A new cornulitid genus from the Silurian of Gotland, Sweden

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**Abstract:** A new genus and species *Septalites septatus* gen. et sp.n. of a possible cornulitid is described from the Silurian of Gotland. The new genus resembles Conchicolites in having a smooth tube interior with multiple septa, but differs in the greater number of septa and microlamellar tube structure. Most of the shell interior (about 3/4) is filled with the septa. *S. septatus* shares several features with *Cornulites* and tentaculitids, but it differs in lacking pseudopuncta and an annulated tube interior. It is affiliated with the Class Tentaculita Bouček (1964) because of micro-lamellar tube structure and the presence of septa.

**Keywords:** Problematic fossils, Tentaculita, cornulitids, *Septalites* gen. n., ultrastructure, Silurian, Gotland.

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Introduction

Cornulitids are small tubular fossils ranging from the Middle Ordovician to the Carboniferous (Fisher 1962; Richards 1974). They have a diverse morphology and achieved a cosmopolitan distribution in the Late Ordovician. The systematic position of cornulitids among invertebrate phyla is still open to debate (Fisher 1962; Morris & Rollins 1971; Richards 1974; Gnoli 1992; Vinn & Mutvei 2005). Four genera – *Cornulites* Schlotheim, 1820, *Conchicolites* Nicholson, 1872a, *Cornulitella* Nicholson, 1872b, *Kolihaia* Prantl, 1944 – have been assigned to Cornulitidae (Fisher 1962). They have been affiliated with sponges (stromatoporoids), cnidarians, fusulines, bryozoans, annelids and molluscs (Schlotheim 1820; Nicholson 1872a; Nicholson 1872b; La Rocque & Marple 1955; Fisher 1962; Blind 1972; Dzik 1991; Kriz et al. 2001). Dzik (1991) erected a new family Cornulitozoidae within the order Cornulitida (Bouček 1964), containing two new genera, *Cornulitozoon* and *Opatozoon*, from the Upper Ordovician and Silurian of Poland. Recently a new genus *Reticornulites* Lardeux et al. 2003 of Cornulitidae Fisher, 1962 with reticulate ornamentation has been described from the Devonian of the western part of Armorican massif (Lardeux et al. 2003).

Scanning electron microscopy (SEM) was carried out with a Hitachi S-4300 at the Swedish Museum of Natural History. Ten specimen of *Septalites septatus* gen. et sp.n. tubes embedded in Canada Balsam were longitudinally, and two perpendicularly sectioned, polished, etched in 1% solution of acetic acid for five minutes, and gold sputtered. For comparative purposes, the tubes of two recent annelids (*Pomatoceros triqueter, Dodecaceria caulleryi*) were immersed in Canada Balsam, sectioned, polished, and etched in 1% solution of acetic acid for two minutes. All figured and measured specimens are deposited at the Swedish Museum of Natural History, Stockholm (NRM).

Systematic palaeontology

**CLASS TENTACULITA BOUČEK 1964**

**ORDER CORNULITIDA BOUČEK 1964**

**Genus Septalites gen.n.**

Figs. 1A–F, 2A–C, 4

**Type species.** – *Septalites septatus* gen. et sp.n.

**Derivation of the name.** – From the septate structure of the tubes.

**Diagnosis.** – Large, thick, slightly expanding calcitic tubes, circular in cross-section, adult specimen nearly cylindrical, with microlamellar shell structure. Tube interior smooth. Tubes filled with semi-regularly spaced septa, fused or arranged obliquely to each other.

**Discussion.** – *Septalites* gen.n resembles *Cornulites* (Vinn & Mutvei 2005) in its micro-lamellar tube structure and the pres-
Fig. 1. Shells of Septalites septatus gen. et sp.n. A. anterior view, NRMAn304, ×4. B. Longitudinal sections of shells showing the shape and placement of septa NRMAn 2761-2762, ×14.7. C. Sectioned shells of S. septatus gen. et sp.n., (1) cross section of a shell, NRMAn2759, (2-6) longitudinal sections of shells NRMAn2760–2765, ×6; a – aperture, lch- living chamber, jvt- juvenile tubes, spt- septa. D. Cross section of two shells showing the microlamellar structure, NRMAn2761, ×53.3; int-interior, ext- exterior. E. Cross section of a shell showing the microlamellar structure, NRMAn2759, ×600; ext-exterior. F. Longitudinal section of the shell wall showing microlamellar structure, NRMAn2762, ×600; int-interior.
Fig. 2. A. Longitudinal sections of the shell of *S. septalites* gen. et sp.n. showing the distribution of secondary calcite prisms (spr) in the micro-lamellar shell (lm), NRMAn2762, ×120. B. Longitudinal sections of the shell of *S. septalites* gen. et sp.n., showing the distribution of secondary calcite prisms (spr) in the micro-lamellar shell (lm), NRMAn2762, ×213. C. Longitudinal sections of the shell of *S. septalites* gen. et sp.n., detail of secondary prismatic calcite (spr) in the external part of the shell wall, NRMAn2762, ×233. D. Longitudinal section of the tube of *Dodecaceria caulleryi* showing the septa (spt), South Africa, Atlantic coast, ×46.7. E. Longitudinal section of the tube of *Dodecaceria caulleryi* showing the growth lamina (lm), South Africa, Atlantic coast, ×1200. F. *Pomatoceros triqueter*, cross section of tube showing oriented chevron structure, Tjärnö, Sweden, ×2333. Ext – exterior, int – interior.
ence of septa, but differs in lacking pseudopuncta (Fig. 3B), vesicles in the tube wall (Fig. 3C), internal annulation and external longitudinal striae. It differs also in presence of septa throughout most of the tube interior. The new genus is similar to *Conchicolites* (Vinn & Mutvei 2005; Fig. 3D) in its smooth tube interior and presence of septa, but differs in having microlamellar shell structure, very short living chamber and by much larger number of septa. The new genus also resembles members of the Microconchida Weeden, 1991 in its microlamellar tube structure and smooth tube interior but is much larger and has no pseudopuncta. Numerous septa occur in *Trypanopora* (Trypanoporida Weeden, 1991) similarly to the *S. septatus* gen. et sp.n. but the new genus differs in lacking vesicles (= oblique peripheral septa *sensu* Weeden 1991, p. 231, fig. 4) and pseudopuncta in the tube wall.

The shell structure of *Cornulites* is regularly foliated and pseudopunctate, while that of *Conchicolites* presumably has a prismatic ultrastructure. *Cornulites* shares characters with the lophoporates and tentaculitids. The biological affinities of *Conchicolites* are controversial, and its morphologic features need further investigation before it can be more certainly affiliated with any extant animal phylum (Vinn & Mutvei 2005). Palaeozoic problematic tubicolous fossils with similar ultrastructures, previously known as spirorbids or vermiliform gastropods (Burchette & Riding 1977), including the Microconchida and Trypanoporida, have been affiliated with the Tentaculitida Bouček, 1964 (Weeden 1991, 1994).

The morphology of the embryonic shell is not known in *S. septatus* gen. et sp.n. but the new genus is tentatively assigned to the Cornulitida Bouček, 1964 within the Tentaculita Bouček, 1964 because of the tubicolous shape, micro-lamellar tube structure and presence of septa.

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**Fig. 3.** A. Longitudinal section of a *Cornulites* sp. shell, showing microlamellar structure, Jaani Stage, Wenlock, Saaremaa, Estonia, NRMAn2732, ×367. B. Cross section of a *Cornulites* aff. *scalariformis* shell showing microlamellar structure with pseudopuncta (psp) Mulde Beds, Wenlock-Ludlow, Djupvik, Gotland, Sweden, NRMMo41452, ×367. C. Longitudinal section of a *Cornulites* sp. shell showing vesicles (vscl) in the tube wall, Jaani Stage, Wenlock, Saaremaa, Estonia, NRMAn2732, ×60. D. Longitudinal section of a *Conchicolites* sp. shell showing prismatic structure, Hamra Beds, Ludlow, Sundre, Hoburgen, Gotland, Sweden, NRMAn2745, ×233.3. Ext – exterior, int – interior.
Septalites septatus gen. et sp.n.
Figs. 1A–F, 2A–C, 4

Holotype. – NRMAn2760 (Fig. 1C2), Lau, Gotland, Ludlow, Silurian.

Paratypes. – Six specimens, NRMAn2759, NRMAn2761–2765 (Fig. 1C1, C3–C6).

Type locality. – Lau, Gotland.

Derivation of the name. – From the septate structure of the tubes.

Diagnosis. – As for the genus.

Description. – Large shells attached to each other at the proximal region, young individuals occasionally attached to the internal surface of the living chambers of adult shells (Fig. 1C). Straight or slightly curved conical shell with a 0.3–0.4 mm thick wall at diameter of 2.5 mm (Fig. 1B, C). Adult specimens nearly cylindrical in longitudinal section (Fig. 1B, C). Cross-section circular (Fig. 1C1). External surface irregularly marked by weakly developed collars and faint growth striations (Fig. 1A). Maximum shell length more than 25 mm and maximum width 4.1 mm.

Internal surface of living chamber smooth (Fig. 1C2). Living chamber very short, restricted to the most apertural region of the shell. Most of shell interior (about \( \frac{3}{4} \)) filled with the septa (10–30 μm thick) varying in shape and spacing (Fig. 1B, C). Number of septa usually exceeds 20 in adult specimens.

Tubes composed of thin (3-6 μm thick) calcitic lamellae subparallel to the tube wall (Fig. 1E, F). In some tubes external parts of wall consists of irregular calcitic prisms, usually without a distinct border between prismatic and microlamellar layers. Micro-lamellar structure occasionally substituted by prismatic calcite, most commonly close to external surface of the tube (Fig. 2A–C).

Ultrastructure and zoological affinities of Septalites gen.n. and tentaculitids

The exact type of microlamellar ultrastructure could not be identified in the studied longitudinal and cross-sections of Septalites septatus gen et sp.n. (Figs. 1D–F, 2A–C). The microlamellar structure is often replaced by calcitic prismatic structure, which forms an external layer in some parts of tubes (Fig. 2A–C). Similar replacement of original laminar structure by secondary prismatic calcite has been described in Trypanopora (Weedon 1991, Weedon & Taylor 1994). The lack of a distinct boundary between the irregular prismatic and microlamellar calcite, and the occurrence of occasional prismatic aggregates in the microlamellar layer (Fig. 2A, B), demonstrate the secondary diageneric nature of the prismatic calcite.

Among molluscs, the tubicolous shells of vermetid gastropods somewhat resemble those of Septalites gen.n., but differ in having a spiral protoconch and juvenile part of the shell (Bandel & Kowalke 1997).

Among the recent annelids, the tubicolous shells of vermetid gastropods somewhat resemble those of Septalites gen.n., but differ in having a spiral protoconch and juvenile part of the shell (Bandel & Kowalke 1997).

Among the recent annelids only sabellitid, cirratulid and serpulid polychaetes have calcified tubes (Neff 1971; Fisher et al. 2000). Serpulid tubes have calcitic, aragonitic or mixed calcitic-aragonitic composition. Septa occasionally occur in the tubes of Pomatoeces triqueret (Serpulidae). However, the tube has an ordered chevron structure (Weedon 1994, p.5, fig. 2; Fig. 2F) which contrasts with the microlamellar structure of Septalites. Microlamellar tube ultrastructure is unknown in serpulid polychaetes (Weedon 1994). Presumably serpulids are not phylogenetically closely related to cornulitids and the Tentaculita Bouček, 1964 (Weedon 1991; Vinn & Mutvei 2005). Numerous septa similar to those of S. septatus gen. et sp.n. occur in the tubes of calcifying cirratulid polychaetes (Fisher et al. 2000) (Fig. 2). In recent Dodecaceria caulleryi the tube is composed of lamellae of aragonitic spherulitic prisms and homogeneous aragonitic granules (Fig. 2E). This aragonitic structure is possibly not homologous to the calcitic microlamellar structures seen in Septalites and their similar septa are presumably convergent arising from the similar functional morphology of the tubicolous calcareous exoskeleton.

Tentaculitids have a calcitic microlamellar shell ultrastructure (Larsson 1979) identified as cross-bladed lamellar in Tentaculitites (Towe 1978). This is the basis for Towe’s theory of the brachiopod affinities of tentaculitids. Among Tentaculita Bouček, 1964 the cornulitids, microconchids and trypanoporids cement their shells to the substrate, similarly to Septalites. The morphology and ultrastructure of Septalites is closest to the cornulitids Conchicocolites and Cornulites. These genera are characterized by a bulbous embryonic shell which has been presumably secreted after settlement of pelagic larva as it has a flattened, cemented...
underside (Vinn & Mutvei 2005). Unfortunately, the morphology of the earliest growth stage of Septalites are not known and comparison cannot be made with Conchicollites or Cornulites.

Fisher (1962) established a separate family for cornulitids of unknown affinities separating these from the tentaculitids. However, the tentaculitid affinities of Cornulites (Vinn & Mutvei 2005) are in agreement with Bouček’s (1964) taxonomic concept of the class Tentaculita. Tentaculitids including cornulitids (Bouček 1964), microconchids and trypanoporids (Weedon 1991) share several morphological affinities, such as microlamellar shell structure, pseudopuncta, and a bulbous initial chamber, with the lophophorates (Towe 1978; Larsson 1979a; Dzik 1991; Vinn & Mutvei 2005). Among the modern lophophorates phoronids have a worm-shaped bodyplan and secrete tubes. Though uncalcified, phoronid tubes have a microlamellar structure and are secreted by the entire body surface of the phoronid (Emig 1982). A similar secretion model is inferred for Cornulites (Vinn & Mutvei 2005). Thus, phoronids may well represent the phylogenetically closest clade to tentaculitids among recent invertebrate phyla (Fig. 4).

There are other worm-like problematic tubicolous fossils known from the Early Palaeozoic, such as Tymbochooos sinclairi from the Ordovician of North America (Steele-Petrovich & Bolton 1998) and serpulid-like worm tubes from the Silurian of Austria (Suttner & Lukeneeder 2004). However, their tube structures need further study before comparisons can be made with Septalites.

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References


Hede, J.E., 1925: Berggrundens (Silurisesystemet). In H. Munthe, J.E. Hede & L. v. Post (eds.): Beskrivning till kartbladet Ronehamn. Sveriges Geologiska Undersöknings Aa 156, 14–47.


Prantl, F., 1944: Kolliahaia eremita n.gen. n.sp. a new tubular Annelid from the Silurian of Bohemia. Vestnik Královská Česká Spolecnost Nauk 24, 1–12.


