

With the best wishes
for father-hero
from Allet,
Thank you for reprint

Some little-known species of hydroids (Cnidaria: Hydrozoa: Lafoeidae) and description of *Papilionella pterophora* gen. nov., spec. nov. (Sertulariidae)

A. Antsulevich & W. Vervoort

Antsulevich, A. & W. Vervoort. Some little-known species of hydroids (Cnidaria: Hydrozoa: Lafoeidae) and description of *Papilionella pterophora* gen. nov., spec. nov. (Sertulariidae).

Zool. Med. Leiden 67 (30), 24.xii.1993: 431-443, figs. 1-7, tables 1-3.— ISSN 0024-0672.

Key words: Cnidaria; Hydrozoa; Hydroida; Lafoeidae; Sertulariidae.

Redescriptions are given of two species of North Pacific Lafoeidae and diagnosis and description of a new genus and species of the family Sertulariidae, *Papilionella pterophora* gen. nov., spec. nov.

Alexander Antsulevich, Hydrobiology Laboratory, Institute of Biology, St. Petersburg State University, 16 Liniya 29, St Petersburg 199178, Russia.

Willem Vervoort, National Museum of Natural History/Rijksmuseum van Natuurlijke Historie, P.O. Box 9517, 2300 RA Leiden, The Netherlands.

Introduction

The present notes are the result of a joint investigation of some North Pacific hydroids in the collections of the Zoological Institute of the Academy of Sciences of Russia, St Petersburg, carried out in the National Museum of Natural History [incorporating the Rijksmuseum van Natuurlijke Historie (RMNH)], Leiden, The Netherlands. In the course of the study it became necessary to include also material from other localities and collections.

Descriptions

Filellum parasiticum (Antsulevich, 1987) (figs. 1, 2)

Lineolaria parasitica Antsulevich, 1987: 57-58, fig. 14; Watson, 1992: 81.

Material.— 18 colonies (one fertile) collected in the Sea of Okhotsk: northern part (120 m; 150 m); central part, SE from St. Jonas Isl. (147 m, 160 m), and SE of Cape Terpeniya, Sakhalin Isl. (396 m; 750 m; 1960-2000 m). One of the colonies was growing on *Sertularia* spec. but all others were attached to stems of *Abietinaria abietina* (L.).

Holotype: Sterile colony, Zoological Institute of Russian Academy of Sciences (ZIRAS), St Petersburg, no 1/10051. Type locality: Central part of Sea of Okhotsk, SE of Iona Isl., depth 160 m, collected 4.viii.1986 by A.V. Smirnoff.

Paratypes: ZIRAS, no 2/10052, collected together with holotype. Sterile colony. ZIRAS, no 3/10052.1, southern part of the Sea of Okhotsk, SE of Cape Terpeniya, Sakhalin Isl., depth 750 m, collected 1.10.1984 by A. Ereskovsky, bottom trawl No 63 D. RMNH Coel. no. 26770 (sample and 3 slides no. 1820), collected together with ZIRAS no. 3/10052.1.

The species was originally referred to *Lineolaria* Hincks, 1861, on vegetative char-

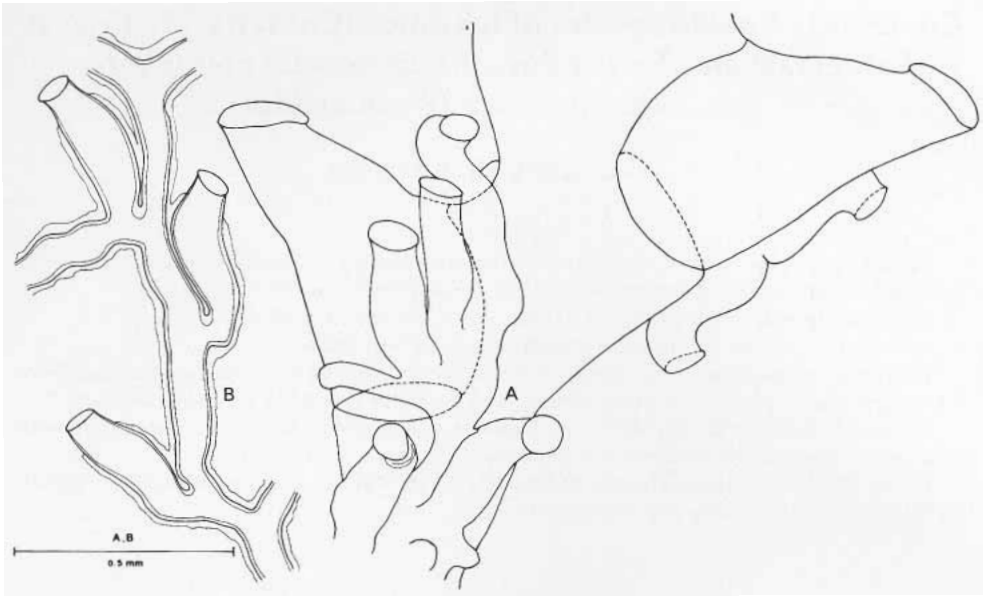


Fig. 1. *Filellum parasiticum* (Antsulevich, 1987), Sea of Okhotsk. A, part of colony growing on *Abietinaria abietina* (L., 1758); B, detail of stolon and hydrothecae, showing almost hyaline perisarc sheath attaching colony to substrate (*A. abietina*).

acters, the gonosome being unknown. The record was the first of the genus *Lineolaria* from the northern hemisphere, so confirmation of it by description of the gonosome was desirable.

Lineolaria parasitica has been considered "to have closer affinities with the Lafoeidae than with the Lineolariidae" (Watson, 1992: 81). A fertile colony is here recorded from the type locality in the Sea of Okhotsk. The gonosome proved to be a typical coppinia, suggesting that, as already proposed by Watson, the species is best referred to the family Lafoeidae. We thus refer *L. parasitica* to *Filellum* Hincks, 1868, and extend the specific diagnosis.

Paraphrased translation of original description.— "Colony with about 100 hydranths of uniform morphology and, probably, function. Colony covers stem and branches of *A. abietina*; in places the hydrothecae and hydrorhiza anastomose in a continuous layer covering the substrate with no free space between. Hydrorhiza flattened and broad. Hydrotheca tubular, prostrate, usually fully adnate to substrate, not widening towards aperture and narrowed slightly towards base; irregularly curved to varied degree in horizontal plane and malformed in places where densely packed; in places, but usually towards periphery of colony, distal $\frac{1}{4}$ - $\frac{1}{5}$ of hydrotheca curved upwards; aperture circular, rather flat, lacking operculum. Hydrorhiza and hydrotheca provided with thin of perisarc, closely attaching colony to substrate. Hydranth with 12-16 tentacles". Mode of development of colony on *Abietinaria abietina* (Linnaeus, 1758) and perisarc sheath illustrated in fig. 1A, B.

Description of gonosome (fig. 2A, B).— The gonosome is a typical coppinia, sur-

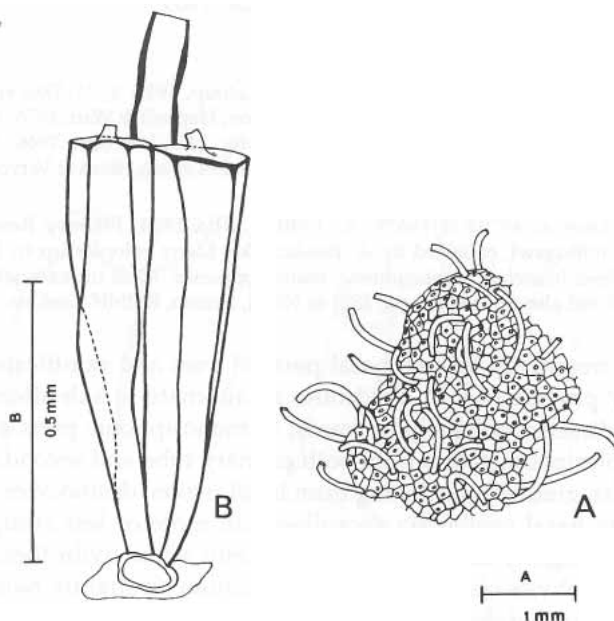


Fig. 2. *Filellum parasiticum* (Antsulevich, 1987), Sea of Okhotsk. A, coppinia viewed from above, with protecting tubes emerging from mass of closely packed gonothecae; B, two isolated gonothecae adhering to protecting tube, in lateral view.

rounding an internode of *A. abietina* for length of 3 mm. Gonothecae closely packed, contiguous laterally, usually 5-6 sided as viewed from above but many varied in shape; slender, inverted-pyramidal, apically contracted and there with remarkable short neck leading to circular rim. Protecting tubes numerous, arising between gonothecae, usually curving.

Table 1. *Filellum parasiticum*. Measurements in μm .

	Sea of Okhotsk
Hydrotheca, length abcauline wall	440-665
length adcauline wall	445-575
diameter of 'pedicel'	60-135
total depth	520-630
length free part	0-150
length adnate part	405-475
diameter at rim	105-135
maximum diameter	160-175
Gonothecha, height	700-800
width at top (maximum width)	140-170
height of neck	23-25
diameter of neck at rim	20-21
Protective tubes, height	1000-1500
diameter	70-80
Stolon, diameter	105-120

Distinguishing characters.— *Filellum parasiticum* differs from other species of the genus by the long adnate part of hydrotheca and rather shorter free portion, by anastomosing hydrotheca and closely packed hydrotheca forming a discontinuous carpet. The gonothecha of *F. parasiticum* has a short neck lacking in *F. serpens* (Hassall, 1848) (cf. Naumov, 1960; 1969) and *F. serratum* (Clarke, 1879) (cf. Ritchie, 1911; Millard, 1975).

Distribution.— Known only from Sea of Okhotsk and Pacific coast of the Kurile Archipelago.

***Lafoea benthophila* Ritchie, 1909**

(figs. 3, 4)

Lafoea gracillima var. *benthophila* Ritchie, 1909: 76-77, fig. 2; Leloup, 1937: 5, 31; Dawydoff, 1952: 55; Rees & Thursfield, 1965: 80, 198; Blanco, 1967: 249; Smaldon, Heppell & Watt, 1976: 15.

Lafoea benthophila; Stechow, 1923: 7; Stechow, 1925: 455-456, fig. 24D; Vervoort, 1946: 303; Vervoort, 1966: 124, fig. 27; Millard, 1975: 185, fig. 61G; Millard, 1978: 194 et seq.; Rees & Vervoort, 1987: 44.

Material.— Sea of Okhotsk, 49°03'N 146°57'E, 1040 m, 01.x.1984, Fishery Research vessel "Novoulyanovsk", bottom trawl, collected by A. Ereskowsky. Many colonies up to 100 mm high, polysiphonic basally, finer branches monosiphonic; many coppiniae. Most of material deposited in ZIRAS; part of material and also three slides no. 1821 in NNM, Leiden, RMNH Coel. no. 26771.

Notes.— Stem frequently forked, basal parts of axes and ramifications polysiphonic; irregularly pinnate (fig. 3). Hydrothecae alternate to sub-alternate, on all sides of branches, directed obliquely upwards; in monosiphonic parts arising from axis (fig. 4A), in polysiphonic parts from both primary tube and secondary tubules. Hydrothecae tubular, gradually widening from basal region; desmocytes easily seen; adcauline wall with basal convexity; abcauline wall more or less straight. Rim of hydrotheca circular, slightly flared, renovated in only a few hydrothecae (fig. 4B); borne on distinct apophysis on axis or secondary tubule on slightly twisted pedicel (considered to end at line of desmocytes). Many hydrothecae containing a hydranth, attached at line of clearly visible desmocytes; hydranth in most contracted within basal third of hydrotheca, small for the large and long hydrotheca, with 10-12 tentacles and a rounded hypostome (fig. 4C).

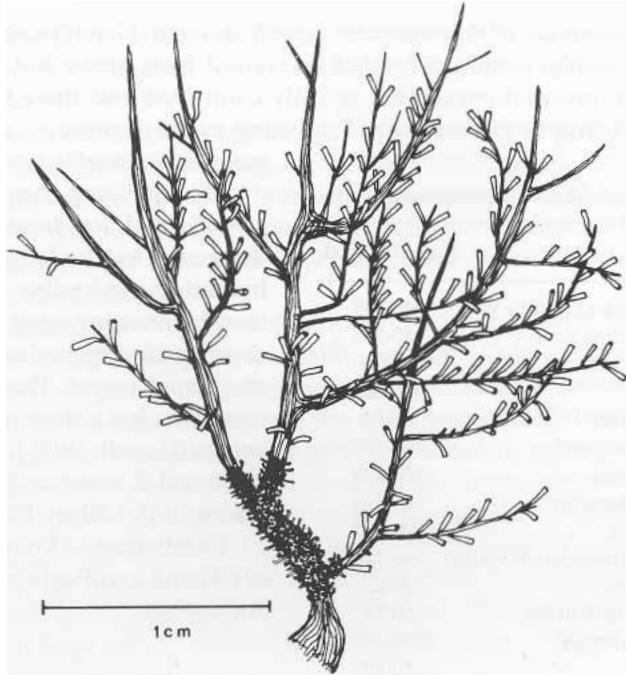


Fig. 3. *Lafoea benthophila* Ritchie, 1909, Sea of Okhotsk, single colony with coppiniae on lower part of stem.

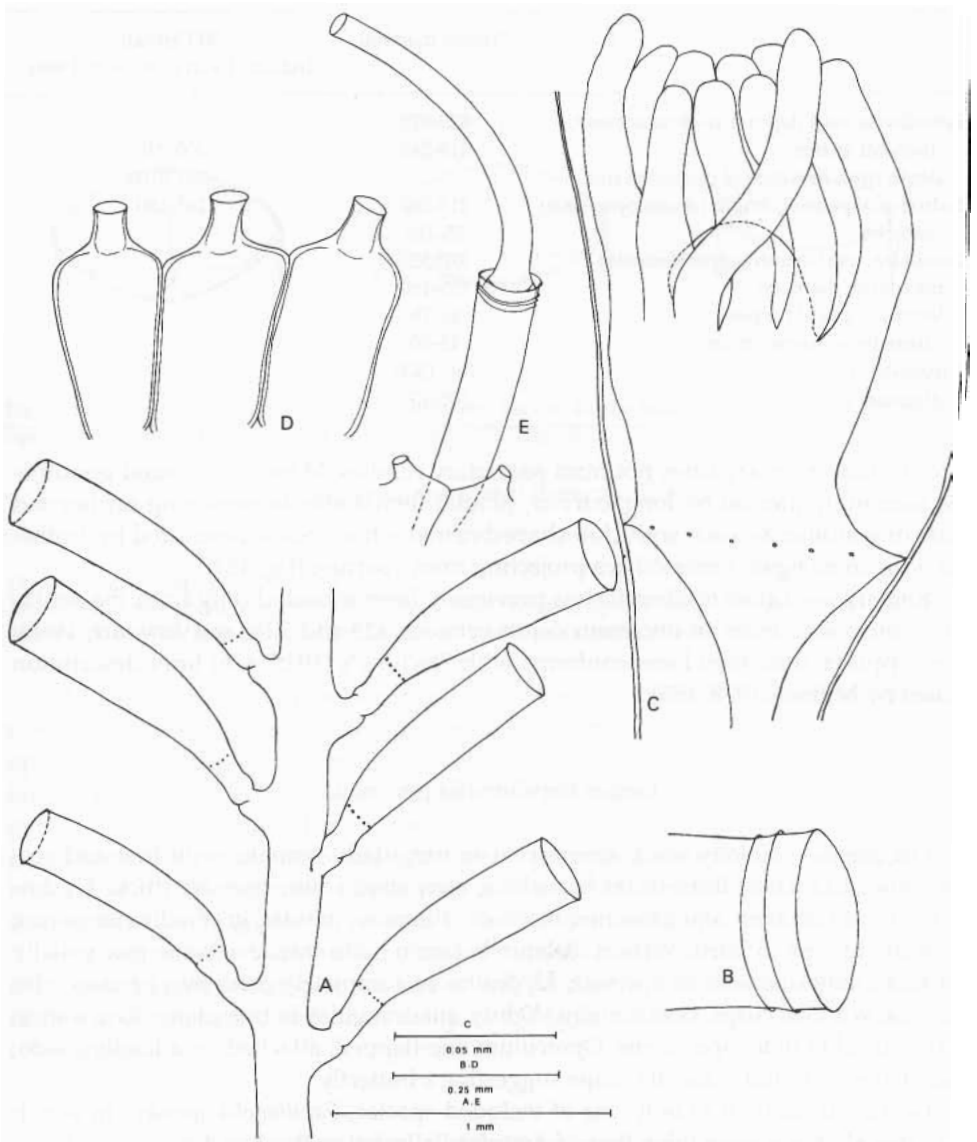


Fig. 4. *Lafoea benthophila* Ritchie, 1909, Sea of Okhotsk. A, monosiphonic part of branch; B, distal part of renovated hydrotheca; C, optical section through basal part of hydrotheca to show attachment of hydranth; D, distal portion of some gonothecae isolated from coppinia; E, distal part hydrotheca projecting through aggregated gonothecae of coppinia; hydrotheca has regenerated a protective tubule.

Coppiniae on both stem and major ramifications (fig. 3), each forming a muff several mm length; comprising many coalesced gonothecae 5-6 sided in cross section, each much constricted apically to form a narrow, straight neck with circular, slightly flared rim, renovated in some (fig. 4D). Gonothecae apparently developing

Table 2. *Lafoea benthophila*. Measurements in μm .

	Present material	Off Durban, Indian Ocean (Vervoort, 1966)
Hydrotheca, total depth (rim-desmocytes)	825-870	
diameter at rim	215-240	200-220
depth from first turn of pedicel to rim		970-1010
Hydrothecal pedicel, length (desmocytes-axis)	215-260	135-150
diameter	85-110	
Gonotheca, total length (approximately)	370-520	
maximum diameter	135-150	
length of apical funnel	65-75	
diameter of funnel at rim	45-50	
Nematotheca, length	760-1520	
diameter at rim	105-130	

directly from primary tube, not from secondary tubules. Mass of coalesced gonothecae seemingly pierced by long, curved, tubular nematothecae projecting far beyond mass of gonothecae, each with club-shaped nematophore. Some renovated hydrothecae with an elongate nematotheca projecting from aperture (fig. 4E).

Remarks.— *Lafoea benthophila* has previously been recorded only from the southern hemisphere, from an uncertain depth between 425 and 3246 m (Vervoort, 1966). The coppinia, described here, conforms with Stechow's (1925: 426) brief description (noted by Millard, 1975: 185).

Genus *Papilionella* gen. nov.

Diagnosis.— Colony erect, arborescent to irregularly pinnate, with first- and second-order branches; third-order branching rare; stem stout, perisarc thick. Hydrothecae borne on stem and branches, biseriate, alternate, tubular, gradually narrowing towards rim, not inflated. Vertical distance between hydrothecae of same row usually not more than diameter of aperture. Hydrothecae completely sunk into perisarc; rim sinuous, without cusps, occasionally slightly quadrangular in one plane. Renovation of rim usual in older specimens. Operculum one-flapped, attached on adcauline side, folded along sagittal plane; its shape suggesting a butterfly.

Gonosome known in only one of included species, *Papilionella spasskii*, in which gonothecal shape resembles that of *Sertularella* in being oval and rugose with an abrupt end and short terminal neck with collar.

Type species: *Diphasia spasskii* Fenyuk, 1947.

Etymology.— Generic name feminine, from Latin "papilio" (butterfly), reflecting form of operculum.

Remarks.— A group of species having operculae of the same form are brought together in the newly proposed genus *Papilionella*. As mentioned below its scope comprises two distinct and two dubious species.

From an evolutionary point of view representatives of *Papilionella* seem to be intermediate between many-flapped and one-flapped operculate hydroids of the family Sertulariidae (Antsulevich, 1988).

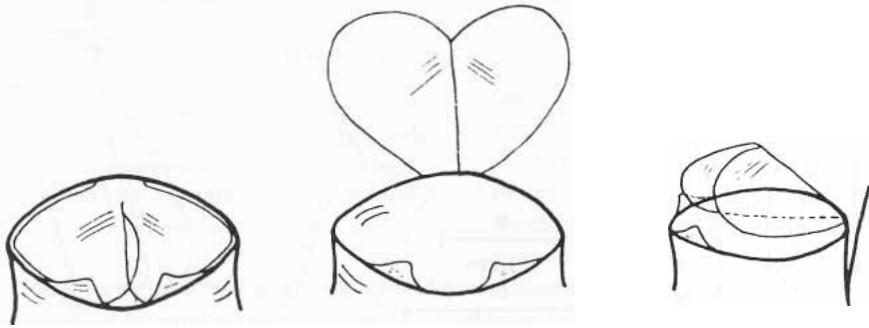


Fig. 5. *Papilionella spasskii* (Fenyuk, 1947), northern Pacific, Kurile Islands region, semi-diagrammatic figure of opercular apparatus. After Antsulevich, 1987, fig. 20.

***Papilionella spasskii* (Fenyuk, 1947)**

(fig. 5)

Diphasia spasskii Fenyuk, 1947: 9, fig. 9.

Abietinaria spasskii; Naumov, 1957: 40; Naumov, 1960: 399-400, fig. 291; Naumov, 1969: 430-431, fig. 291.

Sertularella spasskii; Antsulevich, 1987: 71, fig. 20; Antsulevich, 1988: 115-116, figs. 1-2.

The supposed one-flapped structure of the operculum was the reason for Naumov (1960; 1969) referring this species to *Abietinaria*. Further investigations have shown the operculum to comprise two pieces joined as a single flap, the operculum thus resembling a butterfly. In addition there are two delicate rudimentary flaps that do not take part in the functioning of the operculum (fig. 5). This fact together with the quadrangular hydrothecal rim and *Sertularella*-type of gonotheca were the reasons for Antsulevich (1987; 1988) referring this species to *Sertularella*. However, as he implied, this species differs from all species referred to *Sertularella* in its unique operculum.

P. spasskii is known from a large area of the Sea of Okhotsk and the Pacific coast of the Kurile Islands where it is not rare at bathyal depths. For a complete description, figures and notes on distribution we refer to Naumov (1960, 1969) and Antsulevich (1987, 1988).

***Papilionella pterophora* spec. nov.**

(figs. 6A, B, D, 7)

Material.— Holotype a single sterile colony (in alcohol), second cruise of Russian oceanographic ship "Academician Oparin", Stn 97, central region of Kurile Archipelago, Ushishir Isl., 44°33'N 152°46'E, depth 160-139 m, bottom trawl, collected 25.viii.1986 by A. V. Smirnoff. Holotype and one slide (schizoholotype) in collection of Zoological Institute of Russian Academy of Sciences, St Petersburg. Schizoholotypes.— Two slides no. 1819 in collection of NNM, Leiden, RMNH Coel. no. 26772.

Description.— Colony arborescent, 8 cm high; stem stout, basal part braided by hydrorhiza of *Bonneviella* spec.; internodes of unequal length. Branches arising at 30-45°, narrowing proximally; irregular, alternate in arrangement (fig. 6A).

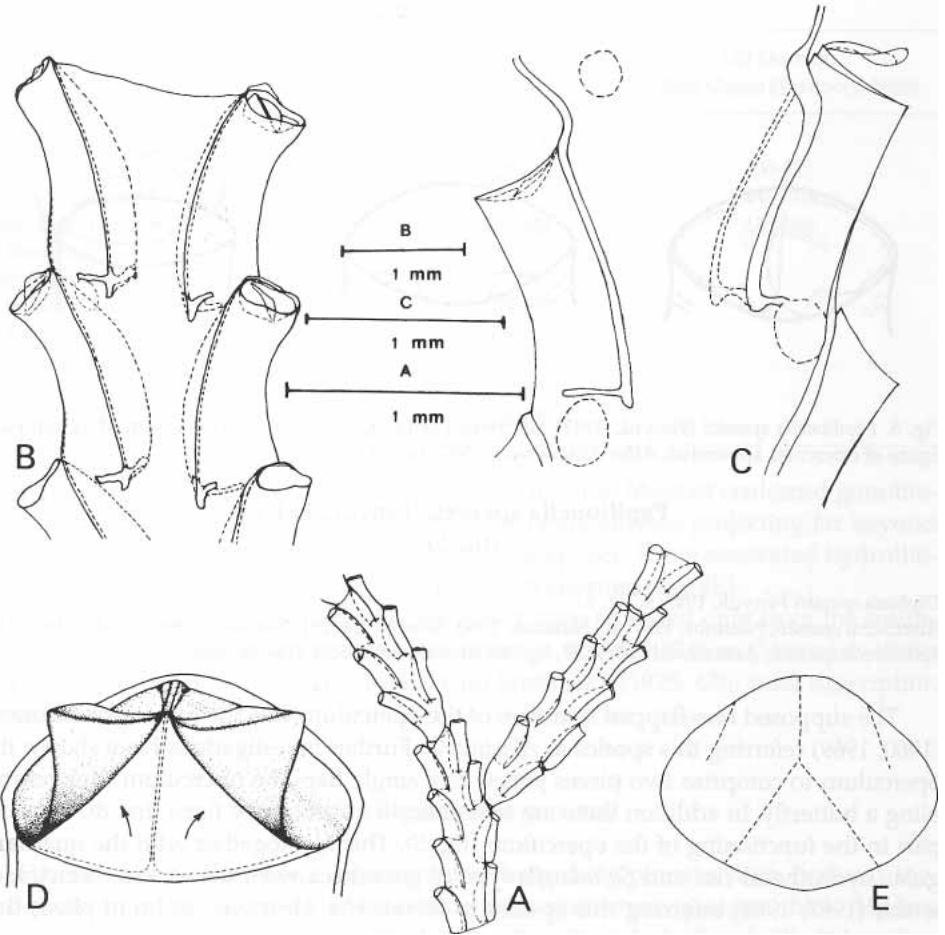


Fig. 6. A, B, D, *Papilionella pterophora* spec. nov., holotype, northern Pacific, Ushishir Island; A, part of colony, showing structure of internodes and ramification; B, top part of one of branches showing young hydrotheca with their operculum; lines on operculum accentuated; D, semi-diagrammatic drawing of top part of hydrotheca to demonstrate folding and mode of operation of opercular apparatus. C, E, *Papilionella verwoorti* (El Beshbeeshy, 1991), Walter Herwig Expedition Stn 329, Argentine coast; C, part of branch to show arrangement of hydrothecae and position of opercular flap; E, opercular apparatus (flap) seen from above, dashed lines representing folds in almost hyaline operculum.

Hydrothecae on stem and branches of uniform shape, biseriate, alternate (figs. 6A, B, 7), vertically contiguous, large, thick walled, tubular, narrowed slightly towards margin, banana shaped; completely sunk and laterally covered by perisarcular folds (figs. 6B, 7), but rim free; rim sinuous, often renovated, slightly quadrangular in one plane; operculum of one composite flap, divided into two wings for $1/2$ - $2/3$ of its sagittal diameter, both 'wings' folded in cauline (sagittal) direction, forming a triangular ridge in median (sagittal) section of aperture, the two wings sometimes opening separately, the one-flapped operculum actually functioning as a two-flapped structure (fig. 6D). Under ideal optical conditions the operculum shows numerous

Table 3. *Papilionella pterophora*. Measurements (in μm).

	Kurile Archipelago
Hydrotheca, abcauline wall	1545-1746
adcauline wall	2032-2308
maximum diameter of aperture	585-683
breadth of base in profile	814-862

fine, roughly concentric lines on its surface. The frontal wall of the hydrotheca, the largest among all known Sertulariidae, is sometimes cracked close to margin.

Gonosome unknown. Round circles of thin perisarc at the base of certain hydrothecae indicate the places of attachment of gonothecae.

Etymology.— From the Greek ‘pteroforos’, bearing wings, referring both to the presence of wing-shaped parts of the axis surrounding part of the hydrotheca, and to the curious structure of the opercular flaps.

?*Papilionella edentula* (Bale, 1924)

Sertularella edentula Bale, 1924: 237, fig. 16; Totton, 1930: 200, fig. 46, pl. 3 fig. 6; Ralph, 1961: 834-835, fig. 25.

Not *Sertularella edentula* Vervoort, 1972: 127, fig. 39 b-d (= *Papilionella vervoorti* El Beshbeeshy, 1991).

Not *Thuiaria edentula* Stepan'yants, 1979: 92, pl. 17 fig. 9 a-b (= *Papilionella vervoorti* El Beshbeeshy, 1991).

This species is provisionally referred to *Papilionella* gen. nov. It corresponds with the generic diagnosis in the shape of the hydrotheca and its position on the hydrocaulus. Of greater importance, however, is the fact that the hydrothecal margin is rounded and smooth and lacking cusps but at the same time is provided with a compound operculum, originally regarded as trivalvate (Bale, 1924). Hitherto the operculum of this species has not been described completely. In its first description Bale (1924: 238) stated: "... operculum generally comes clean away, leaving no trace. Only here and there can a remnant be found, and then usually insufficient to indicate its original form; however, after careful search I succeeded in finding a few specimens intact, all of which were trivalvate, though the margin showed no corresponding divisions". Totton's (1930) material consisted of a single small fragment lacking any operculum. The information given by Ralph (1961) was based on the specimens described by Bale and Totton, while referring to Bale for notes on the operculum.

Previous descriptions of the gonotheca (Bale, 1924; Ralph, 1961) seem rather curious. Gonothecae of the shape and size described are unknown amongst sertulariid hydroids. The gonosome was originally described by Bale (1924), but the gonothecae had become broken from the main stem by the time that Ralph (1961) re-examined Bale's material. The structure of the so-called "gonothecae" shows that they are in all probability egg capsules of molluscs, attached to the perisarc of the hydroid. This is clear from the figures in El Beshbeeshy (1991: fig. 64 b, d), describing the gonotheca of *T. vervoorti* (= *Sertularella edentula* Vervoort, 1972: 127). Consequently both operculum and gonotheca of this species are hitherto undescribed. The description of the operculum at least is needed to support referral of this species to *Papilionella*.

Distribution.— Known from two localities only, both from northern New Zealand (Bale, 1924; Totton, 1930; Ralph, 1961).

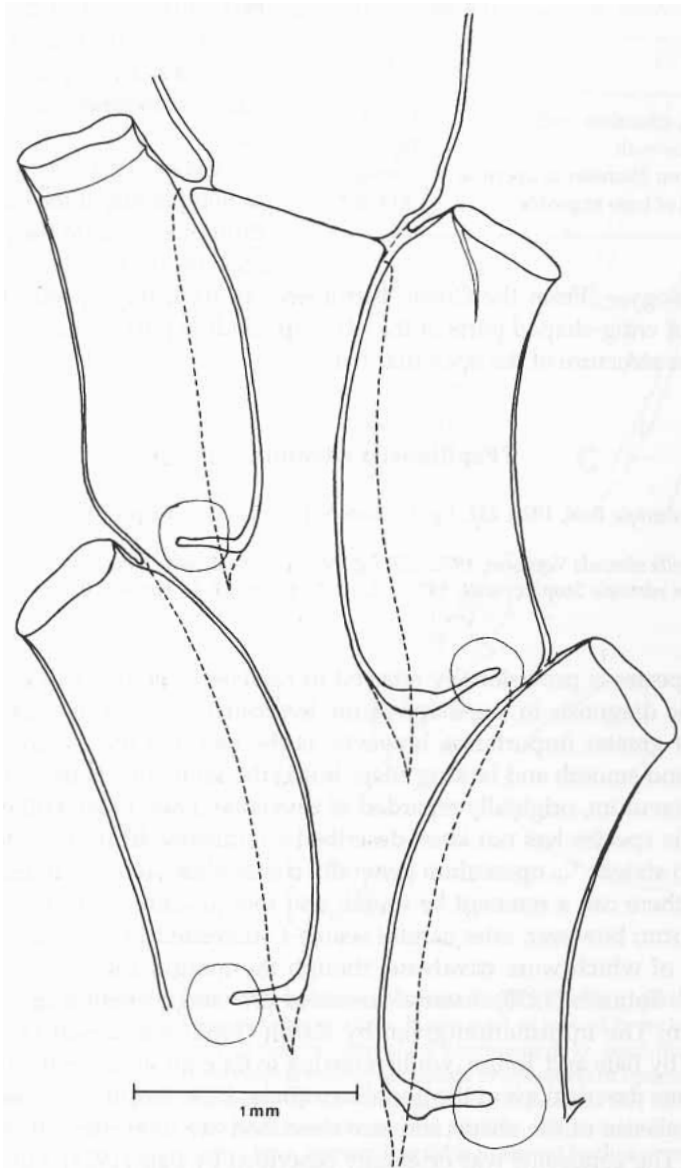


Fig. 7. *Papilionella pterophora* spec. nov., holotype, northern Pacific, Ushishir Island, part of branch showing perisarcular folds covering part of hydrothecae.

?*Papilionella vervoorti* (El Beshbeeshy, 1991)
(fig. 6C, E)

Sertularella edentula; Vervoort, 1972: 127, fig. 39b-d

Thuiaria edentula; Stepan'yants, 1979: 92, pl. 17 fig. 9A-V.

Thuiaria vervoorti El Beshbeeshy, 1991: 250-253, fig. 64.

Material.— R.V. "Zund" (Russia), cruise no. IV, Argentine coast, 47°53'S 58°46'W, 1500 m, trawl 121, collected by I. Smirnov, 15.v.1974, material in collection ZIRAS no. 1 (as *Thuiaria edentula* (Bale, 1924). Single sterile colony 120 mm high.

—VEMA Expedition, Stn 17-62, 54°41'S 55°35'W, 1199-1165 m, 12.v.1961. Four fragments 20-50 mm high without gonothecae, and 2 slides, RMNH Coel. no. 7213; also 2 additional slides no. 1822.

—Walter Herwig Expedition, Stn 329, 41°13'S 56°57'W, 980 m, 23.ii.1971. One colony 120 mm high and some fragments, no gonothecae, lectotype. (N.B. data taken from El Beshbeeshy, 1991: 251; data on label: WH36, St. 329, 41°13'S 56°51'W, 22.ii.1971, 1250 m). Zoologisches Institut und Zoologisches Museum der Universität Hamburg, no. C 11543. Two slides no. 1849 from the lectotype are now in the NNM, Leiden, under RMNH Coel. no. 26773.

Remarks.— This species was first described by Vervoort (1972) as *Sertularella edentula* Bale, 1924. It was later on redescribed by El Beshbeeshy (1991) from additional material, as *Thuiaria vervoorti*. In referring this species to *Thuiaria* Fleming, 1828, he followed Stepan'yants (1979). For the correctness of this view we refer partly to the remarks made above under *Papilionella edentula*. Reinspection was carried out of the VEMA material recorded earlier by Vervoort, the material of El Beshbeeshy (Walter Herwig Exp., Stn 329), kindly sent by prof. dr. M. Dzwillo from Hamburg, and the material described by Stepan'aynts (1979) as *Thuiaria edentula* in the collections of the Zoological Institute of the Russian Academy of Sciences, St Petersburg. It shows the operculum to be a single delicate and folded adcauline hydrothecal flap of slightly quadrangular shape and concave when inside of hydrotheca. The position of the folds of the operculum is fairly constant; they are not pronounced and in some optical sections the folds may give the impression of the flap consisting of three pieces (fig. 6E). A small number of hydrothecae (not more than 5%) has the operculum preserved but usually it has come clean away. More often the operculum can be found at the distal parts of the branches, where the hydrothecae are younger (fig. 6C), or in hydrothecae with recently renovated margin. In last case it is attached to the renovated part. Evidently, the operculum is formed together with the hydrotheca or with a new hydrothecal margin, but the delicate flap is short lived and the hydrothecae do without it normally. The presence of a large adcauline hydrothecal flap precludes the inclusion of this species in *Thuiaria* Fleming, 1828 (considered congeneric with *Salacia* Lamouroux, 1816, by some authors, e.g. Cornelius, 1979, but not Cornelius & Ryland, 1990, nor Cornelius, in press), in which a (single) abcauline hydrothecal flap is considered part of the diagnosis.

The arguments of El Beshbeeshy (1991) for recognizing this species and the synonymy he gave are accepted here. The three localities from where it is known (Falkland Islands, Vervoort, 1972; coast of Argentina, Stepan'yants, 1979; and Patagonia, El Beshbeeshy, 1991) are geographically close. As stated above re-examination of material from the Falklands (Vema 17-62) in the collection of NNM, Leiden, and from Patagonia (WHE, Stn 329) in the collection of Zoological Museum of Hamburg University shows those specimens cannot be referred to *Thuiaria*. Stepan'yants (1979) described a one-flapped operculum of the *Thuiaria* type in her specimens from Argentina; but there are no comments on the operculum in El Beshbeeshy's (1991) paper.

The description and figures of the gonotheca of this species in Stepan'yants (1979) were taken from the account of *S. edentula* in Ralph's (1961) paper. Considering the above remarks on the status of the gonotheca described by El Beshbeeshy (1991), we must consider the gonosome of this species as unknown. Definite referral of the species to *Papilionella* should be supported by new material and new data.

Acknowledgements

This study has been possible because of financial support provided by the Netherlands Organisation for Scientific Research (NWO), enabling A. Antsulevich to work in the National Museum of Natural History, Leiden, for a period of two months. The authors also wish to express their gratitude to the authorities of that Museum for research facilities, to prof. dr. M. Dzwillo, Hamburg, for the loan of material, and to record their thanks to Dr Paul F.S. Cornelius, The Natural History Museum, London, for discussion and linguistic help.

References

- Antsulevich, A.E., 1987. *Gidroidy shel'fa Kuril'skiykh ostrovov*. (Hydroids from the shelf waters of Kurile Islands): 1-165, figs. 1-51.— Zoologicheskii Institut, Akad. Nauk SSSR, Leningrad. (Russian with English summary).
- Antsulevich, A.E., 1988. *Morfologiya gidroida Sertularella spasskii* (Feniuk, 1947) - primer oligomerizatsii chisla klapanov operkulyuma v semeistve Sertulariidae. The morphology of hydroid *Sertularella spasskii* (Feniuk, 1947) as an example of an operculum flaps number oligomerization in the family Sertulariidae.— Vestn. leningr. Univ., Biol.,(3) 1988 (2): 115-116, figs. 1-2. (Russian with English summary).
- Bale, W.M., 1924. Report on some hydroids from the New Zealand coast, with notes on New Zealand Hydroida generally, supplementing Farquhar's list.— Trans. Proc. N. Z. Inst., 55: 225-268, figs. 1-18. (12.vi.1924).
- Blanco, O.M., 1967. Contribución al conocimiento de los hidrozoarios Argentinos.— Revta Mus. La Plata, n. ser. 9, Zool. 71: 243-297, pls. 1-6.
- Cornelius, P.F.S., 1979. A revision of the species of Sertulariidae (Coelenterata: Hydroida) recorded from Britain and nearby seas.— Bull. Br. Mus. nat. Hist., Zool. 34: 243-321, figs. 1-29, tabs. 1-28.
- Cornelius, P.F.S., in press. North-west European thecate hydroids and their medusae (Cnidaria, Leptolida, Leptothecatae).— Synopses of the British Fauna (New Ser.), Linnean Society, London, 1994.
- Cornelius, P.F.S. & J.S. Ryland, 1990. Class Hydrozoa. In: P.J. Hayward & J.S. Ryland., eds., *The marine fauna of the British Isles and North-West Europe. Volume 1, Introduction and Protozoans to Arthropods*: 107-158, figs. 4.3-4.25.— Oxford. (Volume 1: i-xvi, 1-627 plus 44 pp indices, figs. 1-11.32).
- Dawydoff, C.(N.), 1952. Contribution à l'étude des invertébrés de la faune marine benthique de l'Indochine.— Bull. biol. Fr. Belg., 37, suppl.: 1-158. (Coelenterata: 52-78).
- El Beshbeeshy, M., 1991. Systematische, Morphologische und Zoogeographische Untersuchungen an den Thekaten Hydroiden des Patagonischen Schelfs: 1-390, figs. 1-102, tabs. 1-80.— Dissertation, Universität Hamburg.
- Fenyuk, V., 1947. Materialy po gidroidam (Thecaphora) Okhotskogo morya. Some materials on the hydroids (Thecaphora) from the Ochotsk Sea.— Byull. Mosk. Obshch. Ispyt. Prir., n. ser. 52 (2): 3-13, figs. 1-10. (Russian with English summary).
- Fleming, J., 1828. A history of British animals: i-xxiii, 1-565.— Edinburgh.
- Hassall, A.H., 1848. Definitions of three new British zoophytes.— Zoologist, 6: 2223.
- Hincks, Th., 1861. A catalogue of the Zoophytes of South Devon and South Cornwall.— Ann. Mag. nat. Hist., (3) 8: 152-161, 251-262, 290-297, 360-366, pls. 6-8.
- Hincks, Th., 1862a. A catalogue of the Zoophytes of South Devon and South Cornwall.— Ann. Mag. nat. Hist., (3) 9: 22-30, pl. 7 figs. 1-2.
- Hincks, Th., 1862b. A catalogue of the Zoophytes of South Devon and South Cornwall. Appendix.— Ann. Mag. nat. Hist., (3) 10: 360-363.
- Hincks, Th., 1868. A history of the British hydroid zoophytes. Volume 1: i-lxviii + 1-338, frontispiece, figs. 1-45; volume 2: pls. 1-67.— London.
- Leloup, E., 1937. *Hydropolypes et Scyphopolypes recueillis par C. Dawydoff sur les côtes de l'Indochine française*.— Mém. Mus. r. Hist. nat. Belg., (2) 12: 1-73, figs. 1-43.
- Millard, N.A.H., 1975. Monograph on the Hydroida of southern Africa.— Ann. S. Afr. Mus., 68: 1-513, colourplate, figs. 1-143.

- Millard, N.A.H., 1978. The geographical distribution of southern African hydroids.— *Ann. S. Afr. Mus.*, 74 (6): 159-200, figs. 1-9, tabs. 1-2, appendices 1 & 2.
- Naumov, D.V., 1957. Rol' protzessov oligomerizatsii i polimerizatsii v evolyutsii kolonialnykh gidrozoev. The role of oligomerization and polymerization in the evolution of colonial Hydrozoa.— *Trudy leningr. Obshch. Estestv.*, 73 (4): 38-42, fig. 1, tab. (Russian with German summary).
- Naumov, D.V., 1960. Gidroidi i gidromedusy morskikh, solonovotvodnykh i presnovodnykh basseinov SSSR.— *Opredeleteli po faune SSSR, Izdavaemye Zoologicheskim Institutom Akademii Nauk SSSR*, 70: 1-626, figs. 1-463, pls. 1-30, tab. 1. (Russian).
- Naumov, D.V., 1969. Hydroids and Hydromedusae of the USSR: i-vi, 1-631, figs. 1-463, pls. 1-30, tab. 1, I folding plate. (English translation by Israel Program for scientific translations, cat. no. 5108, of D.V. Naumov, 1960).
- Ralph, P.M., 1961. New Zealand thecate hydroids. Part III.- Family Sertulariidae.— *Trans. R. Soc. N.Z.*, 88 (4): 749-838, figs. 1-25.
- Rees, W.J. & S. Thursfield, 1965. The hydroid collections of James Ritchie.— *Proc. R. Soc. Edinb.*, (B) 69 (1-2) (2): 34-220.
- Rees, W.J. & W. Vervoort, 1987. Hydroids from the John Murray Expedition to the Indian Ocean, with revisory notes on *Hydrodendron*, *Abietinella*, *Cryptolaria* and *Zygophylax* (Cnidaria: Hydrozoa).— *Zool. Verh. Leiden* 237: 1-209, figs. 1-43, tabs. 1-37.
- Ritchie, J., 1909. Supplementary report on the hydroids of the Scottish National Antarctic Expedition.— *Trans. R. Soc. Edinb.*, 47 (1) (4): 65-101, figs. 1-11.
- Ritchie, J., 1911. Hydrozoa (hydroid zoophytes and Stylasterina) of the "Thetis" expedition.— *Mem. Aust. Mus.*, 4 (16): 807-869, fig. 126, pls. 84-89.
- Smaldon, G., D. Heppell & K.R. Watt, 1976. Type specimens of invertebrates (excluding Insects) held at the Royal Scottish Museum, Edinburgh.— *Inf. Ser. R. Scot. Mus. (Nat. Hist.)*, 4: i-iv, 1-118.
- Stechow, E., 1923. Neue Hydroiden der Deutschen Tiefsee-Expedition, nebst Bemerkungen über einige andre Formen.— *Zool. Anz.*, 56 (1-2): 1-20.
- Stechow, E., 1925. Hydroiden der Deutschen Tiefsee-Expedition.— *Wiss. Ergebn. dt. Tiefsee-Exped. 'Valdivia' 1898-1899*, 27: 383-546, figs. 1-54.
- Stepan'yants, S.D., 1979. Gidroidy vod antarktiki i subantarktiki. In: *Rezultaty biologicheskikh issledovaniy sovetskikh antarkticheskikh ekspeditsii*, 6.— *Issled. Fauny Morei*, 22 (30): 1-99, figs. 1-9, pls. 1-25, 3 coloured figures on 2 plates, tabs. 1-17. (Russian).
- Totton, A.K., 1930. Coelenterata. Part V. Hydroida.— *Nat. Hist. Rep. Br. Antarct. ('Terra Nova') Exped.*, 1910, *Zool.* 5 (5): 131-252, figs. 1-70, pls. 1-3.
- Vervoort, W., 1946. Exotic hydroids in the collections of the Rijksmuseum van Natuurlijke Historie and the Zoological Museum at Amsterdam.— *Zool. Meded. Leiden*, 26 (1-4): 287-351, figs. 1-10.
- Vervoort, W., 1966. Bathyal and abyssal hydroids.— *Galathea Report, Scient. Res. Danish Deep-Sea Exped.*, 1950-1952, 8: 97-173, figs. 1-66.
- Vervoort, W., 1972. Hydroids from the Theta, Vema and Yelcho cruises of the Lamont-Doherty geological observatory.— *Zool. Verh. Leiden*, 120: 1-247, figs. 1-83.
- Watson, J.E., 1992. Revision of the family Lineolariidae Allman, 1864 (Hydrozoa: Hydroida).— *Proc. R. Soc. Victoria*, 104: 81-87, fig. 1.

Received: 2.v.1993

Accepted: 8.vi.1993

Edited: J.C. den Hartog