

HELMUT E. ZIBROWIUS

*Review of
Some Little Known
Genera of Serpulidae
(Annelida: Polychaeta)*

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ABSTRACT

Zibrowius, Helmut W. Review of Some Little Known Genera of Serpulidae (Annelida: Polychaeta). *Smithsonian Contributions to Zoology* 42:1-00. 197-. Serpulids which had been classified in the genera *Vermilia*, *Miroserpula*, *Chitinopoma*, *Chitinopomoides*, *Hyalopomatus*, *Hyalopomatopsis*, *Cystopomatus*, and *Protis* are examined and discussed.

The genus *Miroserpula* should be included in the genus *Chitinopoma*, as the type-species of both genera are identical. *C. serrula*, single known species of the genus *Chitinopoma*, is widely distributed in the Arctic and Boreal Atlantic (America and Eurasia). It is characterized by incubation in special brood chambers on the tube of adult specimens. As *C. groenlandica*, it has often been confused with a quite different species from the Pacific coast of North America. For this latter species, first described as *Hyalopomatopsis occidentalis*, the new genus *Pseudochitinopoma* has been created. *Chitinopomoides wilsoni*, an insufficiently known species from bathyal depths off Antarctica, may have some affinities with the genus *Chitinopoma*. Affinities of *Chitinopomoides* with the genera *Spirobranchus* and *Serpula* are excluded.

The bathyal and abyssal forms from the Atlantic (Arctic Basin, Azores, Madeira) and from the Mediterranean, described under the generic names *Hyalopomatus* and *Hyalopomatopsis*, and the bathyal *Cystopomatus* from Antarctica, are closely related. The latter two genera are to be considered as synonyms of the former. The validity of the specific distinctions of these forms, based on the known material, is questionable.

The genus *Protis*, known from the Atlantic and Pacific, includes forms which in Arctic regions may be found in lesser depths, but which are at least bathyal when not abyssal at lower latitudes (Azores, Romanche deep, Gulf of Mexico, off California). The specific distinctions of these forms are questionable. A serpulid from the infralittoral at Puerto Rico, described as *P. torquata*, does not belong to the genus *Protis*.

Helmut W. Zibrowius

Review of Some Little Known Genera of Serpulidae (Annelida: Polychaeta)

The present work aims at revising as far as possible several genera of serpulids which are little known or monospecific and which are mainly represented by Atlantic forms living in Arctic and Boreal regions or at great depths in lower latitudes. Forms from the Pacific coast of North America and Antarctica are also included in these considerations. Some of these forms, which by reason their very different morphology should have been classified in separate genera, were placed together, whereas others, despite their great similarities, were classified in separate genera.

Most of the species discussed are known only from few specimens in the collections of many museums throughout America and Europe. In the present study, I have been able to go beyond mere bibliographic research only by the cooperation of many people who gave me the opportunity to examine the material of these collections. For the loan of material, I have the pleasure to express here my thanks to Mrs. G. Hartmann-Schröder, Zoologisches Staatsinstitut und Zoologisches Museum, Hamburg (ZSZM); to Messrs. A. Capart, Institut Royal des Sciences Naturelles, Bruxelles (IRSN); A. G. Chabaud, Muséum National d'Histoire Naturelle, Paris (MNHN), A. Eliason, Naturhistoriska Museet, Göteborg (NMG); J. D. George, British Museum, (Natural History), London (BMNH); J. B. Kirkegaard, Universitetets Zoologiske Museum, Copenhagen (UZMC); E. Kirsteuer, American Museum of Natural History, New York (AMNH); H. W. Levi,

Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); and especially to Dr. Marian H. Pettibone, United States National Museum (USNM), Washington, D. C., who also helped by her suggestions and by correcting the English text. This study was aided in part by a grant to Dr. Pettibone.

The following genera and species are covered in this study (synonyms in parentheses):

Chitinopoma Levinsen, emended

(= *Miroserpula* Dons)

(= *Microserpula* of Hartman)

C. serrula (Stimpson), new combination

(= *C. fabricii* Levinsen)

(= *Miroserpula inflata* Dons)

C. groenlandica (Mörch), indeterminable

Pseudochitinopoma new genus

P. occidentalis (Bush), new combination

(= *Chitinopoma groenlandica* of Pixell)

(= *Chitinopoma groenlandica* of Berkeley and Berkeley)

Chitinopomoides Benham

C. wilsoni Benham

Hyalopomatus Marenzeller

(= *Hyalopomatopsis* Saint-Joseph)

(= *Cystopomatus* Gravier)

H. claparedii Marenzeller

Hyalopomatus sp.

(= Gen. et sp. ? Eliason)

H. marenzelleri Langerhans

Hyalopomatus sp.

(= *Protis arctica* of Bellan)

H. langerhansi Ehlers

H. macintoshi (Gravier), new combination

(= *Cystopomatus macintoshi* Gravier)

Helmut W. Zibrowius, Station Marine d'Endoume, Marseille, France.

Protis Ehlers*P. arctica* (Hansen)(=*P. simplex* Ehlers)*P. pacifica* Moore*Pomatostegus stellatus* (Abildgaard)(=*Protis torquata* Hoagland)

Family SERPULIDAE Savigny

Genus *Chitinopoma* Levinsen, 1883, emended

Miroserpula Dons, 1931. [Type-species: *Miroserpula inflata* Dons, 1931, by monotypy. Referred herein to *Chitinopoma serrula* (Stimpson, 1854). Variant spelling: *Microserpula*.]

Gender: feminine. Type-species: *Chitinopoma fabricii* Levinsen, 1883, by monotypy. Referred herein to *Chitinopoma serrula* (Stimpson, 1854).

DIAGNOSIS.—Special setae of the first thoracic segment with well-separated distal limbate zones and proximal denticulate wings. Thoracic sickle-setae present. Abdominal setae geniculate with a long triangular blade. Thoracic uncini saw-shaped with about 10 teeth, the anterior tooth simple, not bifurcate. Abdominal uncini in all segments rasp-shaped. Opercular stalk without pinnules or wings. Thoracic membranes short, not united at the ventral face of the last thoracic segment. Thoracic setigerous segments 7.

REMARKS.—According to this emended definition, the genus *Chitinopoma* includes only the widespread North Atlantic *Vermilia serrula* Stimpson 1854, a tube-incubating species later described by Dons (1931) as *Miroserpula inflata*. Referring to Levinsen's description of *C. fabricii*, in which no sort of incubation was mentioned, Dons and followers (Brattström, Thorson, Wesenberg-Lund) considered the breeding form as the type of a different genus, in spite of the nearly identical setae and uncini described in both forms. As proved by examination of breeding specimens, there are in fact no differences between the setae and uncini of Levinsen's *Chitinopoma fabricii* and Don's *Miroserpula inflata*. It has further been found that most of the material in the collections of the Copenhagen museum (UZMC), labeled *Chitinopoma fabricii* (at least some of these determinations seem to have been made by Levinsen himself), is identical with Don's *M. inflata*. The existence of a North Atlantic nonbreeding *Chitinopoma* species different from

C. serrula (Stimpson, 1954) (= *Vermilia serrula*, = *Miroserpula inflata*) has never been proved.

Chitinopoma serrula (Stimpson, 1854), new combination

FIGURE 1

Vermilia serrula Stimpson, 1854, pp. 29-30.—Quatrefages, 1865, p. 561.—Packard, 1863, pp. 403, 418; 1867, p. 292.—Verrill, 1873, p. 439; 1874a, pp. 39, 41, 43; 1874b, p. 412; 1874c, pp. 499, 503, fig. 3, pl. 6: fig. 1; 1874d, pp. 351, 355, 358, 361, 362, pl. 4: fig. 3; 1879, p. 11; 1881, pp. 289, 293, 295, 306, 310, 324.—Hartman, 1944, p. 343, pl. 22 (54): fig. 5; 1948: p. 50.—Treadwell, 1948, p. 69.

Serpula (*Vermilia*) *serrula*?—Dawson, 1860, pp. 28-29, fig. 2. *Chitinopoma fabricii* Levinsen, 1883, pp. 194-196, 199, 203, 309, pl. 2: fig. 4, 8f, pl. 3: fig. 20; 1887, p. 300.—Fauvel, 1911a, p. 45.—Derjugin, 1915, pp. 357-358, 363.—Augener, 1928, p. 817.—Ditlevsen, 1929, pp. 54, 78, 79.—Dons, 1934a, pp. 24-27.—Friedrich, 1939, p. 127.—Brattström and Thorson, 1941, p. 21.—Brattström, 1945, pp. 1, 20, 21.—Wesenberg-Lund, 1951, pp. 130, 156, 167; 1953a, pp. 7, 17; 1953b, p. 138.

Chitinopoma greenlandica [sic].—Bush, 1904, pp. 224, 229, pl. 37: figs. 3, 9; pl. 40: fig. 31.—Nelson-Smith, 1967, p. 37 [in part]. [Not *Hydroides norvegica* var. *groenlandica* Mörch, 1863.]

Chitinopoma groenlandica.—Hartman, 1948, pp. 44, 51; 1959, p. 580. [Not *Hydroides norvegica* var. *groenlandica* Mörch, 1863.]

Miroserpula inflata Dons, 1931, pp. 3-5; 1934a, pp. 24-27; 1934b, pp. 35-37; 1937, pp. 73-76.—Brattström and Thorson, 1941, pp. 21-30.—Brattström, 1945, pp. 1-22.—Thorson, 1946, pp. 135, 136, 141, 145, fig. 77.—Wesenberg-Lund, 1950, p. 61; 1951, pp. 129, 140, 155, 181; 1953a, pp. 6-7; 1953b, pp. 113, 123, 138, 140, 149, chart 26.—Nair, 1962, p. 41.—Nelson-Smith, 1967, pp. 36, 37, fig. 27.—Boisen Bennike, 1968, pp. 1, 5.

Mikroserpula inflata.—Thorson, 1936, p. 35.

Microserpula inflata.—Hartman, 1948, p. 50.

Microserpula serrula.—Hartman, 1959, p. 582.

MATERIAL EXAMINED.—Bay of Fundy: 1 spec., Verrill coll., 1872 (USNM 13375). Casco Bay, Maine; empty tubes, Verrill coll., 1873 (USNM 13291). Gulf of Maine: 1 spec., Packard coll., 1873 (USNM 13322). Eastport, Maine: 1 spec., Packard coll., 1866 (UZMC). Kara Sea: 2 spec., "Dijmphna" expedition (UZMC). Greenland: several spec. on algae, Schmidt coll. (UZMC). Lindenovfjord, Greenland: 1 spec., Bertelsen coll., 23 July 1935 (UZMC). Angerrok, Upernavik, Greenland: 1 spec., Salomonsen coll., 29 June 1936 (UZMC). Faroes: 1 spec. (UZMC). Oersund: empty tubes, Eliason coll. (NMG). East-Spitzbergen: several spec. (ZSZM).

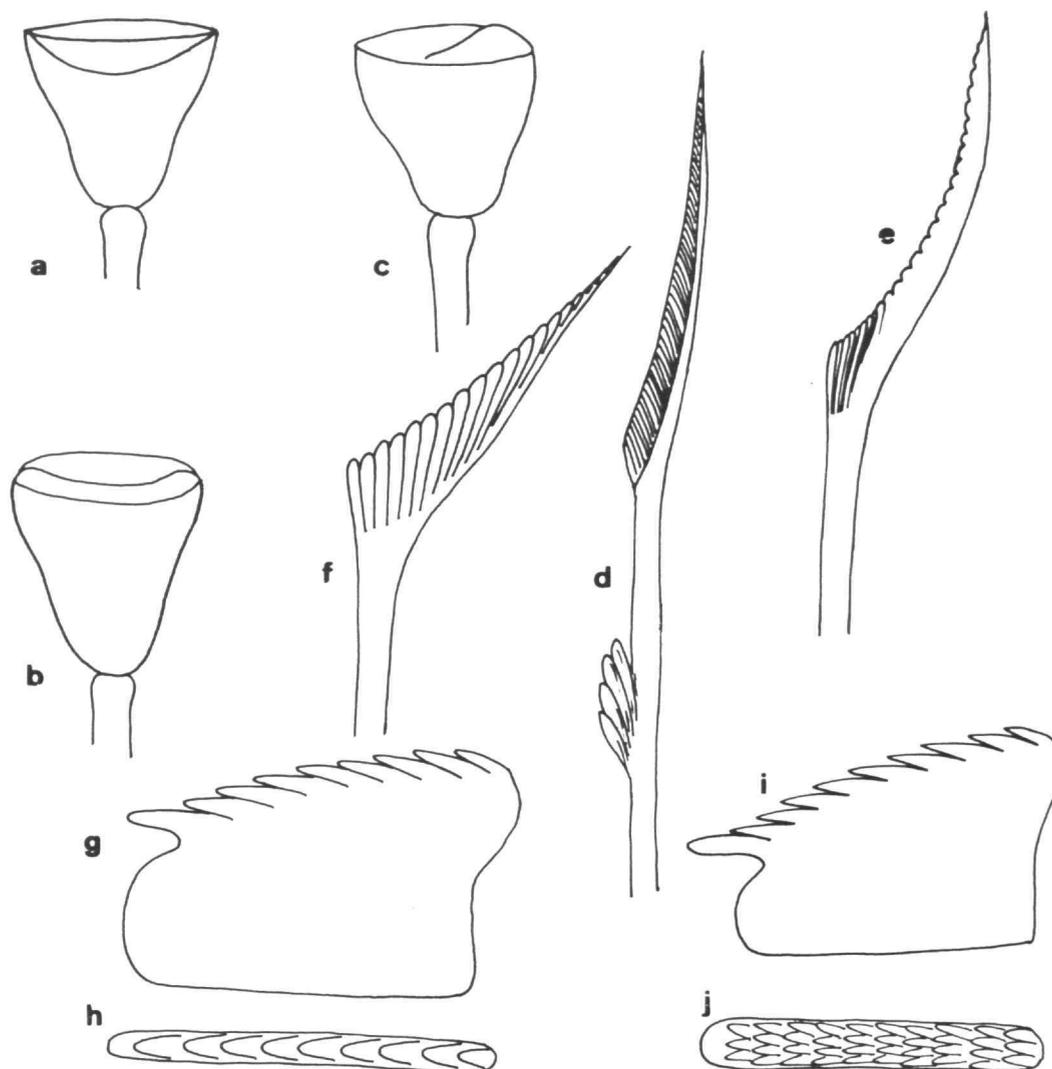


FIGURE 1.—*Chitinopoma serrula* (a, d-j, from specimen from Maine, USNM; b, c, from specimens from Spitzbergen, ZSZM): a-c, opercula; d, special seta of first thoracic segment; e, thoracic sickle-seta; f, abdominal seta; g, h, thoracic uncinus, lateral and edge views; i, j, abdominal uncinus, lateral and edge views.

DESCRIPTION.—Tube white, subtriangular in cross section, and adherent along its whole length to the substratum. The lateral faces may be wrinkled transversely by growth marks. Median keel more or less denticulate. Tubes of adult specimens may have one or several pairs of calcareous brood chambers ("ovicells"), one chamber on each side of the

keel. The mouth of the tube may be widened out in irregular lobes. The length of the animal may attain 20 mm, the operculum diameter 500 μ . About 50 abdominal segments in adult specimens. Collar large and trilobed. Thoracic membranes short, extending not further than the second setigerous segment. Gill tuft composed of 5 to 7 filaments on each

side. No gill membrane. The second filament, on the right or on the left side, forms the smooth non-pinnate opercular peduncle. Operculum almost radially symmetrical and covered by a horny distal plate of brown color. Generally, this horny plate is more or less concave but variations can sometimes be observed: plate almost flat, or slightly convex, or with a more or less large knob or ridge near its dorsal rim. First thoracic setigerous segment with two types of setae: capillary setae and special setae with a distal limbate zone and a proximal wing of a few well-marked teeth, both zones well separated by a gap as long as the wing. The other thoracic segments with limbate setae and capillary ones. Sickle-shaped setae with a short proximal limbate zone present in segments 3 to 7. Abdominal setae geniculate. No long capillary setae in the last segments. Thoracic uncini saw-shaped with about 9 to 12 teeth, the anterior one simple, not bifurcate. The abdominal notopodial uncini in all segments rasp-shaped.

Chitinopoma serrula is mainly characterized by the incubation of the larvae, up to the stage of metatrochophore, inside paired brood chambers with calcareous walls which are attached to the tube on both sides of the median keel.

DISTRIBUTION.—New England, Gulf of Maine, Bay of Fundy, Gulf of St. Lawrence (Gaspé and Labrador), Strait of Belle Isle, East and West Greenland, Iceland, Faroes, Spitzbergen, between Hope Island and Bear Island, Novaja Zemlya, Isle of Vaigach, Gulf of Kola, Murman coast, entire coast of Norway, West coast of Sweden, Oersund, North-West of Jutland. From the tidal zone down to more than 300 m.

The tube of *Chitinopoma serrula* has been found attached to various such solid objects as stones, shells of Mollusca and Brachiopoda, and Bryozoa with calcareous skeleton, as well as on comparative soft substratum, such as the mantle of ascidian species and even on algae. Nair (1962) included *C. serrula* (as *Miraserpula inflata*) in the list of species collected during a study on fouling organisms made in the Bergen area. Nevertheless, the species should not be considered as a main fouling organism.

REMARKS.—The species has a large distribution throughout the Arctic and Boreal Atlantic Ocean where it has been described under different names, chiefly as *Vermilia serrula* Stimpson on the American coast, as *Chitinopoma fabricii* Levinsen from

Greenland and Faroe waters, and as *Miroserpula inflata* Dons on the coast of Norway. Of the generic names, *Chitinopoma* and *Miroserpula*, created specially for the same species, the former is the older one. Thus the species should be named *Chitinopoma serrula* (Stimpson, 1854).

The only publication in which *Vermilia serrula* and *Miroserpula inflata* are considered as identical (under the name of *Microserpula inflata* [sic], seems to be the "Catalogue of the Polychaetous Annelids of the World" by Hartman (1959), in which, however, no proof for this synonymy is given. Apparently the Scandinavian authors, when treating of the morphology, breeding, geographical distribution and ecology of *Miroserpula inflata* (Dons, Brattström, Thorson, Wesenberg-Lund), completely ignored the former American publications containing some very good descriptions and figures of the tube of *Vermilia serrula* well characterized by its brood-chambers (Dawson, 1860; Verrill, 1874c, 1874d). Hartman (1944) did not refer to these latter publications when she published the plates prepared by Verrill on the New England Polychaeta or when she (Hartman, 1948, p. 50) discussed the affinities of *Chitinopoma* and *Miroserpula*: "*Chitinopoma* may be nearly related to *Microserpula* [sic] Dons for which the single known species, *M. inflata* Dons, has been recorded from Arctic Seas (Brattström, 1945). In the latter, the tube is said to have ovicels distally."

The original description of *Vermilia serrula* Stimpson (1854), based on material from the Bay of Fundy, is incomplete and only refers to the characters of the tube. No type material is known to exist. Dawson (1860) then found this species on the coasts of the Gulf of St. Lawrence (Gaspé and Labrador). Giving a detailed description of the tube with its brood chambers near the orifice, he supposed that "As they appear only in certain specimens, they may perhaps be connected with the function of reproduction, and be of the nature of ovi-capsules." Packard (1863, 1867) noticed the presence of *V. serrula* in the Strait of Belle Isle. Verrill (1873, 1874 a-d) mentioned *V. serrula* among the species dredged off the coast of Maine and observed that the brood chambers of the tube are only present when mature but wanting in immature specimens. All these early references of *V. serrula* are cited by Verrill (1881) in a historical sketch on New England

Annelida, with annotated lists of the species hitherto recorded.

Bush (1940), in a publication chiefly dealing with species from Alaska but giving also a revision of the genera of Serpulidae and mentioning species from the Atlantic, Mediterranean, and other areas, did not mention *Vermilia serrula* Stimpson. Nevertheless Bush (1940, p. 229, footnote, pl. 37: fig. 3, 9, pl. 40: fig. 31) figured two opercula and a special seta of this species, referring the specimens to Levinsen's *Chitinopoma fabricii* (as *Chitinopoma greenlandica* [sic]: "Specimens attached to stones from Greenland and to tubes of *Nothria conchylega* from 32 fathoms off the New England coast are in the Yale University Museum, and may prove to be the same as those on the same host from Greenland identified by Moore (1902) as *Serpula* sp.; these could not be compared. The operculum is covered by a thin chitinous cup-like plate." As clearly shown by the figures, Bush's specimens were typical *Chitinopoma serrula*. Under the name of *Vermilia serrula*, apparently no other structure of *C. serrula* than its tube with the characteristic brood chambers has been described. Bush (1904) is probably the only American author who has figured a seta of this species. The other published figures of *V. serrula* by Dawson, Verrill, and Hartman only show the tube and the operculum.

As the setae and uncini of *Vermilia serrula* remained unknown, the species was not mentioned when a system of the Serpulidae, based on these structures, was proposed (Saint-Joseph, 1894, and others). Only Quatrefages (1865), referring to Dawson (1860) for the brood chambers of the tube, has cited *V. serrula* among the serpulid species *incertae sedis*.

On the basis of material from Norway, and independently from the American authors, Dons (1931, 1934a, 1934b, 1937) gave a more complete description of the species and created for it a new genus, *Miroserpula*. Dons always wrote *Miroserpula* and not *Microserpula* [sic], spelling used by Hartman (1948, 1959). Dons' description was taken up and completed by Thorson (1946). Two further papers dealt with the geographic distribution (Brattström and Thorson, 1941; Brattström, 1945). Records of this species are also found in Wesenberg-Lund's papers (1950, 1951, 1953a, 1953b). It should be noted that the latter author, ignoring the identity of *Vermilia serrula* and *Miroserpula inflata*,

mentioned *Chitinopoma serrula*, in a survey of the distribution of Polychaeta in Arctic and Boreo-Arctic areas, under the first name for the New England region, and under the other name for Greenland and other regions of the North Atlantic.

Levinsen (1883) created the genus *Chitinopoma* for *C. fabricii* n. sp., a serpulid found commonly on shells and algae from Greenland and the Faroes. Levinsen's description is rather superficial and it lacks details about the operculum as well as observation of the brood chambers. It can be summarized as follows: Tube white, subtriangular in cross section, with transverse growth striations and a median keel which is slightly denticulate. Total length of the animal attaining 12 mm, diameter about 0.5 mm. Thoracic setigerous segments 7. Gill filaments 6 on each side, opercular peduncle non-pinnate. Operculum with a horny dark-coloured distal plate. First thoracic setigerous segment with capillary setae and special setae which are provided with a basal wing of 4 teeth well-separated from the distal limbate zone. Posterior segments with capillary and limbate setae, and, beginning with the third segment, with sickle-shaped setae. Uncini with 9 teeth.

Brattström (1945, pp. 19-22) has shown that the tube of juvenile *Chitinopoma serrula* (as *Miroserpula inflata*), still lacking the characteristic brood chambers and the lobated orifice, could easily be mistaken for the tube of *C. fabricii* as described and figured by Levinsen. As shown by the examination of museum material from various museums, the teeth of the keel, which in general are said to characterize the tube of *C. serrula* (as *Miroserpula inflata*), may be much less developed than indicated by Stimpson (1854), Dawson (1860), Dons (1931), and others, and the tube would then resemble still more closely that of *C. fabricii*, the keel of which should be rather smooth.

Examination of the material in the collections of the Copenhagen Museum (UZMC), labelled "*Chitinopoma fabricii* Levinsen," has shown that all specimens of *Chitinopoma* are referable to *C. serrula*, among them specimens from Eastport, Maine, collected by Packard, 1866, and undoubtedly seen by Levinsen himself. One specimen from the "Dijmphna" expedition to the Kara Sea, labelled "*Chitinopoma fabricii* Levinsen" (undoubtedly determined by Levinsen and referred to in 1887), turned out to be a *Protula*. The specimens from East Spitzbergen (ZSZM), referred to by Augener

(1928) as *Chitinopoma fabricii*, are typical *C. serrula*, some of which have tubes with brood chambers.

The records of the North Atlantic *Chitinopoma serrula*, as *C. fabricii* Levinsen, are rare and Levinsen's original description was never emended. Levinsen (1887) has cited *C. fabricii* among the records from the "Dijmphna" Expedition in the Kara Sea. Fauvel (1911a) cited a record from the "Belgica" Arctic Expedition, in the strait between Novaja Zemlja and the isle of Vaigach. According to Derjugin (1915), *C. fabricii* is most abundant in the innermost part of the White Sea, the Gulf of Kola. Friedrich (1939) referred to *C. fabricii* specimens from the Barents Sea, Augener (1928)—specimens from Spitzbergen, Ditlevsen (1929) from the Faroes, and Bush (1904)—specimens from New England (see above). According to Wesenberg-Lund (1951), the presence of *C. fabricii* in Icelandic waters is not proved. Wesenberg-Lund (1953a) has then in a rather questionable way referred empty tubes from different localities on the Norwegian coast to *C. fabricii*. From all these regions the true *Chitinopoma serrula*, with its characteristic brood chambers, is known.

Citations of *Chitinopoma serrula*, as *C. fabricii* Levinsen, often contain errors caused by Levinsen's insufficient description, or confusions with other species. For instance, Levinsen's *C. fabricii* is cited by Meyer (1888, p. 495) and by Saint-Joseph (1894, pp. 246, 260, 264, 265) as a species lacking thoracic membranes. This is a misinterpretation of the short membranes which end between segments 2 and 3. In the key to the serpulid genera, Southward (1963, p. 587) indicates that the genera *Miroserpula* and *Chitinopoma* are related but distinguished by the basal denticulate expansion of the special setae. However, belonging to the same species, *M. inflata* Dons and *C. fabricii* Levinsen possess the same type of special setae. Apparently, a reference to the Pacific species *Pseudochitinopoma occidentalis* (see below), often cited as *Chitinopoma groenlandica* (or *C. greenlandica*—variant spelling), was used for this key. Under the name of *Chitinopoma greenlandica* [sic], Nelson-Smith thus confused Levinsen's Atlantic species together with the Pacific species.

***Chitinopoma groenlandica* (Mörch, 1863) = indeterminate serpulid**

Serpula triquetra Fabricius, 1780, p. 379, no. 374. Not Linné, 1758.

Hydroides norvegica var. *grønlandica* Mörch, 1863, p. 377.

?*Hydroides grønlandica*.—Malmgren, 1867, p. 120.

Not *Chitinopoma greenlandica* [sic].—Pixell, 1912, p. 790
[= *Pseudochitinopoma occidentalis* (Bush); see below.]

REMARKS.—Levinsen (1883, pp. 199, 203) referred *Serpula triquetra* Fabricius (1780) to his new species, *Chitinopoma fabricii*. However, Fabricius' *Serpula triquetra* is indeterminate and had previously been referred by Mörch (1863, p. 377) to *Hydroides norvegica* var. *grønlandica*. Malmgren (1867, p. 120) mentioned this form as a questionable species, not yet described: "?*Hydroides grønlandica* Mörch. . . Hab. in mari grønlandico. Species incerta, nondum descripta." Nevertheless, Bush (1904, p. 229) and Hartman (1948, p. 48) considered Levinsen's *Chitinopoma fabricii* as identical with Malmgren's "?*Hydroides grønlandica*", the latter name would then have priority. Thus Levinsen's species from the North Atlantic is listed in Hartman's catalogue (1959) under the name of *Chitinopoma groenlandica*. It is quite uncertain whether Fabricius' *Serpula triquetra* from Greenland is identical with the species described by Levinsen and which should be named *Chitinopoma serrula* (Stimpson) (see above).

Another reason for dropping the name of *Chitinopoma groenlandica* is that Pixell (1912), Berkeley (1930), and Berkeley and Berkeley (1942, 1952, 1961) used the name of *Chitinopoma groenlandica* (or *C. greenlandica* [sic]) for a serpulid from the Pacific coast of North America quite different from the North Atlantic species *Chitinopoma serrula* (see below under *Pseudochitinopoma occidentalis* p. 7).

***Pseudochitinopoma* new genus**

Gender: feminine. Type-species: *Hyalopomatopsis occidentalis* Bush, 1904.

DIAGNOSIS.—Special setae of the first thoracic segment with a distal limbate zone and a proximal wing not well separated. No thoracic sickle-setae. Abdominal setae with a narrow spatulate end and a long lateral tip. Thoracic uncini saw-shaped with about 12 teeth, the anterior tooth bifurcate. Abdominal uncini in all segments rasp-shaped. Opercular stalk without pinnules or wings. Thoracic membranes short, not united at the ventral face of the last thoracic segment. Thoracic setigerous segments 7.

***Pseudochitinopoma occidentale* (Bush, 1904),
new combination**

FIGURE 2

Hyalopomatopsis occidentale Bush, 1904, pp. 229-230, pl. 40: figs. 3, 22; pl. 44: figs. 2, 4, 8, 9.—Moore, 1908, p. 362; 1923, p. 254.—Hartman, 1942, pp. 89, 90.

Chitinopoma groenlandica [sic].—Pixell, 1912, pp. 790-792, pl. 88: fig. 6, a-c.—Nelson-Smith, 1967, p. 37, fig. 29 (in part). [Not *Chitinopoma groenlandica* (Mörch, 1863).]

Chitinopoma groenlandica.—Berkeley, 1930, p. 74.—Berkeley and Berkeley, 1942, p. 207; 1952, pp. 129-130, figs. 265, 266; 1961, p. 663. [Not *Chitinopoma groenlandica* (Mörch, 1863).]

Chitinopoma occidentale.—Hartman, 1948, pp. 49-51, fig. 12, a-f; 1959, p. 570.

MATERIAL EXAMINED.—Off Brockway Point, Santa Rosa Island, California: several spec., "Albatross" St. 4431, 1904 (USNM 17318). Shelton, Washington: 20 spec., Muller coll., 1934 (USNM 36658). Brown Island, San Juan Archipelago, Washington: 20 spec., Pettibone coll., 1 August 1935 (USNM 36659). Wasp Passage, San Juan Archipelago, Washington: several spec., Pettibone coll., 27 July 1935 (USNM 38726). Off Nigerson Point, Puget Sound, Washington: 20 spec., Pettibone coll., 29 June 1936 (USNM 36660). Canoe Bay, Alaska: 3 spec., Alaska King Crab investigation, sta. 17, 1940 (USNM 23621). Canoe Bay,

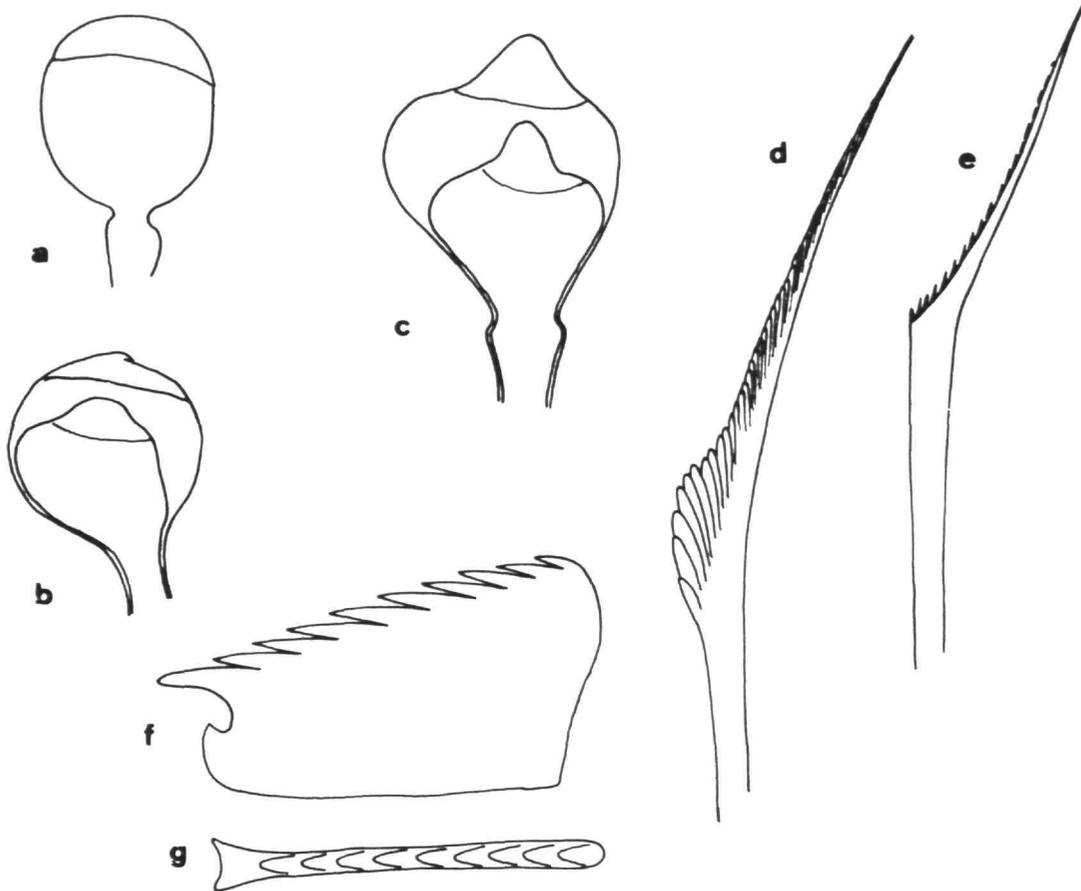


FIGURE 2.—*Pseudochitinopoma occidentale* (from specimens from Wasp Passage, Washington, USNM): a-c, opercula; d, special seta of first thoracic segment; e, abdominal seta; f, g, thoracic uncinus, lateral and edge views.

Alaska: 2 spec., Alaska King Crab investigation, sta. 21, 1940 (USNM 21282). Canoe Bay, Alaska: numerous spec., Alaska King Crab investigation, sta. 24, 1940 (USNM 21272).

DESCRIPTION.—Tube white, solid, attached to the substratum over its whole length, subtriangular in cross section, with a more or less marked nondenticulate keel, somewhat similar to the tube of *Pomatoceros triqueter* (L.) but smaller (length may attain 50 mm, according to Hartman, 1948). Surface of the tube almost smooth, sometimes with slightly indicated transverse growth striations; median keel forming a sharp tooth above the aperture. Longest specimens examined measuring 13 mm (according to Hartman, 1948, larger individuals measure 15 mm to 20 mm). Opercular diameter attains 800 μ . Up to 60 abdominal segments. Collar divided into a large median lobe and a pair of laterodorsal ones which are continued into short thoracic membranes ending at the limit of segments 2 and 3. Branchial lobes short, supporting up to 10 gill filaments on each side, inserted in a semicircle. No gill membrane. Operculum always on the left side, first non-pinnate filament transformed into an opercular peduncle completely covered by a thick transparent cuticle. Distal part of the operculum often tapering, having more or less conical form, with a still thicker, brown-colored cuticle. On preserved material, the opercular tissues are often contracted inside the cuticle which maintains the original form, thus giving the impression of two opercula, one enclosed in the other.

First thoracic setigerous segment with fine almost capillary setae and special setae possessing a proximal denticulate expansion which is close to the distal limbate zone and well separated. Setigerous segments 2 to 7 with only two types of setae, capillary and simple limbate. No thoracic sickle-setae. Abdominal setae with a narrow spatulate tip drawn out on one side into a long point with a denticulate edge. Setae of the posterior segments still narrower, but not long capillary. Thoracic uncini saw-shaped with 10 to 12 teeth; anterior tooth bifurcate; base below the anterior tooth curved and forming a hook directed slightly upwards. The number of uncini in the thoracic rows increases slightly from segments 2 to 7. Abdominal uncini in all segments rasp-shaped.

DISTRIBUTION.—*Pseudochitinopoma occidentalis*

is known all along the Pacific coast of North America, roughly between lat. 61°N and 34°N: southern coast of Alaskan Peninsula and Kodiak Island, Chignik Bay, Prince William Sound, West and East coast of Vancouver Island, Strait of Georgia and Puget Sound, off Santa Rosa Island and Carmel Canyon, California.

The bathymetric range of the collection from Alaska (Hartman, 1948) was from shore to 229 m. The Berkeleys (1952) indicate for Vancouver Island from lowest tide mark to 128 m. The southernmost records, from off Santa Rosa Island (Moore, 1923) and from Carmel Canyon (Berkeley and Berkeley, 1961), were from depths of 70 to 146 m.

REMARKS.—This species, known only from the Pacific coast of North America, has often been mistaken for the Atlantic *Chitinopoma fabricii* Levinsen, which is identical with *Chitinopoma serrula* (see above). In the original description as *Hyalopomatopsis occidentalis*, by Bush (1904), most of its essential structures are mentioned (tube, gill tuft with operculum, collar and thoracic membranes, special setae of the first segment, abdominal setae); this description is completed by figures of the operculum, the special setae, and the abdominal setae. According to Bush (1904), the tube is white and sinuous and has a well-marked keel, thus resembling the tube of *Chitinopoma fabricii* as figured by Levinsen (1883). It is undoubtedly due to this remark on the similarities of the tubes that Pixell (1912), when describing in detail Bush's species, referred it, under the name of *Chitinopoma greenlandica* [sic], to Levinsen's Atlantic species. Possessing uncini of a quite different type, Bush's species cannot belong to the genus *Hyalopomatopsis* (which is a synonym of *Hyalopomatus*, see below). The generic name *Hyalopomatopsis* has nevertheless been applied to this species by Moore (1908, 1923) and by Hartman (1942). The diagnosis of the genus *Chitinopoma*, as given by Pixell (1912), is based on the description of *C. fabricii* Levinsen (identical with *C. serrula*). The latter species has thoracic sickle-setae whereas Bush's species lacks this type of setae. The thoracic sickle-setae were later even incorrectly considered by Berkeley and Berkeley (1952) as a specific character of Bush's species. Under the name of *Chitinopoma occidentalis*, Hartman (1948) gave a detailed description of Bush's

species, which was indicated to be different from the *Chitinopoma groenlandica* reported by Pixell (1912) and Berkeley (1930) from the northeastern Pacific.

Because of its important differences with *Chitin-*

opoma serrula (Stimpson) (= *C. fabricii* Levinsen), Bush's species is placed here in the new genus *Pseudochitinopoma*. The tabulation below summarizes the differences:

Setae	<i>Pseudochitinopoma occiden- talis</i> (Bush)	<i>Chitinopoma serrula</i> (Stimpson) (= <i>C. fabricii</i> Levinsen)
Thoracic uncini	anterior tooth bifurcate.	anterior tooth simple.
Special setae of the first seg- ment	basal expansion composed of more numerous teeth; distal limbate zone almost con- tinuous with basal expan- sion.	basal expansion composed of a few teeth; distal limbate zone well separated from basal ex- pansion.
Thoracic sickle-setae	absent.	present.
Abdominal setae	narrow and spatulate tip, with a long lateral point.	geniculate, with a rather long triangular blade.

Genus *Chitinopomoides* Benham 1927

Gender: masculine. Type-species: *Chitinopomoides wilsoni* Benham, 1927, by monotypy.

DIAGNOSIS.—Special setae of the first thoracic segment with a large knob below the limbate zone [?]. Thoracic sickle-setae present. Abdominal setae geniculate with a long triangular blade. Thoracic uncini saw-shaped with about 15 teeth; the anterior tooth simple, not bifurcate. Abdominal uncini rasp-shaped in all segments. Opercular stalk without pinnules and wings. Thoracic membranes short, not united at the ventral face of the last thoracic segment. Thoracic segments 7.

Chitinopomoides wilsoni Benham, 1927

FIGURE 3

Chitinopomoides wilsoni Benham, 1927, pp. 156-158, pl. 5: figs. 162-173.—Hartman, 1959, p. 570; 1966, pp. 128-131, pl. 43: fig. 4-7.—Southward, 1963, p. 586.

MATERIAL EXAMINED.—McMurdo Sound, Ross Sea: holotype, British Antarctic "Terra Nova" Expedition, 1910 (BMNH 1928:2:29:174).

DESCRIPTION.—Tube white, of almost circular section, 2.2 mm in diameter, with a median keel smooth and compressed, and two poorly-defined smooth ridges along the sides. Distal end of the tube projecting freely at right angles with its main course. Total length of the animal about 25 mm, of which the gill filaments account for 5 mm. About 50 abdominal segments. Collar continued in very

short thoracic membranes. Gill tuft composed of about 14 filaments on each side. Opercular stalk without pinnules and wings, its exact position unknown. Operculum partly constricted at two places by deep grooves which, however, extend only for

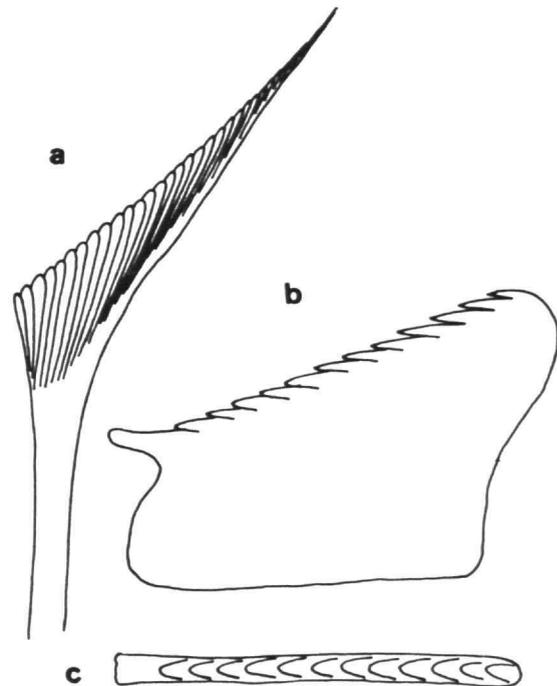


FIGURE 3.—*Chitinopomoides wilsoni* (from holotype, McMurdo Sound, BMNH): a, abdominal seta; b, c, thoracic uncinus, lateral and edge views.

about three-fourths of the circumference, and may be artifacts.

First thoracic segment with almost capillary setae and stouter special setae characterized by a "large blunt knob some distance below the point or commencement of the wing" (this important detail could not be verified on the fragments left of the holotype as all setae of the first segment were broken). Segments 2 to 7 with capillary setae and ordinary limbate setae, together with a third type of setae: in segments 3 to 7 these are typical thoracic sickle-setae with a short proximal wing and a distal blade with a blunt denticulation, whereas in segment 2 the setae have the same curved form as those of the posterior segments, but have a continuous wing instead of the blunt denticulation in the distal part. The typical geniculate abdominal setae with a long triangular blade give way to long capillary setae on the posterior segments. Thoracic uncini saw-shaped (not rasp-shaped as indicated by Benham) with about 14 to 16 teeth; anterior tooth simple (not bifurcate as indicated by Benham). Abdominal uncini rasp-shaped in all segments, with more teeth in posterior segments than in anterior segments. Anterior abdominal uncini with at least 12 teeth when seen in profile.

DISTRIBUTION.—*Chitinopomoides wilsoni* is known only from one specimen dredged in the Ross Sea (McMurdo Sound, depth 366 m) by the British Antarctic "Terra Nova" Expedition (1910).

REMARKS.—In spite of the poor condition of the holotype (gill tuft and operculum lost, only the right half of the thorax present, with the setae of the first segment all broken, and the abdomen damaged) Benham's description can be improved on many points, chiefly concerning setae and uncini. The original description and figures of the setae and uncini differ considerably from my observations on these structures. So Benham's description of the special setae has to be accepted with reservations. The affinities of *Chitinopomoides* are hypothetical and its generic justification remains questionable, as the detailed structure of the special setae is not well known. According to Benham, the species agrees with the genera *Chitinopoma* and *Hyalopomatus* by the absence of thoracic membranes. However, as shown above, short thoracic membranes were often considered as mere parts of the collar. Uncini, setae, and operculum are not similar to those of *Spirobranchus*, as indicated by Benham, but

rather to those of *Chitinopoma*. There are no structures similar to the genus *Serpula*, except perhaps the special setae which, as indicated above, are poorly known.

Genus *Hyalopomatus* Marenzeller, 1878

Hyalopomatopsis Saint-Joseph, 1894. [Type-species: *Hyalopomatus marenzelleri* Langerhans, 1884, by monotypy.]

Cystopomatus Gravier, 1911. [Type-species: *C. macintoshi* Gravier, 1911, by monotypy. Referred herein to *Hyalopomatus macintoshi* (Gravier).]

Gender: masculine. Type-species: *H. claparedii* Marenzeller, 1878, by monotypy.

DIAGNOSIS.—Special setae of the first thoracic segment with a uniform distal wing or having a proximal denticulate zone more or less separated. No thoracic sickle-setae. Abdominal setae almost capillary, with only the tip geniculate. Thoracic uncini, as well as abdominal uncini, rasp-shaped, with numerous small teeth (about 20 when seen in profile); anterior tooth bifurcated. Opercular stalk without pinnules or wings, very thin. Sometimes no operculum. Thoracic membranes short, not united at the ventral face of the last thoracic segment. Thoracic setigerous segments 6.

REMARKS.—The three species mentioned in Hartman's (1959) catalogue under the name of *Hyalopomatus claparedii* Marenzeller, 1878, *Halopomatus langerhansi* Ehlers, 1887, and *Hyalopomatopsis marenzelleri* (Langerhans, 1884) are herein described under the common genus *Hyalopomatus* Marenzeller because of their great similarities, which were well recognized by the original authors. When introducing the new genus *Cystopomatus* and discussing the affinities of *Cystopomatus macintoshi*, Gravier (1911) did not mention the species of *Hyalopomatus* in spite of the great resemblance shown by these forms with *Cystopomatus macintoshi*. The four species have the above generic characters in common.

Differences between the species of *Hyalopomatus* to which various authors have called attention (Langerhans, 1884, Ehlers, 1887, Knox, 1959) are those of the thoracic membranes, special setae of the first segment, and the thoracic uncini. However, these proposed differences are not always of specific validity since they may refer to an incorrect interpretation of short thoracic membranes considered as collar lobes, superficial examination of setae and figures of uncini.

Marenzeller (1878) and Knox (1959) have indicated that *Hyalopomatus claparedii* has no thoracic membranes and that the setae of the first segment are simple limbate ones. Apparently the authors did not distinguish between short thoracic membranes, which are always present at least to the limit of segments 2 and 3, and the real collar. Saint-Joseph (1894) followed Langerhans' (1884) proposition of a generic separation. *Hyalopomatus marenzelleri* Langerhans and *H. langerhansi* Ehlers were said to differ from *H. claparedii* Marenzeller and were referred to the new genus *Hyalopomatopsis*, characterized by the presence of short thoracic membranes and special setae with denticulate basal wings.

The generic distinction between *Hyalopomatopsis* and *Cystopomatus* according to a presumed difference in the length of the thoracic membranes (Southward, 1963, p. 587) is not justified, as the membranes end at about the same level and all other details are the same. As to the setae of the first thoracic segment, the differences are less important than claimed. The separation into a distal limbate zone and a proximal wing of stronger teeth is rather indistinct even in the setae of *H. marenzelleri*, *H. langerhansi* and *Cystopomatus macintoshi*; there is no wide gap as is found in the special setae of *Chitinopoma serrula* (Stimpson). A more careful examination may reveal that the distal limbate zone of the setae of *H. claparedii* is perhaps less uniform than shown by the very schematic figures given by Marenzeller. These slight and even questionable differences seem to be rather artificial in comparison with all characters common to the species. For *Hyalopomatus* and *Hyalopomatopsis*, Knox (1959) came to the same conclusion.

The abdominal setae of the species in question have been referred to as capillary. However, closer examination of *H. marenzelleri* and of *Cystopomatus macintoshi* has shown that the abdominal setae of these species have their distal tip geniculate, corresponding to about one-tenth of their length. These setae differ from the geniculate abdominal setae of *Vermiliopsis*, *Omphalopoma*, *Chitinopoma*, etc. This detail was over-looked because of the very small size of the abdominal setae. We may suppose that the abdominal setae of the closely related *H. claparedii* and *H. langerhansi* belong to the same type and are not really capillary.

The known species of *Hyalopomatus* (including *Cystopomatus*) are morphologically very similar and closely allied. The synonymy of some of these forms is not excluded. The genus contains species mostly from bathyal depths in zones covering 150° of latitude, as shown in the list below:

- Hyalopomatus claparedii* Marenzeller: Arctic Basin (Franz-Joseph Land, Kara Sea, north of Ellesmere Land, north of Alaska, between Hebrides and Iceland?)
Hyalopomatus sp.: Central Atlantic (West of Azores)
Hyalopomatus marenzelleri Langerhans: temperate East Atlantic (Bay of Biscay, Portugal, Josephine Bank, Madeira, Azores)
Hyalopomatus sp.: Mediterranean (off Algeria, northern Tyrrhenian Sea)
Hyalopomatus langerhansi Ehlers: tropical West Atlantic (northwest of Cuba)
Hyalopomatus macintoshi (Gravier): Antarctic Sea (off South West of Antarctic Peninsula)

Hyalopomatus claparedii Marenzeller, 1878

- Hyalopomatus claparedii* Marenzeller, 1878, pp. 393-394, pl. 4: fig. 2.—Ehlers, 1887, p. 307.—McIntosh, 1879, p. 217.—Langerhans, 1884, p. 278.—Brattström and Thorson, 1941, p. 21.—Brattström, 1945, p. 1.—Uschakov, 1957, pp. 1668-1669.—Knox, 1959, pp. 110-112, pl. 4: figs. 1-5.—Hartman, 1959, p. 577.
Hyalopomatus claparedii.—Levinsen, 1883, pp. 195, 197, 310; 1887, p. 300.—Horst, 1882, p. 3.
Hyalopomatus.—Dons, 1931, p. 5; 1934a, pp. 24-26.

DESCRIPTION (taken from literature only).—Tube white, round and smooth, sometimes with slightly indicated growth rings; distal end free. Whole length of the animal 10-23 mm, about half the length for the gill tuft. About 30 abdominal segments. Collar a thin, transparent membrane composed of three lobes. Thoracic membranes short, ending at the limit of segments 2 and 3. About 10 gill filaments on each side. Operculum a soft transparent vesicle, without any horny or calcified distal plate. Setae of the first thoracic segment with a striated and denticulate limbate zone. Similar setae in the following segments. Anterior and median abdominal segments without setae; posterior segments with isolated capillary neuropodial setae. Thoracic uncini roughly rectangular in shape, rasp-shaped, with numerous small teeth (about 20 when seen in profile) and an anterior bifurcate process. Abdominal uncini similar to those of the thoracic region.

DISTRIBUTION.—Only few records in the Arctic

Basin: Off southern Franz-Joseph Land (79° 13'1"N, 63° 21'47"E, 230 m), off northern Ellesmere Land (82° 39'N to 82° 50'N, 93° 05'W to 94° 10'W, 441 m to 740 m), off north coast of Alaska (80° 47'9"N, 170° 48'W, 3622 m), Kara Sea, 128 m, between the Hebrides and Iceland ? (61° 02'N, 12° 04'W, 1190 m).

REMARKS.—The original material of this Arctic species described by Marenzeller was collected by the Austrian Arctic Expedition (1873) off South of Franz-Joseph Land. According to Marenzeller, a serpulid specimen collected by the British "Lightning" Expedition (1868) between the Hebrides and Iceland perhaps belong to the same species. Only the transparent and vesicular operculum of this specimen was described by Claparède in a report on the Polychaeta of the "Lightning" Expedition which, after the author's death, was published by Ehlers (1875, p. 9, pl. 1: fig. 14). Without giving any details, Levinsen (1887) referred two specimens from the Kara Sea to Marenzeller's species. More recently, *H. claparedii* was only cited as an Arctic species or mentioned in discussions on related forms. The only new records are given by Knox (1959) and Uschakov (1957): some specimens and numerous tubes were obtained at three stations by Fletcher's Ice Island (1955) drifting off the northern Ellesmere Land, two other specimens off the north coast of Alaska in an abyssal station.

Hyalopomatus sp.

Gen. et sp. ? Eliason, 1951, p. 142.

MATERIAL EXAMINED.—Central Atlantic, west of the Azores: 1 spec., Swedish Deep Sea Expedition, sta. 387, 1948 (NMG).

REMARKS.—An undetermined tiny serpulid from abyssal depths in the Central Atlantic west of the Azores (40° 33'N, 35° 24'W to 40° 34'N, 35° 52'W, 4540 m to 4600 m) must be referred to the genus *Hyalopomatus*. No really specific characters have been observed on this specimen which lacked an operculum and was in poor condition. The details observed are general features of the genus *Hyalopomatus*: thoracic setigerous segments 6, of which 5 have rasp-shaped uncini with numerous teeth (more than 15 when seen in profile, anterior tooth slightly bifurcate); thoracic sickle-setae absent; abdominal capillary setae observed only in the last segments; thoracic membranes very short. On the basis of its

setae on the first thoracic segment, which have a uniform simple limbate zone, the serpulid resembles most closely *H. claparedii* as described by Marenzeller (1878) and Knox (1959).

Hyalopomatus marenzelleri Langerhans, 1884

FIGURE 4

Hyalopomatus marenzelleri Langerhans, 1884, p. 278, pl. 17: fig. 49, a-d.—Ehlers, 1887, p. 307.—Knox, 1959, p. 111.

Hyalopomatopsis marenzelleri.—Saint-Joseph, 1894, pp. 224, 261.—Fauvel, 1909, p. 59; 1911b, p. 39; 1914, p. 341; 1932, p. 39.—Hartman, 1948, p. 48; 1959, p. 577.—Southward, 1963, pp. 578-580, fig. 4, A-J.—Zibrowius, 1968a, p. 177; 1968b, pp. 385-386, 387, figs. 19-23.

MATERIAL EXAMINED.—Madeira: 4 spec., empty tubes, French "Jean Charcot" expedition, several stations, 1966. Southern Portugal: several spec. and tubes on corals, French-Portuguese "Faial" Expedition, sta. P. 59, 1957. Josephine Bank: empty tubes, Swedish "Skagerak" Expedition, station of 31 May 1946 (NMG).

DESCRIPTION.—Tube white, round and smooth, without keels, diameter about 500 μ . Part attached to the substratum sometimes with some transverse peristomes slightly widened out. Total length of the animal about 11 mm, more than a third for the gill tuft. Up to 45 abdominal segments. Collar trilobed, short thoracic membranes ending at the posterior limit of segment 2. Gill tuft composed of about 7 filaments on each side, first dorsal filament on the left side non-pinnate, transformed into a very thin opercular peduncle. Operculum a vesicle of globular or slightly oval shape, with a distal, slightly convex, slightly differentiated horny cap. First thoracic setigerous segment with capillary setae and special setae, the latter with a distal limbate zone and a distinct but not well separated proximal wing of stronger teeth. Segments 2 to 7 with limbate and capillary setae. No thoracic sickle-setae. Distal part of the abdominal setae (about one-tenth of their length) geniculate. Thoracic uncini rasp-shaped with the anterior tooth bifurcate; when seen in profile with about 20 teeth. Abdominal uncini of smaller size but similar.

DISTRIBUTION.—*Hyalopomatus marenzelleri* is known from a large zone in the temperate North Atlantic comprising the Azores, Madeira, and the Gulf of Biscay. It is common in bathyal depths, whereas its records from depths of only 100-200 m

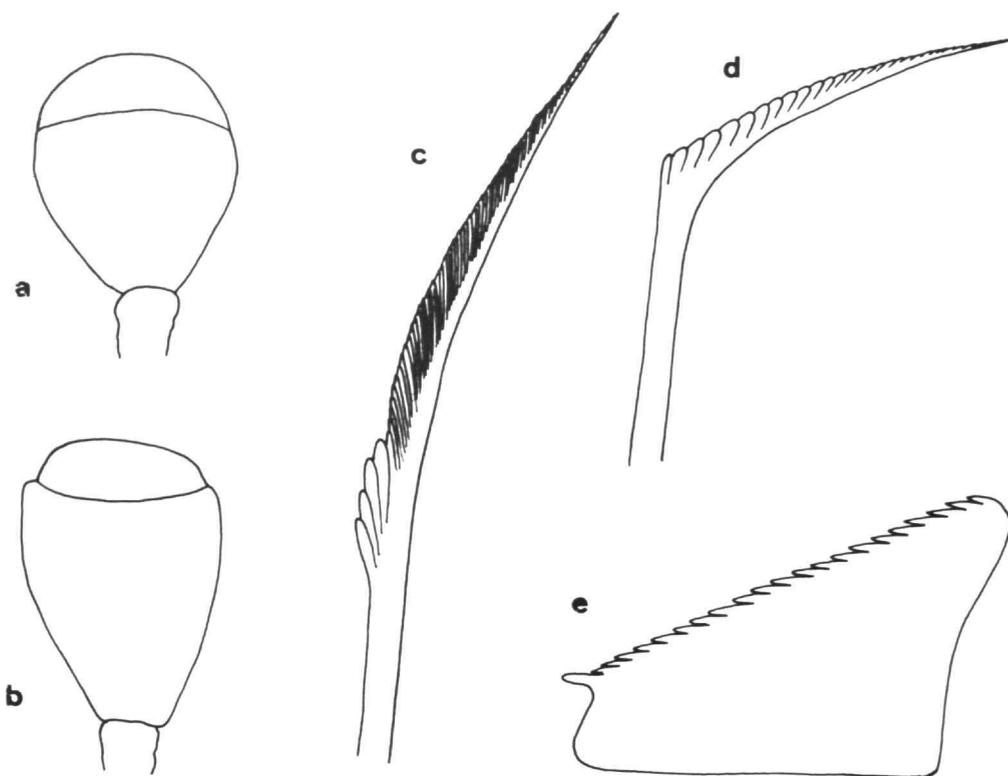


FIGURE 4.—*Hyalopomatus marenzelleri* (from specimens from Madeira, "Jean Charcot" Expedition 1966): a, b, opercula; c, special seta of first thoracic segment; d, tip of abdominal seta; e, thoracic uncinus.

are less frequent: Azores (845-1850 m), Madeira (100-2800 m), Josephine Bank (208-225 m), southern Portugal ($38^{\circ}16'8''N$, $8^{\circ}56'43''W$, about 300 m), continental slope off Brittany and Scilly Islands (366-1630 m).

REMARKS.—The original description of *H. marenzelleri* by Langerhans (1884) is very brief but illustrated by some figures and was based on specimens from Madeira. More detailed descriptions were furnished recently by Southward (1963) and by Zibrowius (1968a, 1698b).

Hyalopomatus sp.

Protis arctica.—Bellan, 1964, pp. 179-180, 226.—Nelson-Smith, 1967, p. 50 (in part). [Not *Protis arctica* (Hansen, 1878).]
Hyalopomatopsis sp.—Zibrowius, 1968a, pp. 177-178, pl. 9: fig. 36.

MATERIAL EXAMINED.—Off Algeria: mounted specimens. Tyrrhenian Sea: 1 spec., "Calypso", station SME. 1752, 1961.

REMARKS.—In the Mediterranean a form closely allied to *Hyalopomatus marenzelleri* Langerhans (if not the same species) has been recorded from bathyal depths off the Algerian coast [on the Gorgonian species *Isidella elongata* (Esper), in 570-670 m] and in the Tyrrhenian Sea (South West of Gorgona Island in 600-660 m). Bellan referred to these specimens as *Protis arctica* (Hansen) (quoted by Nelson-Smith, 1967) but, as shown by Zibrowius (1968a), these serpulids with only 6 thoracic setigerous segments have the same type of setae and uncini as *Hyalopomatus marenzelleri*. All five specimens known from the Mediterranean (4 from Algeria, 1 from the Tyrrhenian Sea) had no operculum, but were otherwise identical with *Hyalopo-*

matus marenzelleri from Madeira. Rare specimens lacking an operculum among typical operculate specimens of this latter species have already been found at Madeira by Langerhans (1884) and by Zibrowius (1968a, 1968b). In some populations there may be a tendency towards a reduction of the operculum which even in normal individuals is fixed to a very thin stalk.

Hyalopomatus langerhansi Ehlers 1887

Hyalopomatus langerhansi Ehlers, 1887, pp. 304-307, pl. 60: figs. 14-15.—Hartman, 1938, p. 20; 1959, p. 577.—Knox, 1959, p. 111.

Hyalopomatopsis langerhansi.—Saint-Joseph, 1894, pp. 261, 264.

DESCRIPTION (taken from literature only).—Tube white, somewhat flattened, with slight lateral keels in the part attached to the substratum, but quite smooth and of circular cross section in the erect distal part. Total length of the animal about 11.5 mm, including 3 mm for the gill tuft. About 40 abdominal segments. Collar divided into 3 lobes; short thoracic membranes ending at the limit of segments 2 and 3. Gill tuft composed of about 12 filaments on each side. Operculum borne by the first dorsal filament on the left side which is non-pinnate and longer than the other filaments. Operculum a transparent vesicle, pear-shaped, without a differentiated distal plate. Special setae of the first thoracic segment with a group of teeth at the base of the limbate zone; these setae less numerous than the setae of the following segments. Abdominal setae capillary. Uncini of the thoracic region rasp-shaped with numerous teeth (about 20 when seen in profile) and an anterior bifurcate process. Abdominal uncini of smaller size but similar.

DISTRIBUTION.—The two original finds of *Hyalopomatus langerhansi* were collected by the "Blake" Expedition (1868), northwest of Cuba (near Havana in 535 m, and 23°42'N, 83°19'W, in 1573 m). There seems to be no other record of this species in the Gulf of Mexico.

REMARKS.—The above summary is taken from the description and figures by Ehlers (1887), since further details are not available, as the type material (MCZ) is in bad condition (Hartman, 1938).

Hyalopomatus macintoshi (Gravier, 1911), new combination

FIGURE 5

Cystopomatus macintoshi Gravier, 1911a, pp. 315-316; 1911b, pp. 149-152, pl. 11: figs. 145-152.—Fauvel, 1936, pp. 39-40.—Hartman, 1959, p. 572; 1966, pp. 128-129, 131, pl. 43: figs. 8-11.

MATERIAL EXAMINED.—West coast of Antarctic Peninsula: 1 spec., incomplete, Second French Antarctic Expedition ("Pourquoi-Pas"), 1908-1910 (MNHN). Bellingshausen Sea: 2 spec., incomplete, "Belgica" Expedition, 1897-1899 (IRSN).

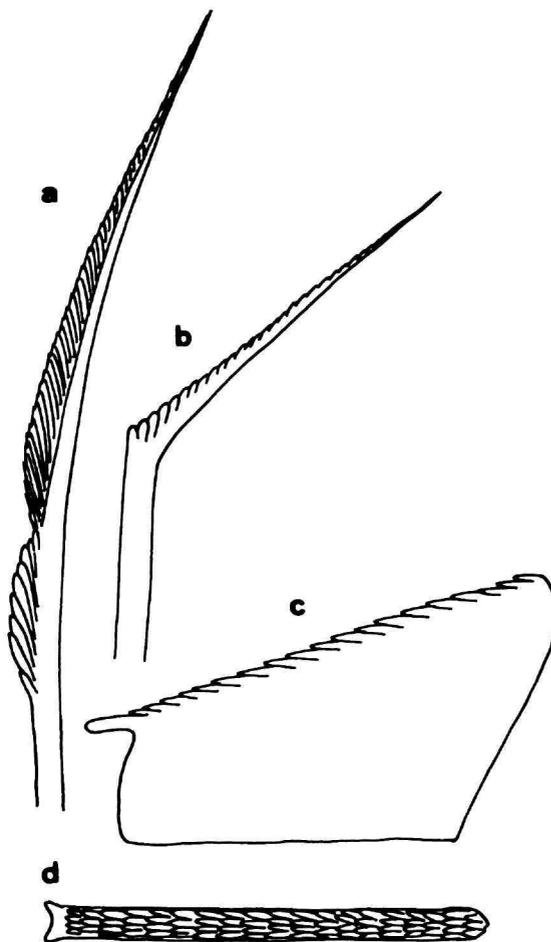


FIGURE 5.—*Hyalopomatus macintoshi* (specimen from the "Belgica" Expedition, Antarctica, IRSN): a, special seta of first thoracic segment; b, abdominal seta; c, d, thoracic uncinus, lateral and edge views.

DESCRIPTION.—Tube white, smooth and of circular cross section, more or less curved or straight and erect distally for some length. The whole length of the tube may attain 50 mm, its diameter 750 μ . Length of the animal up to 12 mm, including 4 mm for the gill tuft. About 40 abdominal segments. Collar large and divided into 3 lobes, the laterodorsal ones continued into short thoracic membranes ending at the limit of segments 2 and 3. Gill tuft composed of about 12 filaments on each side. Operculum a transparent almost globular vesicle fixed to a very thin, smooth, non-pinnate opercular stalk. The specimens studied are in too poor condition to show the insertion of the opercular stalk or the existence of a gill membrane.

First thoracic segment with capillary setae and stronger special setae, with a distal limbate zone and a proximal more coarsely denticulate wing, the two zones not well separated. The following 5 segments with only two types of setae: capillary and limbate; no thoracic sickle-setae. The posterior abdominal setae are long and almost capillary, with their distal tips (about one-fifteenth of their length) slightly geniculate. The setae of the more anterior segments are shorter and more geniculate (geniculate part corresponding to about one-tenth of their whole length). Thoracic uncini rasp-shaped with 2 or 3 teeth in transverse rows, in lateral view with about 20 teeth; the most anterior tooth large and bifurcate. The number of thoracic neuropodial uncini decreases in the posterior segments: there may be 110 in the second setigerous segment but only 80 in one row in segment 6. Abdominal notopodial uncini in rows of 20 to 30, rasp-shaped, with a more curved profile than the rather rectangular thoracic uncini and with more teeth in transverse rows.

DISTRIBUTION.—The type specimens collected by the Second French Antarctic Expedition ("Pourquoi-Pas," 1908-1910) are from Peterman Island off the west coast of Antarctic Peninsula (about 67°S, 69°W, no indication of depth, mixed with *Serpula vermicularis* var. *narconensis*). The specimens from the "Belgica" Expedition are from a large zone in the Bellingshausen Sea (between 80°48'W and 87°37'W, 70°00'S and 71°19'S, in about 400-500 m). No other records are known.

REMARKS.—Gravier's (1911a, 1911b) description, in which some structures are neglected and the importance of other structures over-estimated, deals

sufficiently well with the essential characters (setae and uncini, operculum, tube) which are typical *Hyalopomatus* characters. These were confirmed by examination of original material, as well as the identity of the material of both expeditions. Of Gravier's material (MNHN), only one incomplete syntype in poor condition is left (gill tuft and thoracic region, tube fragments). According to Fauvel (1936), *Cystopomatus macintoshi* was collected by the "Belgica" in 3 stations (28 May 1898, no. 996; 8 October 1898, no. 1010; 18 October 1898, no. 893; the numbers refer to samples or bottles and not to stations). There were several specimens and at least two of them still had their operculum, but the material of these 3 stations still available (IRSN) is very poor (no tube fragments left; no. 996, one specimen without a gill tuft; no. 983, one specimen with an operculum but abdomen lost, compressed by mounting (?); no. 1010, label only "*Cystopomatus macintoshi* ??").

Genus *Protis* Ehlers, 1887

Gender: feminine. Type-species: *Protis simplex* Ehlers, 1887, indicated by Hartman, 1959, p. 588. Referred herein to *Protis arctica* (Hansen, 1878).

DIAGNOSIS.—Special setae of the first thoracic segment with well separated distal limbate zone and proximal denticulate wing. Thoracic sickle-setae present. Abdominal setae almost capillary, with a limbate tip. Thoracic uncini saw-shaped with about 6 teeth, the anterior simple, not bifurcate. Abdominal uncini rasp-shaped in all segments. No operculum. Thoracic membranes long, united at the ventral face of the last thoracic segment. Thoracic setigerous segments 7.

REMARKS.—The first species of this genus to be known, the North Atlantic *Protis arctica* (Hansen), was described under the name *Protula arctica* and was transferred by Ehlers (1887) into the genus *Protis* created for a similar form from the Gulf of Mexico, *Protis simplex* Ehlers, which seems to be nothing more than a small specimen of *Protis arctica*. Another very similar species, *Protis pacifica* Moore, was described from the Pacific coast of North America. Since an operculum is lacking, which in most other serpulid genera provides good specific characters, and all other structures are very similar, the specific distinction of these forms is rather questionable. It should be based on com-

parison of fresh material and not on the more or less sketchy descriptions which are not always comparable.

As the serpulids from off Algeria considered by Bellan (1964, p. 179) as *Protis arctica* do not belong to the genus *Protis* but to *Hyalopomatus* (see above), Bellan's considerations on the genus *Protis* (quoted by Nelson-Smith, 1967, p. 50) are in error. The genus *Protis* is not a transition between the genera *Protula* and *Filograna* (= *Salmacina*); it seems not even related to them, as claimed by Hartman (1955, p. 51). Although without an operculum, it should not be put together with these other non-operculate genera. It is in fact a well-defined genus (cf. Saint-Joseph, 1894, p. 259, and others) and well distinct from *Protula* and *Filograna* with its thoracic uncini (saw-shaped, with only a few teeth, resembling the uncini of *Serpula*) whereas its special setae belong to a more common type (e.g., the genera *Omphalopoma* and *Filograna*).

Protis arctica (Hansen, 1878)

FIGURE 6

Protula arctica Hansen, 1878, pp. 13-14, pl. 10: figs. 1-10; 1882, p. 43, pl. 7: figs. 28-34.—Levinsen, 1883, pp. 202, 309.—Ehlers, 1887, p. 328.—Bidenkap, 1895, pp. 41, 45, 141.—Wollebaek, 1912, pp. 120-122, pl. 48: fig. 1-6, pl. 50: fig. 7.—Saemundsson, 1918, p. 230.—Wesenberg-Lund, 1950, pp. 41-42, chart 66; 1951, pp. 131, 156, 167 (in part?); 1953b, pp. 114, 123, 138, 139, 149, 158, 162, 164, chart 26.
Protis simplex Ehlers, 1887, pp. 325-328, pl. 56: figs. 10-14.—Bush, 1904, pp. 227, 229.—Eliason, 1951, p. 142.—Hartman, 1955, p. 51; 1959, p. 588.
Protis arctica.—Fauvel, 1909, pp. 50-51; 1914, pp. 325-327, pl. 30: figs. 18-25.—Eliason, 1951, p. 142.—Hartman, 1959, p. 588.—Zibrowius, 1968a, p. 178. Not Bellan, 1964, pp. 179-180, 226. Not Nelson-Smith, 1967, p. 50 (= *Hyalopomatus* sp.).

MATERIAL EXAMINED.—Romanche Deep in Central Atlantic: 1 spec., Swedish Deep Sea Expedition, sta. 342 (NMG).

DESCRIPTION.—Tube white, of circular cross section and more or less distinctly marked with transverse striations, similar to a tube of *Protula*. Longest tube known 77 mm, diameter about 3 mm. Total length of the animal may attain 20 mm to 30 mm. Up to more than 100 abdominal segments. Collar divided into 3 lobes. Thoracic membranes long, united at the ventral face of the last thoracic segment. Gill tuft without an oper-

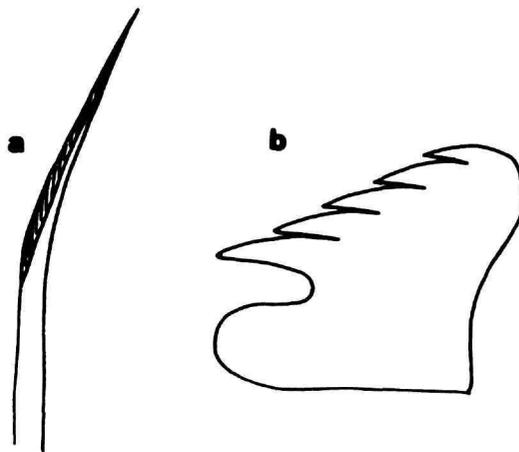


FIGURE 6.—*Protis arctica* (from specimen from Romanche Deep, Swedish Deep Sea Expedition, NMG): a, tip of abdominal seta; b, thoracic uncinus.

culum. Up to 23 gill filaments on each side. No gill membrane [?]. First thoracic segment with capillary setae and stouter special setae which have a proximal denticulate wing well separated from the distal limbate zone. Posterior thoracic segments with sickle-shaped setae with a proximal limbate zone and a blunt denticulation on the distal edge. Segments 2 to 7 with capillary setae and simple limbate setae. Abdominal setae of capillary aspect but in the distal tip with a short and narrow wing. Thoracic uncini saw-shaped with about 6 teeth, anterior tooth bigger and simple, not bifurcate. Abdominal uncini of similar form, in all segments rasp-shaped. Uncini of the posterior segments with more teeth than those of the more anterior segments.

DISTRIBUTION.—The original specimens of *Protis arctica* described by Hansen (1878, 1882) were collected by the Norwegian North Atlantic Expedition between Iceland and Norway (65°53'N, 7°18'W, 2127 m, temperature at the bottom -1.1°C). Wollebaek (1912) gave a more detailed description of the species, but gave no new records. Many new records from the Arctic North Atlantic were later given by Wesenberg-Lund (1950, 1951, 1953b), but, as proved by examination of some of this material (UZMC) (see below), at least some of the records from the fjords of East Greenland in depths of less than 100 m are records of *Protula tubularia* and not of *Protis arctica*. Records from the fjords of Iceland perhaps

are not *Protis arctica* either, whereas the other records from bathyal and abyssal depths in the Arctic Atlantic (between Labrador and Greenland, between Greenland and Iceland, between Iceland and Jan Mayen, depths down to 2402 m) may well refer to *Protis arctica*.

Fauvel (1909, 1914) recorded *Protis arctica* from the Azores between Flores and Faial (39°22'48"N, 31°25'15"W, in 1384 m) and between the Azores and Maderia (36°54'N, 20°46'15"W, in 440 m). In the Gulf of Mexico the species is known as *Protis simplex* Ehlers, 1887 (28°42'N, 83°13'W, in 1572 m). The southernmost record of *Protis* in the Atlantic (Eliason, 1951) is from the Romanche Dcep in the Central Atlantic (about 01°N, 18°40'W, in 5250 m).

Protis arctica had not been found in the Mediterranean, where the bottom water in the great depths would probably be too warm for this species. It has not been recorded from the Indian Ocean (erroneous quotation of Eliason, 1951, by Bellan, 1964, p. 181, and copied by Nelson-Smith, 1967, p. 50).

REMARKS.—*Protis arctica* is known by several more or less detailed and illustrated descriptions (chiefly Hansen, 1878, 1882; Wollebaek, 1912; Fauvel, 1914). Although Ehlers (1887) indicated the differences between the genera *Protula* and *Protis*, Hansen's species was later attributed to the genus *Protula* by some authors, chiefly by Wollebaek (1912) and Wesenberg-Lund (1950, 1951, 1953b). The latter (1950, p. 42), however, had emphasized the difference between the uncini of Hansen's species and those of *Protula tubularia* (Montagu). Despite this exact comparison, Wesenberg-Lund has sometimes mistaken specimens of *Protula tubularia* for *Protis arctica*, for 6 lots of serpulids from East Greenland (UZMC) turned out to be *Protula tubularia* and not *Protis arctica* (Hansen) as indicated by Wesenberg-Lund (1951, p. 114). Some of these specimens were still in their tubes and could not have been studied in detail; they must have been determined on the aspect of the tube. This casts doubt on the distributional survey of *Protis arctica* indicated by Wesenberg-Lund.

There are no confirmed features which allow a specific distinction between the forms described as *Protis arctica*, mostly from the North Atlantic, and *Protis simplex* Ehlers from the Gulf of Mexico. The latter form, described from a single specimen, was said to differ from the North Atlantic representa-

tives of *Protis* by its smaller size and smaller number of gill filaments. Fauvel (1909, 1914) described specimens of intermediate size and showed that these differences are insignificant. The synonymy of *Protis simplex* with *Protis arctica* was also accepted by Eliason (1951), who recorded a rather large specimen from the Central Atlantic near the equator.

Protis pacifica Moore, 1923

FIGURE 7

Protis pacifica Moore, 1923, pp. 253-254.—Hartman, 1955, pp. 51, 52, pl. 4; 1959, p. 588; 1960, pp. 163, 164; 1963, p. 79.—Hartman and Barnard, 1958, pp. 2, 10, 11, 27, etc., 65.

MATERIAL EXAMINED.—Off Brockway Point, Santa Rosa Island, California: holotype and 4 paratypes, "Albatross" sta. 4433, 1904 (USNM 17434, 17435).

DESCRIPTION.—Tube white, straight or more or less tortuous and bent, approximately cylindrical, of circular cross section as its distal and free end but slightly flattened where attached to the substratum. No keels, surface somewhat rugose due to the presence of irregularly spaced annulated growth rings. Longest tube described 65 mm, thickest one 4.2 mm at the mouth. The length of the animal may attain 40 mm. Sometimes more than 60 abdominal segments. Collar divided into 3 lobes, the laterodorsal ones continued in long thoracic membranes which are united at the ventral face of the last thoracic segment. Gill tuft without an operculum. Gill lobes short, with the filaments arranged in a semicircle. Up to 20 filaments on each side.

First thoracic segment with capillary setae and stouter special setae, with a well separated distal limbate zone and a proximal wing of about 6 teeth. Segments 2 to 7 with capillary setae and simple limbate ones. Segments 3 to 7 also with sickle-shaped setae and with a short proximal limbate zone preceding the distal edge with a blunt denticulation. Posterior abdominal segments with long capillary setae. Setae of the anterior segments almost capillary but with a very small narrow limbate edge just below the tip. Thoracic uncini saw-shaped, with 6 to 8 teeth, the anterior one simple, not bifurcate. Abdominal uncini of similar form but rasp-shaped in all segments. Uncini of the posterior segments with more teeth than those of the more anterior segments.

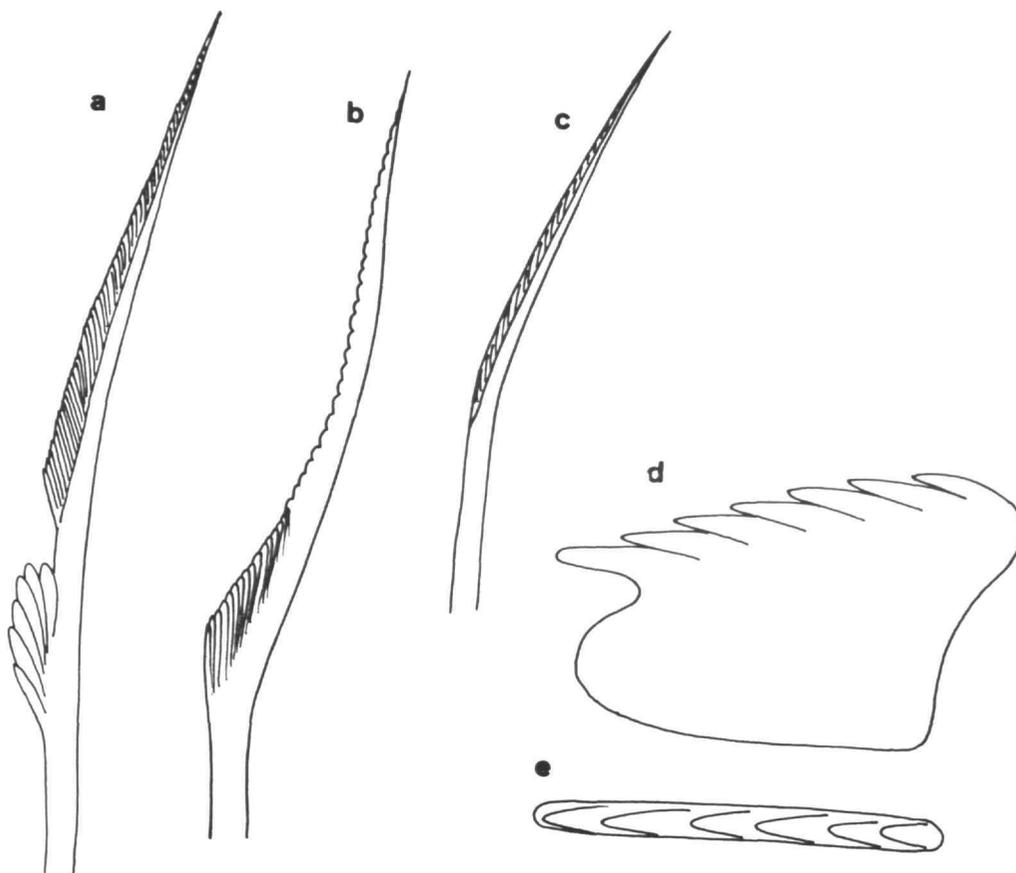


FIGURE 7.—*Protis pacifica* (from holotype, Santa Rosa Island, USNM): a, special seta of first thoracic segment; b, thoracic sickle-seta; c, tip of abdominal seta; d, e, thoracic uncinus, lateral and edge views.

DISTRIBUTION.—In the Pacific the genus *Protis* is known by one species from off the California coast. The original specimens of *Protis pacifica* Moore were dredged off Santa Rosa Island (depth about 485 m). Many new records were given by Hartman (1955, 1960, 1963) and by Hartman and Barnard (1958) from deep basins and submarine canyons off California (depths from several hundred meters down to 787 m). It seems to be an exclusively bathyal species.

REMARKS.—There appears to be a slight difference in the form of the uncini from the Atlantic *Protis arctica*. This, however, should be confirmed by a detailed study of more specimens from both

oceans. Otherwise *Protis pacifica* is most similar to *Protis arctica*.

***Pomatostegus stellatus* (Abildgaard, 1779)**

Protis torquata Hoagland, 1919, pp. 580-581, pl. 32: figs. 9-13.

—Treadwell, 1939, pp. 304-305.—Hartman, 1955, p. 51; 1959, p. 588.

MATERIAL EXAMINED.—Puerto Rico, San Juan, Condado Bay: 1 spec. lacking operculum, 2 July 1915, holotype of *Protis torquata* Hoagland (AMNH). Puerto Rico, St. Thomas, Jamaica, Quintana Roo (Mexico): several spec. (USNM). Fernando da Noronha Island, Brazil: 1 spec., Laborel coll.

REMARKS.—*Protis torquata* was described from a single nonoperculate serpulid specimen from intertidal rock crevices at Condado Bay, Puerto Rico. The holotype (AMNH) proved to be a young specimen of *Pomatostegus stellatus* (Abildgaard) which had accidentally lost its operculum. The base of the thick opercular stalk is still visible on the left side of the gill tuft. The specimen agrees in structures, such as thoracic membranes, setae and uncini, with complete specimens of *Pomatostegus stellatus* from Brazil and from the West Indies (USNM). (See also the new definition of the genus *Pomatostegus*, Zibrowius, 1968a, p. 153).

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