9 (elytragerous), showing only base of dorsal cirrus. nB, notopodial bract. Scales = 1.0 mm for A, B, I; 1.0 mm for C; 2.0 mm for D–H.

lateral to prostomium, each with dorsal and ventral tentacular cirri, without setae. Second or buccal segment with first pair of elytra, biramous parapodia, and ventral or buccal cirri attached to basal parts of parapodia lateral to mouth; styles longer than following ventral cirri. Parapodia biramous, with notopodia shorter than neuropodia. Notopodia of elytragerous segments 2–17 with prominent rounded bracts enclosing conical acicular lobes and notosetae, or only on segment 2. Neuropodia with longer, flattened, conical presetal and shorter, rounded postsetal lobes. Notoseta stouter than neurosetae, straight, acicular, smooth or with spines. Neurosetae long, slender, finely spinous, with slightly hooked tips. Ventral cirri short, tapered. Posterior 4 segments (18–21) compressed; parapodia directed posteriorly and greatly modified, with expanded delicate lamellae; elongated cylindrical notopodia fused with dorsal cirrophores and distal styles on segments 20 and 21; with unique neuropodial wheel organs on segment 20, including stout acicular neurosetae. Pharynx with 5 border papillae, 3 dorsal and 2 ventral; 2 pairs of dorsal and ventral hooked jaws, each with row of numerous, minute teeth along edge. Segmental ventral papillae or lamellae on segments 12–17. Pygidium with or without pair of anal cirri.

*Opisthotrochopodus tunnicliffeae*,

new species

Figs. 6–9

*Material.*—Hydrothermal vents of Northeast Pacific, dives by DSRV *Pisces IV* (P) and DSRV *Alvin* (A): EXPLORER RIDGE, 49°45'N, 130°16'W, 1818 m: P1494, 1 Jul 1984, paratype (NMCA 1987-0450); P1495-606, 2 Jul 1984, Lunch Hour vent, paratype (USNM 102877).—AXIAL SEAMOUNT, JUAN DE FUCA RIDGE, 16 Jul 1984, 45°57'N, 130°01'W, 1553 m, A1411, residue from animal container, holotype (USNM 102873), 4 paratypes, 2 young (USNM 102874-6).

*Description.*—Length of holotype 25 mm, width with setae 11 mm, segments 21. Length of largest paratype (USNM 102874) 30 mm, width 12 mm, segments 21. Two smaller paratypes 15–17 mm long, 7–9 mm wide, with 21 segments. Two young paratypes (USNM 102876) 2–2.5 mm long, 2–2.5 mm wide, with 14–17 segments, last ones minute. Body flattened ventrally, arched dorsally, slightly tapered anteriorly and posteriorly, with parapodia longer than body width; posterior few segments (18–21) compressed, with parapodia modified (Fig. 8B, C). Elytra large, overlapping, covering dorsum; round to oval, posterior pair smaller, elongate-oval, enclosing posterior modified segments (Fig. 6D–H). Elytra smooth, stiff, somewhat vaulted around place of attachment to elytraphores. Elytraphores large, projecting posteriorly, with arborescent branchiae attached on lateral sides (Figs. 6I, 7B, 8C, D). Dorsal tubercles elongate, projecting posteriorly with arborescent branchiae on distal part (Figs. 6I, 7A, 8C).

Prostomium bilobed, without eyes or lateral antennae; anterior lobes subtriangular, with rather long frontal filaments; median antenna with bulbous ceratophore in anterior notch, subulate style with long slender tip, shorter than tentacular cirri; palps stout, tapered, smooth (Fig. 6A, B). First or tentacular segment forming upper and lateral lips of mouth; tentaculopores lateral to prostomium, without setae, each with pair of tentacular cirri, dorsal tentacular cirrus longer than palp, ventral one shorter than dorsal (Fig. 6A, B). Second or buccal segment forming posterior lip of mouth, bearing biramous parapodia and first pair of elytraphores; notopodia with hood or bract (nB) on anterodorsal side encircling small bundle of notosetae and conical acicular lobe; ventral buccal cirri similar to tentacular cirri, longer than following ventral cirri (Fig. 6A–C). Muscular pharynx observed cut open, showing usual pattern in genus: 5 papillae around opening, 3 dorsal and 2 ventral; 2 pairs of amber-colored jaws minutely den-

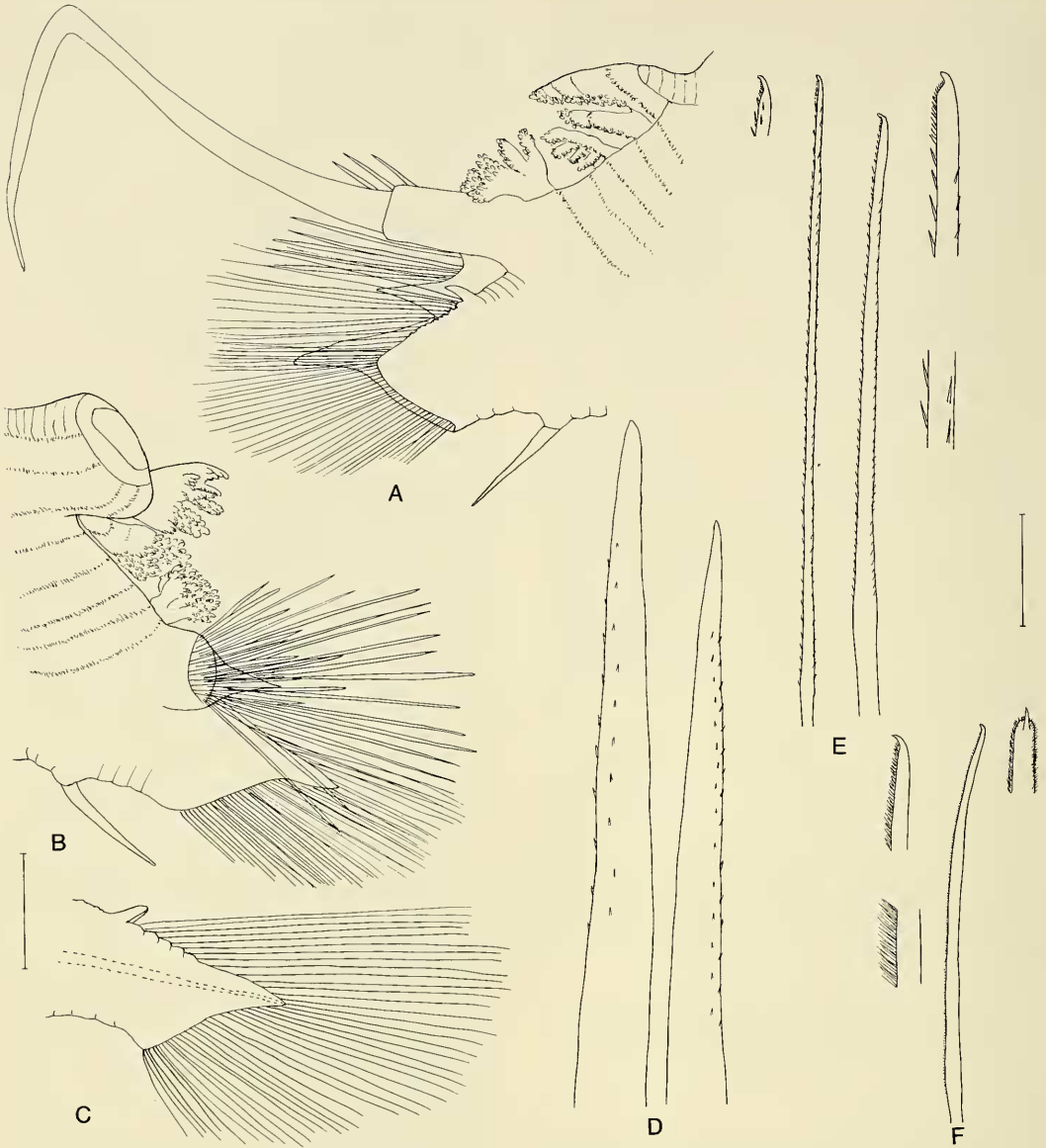


Fig. 7. *Opisthotrochopodus tunnicliffeae*, holotype: A, Left middle cirriferous parapodium, posterior view; B, Left middle elytriferous parapodium, anterior view; C, Left middle neuropodium, anterior view, notopodium cut off, neuroaciculum dotted; D, Notosetae from same; E, Supraacicular neurosetae from same, with detail magnified; F, Subacicular neuroseta from same, with detail magnified, one view of tip turned. Scales = 1.0 mm for A-C; 0.1 mm for D, F.

titled on inner border (see Pettibone 1985a: fig. 8H, I).

Biramous parapodia of segments 3-17 similar, with smaller notopodium on anterodorsal side of larger neuropodium;

notopodium rounded, with projecting, tapered acicular lobe and radiating bundle of numerous notosetae; neuropodium with presetal lobe long, subconical, with projecting acicular lobe; postsetal lobe shorter,

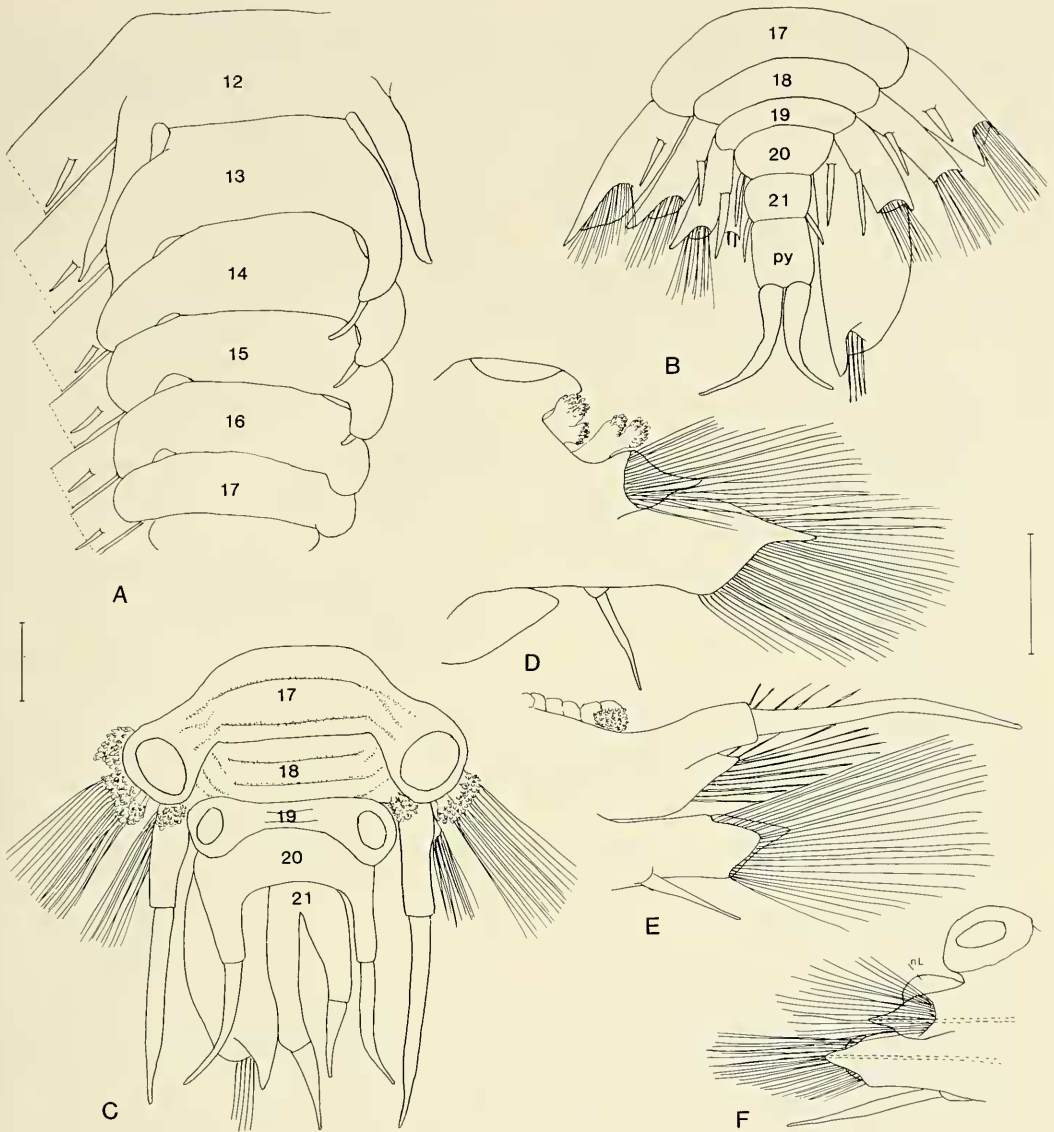


Fig. 8. *Opisthotrochopodus tunnicliffae*, holotype: A, Ventral view of segments 12-17, showing ventral papillae on segments 12-15 and ventral lamellae on segments 16 and 17, parapodia incompletely shown; B, Ventral view of posterior end, including segments 17-21 and pygidium, wheel organ of segment 20 withdrawn on right side; C, Dorsal view of same; D, Left elytragerous parapodium from segment 17, anterior view; E, Right cirriferous parapodium from segment 18, posterior view; F, Right elytragerous parapodium from segment 19, anterior view, acicula dotted. nL, notopodial lamella. Scales = 1.0 mm for A-C; 1.0 mm for D-F.

rounded; lobes widely separated on dorsal side, with projecting small lobe on dorsal base (hidden from view by anterior notopodium), with fan-shaped bundle of very numerous neurosetae (Figs. 7A-C, 8D). No-

tosetae stouter than neurosetae, long, straight, tapered, acicular, with 2 rows of spines; shorter notosetae mostly smooth (Fig. 7D). Neurosetae long, slender, slightly wider basally, with slightly hooked tips; su-

praacicular neurosetae with widely spaced spines extending to near tips, finely spinous distally (Fig. 7E); subacicular neurosetae finely spinous (Fig. 7F). Dorsal cirrus on cirriferous segments on posterodorsal side of notopodium, with cylindrical cirrophore and long style extending far beyond setae; dorsal tubercle extending laterally, with arborescent branchia distally; additional branchia on dorsal base of notopodium (Figs. 6I, 7A). Elytragerous segments with large, bulbous elytraphore extending posterolaterally, with large arborescent branchia on lateral base and additional branchia on dorsal base of notopodium (Figs. 7B, 8C, D). Ciliated bands on dorsum, extending onto elytraphores and dorsal tubercles, as well as on anterior and posterior sides of parapodia (Figs. 6A, I, 7A, B). Ventral cirri on middle of neuropodia tapering to slender tips (Fig. 7A, B).

Cirriferous parapodium of segment 18 much smaller than preceding parapodium, with long dorsal cirrus projecting posteriorly and single, small arborescent branchia projecting from dorsal tubercle (Fig. 8B–E).

Segment 19 with smaller elytraphores approaching medially, usually without branchiae (small one on under side of left elytraphore of holotype), with small parapodia wedged between adjacent parapodia and hidden from view dorsally; notopodium with delicate lamella (nL) on dorsal side; notosetae stout, acicular, with 2 rows of spines; neurosetae slender, minutely spinous, with capillary tips (Fig. 8B, C, F).

Segment 20 with parapodia greatly modified. Neuropodium enlarged (corresponding to wheel organ of *O. alvinus*), inflated, with projecting, conical acicular lobe, with neurosetae projecting from wide opening and ventral cirrus attached near base (Figs. 8B, C, 9A, B, F). Neurosetae consisting of up to 4 stout, acicular, harpoon setae (Fig. 9E) and long slender setae with 2 rows of long spines on basal half, tapering to slender, bare tips (Fig. 9D). Neuropodium on holotype inflated and extended on left side

but retracted and wrinkled on right side (Figs. 8B, C, 9A, F); largest paratype (USNM 102874) with modified neuropodia extended on both sides. Notopodium with acicular lobe fused to cirrophore of dorsal cirrus, with style extending posteriorly; basal part of notopodium compressed against inflated neuropodium and hidden from view until separated, with row of about 13 short, spinous notosetae enclosed in delicate lamella (nL) (Fig. 9A–C). Small paratype of  $17 \times 9$  mm (USNM 102877) with both neuropodia inflated, each with 2–3 harpoon neurosetae. Slightly smaller paratype of  $15 \times 7$  mm (NMCA 1987-0450) with right neuropodium long, inflated, with 3 harpoon neurosetae; left side short, slightly inflated, without harpoon setae. Small paratype of  $17 \times 9$  mm (USNM 102875) with neuropodia only slightly inflated and neurosetae only slender, spinous; notosetae short curved, smooth (Fig. 9H, J).

Segment 21 with elongate cirrophores fused medially with each other and laterally with notopodial lobe containing stout notoaciculum: dorsal cirrus short; notosetae absent (Figs. 8C, 9G). Neuropodium with small conical acicular lobe containing slender neuroaciculum, with small bundle of smooth capillary neurosetae; ventral cirrus longer than neuropodium, attached on lateral side of segment (Figs. 8B, 9G).

Pygidium rectangular, posterior to segment 21, with pair of stout anal cirri (Fig. 8B). Anal cirri sometimes broken off.

Ventral segmental papillae long, tapered on segment 12, shorter and thicker with slender distal part on segments 13–15, reduced to rounded lamellae on 16 and 17; papillae directed dorsally between parapodia, sometimes with yellowish secretion inside and pushed to outside (Fig. 8A, D).

*Etymology.*—The species is named for Verena Tunnicliffe, who sent me the polynoid specimens for study and furnished valuable information.

*Distribution.*—Hydrothermal vents of Northeast Pacific: Explorer Ridge and Axial

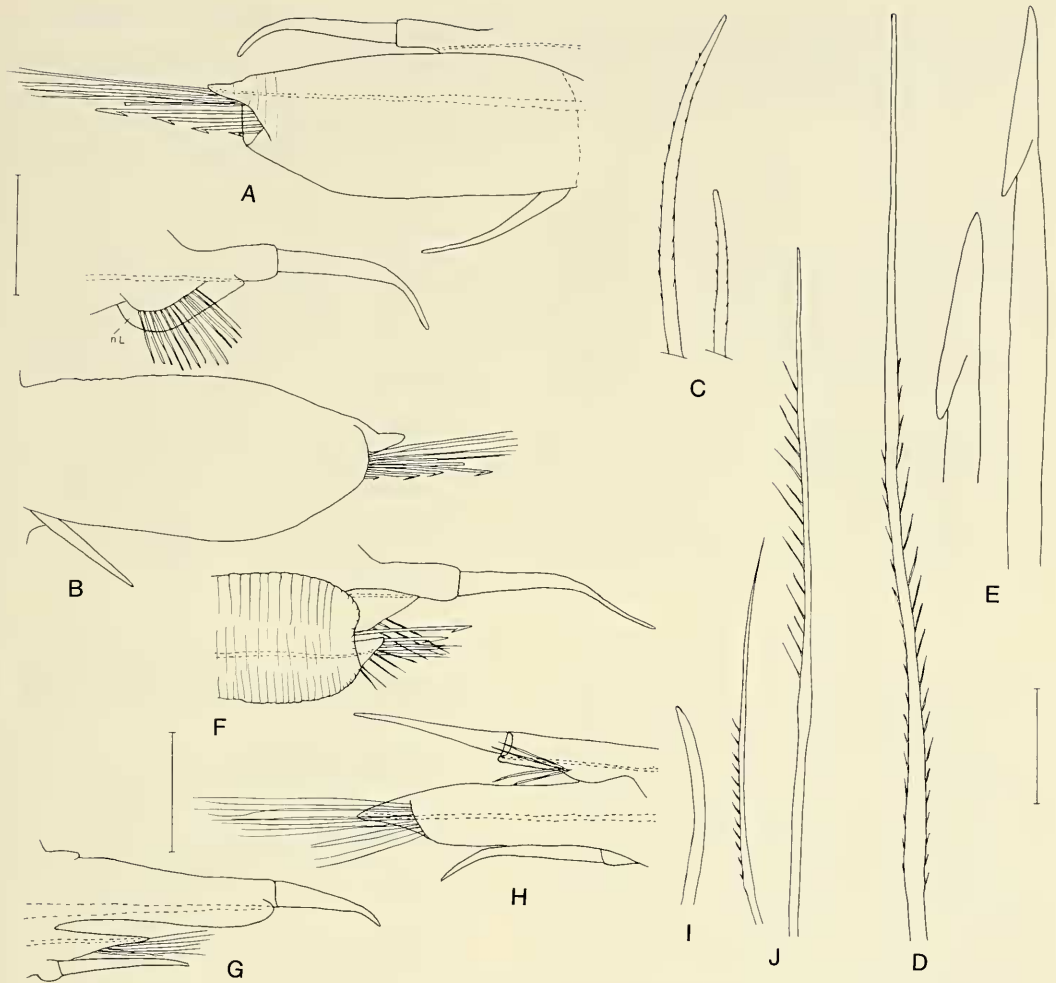


Fig. 9. *Opisthotrochopodus tunnicliffeae*, A–G, holotype; H–J, small paratype, USNM 102875: A, Left cirriferous parapodium from segment 20, anterior view, acicula dotted; B, Notopodium and neuropodium of same, separated, posterior views; C, Notozetae from same; D, Slender neuroseta from same; E, Stout harpoon neurosetae from same; F, Right cirriferous parapodium from segment 20, posterior view, basal part not shown, acicula dotted; G, Left cirriferous parapodium from segment 21, anterior view, acicula dotted; H, Right parapodium from segment 20, anterior view, acicula dotted; I, Notozeta from same; J, Neurosetae from same. nL, notopodial lamella. Scales = 1.0 mm for A, B, F, G; 0.1 mm for C–E, I, J; 0.5 mm for H.

Seamount, Juan de Fuca Ridge, in 1818–1553 m.

**Differential diagnosis.**—*Opisthotrochopodus tunnicliffeae* differs from *O. alvinus* in having notopodial bracts only on segment 2, instead of on all clytragerous segments of 2–17, and agrees with *Brachinotogluma sandersi* and *B. grasslei* in this regard. The posterior modified segments dif-

fer in the two species: in *O. alvinus*, specialized neuropodia of segment 20 flare out and have several types of neurosetae appearing like spokes of a wheel, thus the name wheel organ; whereas in the new species, neuropodia are inflated and have stout, harpoon neurosetae, with “balloon organ” a more appropriate name. In *O. alvinus*, parapodia of segments 18–21 are more modi-



fied, lacking neurosetae on segments 18 and 19, ventral cirri on segments 20 and 21, and anal cirri; whereas these structures are present in *O. tunnlicliffae*.

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