FACIES	36	57-68	Pl. 17-20	1 Fig.	--	ERLANGEN 1997

Barbafera carnica Senowbari-Daryan, 1980: A Triassic Worm-tube

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KEYWORDS: SYSTEMATIC PALEONTOLOGY – WORMS – SERPULIDS – DOLOMITES (ITALY) – TRIASSIC (CARNIAN, CASSIAN BEDS)

SUMMARY

Barbafera carnica Senowbari-Daryan (1980), a Carnian reef fossil of uncertain systematic position, is redescribed based on extraordinarily preserved material from Carnian reef boulders of the Cassian Formation of the Southern Alps (Dolomites/Italy). *Barbafera* is interpreted as a worm tube characterized by a complicated wall structure. *Barbafera* may belong to the family Serpulidae Rafinesque.

1 INTRODUCTION

Due to the intensive studies of Triassic reef and shelf carbonates during the last thirty years, many taxa were described whose systematic position remains a question of discussion (Flügel 1972, Borza 1975, Senowbari-Daryan 1984, Senowbari-Daryan & Flügel 1996). As most of these microorganisms are known only from thin-sections characteristics for a taxonomic determination are frequently lost or poorly known so that the interpretation of the complete organisms often is incomplete.

Many of these 'microproblematica' exhibit strong facies controls and are restricted to limestones of the central reef environment and are therefore important facies indicators. Only a few microproblematica occur in other shallow-marine environments. Some microproblematica can be used as index fossils. Carnian microproblematica are different from Norian-Rhaetian taxa (Senowbari-Daryan 1984) and generally less common than during the Norian-Rhaetian time span.

Barbafera carnica Senowbari-Daryan (1980) is one of the largest and in places also most frequent problematicum in Carnian reef limestones.The fossil was first described from the *Amphyclina* beds near Huda Juzna (Slovenia) and the *Cidaris* beds of the Gosaukamm (Austria). The species occurs in different parts of the Tethys including Hungary, Greece, Sicily, Southern Turkey and Oman (see list of synonyma).

New samples (D 56) of *Barbafera carnica* were collected by J. Wendt (Tübingen) near the old military street fromSchluderbach (Carbonin) to Prags (Braies) in the area of the Seelandalpe (Alpe di Specie) about 300 m south of the Dürrenstein hotel (Rif. Pico Valloandro). The exact position of the locality is shown by Fürsich & Wendt (1977) and Wendt & Zardini (1979). Samples numbered D69 come from the Valle di Rimbianco, north of Misurina (see Ogilivie 1893: 36).

The well-preserved material from the Cassian beds allows the description of the main morphological characteristics of *Barbafera* in thin-sections as well as studies by SEM. The recognition of up to now unknown morphological and microstrucural criteria points to an interpretation of *Barbafera carnica* as a polychaete worm tube.

The material is housed in the Geologisch-Paläontologisches Museum der Universität Tübingen (Material J. Wendt, Thin-sections D, No. 1635/....) and in the Institut für Paläontologie, Universität Erlangen.

2 PALEONTOLOGY

Annelida
Class Polychaetia Grube, 1850
Order Sedentaria Lamarck, 1818
Family Serpulidae Rafinesque, 1815

Several scientists have been regarded as authors of the family Serpulidae (Savigny 1818 or 1820 – see Jäger 1983 and Dragastan 1966; Burmeister 1837 – see Regenhardt 1961, Howell 1962; Johnson 1865 – see Bianchi 1995). According to Jäger (1983), Rafinesque (1815) is the author of the family. I agree with this opinion (cf. Radwanska 1994). *Barbafera* is only tentatively included in the family Serpulidae.

Worms with calcareous skeletons (generally called 'serpulids') occur within the families Serpulidae Rafinesque and Spirorbidae Pialli. The Sabellidae Malmgrenwhich are rather similar in the tube morphology use gelatinous or chitinous material in building their tubes and are agglutinating (Bianchi et al. 1995, Wieland 1995). Only one genus of this family builds calcareous tubes (Perkins 1991, Bianchi et al. 1995).

In contrast to Sabellidae, Serpulidae can construct a

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tegament closing the tubes. Both, Serpulidae and Sabellidae are morphologically rather similar because of evolute tubes. Spirorbidae are usually involute. Serpulid tubes are made of calcite or aragonite.

The systematic position of recent serpulids is based on the animal's soft body as e.g. bristles and tentacles, while the hard parts are regarded as being of minor importance (PARSCH 1956, BIANCHI et al. 1995). Internal structures are in most cases not preserved and rarely used for systematic considerations. Microstructures of serpulids were studied by NISHI (1993) and WEEDON (1994).

Many studies of fossil serpulid worm tubes deal with examples from the Mesozoic (especially Jurassic-Cretaceous) and Cenozoic. Only a few descriptions of Triassic serpulids are known (cf. GÖTZ 1931). According to BRÖNNIMANN & ZANINETTI (1972) *Spirobis* DAUDIN seems to be most frequent during the Triassic, while *Serpula* LINNAEUS becomes more frequent from the Jurassic onward. SENOWBARI-DARYAN (1994) described a worm from the Ladinian and Carnian of the Alpine-Mediterranean area as *Alpinotubus lamellatus* which differs from *Barbafera* by its mineralogy, morphology, and a simple wall. FLÜGEL et al. (1984), BRANDNER et al. (1991), SENOWBARI-DARYAN et al. (1993) and BERRA & JADOUL (1996) figured worm tubes occurring in thin-sections of various Triassic reef limestones. These fossils can not be compared with *Barbafera* and may represent new taxa

As the tubes of *Barbafera* reveals only few taxon-specific criteria (shape, ornamentaion, dimensions) the attribution to the family Serpulidae remains questionable, especially because of the great differences in the construction of the tube which perhaps may suggest a position of *Barbafera* within a new family, but as the characteristics of the tube are thought to be of minor systematic value I propose to include *Barbafera* in the family Serpulidae.

Genus *Barbafera* SENOWBARI-DARYAN, 1980

Original diagnosis: 'Zylindrischer, aus mehreren Ringkammern um einen Kanal gebauter Organismus mit einer äußeren, bartartigen Verkalkung' (SENOWBARI-DARYAN, 1980:106).
Emended diagnosis: Cylindical test, consisting of an axial, tube-like channel. This channel is surrounded by a wall from which ring-like umbrella-shaped walls originate. Multiple bifurcation of these walls form a peripheral lamella-like calcified zone, which is oriented obliquely to the central tube axis (shown in longitudinal sections). The wall of the axial channel and the walls ring-like surrounding the channel are not perforated and reveal a lamellar microstructure running parallel to the wall. The primary composition of the wall was aragonite.
Type species: *Barbafera carnica* SENOWBARI-DARYAN, 1980
Additional species: *Barbafera jurassica* DRAGASTAN, 1990

Barbafera carnica SENOWBARI-DARYAN, 1980
(Pls. 17-19, Pl. 20/1-3; Fig. 1)

*	1980	*Barbafera carnica* n. g., n. sp. – SENOWBARI-DARYAN, p. 106, Pls. 1-2.
v.	1986	*Barbafera carnica* SENOWBARI-DARYAN. – SENOWBARI-DARYAN & ABATE, p. 69, Pl. 2, Fig. 7.
v.	1990	*Barbafera carnica* SENOWBARI-DARYAN. – RIEDEL, Pl. 13, Fig. 4.
v.	1991/92	*Barbafera carnica* SENOWBARI-DARYAN. – FLÜGEL et al., p. 46, Pl. 5, Fig. 12
v.	1995	*Barbafera carnica* SENOWBARI-DARYAN. – BERNECKER, p. 76, Pl. 10, Fig. 5
v.	1996	*Barbafera carnica* SENOWBARI-DARYAN. – BERNECKER, p. 71.

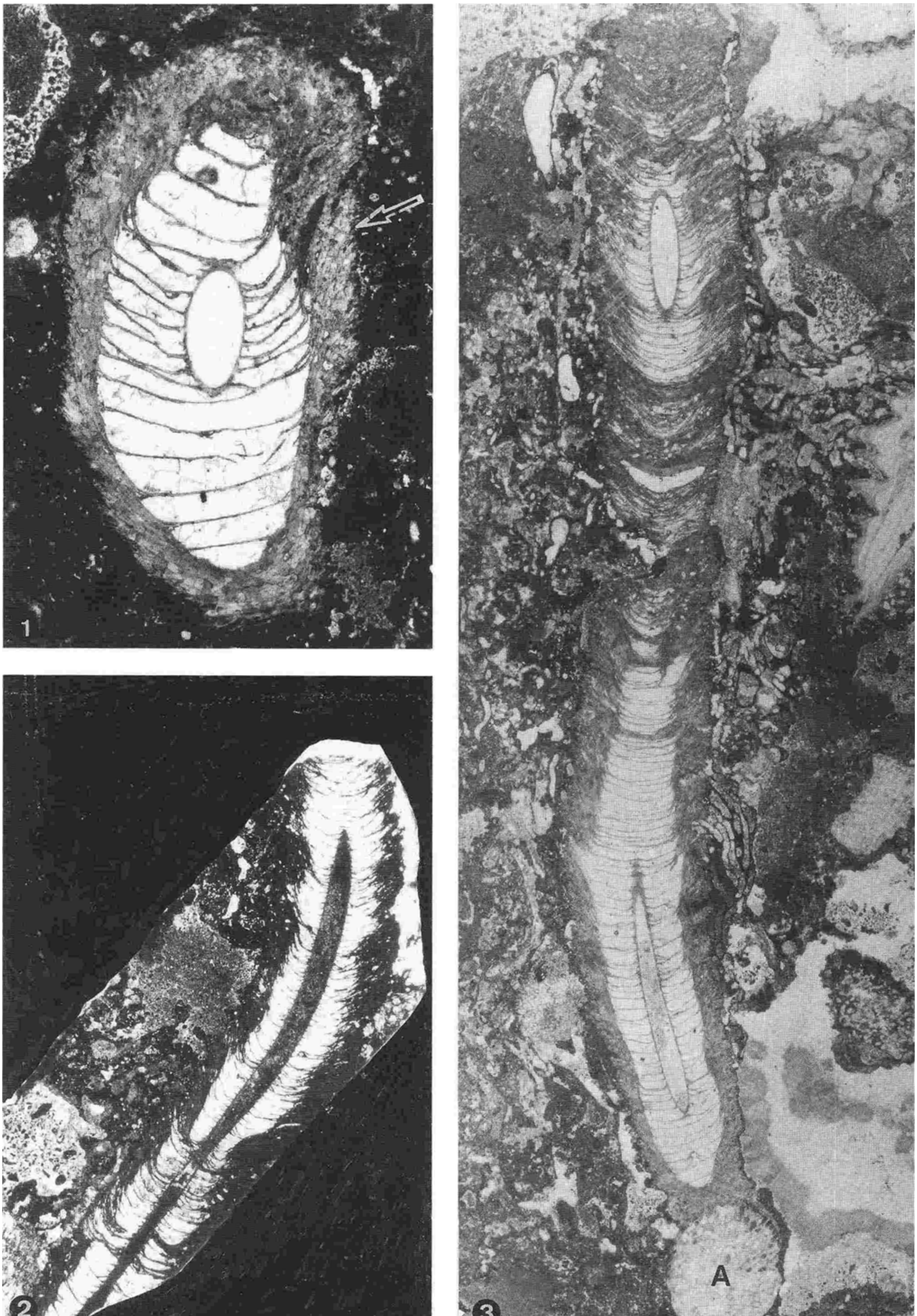
Description: The relatively large calcareous tubes (diameter up to 1 cm, length 10 cm) consists of three distinctly separated parts (Fig. 1):
Part A: This part is characterized by an axial channel passing through the entire test. The wall of the axial channel as well as that of the ring-like walls of part B is relatively thin (100 µm, Pl. 19/1, 5) and not perforated. The inner boundary of the wall is even and distinct, while the outer one is uneven (Pl. 19/1-5). The diameter of the axial channel remains constant within a specimen. Depending on the overall size of the specimen it exhibits small variations but usually remains constant (about 1 mm). The internal cavitiy of the channel is commonly filled by cement or in places by sediment (Pl. 17/2) or by both (Pl. 18/4, 6). Tabulae, internal walls or organic carbonate precipitates known from some serpulids (GÖTZ, 1931, MÜLLER 1963, NESTLER 1963) were never observed within the channel of *Barbafera*.

Plate 17 *Barbafera carnica* SENOWBARI-DARYAN. All specimens from the Carnian reef boulders within the Cassian Beds (Seelandalpe/Alpe di Specie, Dolomites, Southern Alps)

Figs. 1. Oblique longitudinal section showing the axial channel and the thin walls of part B of the test and the lamellae of part C. The arrow points to a not completely developed and sediment-filled area of part C. Thin-section D56/10. x 5

Fig. 2. Axial section through a rather long specimen. The axial channel is filled with sediment. Growth breaks are evident in three or four areas. Thin-section D56/10. x 4

Fig. 3. Longitudinal section of the longest specimen. The axial channel is visible in two places. The organism grows on a chaetetid sponge (A). The skeleton is completely encrusted by microbial crusts and *Uvanella*. Thin-section D56/1. x 4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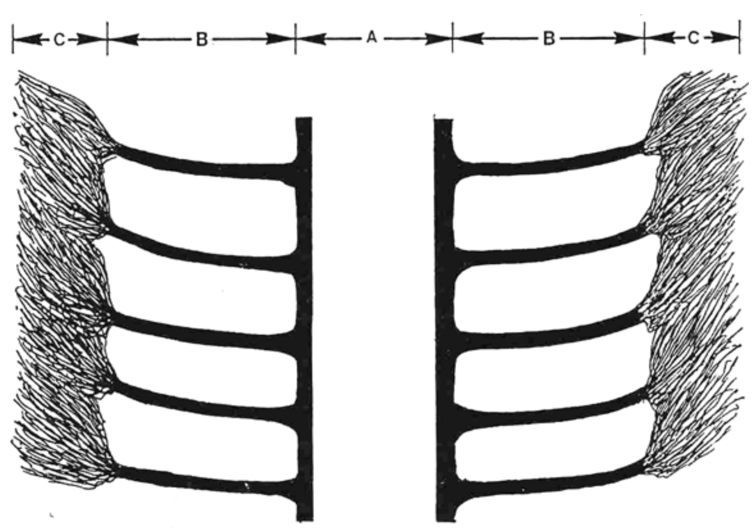


Fig. 1. Part of the tube (vertical section) of *Barbafera carnica* indicating the parts A-C. Schematic drawing not to scale, for explanations see text.

Part B: Longitudinal sections reveal 'chambers' around an axial tube, consisting of numerous thin walls, with an umbrella-like or plate-like appearance. Using the picture of an umbrella for comparison the axial tube would correspond to the handle of the umbrella, while the plate-like walls correspond to the rain-protecting cover.The walls of the umbrella are approximately as thick as the wall of the axial tube, but can vary slightly within an umbrella (Pl. 19/5). The distance between walls varies between 200 and 450 µm (average 300 µm). SEM microphotographs show that the walls are constructed by lamellae running parallel to the surface of the wall (Pl. 19/ 1, 4). Spaces between the ring-like walls (umbrella) are usually filled by carbonate cement (Pl. 17/1-3, Pl. 19/1), rarely with sediment (Pl. 18/1). The walls can be destroyed by crystal growth of the cement (Pl. 17/1). The contact between the lower side of the umbrellas and the cement is usually more heavily corroded by etching agents than the convex side (Pl. 19/1, 4). This may indicate the former existence of an organic layer on the concave side of the wall.

Part C: Thin-sections and especially SEM pictures show that the peripheral part of the shell consists of extremely fine lamellae,exhibiting a beard-like pattern especially in longitudinal sections. This pattern originate from a multiple peripheral splitting of umbrella-like walls of part B (Pl. 18/3, Pl. 19/2-3). The thickness of part C varies between specimens and within individual tests, but is usually as thick as in part B. The boundary between part C and the surrounding sediment is uneven and not distinct. The peripheral part C cuts the connection between the interstices of part B to the outside which are usually filled by cement and only in few places with sediment. Where part C is not completely developed, the walls of part B conceal the connection with the outer area (Pl. 17/1: arrow; Pl. 18/4: arrow, Fig. 1).

The internal microstructure of the test consists of lamellae which run obliquely outward in the wall of the axial channel and are slightly bent towards the top. In part B and part C the lamellae run parallel to the boundary of the wall (Pl. 19/1-4).

Plate 18 *Barbafera carnica* Senowbari-Daryan. All specimens from Carnian reef boulders within the Cassian Beds (Seelandalpe/Alpe di Specie, Dolomites, Southern Alps)

Fig. 1. Oblique section. The axial channel and the area between the ring-like walls of the segments are completely or partly filled with sediment. Thin-section 8K. x 13

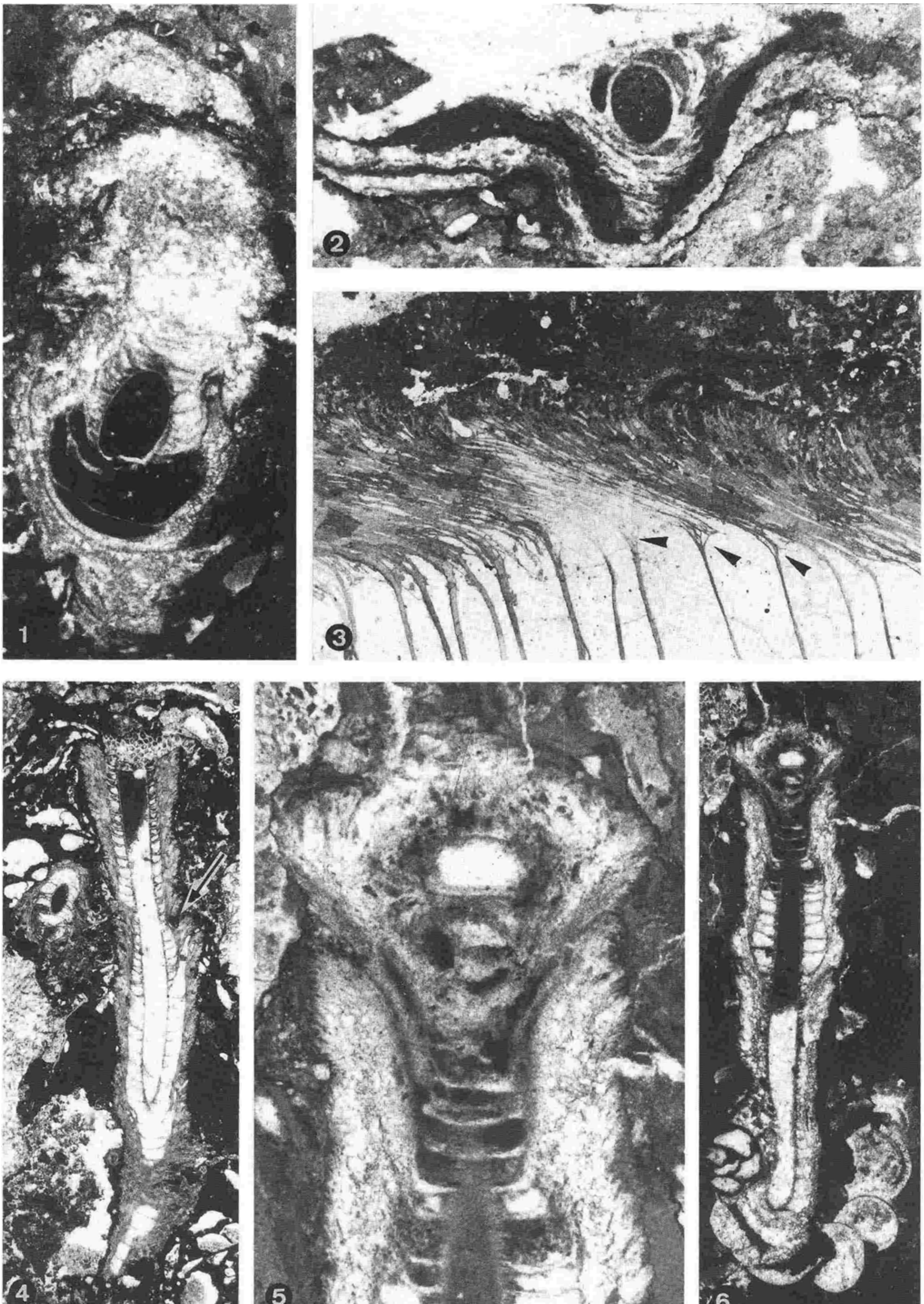
Fig. 2. Cross- to oblique section. The axial channel is filled by sediment. The specimen exhibits encrustations on one side. Thin-section 14a. x 32

Fig. 3. Enlargement of the central part of the specimen figured in Pl. 1/3 (part B, lower part of the Figure). The arrows point to the multiple splitting of the ring-like walls, causing the lamellae of the peripheral part. Thin-section D56/1. x 26

Fig. 4. Longitudinal section. Axial channel with geopetal filling. The open end is partially encrusted by sclerosponges and partially by a sphinctozoid sponge (*Uvanella irregularis* Ott). The arrow points to a growth interruption in part C (lamellae of the peripheral part). Thin-section D69/9/6. x 7

Fig. 5. Enlargement of Fig. 4 showing the growth interruption in the younger part of the skeleton. Thin-section 11c. x 26

Fig. 6. Longitudinal section. Growth direction most probably corresponds to that of the sphinctozoid sponge *Colospongia* sp.. *Barbafera* encrusts the sphinctozoid sponge (*Uvanella irregularis* Ott) at the base. The youngest part of the tube is characterized by growth interruption. Thin-section 11c. x 7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Orientation of the test

The interpretation of the life position of the animal is crucial in the systematic position of the fossil. It has to be explained whether the convex upper sides of the ring-like walls (umbrellas of part B) point to the top, the younger part or to the bottom, the oldest part of the shell. In the original description of the fossil the curvature of the umbrellas was interpreted as pointing downwards based on incrustations patterns seen in the holotype material (SENOWBARI-DARYAN 1980).

The new material from the Cassian beds and other localities brought additional hints to the life orientation of the test. Most of the fossils lie isolated in a bafflestone. The fossils are frequently overgrown and circumcrusted by sponges (*Uvanella irregularis* OTT) or by other serpulid worms. The regular development of part C around the individual tubes as well as distinct circumcrustations indicate an original upright position of the tubes (Pls. 17/3; 20/1, 3).

Geopetal fabrics within some tubes point in different directions. However, the interpretation of a downward curvature of the umbrellas is preferred because of the following criteria:

(a) The longest specimen (Pl. 17/3) growing upon a sponge ('Sclerospongea') exhibits the primary growth position. Changes in the circumcrustations of *Barbafera* by *Uvanella* may indicate interruption or at least retardation of growth. The curvature of the sponge segments, which are oriented upward indicate the original growth position of the sponge and the worm tube. The specimen figured in Pl. 20/1 (cf. Fig. 2) growing upon the sphinctozoid sponge *Cryptocoelia zitteli* STEINMANN also exhibits life position.

(b) A geopetal infill, which is obliquely oriented to the axial channel (Pl. 18/4) indicates that the organism is not preserved in life position. Here the open end of the tube represents the younger part of the test, which is in part overgrown by sclerosponges, and in part by the sphinctozoid sponge *Uvanella irregularis* OTT. The concave parts of the umbrella, therefore, should point to the top. This indicates that *Barbafera* was overgrown by the sponges in life position. However, a connection between axial channel and the outer environment must have been open as indicated by the geopetal fabric.

(c) One end of the specimen figured in Pl. 18/6 is open, the other is overgrown by the segmented sponge *Colospongia* sp.. The open end is more or less free and exhibits no indication to a cementation of the worm tube to the substrate. Interruptions of the normal growth near the open end (Pl. 18/5) indicate that this end correspond to the younger part of the test. The inverse geopetal fabric in the axial channel and between the umbrella walls in the upper part of the shell can be explained by an allochthonous position of the tube or by growth within a cryptic habitat. Life in a cryptic habitat might be also indicated by the extraordinary preservation of the fine lamellae of the peripheral part C of the skeleton. Rapid overgrowth by microbial crusts and sponges might have contributed to the excellent preservation.

4 DISCUSSION

Barbafera carnica was compared with the sphinctozoid sponge *Amblysiphonella* STEINMANN and with dasycladacean green algae (SENOWBARI-DARYAN 1980: 108-109). The author favoured the interpretation as dasyclad alga, explaining the 'chambers' (interstices in part B and part C) as fertile elements and the outer parts of part C as sterile branches. The systematic position was left open, as " the existence of such fertile elements in form of ring-chambers is unknown in dasycladaceans" (SENOWBARI-DARYAN 1980: 108).

The perfect preservation of the specimens from the Cassian beds shows that the 'Ringkammern' described 1980 correspond to the sparite-filled spaces between the plate-like walls (umbrellas) forming the peripheral lami-

Plate 19 SEM microphotographs of *Barbafera carnica* SENOWBARI-DARYAN. All specimens from Carnian reef boulders within the Cassian Beds (Seelandalpe/Alpe di Specie, Dolomites, Southern Alps). Samples were cut, polished and etched for some hours with Titriplex-III solution. Sample D56.

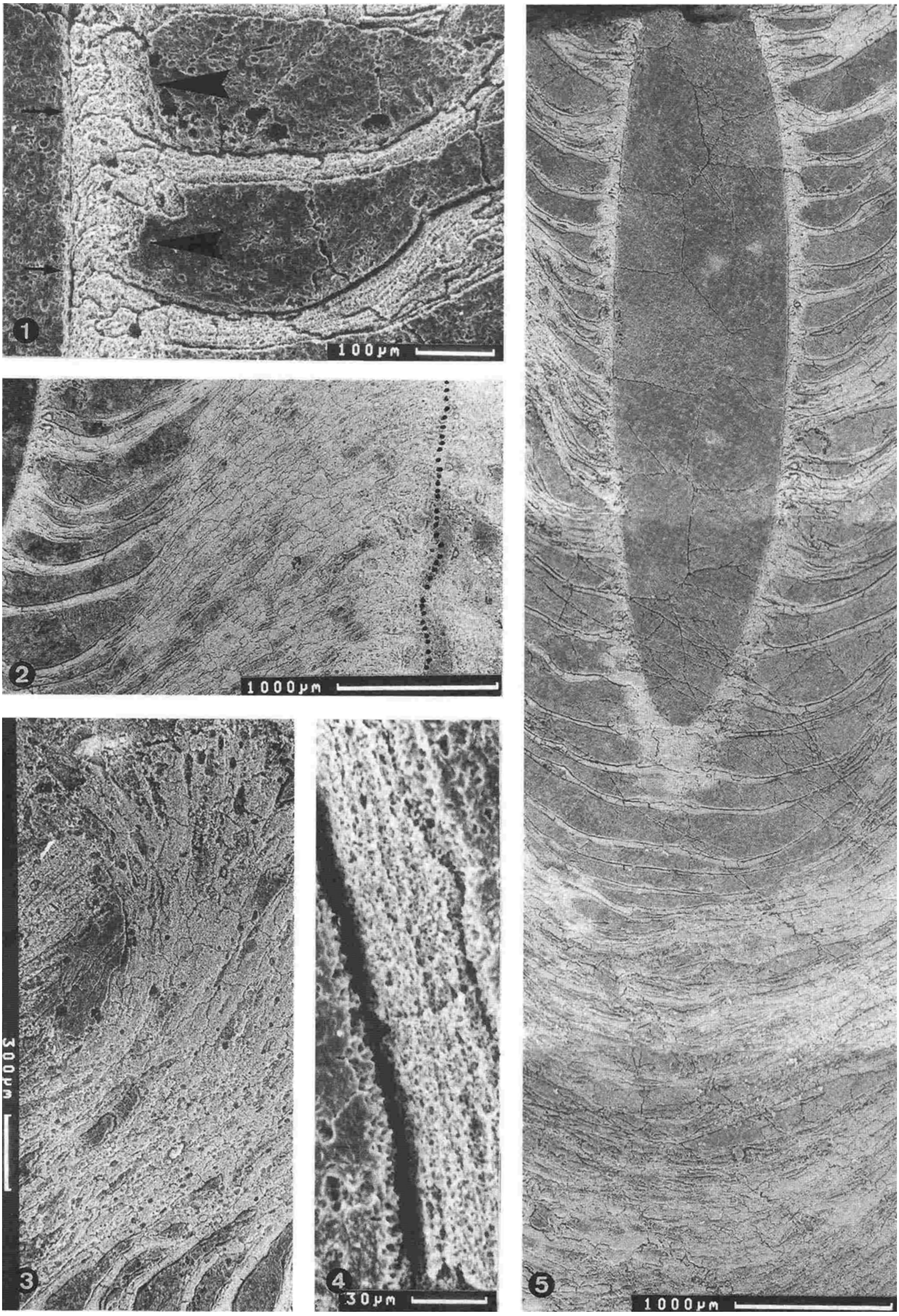
Fig. 1. Enlargement of Pl. 19/5 exhibiting the wall of the central tube (left side of picture) and three of the ring-like walls of part B. The lower outline of the concave side of the walls is strongly etched (indicating organic coating ?). Large arrows point to the 'Parabel-Schicht' (parabel layer) of the axial wall. The arches of this layer points towards the younger part of the skeleton. Small arrows mark the thin layer of the skeleton on the inner side of the channel. An explanation of this layer as 'Zylinder- oder Röhren-Schicht' must remain uncertain.

Fig. 2. Specimen as in Pl. 19/5. Note the distinct wall of the axial tube (left side of Figure, part A of the test), ring-like walls around the wall of the axial channel (left side, part B) and the peripheral, laminated part of part C (area comprising approximately 2/3 of the right side of the Figure) constructed by multiple splitting of the ring-like umbrellas. The border line between the skeleton and the adjacent sediment is dotted.

Fig. 3 . Specimen as in Pl. 19/5. Enlarged view of the ring-like walls (lower part of Figure) and peripheral part exhibiting the extremely fine and more or less parallel-running lamellae.

Fig. 4. Wall of the ring-like segments exhibiting a laminated microstructure and a more heavily etched area at the border line (in the Figure dark) of the concave side of the walls.

Fig. 5. Oblique section with axial tube (part A) and the surrounding ring-like walls (part B, upper half of Figure) with their peripheral, 'bearded' annexes (part C, lower half of Figure). Axial tube and the space between the surrounding walls are filled with carbonate cement.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nated parts of the skeleton. Because of the conspicuous lack of pores within the walls of the axial channel a dasycladacean as well as a sponge nature of the fossil can be excluded.

Barbafera was an organism living within an axial channel of an exoskeleton. The animal got in contact with its surrounding only through the open end of the axial channel.

Barbafera most probably was a worm, living in a calcified cylinder consisting of a central tube and plate-like umbrella annexes. Comparable cylindrical tests consisting of numerous stacked segments which form tubes are rather frequent with worms belonging to the order Sedentarida LAMARCK either growing upward or fixed to the substrate. Worm tubes consisting of stacked elements occur in various Triassic sediments (RIEDEL 1990, BRANDNER et al. 1991, SENOWBARI-DARYAN 1994) and have been also found in thin-sections of the studied reef boulders. These fossils can be attributed to serpulids (Pl. 20/5). They differ from *Barbafera* by the distinct splitting of the outer peripheral ring walls (umbrellas). This type of wall construction is unknown in calcareous tubes of fossil and modern worms.

The internal microstructure of *Barbafera* also reveals only low similarites with modern or fossil serpulids. Serpulids usually construct their tube by an outer thick 'Parabel-Schicht' where the doming of the lamellae is pointing towards the youngest part of the tube and a thin inner 'Röhren-Schicht' (REGENHARDT 1961) or 'Zylinder-Schicht' (JÄGER 1983). The inner layer appears in transversal sections as concentrically arranged lamellae (GÖTZ 1931, REGENHARDT 1961). Only a few exceptions from this constructional type are known. SEM microphotographs show that the wall of *Barbafera* consists of lamellae (Pl. 19/1-5). These lamellae run parallel within the wall of the axial channel in form of bending curves, where the arches point towards the younger part of the test (Pl. 19/1, large arrows). The lamellae within the umbrella walls run parallel to the outer boundary of the wall (Pl. 19/4). Both lamellar layers, especially the arched lamellae within the wall of the axial channel, can be compared with the 'Parabel-Schicht' of serpulids, but the explanation of the thin and indistinct layer around the axial lumen as 'Röhren-Schicht' or 'Zylinder-Schicht' is problematic.

Segmented tubes similar to those of *Barbafera* are rare in the studied reef boulders. The specimen figured in Pl. 20/4 (see also Pl. 20/5) consists of three relatively high stacked segments exhibiting the same subdivision into three parts as *Barbafera carnica*. Differences concern the structure of part B (walls of the umbrellas are only poorly developed and not widely spaced) and part C (poor development of the lamellated part at the outer periphery).

What was the function of the umbrellas and the lamellar splitted walls at the periphery of the test? As *Barbafera* occurs in reef environments, stable tests and rigid walls offer an advantage for animals thriving in turbulent waters. The construction of a stable cylindical test with thick walls demands enlarged carbonate production and needs more energy. *Barbafera* might have overcome these problems by the construction of a calcareous wall with umbrella-like walls. The economic formation of modern calcareous worm tubes is well known (GÖTZ 1931, REGENHARDT 1961). Flat-lying worms reduce the outer parabel-layer at places where they are in contact with the substrate. Colonial forms react similar or even do not construct a wall were adjacent tubes get in touch.

The construction of the *Barbafera* tube can best be compared with *Sclerostyla* MÖRSCH. This genus produces a reticulate, cyst-like intermediate layer between the inner and outer tube-layer in order to reduce carbonate production. *Sclerostyla? basisculpta* JÄGER even produces walls running perpendicular to the main axis (comparable with *Barbafera*) which are lined by an inner and outer layer (cf. JÄGER 1983: Pl. 1 and RADWANSKA 1996: Pl. 9, Fig. 3-5). JÄGER (1983: 92) describes a 'wohlausgebildeten Zellenbau aus kurzen, sehr breiten, ziemlich hohen Zellen' and RADWANSKA (1996: 72) notes the 'characteristic regular septa' in the wall of the tube.

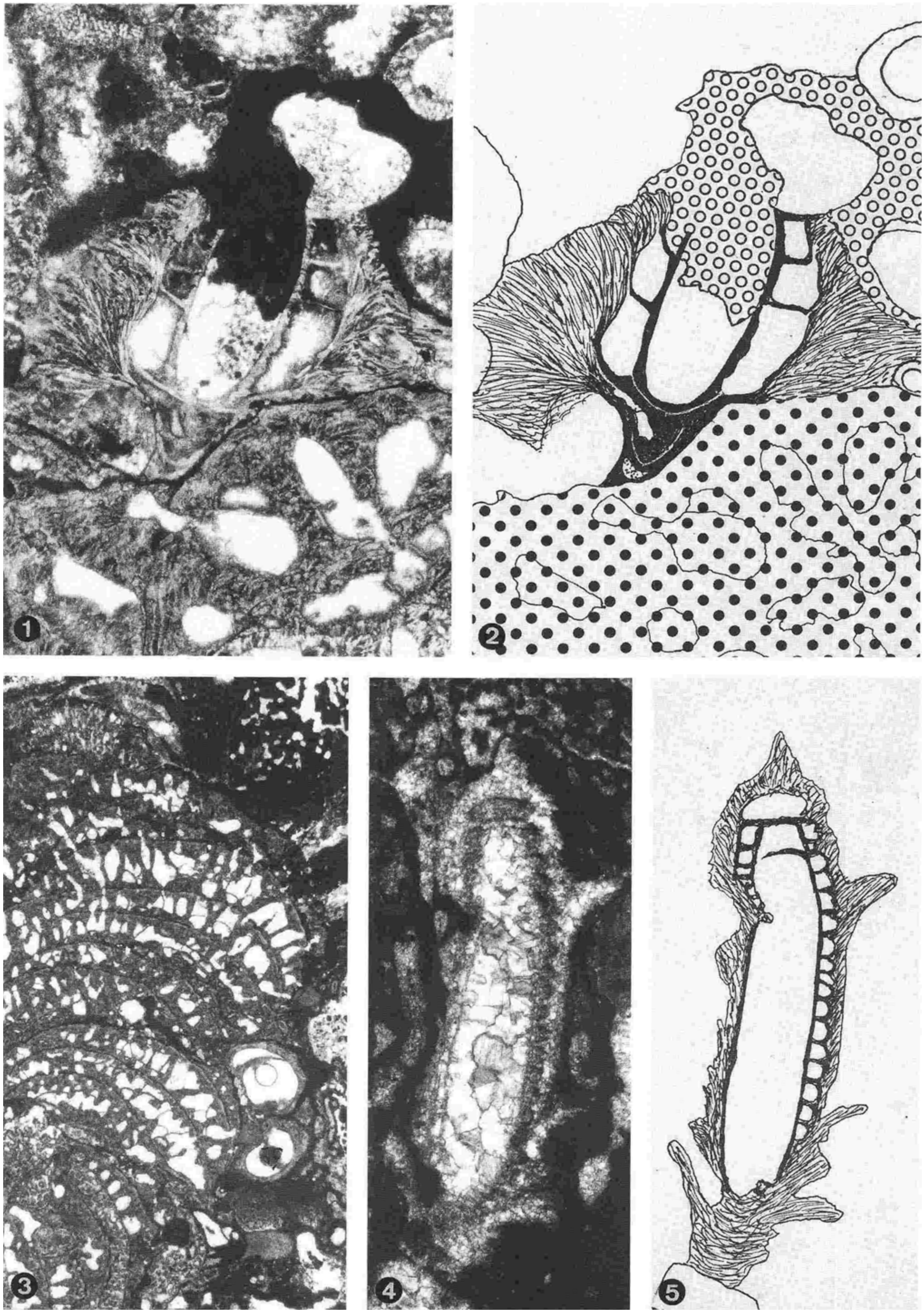
As living space is limited within reefs, the construction of umbrella-like walls with laminated parts around a tube

Plate 20 *Barbafera* from Carnian reef boulders within the Cassian Beds (Seelandalpe/Alpe di Specie, Dolomites, Southern Alps)

Figs. 1.-2. *Barbafera carnica* SENOWBARI-DARYAN. Microphotograph and drawing of the longitudinal section of a non-adult or broken specimen in life position growing on the sphinctozoid sponge *Cryptocoelia zitteli* STEINMANN (lower part of Figure, dotted area in the schematic drawing of Fig. 2). Thin-section D56/9. x 30

Fig. 3. Two specimens of *Barbafera carnica* SENOWBARI-DARYAN in life position growing on and partly encrusted by the sphinctozoid sponge *Cryptocoelia zitteli* STEINMANN. Thin-section D/56/9. x 9

Fig. 4.-5. Microphotograph and schematic drawing of an oblique section through a worm tube most probably belonging to *Barbafera*, built by three or four high segments. As in *Barbafera carnica* three 'parts' are visible (axial channel, ring-like walls around this channel and a peripheral 'beard'-like area exhibiting lamellae). The specimen differs from *Barbafera carnica* in having a much wider axial channel, densely-spaced segments surrounding the axial channel and an only short peripheral part of the test. Thin section 8R. x 20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increases the area inhabited and enlarges the possibility of nutrient supply. The animal had a better chance to catch food with the tentacles farther out over the distance of the plate-like area (umbrella, Pl. 19/1, 4). The lower side of the walls (lower side of the umbrella) was eventually covered by an organic layer, where smaller organisms got attached.

The umbrella-like walls and the laminated part possible had a two-fold function assisting food recovery and support and stabilization of the skeleton structure.

4 ASSOCIATIONS

The Carnian reef boulders of the Cassian beds as well as other Carnian reef limestones contain *Barbafera carnica* together with inozoid, sphinctozoid and chaetetid sponges (in the Cassian material also hexactinellids), corals, algae (solenoporaceans, *Dendronella articulata* MOUSSAVIAN & SENOWBARI-DARYAN), rare porostromate cyanophyceans, various microproblematica (*Ladinella porata* OTT, *Radiomura cautica* SENOWBARI-DARYAN & SCHÄFER,, '*Tubiphytes*'), Foraminifers (rare in the Cassian reef boulders, in other localities frequently associated with spiramphiporellids, cucurbitids and ophthalmids, cf. SENOWBARI-DARYAN 1987), brachiopods and serpulid tubes. *Barbafera* is commonly encrusted by the sphinctozoid sponge *Uvanella irregularis* OTT and mircrobial crusts. Sponges are the preferential substrate for *Barbafera* (Pl. 17/3).

5 DISTRIBUTION

In addition to the localities studied in 1980 (Huda Juzna/Slovenia and Gosaukamm/Austria) *Barbafera carnica* SENOWBARI-DARYAN is known from the following Carnian localities: Cassian beds (Southern Alps, the material here described), Hydra/Greece (own material), Sicily (SENOWBARI-DARYAN & ABATE 1986), Hungary (FLÜGEL et al. 1992), Southern Anatolia (RIEDEL 1990) and Oman (BERNECKER 1995, 1996). The occurrence of *Barbafera carnica* is restricted to the central reef area. As the species occurs only in Carnian reefs it is regarded as index fossil for the time span Cordevolian ? to Julian-Tuvalian.

The type species *Barbafera carnica* is up to now only known from Triassic sediments. Carnian and Norian reef sediments from Turkey as well as the Cassian beds of the Southern Alps yield worm tubes which may also belong to the genus *Barbafera* (cf. Pl. 20/4-5).

DRAGASTAN (1990: 29-30) described *Barbafera jurassica* from the Tithonian of Romania. The fossil was attributed to dasycladacean green algae. Until now no reports of *Barbafera* are known from the time span Norian to Middle Jurassic.

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REFERENCES

BERRA, F. & JADOUL, F. (1996): Norian Serpulid and Microbial Bioconstructions: Implications for the Platform Evolution in the Lombardy Basin (Southern Alps, Italy). – Facies, **35**, 143-162, 6 Fig., 1 Tab., Pls. 35-38, Erlangen

BERNECKER, M. (1995): Rekonstruktion einer Karbonatplattform in der Obertrias: Palökologie, Mikrofazies und Biostratigraphie von Plattform- und Riffkalken in den Oman-Bergen. – Unpubl. Thesis. Universität Erlangen-Nürnberg, 167 p., 40 Figs., 27 Pls., Erlangen

-- (1996): Upper Triassic Reefs of the Oman Mountains: Data from the south Tethyan Margin.- Facies, **34**, 41-76, 11 Fig., Pl. 11-18, Erlangen

BIANCHI, C. N., ALIANI, ST., & MORRI C. (1995). – Present-day serpulid reefs, with reference to an ongonig research project on *Ficopomatus enigmaticus*. – In: LATHUILIERE, B. & GEISTER, J. (eds.): Coral Reefs in the past, present and future. – Intern. Soc. Reef Studies, 2nd European Regional Meeting. Serv. Geol. Luxembourg, **39**, 61-65, Luxembourg

BORZA, K. (1975): Mikroproblematika aus der oberen Trias der Westkarpaten. – Geol. Zbornik - Geol. Carpathica, **26**/2, 199-236, 10 Fig., 8 Pls. Bratislava

BRANDNER, R., FLÜGEL, E. & SENOWBARI-DARYAN, B. (1991): Microfacies of Carbonate Slope Boulders: Indicator of the Source Area (Middle Triassic: Mahlknecht Cliff, Western Dolomites). – Facies, **25**, 279-296, 3 Fig., 1 Tab., Pls. 69-74, Erlangen

BRÖNNIMANN, P. & ZANINETTI, L. (1972): On the occurrence of the Serpulid *Spirorbis* DAUDIN, 1800 (Annelida, Polychaetia, Sedentarida) in the section of Triassic rocks of Europe and Iran. – Riv. Ital. Paleont., **78**/1, 67-90, 3 Fig., Pl. 10-12, Milano

DRAGASTAN, O. (1966): A new Serpulid species in the Upper Jurassic of Romania. – Paläont. Z., **40**/1-2, 147-150, 2 Fig., Stuttgart

-- (1990): New 'Porostromata' algae of the Mesozoic (III).- Rev. Esp. Micropaleont., **22**/1, 5-32, 11 Fig., Madrid

FLÜGEL, E. (1972): Mikroproblematika in Dünnschliffen von Trias-Kalken. – Mitt. Ges. Geol. Bergbaustud., **21**, 957-988, 2 Fig., 2 Pls., Innsbruck

FLÜGEL, E., FLÜGEL-KAHLER, E., MARTIN, J. M. & MARTIN-ALGARA, A. (1984): Middle Triassic Reefs from Southern Spain. – Facies, **11**, 173-218, 7 Fig., 2 Tab., Pls. 20-30, Erlangen

FLÜGEL, E. VELLEDITS, F.; SENOWBARI-DARYAN, B. & RIEDEL, P. (1991/92): Rifforganismen aus "Wettersteinkalken" (Karn?) des Bükk-Gebirges, Ungarn. – Geol. Paläont. Mitt. Innsbruck, **18**, 35-62, 5 Fig., 9 Pls., Innsbruck

FÜRSICH, F. T. & WENDT, J. (1977): Biostratinomy and Palaeoecology of the Cassian Formation (Triassic) of the Southern Alps. – Palaeogeogr., Palaeoclimatol., Palaeoecol., **22**, 257-323, 26 Figs., 10 Tab., Amsterdam

GÖTZ, G. (1931): Bau und Biologie fossiler Serpuliden. – N. Jb. Min., Abt. B, Beilage-Bd. **66**, 385-438, Pl. 12-13, Stuttgart

JÄGER, M. (1983): Serpulidae (Polychaeta sedentaria) aus der norddeutschen höheren Oberkreide - Systematik, Stratigraphie, Ökologie. – Geol. Jb., **A 68**, 1-219, 7 Fig., 15, Tab., 16 Pls., Hannover

MÜLLER, A. H. (1963): Kammerung in Serpulidenröhren (Annelida, Polychaeta) der oberen Kreide. – Geologie, **12**/10, 1194-1205, 2 Figs., 1 Tab., 3 Pls., Berlin

NESTLER, H. (1963): Querböden bei Serpuliden (Polychaeta sedentaria) aus dem Unter-Maastricht der Insel Rügen. – Geologie, **12**/5, 596-603, Berlin

NISHI, E. (1993): On the internal structure of calcified tube walls in Serpulidae and Spirorbidae (Annelida, Polychaeta). – Marine Fouling, **10**, 17-20

OGILVIE, M. M. (193): Contribution to the geology of the Wengen and St. Cassian strata in southern Tyrol. – Quart. J. geol. Soc. London, **49**, 1-78, 14 Figs., 2 Tab., London

PARSCH, K. O. A. (1956): Worms. – In: MOORE, R. D. (ed.): Treatise on Invertebrate Paleontology, Part W (Miscellanea). – 144-177, Kansas

PERKINS, T. H. (1991): *Calcisabella piloseta*, a new genus and species of Sabellinae (Polychaeta: Sabellidae). – Bull. Marine Sci. **48**, 261-267

RADWANSKA, U. (1994): Tube-dwelling polychaetes from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland). – Acta Geol. Polonica, **44**/1-2, 35-81, 26 Fig., 10 Pls., Warszawa

-- (1996): Tube-dwelling polychaetes from some Upper Cretaceous sequences of Poland. – Acta geol. Polonica, **46**/1-2, 61-80, 12 Pls., Warszawa

RIEDEL, P. (1990): Riffbiotope im Karn und Nor (Obertrias) der Tethys: Entwicklung, Einschnitte und Diversitätsmuster. – Unpubl. Thesis naturwiss. Fak. Univ. Erlangen-Nürnberg, 96 p., 36 Figs., 9 Tab., 15 Pls., Erlangen

SENOWBARI-DARYAN, B. (1980): *Barbafera carnica* n. g., n. sp., ein Problematikum aus den *Cidaris*-Schichten (Gosaukamm, Oberösterreich) und Amphyclinen-Schichten (Slowenien, Jugoslawien) - Karn (Ober-Trias). – Verh. Geol. B.-A., Jg. **1980**/2, 105-113, 3 Figs., 2 Pls., Wien

-- (1984): Mikroproblematika aus den obertriadischen Riffkalken von Sizilien. – Münster. Forsch. Geol. Paläont., **61**, 1-81, 2 Fig., 3 Tab., 11 Pls., Münster

-- (1987): Nachweis der Pseudocucurbiten in den Alpen (Foraminifera; Obere Trias). – Senck. leth., **68**/1-4, 255-261, 1 Pl., Frankfurt am Main

-- (1994): *Alpinotubus lamellatus* n. gen., n. sp., ein Wurm aus der Mittel- und Ober-Trias (Ladin-Karn) des alpin-mediterranen Raumes: Fazies- und Leitfossil. – Giessener Geologische Schriften, **51**, 255-265, 1 Tab., 1 Pl., Giessen

SENOWBARI-DARYAN, B. & ABATE, B. (1986): Zur Paläontologie, Fazies und Stratigraphie der Karbonate innerhalb der "Formazione Mufara" (Obertrias, Sizilien). – Naturalista Sicil., S. IV, **10**/1-4, 59-104, 2 Fig., 12 Pls., Palermo

SENOWBARI-DARYAN, B. & FLÜGEL, E. (1996): A "Problematic Fossil" revealed: *Pycnoporidium? eomesozoicum* FLÜGEL, 1972 (Late Triassic, Tethys) - not an Enigmatic Alga but a Strophomenid Brachiopod (*Gosaukammerella* n. g.). – Facies, **34**, 83-100, 3 Fig., 1 Tab., Pl. 21-27, Erlangen

SENOWBARI-DARYAN, B., ZÜHLKE, R., BECHSTÄDT, TH. & FLÜGEL, E. (1993): Anisian (Middle Triassic) Buidups of the Northern Dolomites (Italy): The Recovery of Reef Communities after the Permian/Triassic Crisis. – Facies, **28**, 181-256, 17 Fig., Pl. 40-56, Erlangen

WEEDON, M. J. (1994): Tube microstructure of Recent and Jurassic serpulid polychaetes and the question of the Paleozoic "spirorbids". – Acta Palaeont. Polonica, **39**/1, 1-15, 4 Fig., Warszawa

WENDT, J. & ZARDINI R. (1979). Formazione di S. Cassiano of Alpe di Specie (Seelandalpe). – In: GAETANI, M. (ed.): Riccardo Assereto and Giulio Pisa Field Symposium on Triassic Stratigraphy in Southern Alps, Field Guide-Book, 62-64, 2 Fig., Bergamo

WIELAND, U. (1995): Biogenic mound structures in the Paleocene of Egypt. – In: LATHUILIERE, B. & GEISTER, J. (eds.): Coral reefs in the past, present and future. – Intern. Soc. Reef Studies of Second European Reg. Meeting. Ser. Geol. Luxemburg, **39**, 61-65, Luxemburg

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