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MUCCHI - MODENA

Remarks on *Anthracoporella spectabilis* Pia, 1920, a supposed Permian-Carboniferous dasyclad

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ABSTRACT – Some specimens of *Anthracoporella spectabilis* coming from Tržič zone (Slovenia) displays features awakening perplexity on the systematic position (*dasycladaleans*) of the species and, consequently, of the genus *Anthracoporella* too of which it is the type. Indeed not infrequently *Anthracoporella* sections show calcified-sheath groups that can originate much more inwards (i.e. near the skeleton axis) than the others do; moreover the sheaths can grade inwards to a calcareous, structureless or perforated, material which fully fills the place pertaining, in the section, to the central cavity; in this some clear individual sheaths may occasionally persist. Besides, irregular strips of calcified material, pore bearing, (similar to the skeleton one) often divide in two the central cavity of the transverse sections. The now-mentioned characters, though not much frequent, are incompatible with a continuous stem together with the radial symmetry of the skeleton, therefore with the organization of a *dasyclad*. Moreover, contrary to what occurs in true *dasyclads*, the (just unusual) dichotomous branching of the pores takes place randomly at various distances from the skeleton axis. Furthermore a "cuticle" surrounds the skeleton.

In the present paper, the above quoted phenomena are related to calcified sheaths which, during the life, grew outwards while their older inner parts disintegrated; the disintegrated parts could be witnessed by calcareous, structureless or perforated, material.

Other reasons (but of lesser importance) of perplexities on *Anthracoporella* current systematic follow. 1) The above-cited calcareous cuticle is little pertaining to *dasyclads*; in which it is recorded exceptionally and even in these cases should be better documented. 2) Moreover, the outer/inner diameter ratio of the skeleton cylindrical segments can assume too widely varying values.

Organisms able to show growth/disintegration phenomena resembling those described, in this paper, in *Anthracoporella spectabilis*, are certainly present among cyanobacteria and algae (e.g. *thaumatoporellaleans*). However, I am not able for the moment to propose a suprageneric taxon including this species.

RIASSUNTO – [Osservazioni su *Anthracoporella spectabilis* Pia, 1920, una presunta *Dasycladale* del Permo-Carbonifero] – *Anthracoporella spectabilis*, specie tipo del genere *Anthracoporella*, è rappresentata da fossili di mare poco profondo contenuti in rocce lapidee, studiabili perciò mediante sezioni sottili (Tav.1). Questi fossili hanno uno scheletro tubolare, generalmente cavo, ramificato dicotomicamente, perforato trasversalmente da numerosi pori e circondato da una cuticola calcarea; questa è stata evidenziata da Pia (1920) e Kochansky ed Herak (1960), ma secondo alcuni sarebbe d'origine secondaria (Bebout & Coogan, 1964). Le parti dello scheletro comprese tra due punti di ramificazione successivi (qui indicate con segmenti) hanno generalmente, ma non sempre, simmetria radiale.

La specie fu istituita da Pia (1920) su materiali del Carbonifero superiore delle Alpi Carniche e delle Caravanche ed attribuita ad alghe verdi *Dasycladali*. Secondo quest'accezione lo scheletro di quest'alga rappresenterebbe l'insieme delle guaine calcificate dei laterali del tallo; i pori corrisponderebbero agli spazi occupati da essi, durante la vita; la cavità assiale corrisponderebbe alla cavità centrale in cui alloggiava lo stelo.

Dal tempo della sua istituzione l'appartenenza di *Anthracoporella spectabilis* a *Dasycladali* non è stata mai messa in discussione. Alcuni esemplari in sezione sottile provenienti dalla zona di Tržič (Slovenia), hanno però evidenziato caratteri che destano perplessità sulla posizione sistematica attribuita alla specie e conseguentemente anche al genere *Anthracoporella* di cui essa è il tipo. Le sezioni, infatti, mostrano non infrequentemente che gruppi di guaine confluenti calcificate possono originarsi anche molto più internamente (cioè più vicine all'asse dello scheletro) di altri (Tav. 2, figg. 9-11); inoltre, in alcuni casi, essi fanno passaggio a materiale calcareo, indifferenziato o perforato (Tav. 2, figg. 10-11), che occupa completamente o quasi il posto che spetterebbe, nella sezione, alla cavità centrale; in questa si possono rinvenire eccezionalmente singole guaine (Tav. 3, fig. 1). Infine, strisce irregolari di materiale perforato, simile a quello dello scheletro, possono dividere in due parti la cavità centrale delle sezioni trasversali od oblique dei segmenti dello scheletro (Tav. 2, figg. 7-8, 11-12; Tav. 3, fig. 2).

I caratteri trasversali, per quei poco frequenti, sono incompatibili con la presenza, in vivo, di uno stelo continuo e con la simmetria radiale e, quindi, con l'organizzazione di una *Dasycladale*.

Inoltre, contrariamente a quanto si verifica nelle *Dasycladali*, la ramificazione dicotomica (inusuale in queste alghe) interessa i pori disordinatamente perché i piedi delle ramificazioni di uno stesso ordine possono trovarsi a distanze molto variabili dall'asse dello scheletro (Tav. 2, figg. 2, 4-5, 9).

In questa sede si suppone che i fenomeni menzionati siano dovuti a guaine calcificate che, durante la vita, si originavano nella parte più interna dello scheletro; quindi, durante la crescita dell'organismo, si disgregavano verso l'interno e si accrescevano verso l'esterno; le parti più interne disgregate potevano, in alcuni casi, rimanere testimoniate da materiale calcareo indifferenziato o irregolarmente poroso.

Altre cause di perplessità, però d'importanza subordinata, sull'attuale posizione sistematica di *Anthracoporella*, sono le seguenti. 1) La cuticola calcarea, già menzionata (Tav. 3, figg. 3-5), è poco pertinente alle *Dasycladali* e nei casi, peraltro eccezionali, in cui è segnalata nelle forme viventi andrebbe meglio documentata. 2) Inoltre, il rapporto D/d tra il diametro esterno e quello interno dei segmenti dello scheletro può assumere valori variabili in limiti molto ampi, del tutto inusuali per le *Dasycladali* (Tav. 2, figg. 1-3).

Organismi potenzialmente capaci di presentare fenomeni simili a quelli descritti, in questa sede, in *Anthracoporella spectabilis*, sono certamente presenti tra le alghe s.l., p.es. *Cyanoficee* e *Thaumatoporellati* (vedi De Castro, 1990). Per il momento, però, non si è in grado di prospettare un taxon supragenerico che includa questa specie.

GENERAL NOTICES ON *ANTHRACOPORELLA*

The genus *Anthracoporella* and its type-species *A. spectabilis*, were erected by Pia (1920) on material from the Upper Carboniferous of the Carnic Alps and Karawanken Mountains. The fossils are made up of tubular, non-articulate skeletons, dichotomously branched at variable angles, surrounded by a thin calcified "cuticle". Moreover, according to Pia, the skeleton-wall is very much variable in thickness; it is perpendicularly perforated by very numerous, fine and closely-set, aspondylous pores, very slightly widening outwards, branching dichotomously once (presumably twice too) in planes perpendicular to the skeleton-axis.

Pia referred *Anthracoporella spectabilis* to dasyclad green algae. In this meaning the skeleton corresponds with the whole of calcified confluent sheaths of the thallus laterals; the pores represent the spaces occupied by laterals during the life and the axial hollow corresponds with the central cavity in which thallus stem lodged. The cuticle on the skeleton surface was believed like to calcareous film which, according to Cramer (1891) and Solms-Laubach (1893), covers the cortex of the today-living *Bornetella*. (As regards the thallus nomenclature refer to De Castro, 1997).

Anthracoporella has been formally revised by Bebout & Coogan (1964) that however have not meaningfully modified the Pia description. Recently, Flügel & Flügel-Kahler (1998) give further information on *Anthracoporella spectabilis* growth-mode and environment; they agree with the Pia hypothesis that the laterals may branch to third order, moreover point out that the reproductive structures, supposed endospore by Pia, are located really within the branches (cladospore type).

Up to today the genus groups about ten species but their description is not always exhaustive; some authors (i.e. Vachard, 1980, p. 346) believe that their classification, with the exception of *A. spectabilis*, *A. uralensis* and *A. vicina*, should be revised.

In the following list, the age of the holotype is reported beside each species; moreover an asterisk marks the Permian-Carboniferous taxa which in the recent inventory of Granier and Grgasovic (2000) are surely attributable to *Anthracoporella*.

A. fragilissima Maslov, 1939; Kazakhstan, Lower Carboniferous. The species has been later ascribed to *Nanopora* from Wood (1964); refer to Mamet & Roux (1975) too.

* *A. girtyi* Mamet & Roux in Mamet, Roux & Nassichuk, 1987; Canada, Middle Carboniferous (Moscovian) – Lower Permian (Sakmarian).

A. kasachiensis Maslov, 1939; Kazakhstan, Lower Carboniferous. This species also has been ascribed to *Nanopora* (refer to Mamet & Roux, 1975).

A. laevis Šhujskij, 1973 (central Urals) (Lower Devonian: Upper Emsian).

* *A. magnipora* Endo, 1951; Japan (Honshu: Kitakami Mountains) Lower Permian.

A. menchikoffi Chanton, 1965; Algerian oriental Sahara, Carboniferous. According to Vachard (1980) this taxon could belong to an other dasyclad genus.

* *A. mercurii* Elliott, 1968; Oman (Jebel Qamar), Permian (Wordian). According to Vachard (1980) it could be a recrystallized *Pseudovermiporella*.

A. setosa Šhujskij, 1973 (central Urals) (Lower Devonian: Upper Emsian).

* *A. spectabilis* Pia, 1920. The lectotype reported in this paper comes from the Upper Carboniferous of the Italian-Austrian boundary (Monte Corona, or Kronalpe, in the Carnic Alps).

A. ? torinosensis Endo, 1961; Japan, Malm.

* *A. uralensis* Chuvashov, 1974; Federation of Russia (western Urals, to west of Yekaterinburg), Lower Permian (Asselian)

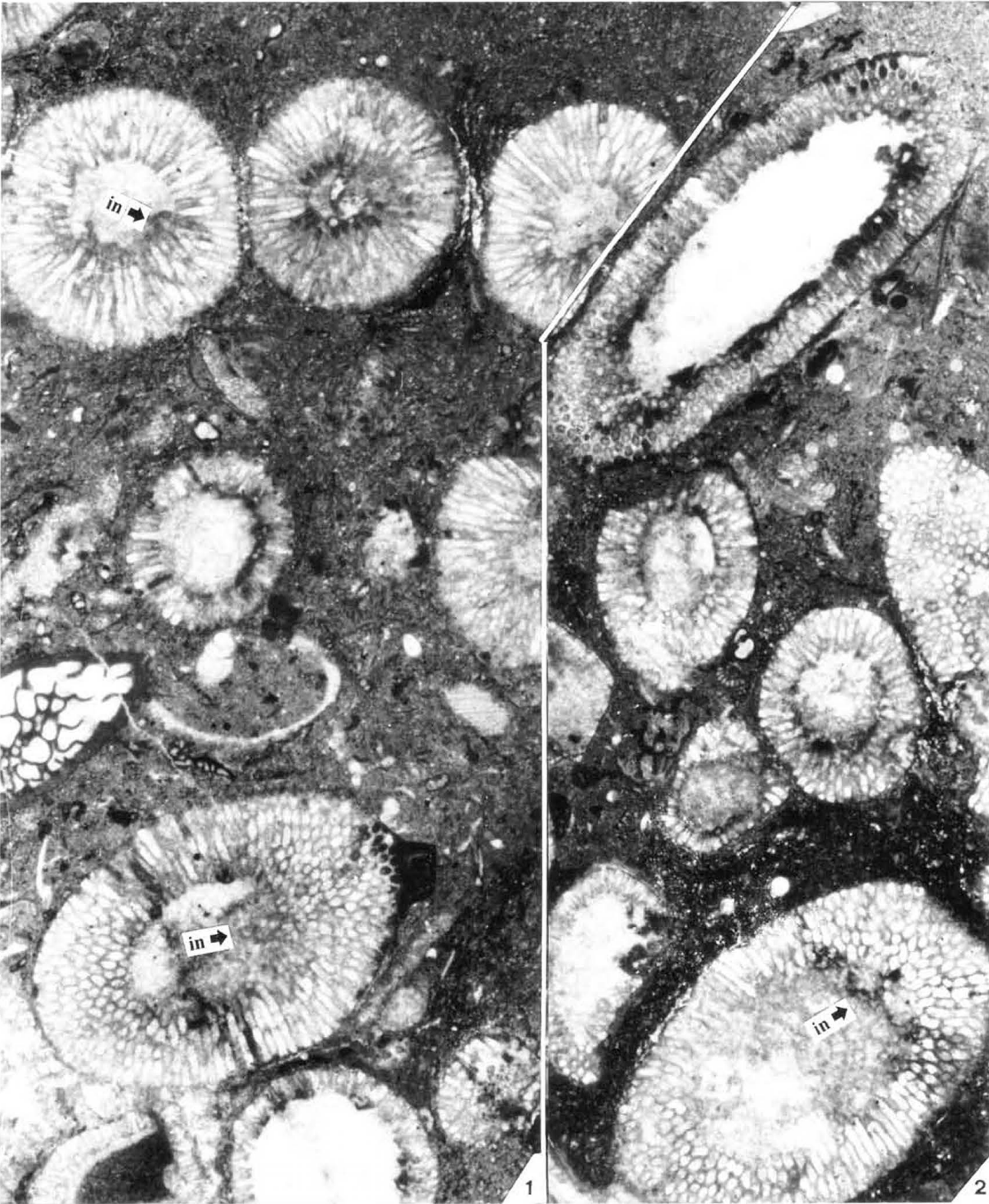
A. vicina Kochansky & Herak, 1960, Slovenia (Vitanje), Upper Carboniferous.

Anthracoporella is reported from Devonian (Šhujskij, 1973) to Permian and dubitatively in Jurassic too (Endo, 1961) but it occurs mainly from the Upper Carboniferous to the Lower Permian of many regions: from Japan to Spain. Johnson (1951) has pointed out it in western Texas. Synthetic indications on the geographic distribution of the *Anthracoporella* species are joined to the synonymies furnished by Emberger (1976, 1978), Vachard (1980), Granier & Deloffre (1994) and, mainly, in the inventory of the Permo-Triassic dasyclads of Granier and Grgasovic (2000).

EXPLANATION OF PLATE 1

Figs. 1-2 - Microfacies with *Anthracoporella spectabilis* Pia. The gross aspect of many *Anthracoporella* sections which cut skeleton segments (viz. skeleton-parts between two branching points) is similar to an aspondylous mainly-acrophorous dasyclad. But the dichotomous lateral branching takes place randomly at various distances by the skeleton axis, often at very proximal position and other times at distal one; on this subject, it is to be noted that the dichotomous branching is non characteristic of dasyclad and is unknown in living species. Moreover groups of calcified sheaths may originate more inward (in →) then one expects (refer to the other plates too).

Locality: Dolina village, between Cadovlje and Jelendol, Northway of Tržič (Slovenian Karawanken). Upper Carboniferous (Oreburgian). 19 ×. (fig. 1: thin section A3653.3; fig. 2: thin section A3653.1).



WITH REGARD TO THE *ANTHRACOPORELLA*
SPECTABILIS TYPE

Lectotype – Pia (1920) did not designate the holotype of *Anthracoporella spectabilis*. I propose therefore as lectotype the specimen (oblique section) figured at pl. 1, fig. 7 by Pia (1920).

Depository – The Pia collection (rock samples and thin sections) is present today in the Naturhistorisches Museum of Wien (Austria) and is listed in its Annalen (vol. 33, 1919, "Katalog der Diploporensammlung", n° 1-7); the thin section containing the lectotype has the n° 317a.

Lectotype locality – Pia (1920, p. 18) indicated as locality of the here-selected lectotype "Krone, bei Pontafel", i.e. the Italian Monte Corona, Northway of Pontebba, to the Austria-Italy boundary (Carnic Alps).

Lectotype level – "Fusulinid limestone of the Upper Carboniferous" (Pia, 1920). At Monte Corona, famous for its fossil plants, the fusulinid-bearing limestone is present, but exceptionally, in the Corona Formation, which outcrops along the western slopes of the mountain. The fusulinid limestone is frequent instead along the whole Auernig Formation, which is here present only with the lower part; this outcrops in the upper part of the relief. Both these formations belong to the cyclothemic Auernig Group and are Upper Carboniferous in age (Upper Gzhelian). The Auernig Fm. in particular, already believed of the Carboniferous-Permian boundary (Pasini, 1963), has been ascribed to the uppermost Gzhelian by Kahler (1985).

The Corona Fm. is mainly siliciclastic and made up of conglomerates, arenites and pelites; it witnesses an environment oscillating between the fluvio-deltaic and the submerged beach (shoreface). The fusulinid limestone occurs as an only one, occasional, not

much important level, 2 ms thick at the most, present at the end-part of the formation (Massari *et al.*, 1991); *Anthracoporella* too is reported there.

The Auernig Fm. is a mainly pelitic-arenitic sequence including meaningfully limestone and conglomerate too. This formation, though contains various fluvio-deltaic, siliciclastic episodes, originated mainly in shallow marine environment (lower shoreface and outer platform margin) (Venturini, 1990). Krainer (1991) reports in the limestone levels some microfacies-types in which calcareous algae (chiefly *Anthracoporella spectabilis*, *Epimastopora*, *Archaeolithophyllum missouriense*, *Eugonophyllum*) and fusulinids, are usually associated with other fossils, e.g. forams, bryozoans, brachiopods, crinoids and *Tubiphytes* (i.e. *Shemowella*; refer to Riding, 1993).

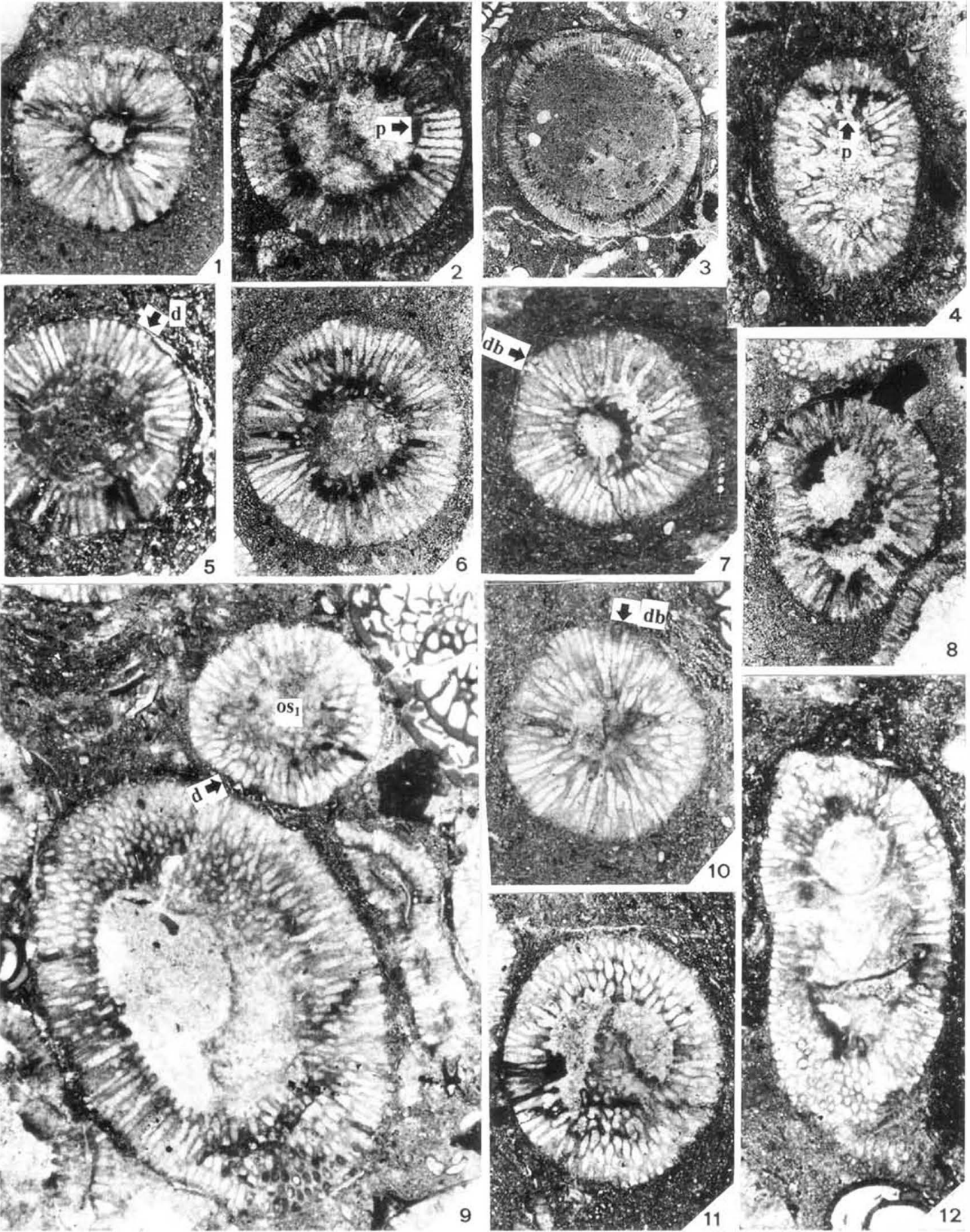
The lectotype material comes likely from the Auernig Fm. because the high frequency reached by the *Anthracoporella*-fusulinid limestone and, at the same time, owing to the scarcity of similar levels in the Corona Fm.

Refer to Venturini (1990), Flügel *et al.* (1994), Vai (1998), Venturini & Spalletta (1998) for geological regional setting and informations on previous literature, to Vai (1998) and Schönlaub (1998) for palaeogeography, to Venturini (1990) and Massari *et al.* (1991) for stratigraphy, to Krainer (1991, 1995) and Samankassou (1998) for facies analysis (particularly for the *Anthracoporella* facies). Paleontological studies on the Auernig Group have been carried out, among the others, by Flügel (1966, 1977) on the algae, Pasini (1963), Kahler (1983, 1985), Kahler & Krainer (1993), Davidow & Krainer (1999), Forke & Samankassou (2000) on the forams (mainly fusulinids), Kügel (1987) on the sphinctozoans, Kodsi (1967) on the bryozoans, Fohrer (1991) on the ostracods.

EXPLANATION OF PLATE 2

- Figs. 1-12 - *Anthracoporella spectabilis* Pia. 1-3) Transverse sections showing the very high variability of D/d (outer/inner diameter ratio) in cylindrical segments of *Anthracoporella spectabilis*; the magnification of figs 1-2 is the same ($\times 19$) instead that of fig.3, related to a much larger segment, is lower ($\times 7.3$).
2, 5-7, 10) Transverse sections showing that the dichotomous branching of the laterals takes place randomly at various distances by the skeleton axis, sometimes at very proximal position (p $\rightarrow$; e.g. fig. 2, and 4) and other times at distal one (d $\rightarrow$; e.g. fig. 5 and os₁ of Fig. 9).
7, 10) Transverse sections showing laterals may branch dichotomously two times too (db $\rightarrow$).
4) Slightly-oblique transverse section in an almost-cylindrical (flattened) segment. The calcified sheaths pass inwards into a calcified mass, believed not diagenetic but primary.
7-8, 11-12 upper part) Transverse (figs. 7-8), slightly oblique (fig. 11) and oblique (fig. 12) sections in cylindrical segments. Pore-bearing calcified bodies join opposite parts of the skeleton inner surface.
9) os₂: in the upper right part of the section, calcified sheaths protrude inwards and gradually disappear.
10) Transverse section. In the right half of the section, calcified sheaths protrude inwards and pass into a non-structured calcified mass, believed non-diagenetic but primary.

Locality: Dolina village, between Cadovlje and Jelendol, Northway of Tržič (Slovenian Karawanken Mountains). Upper Carboniferous (Oreburgian). Magnification: about $\times 19$ (Figs. 1-2 and 4-12), $\times 7.3$ (fig.3). Thin sections: fig. 1 (A3653.4), fig. 2 (A3653.3), fig. 3 (A3653.6), fig. 4 (A3653.2), fig. 5 (A3653.3), fig. 6 (A3653.4), fig. 7 (A3653.1), fig. 8 (A3653.4), fig. 9 (A3653.8), fig. 10 (A3653.4), fig. 11 (A3653.7), fig. 12 (A3653.3).



STUDIED MATERIAL AND NEW DATA

The *Anthracoporella spectabilis* material (sample A3653) described in this paper was taken many years ago in Tržič (Neumarkt *in* Pia, 1920) zone, Slovenian Karavanken Mountains, during a field trip organized by the Società Paleontologica Italiana (Montanaro-Gallitelli & Serpagli, 1967). The sample comes by the Upper Carboniferous (Orenburgian) outcropping near the school of the Dolina village, between Cadovlje and Jelendol small towns.

The Permo-Carboniferous biostratigraphy and paleontology (mainly forams and algae) of carbonate facies of this region have been treated chiefly by Kochansky & Herak (1960), Kochansky-Devidé (1970, 1971), Kochansky-Devidé *et al.* (1973), Kochansky-Devidé & Ramovš (1966), Ramovš (1971), Ramovš & Kochansky-Devidé (1981).

The sample A3653 is a bioclastic, fossil-rich limestone (wackestone, partially packstone) poorly sorted, finely porous, containing small amount of metallic grains (chiefly pyrite). *Anthracoporella spectabilis* is abundant; some other fossils are *Epimastopora alpina* (*sensu* Kochansky & Herak, 1960), *Daixina alpina* (Schellwien), *Glyphostomella*, *Polytaxis*, *Climacamina*, *Palaeotextularia*, *Palaeonubecularia uniserialis* Reitlinger, *Tuberitina bulbacea* Galloway & Harlton, *Diplosphaerina inequalis* Derville, *Eotuberitina reitlingerae* Miklukho-Maklay, *Shamowella obscura* (Maslov) Riding. The greater fossils (e.g. *Anthracoporella*, *Daixina*) are usually broken; the smaller ones (chiefly if they are porcellaneous) often are partly or fully pyritized (e.g. *Palaeonubecularia*).

My observations on *Anthracoporella spectabilis* agree in general with the careful Pia description; some characters (as multiple branching of the laterals), which this author had only supposed, have been confirmed by Flügel & Flügel-Kahler (1998) and documented in this paper too. However some transverse to oblique sections of the tubular skeleton segments (parts between two subsequent branching-points) display the following characters (1-4) alien or not very pertinent with the systematic position attributed until now to this species.

1 - Calcified-sheath groups of the skeleton pro-

trude much more inwards (i.e. towards the skeleton axis) than others do (Pl. 2, figs. 9-11). In tubular skeletons of the true dasyclads, on the contrary, all the confluent, pore-surrounding, calcareous sheaths originate at the same distance from the skeleton axis.

2 - Skeleton material protrudes inwards and forms pore-bearing irregular strips which cross and divide in two parts the central cavity (Pl. 2, figs. 7-8, 11-12; Pl. 3, fig. 2).

3 - The skeleton wall protrudes inwards fully filling the central cavity (Pl. 2, figs. 10-11); at same time the usually pore-bearing skeleton-wall grades inwards to a lesser porous material or even to a structureless material in which occasional pore-encircling sheaths may persist (Pl. 2, fig. 10; Pl. 3, fig. 1).

4 - The pore dichotomous branching (just unusual among the dasyclads) riches very often the second order and seldom the third (Pl. 2, figs. 7, 10). But contrary to what happens in dasyclads with branched laterals, some or more laterals cannot branch. Moreover the branching-points of a same branching-order occurs randomly at various distances from the skeleton-axis; besides some branching-points can originate just at the inner-surface of the skeleton; others, on the contrary, very near the outer surface (Pl. 2, figs. 2, 4-5, 9). In accordance with Pia (1920), due the almost-constant thickness of the pores and their close-setting (refer to what follows too), the dichotomy occurs usually perpendicularly to the skeleton axis in order to refill the widening empties which would become available between the "laterals" as they lengthen outwards during the growth.

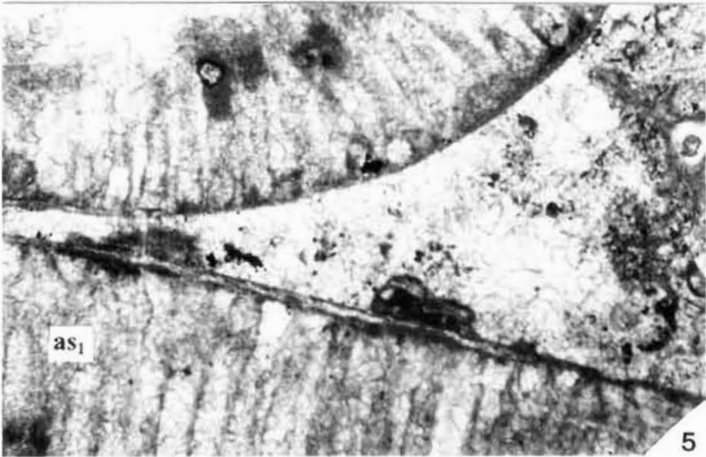
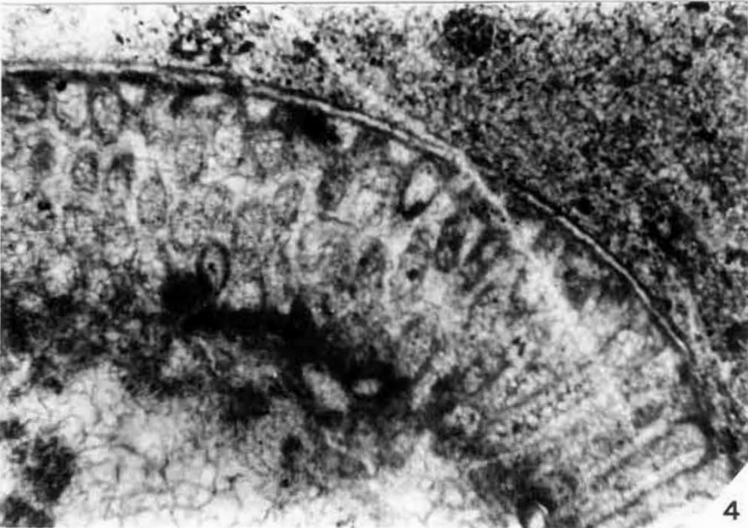
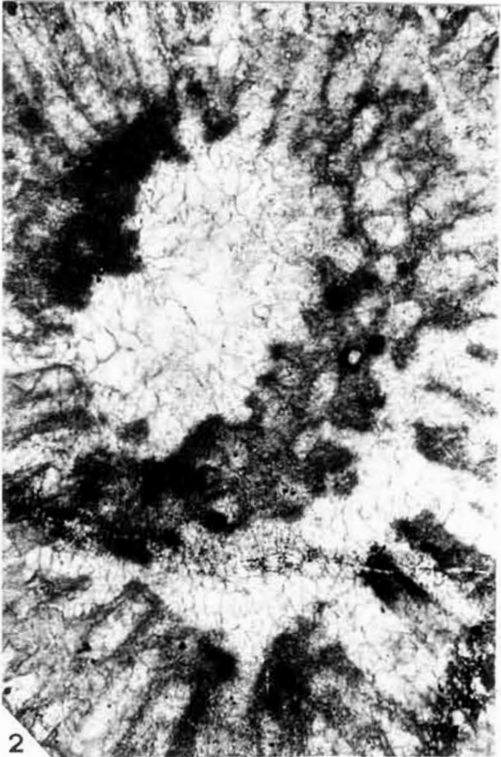
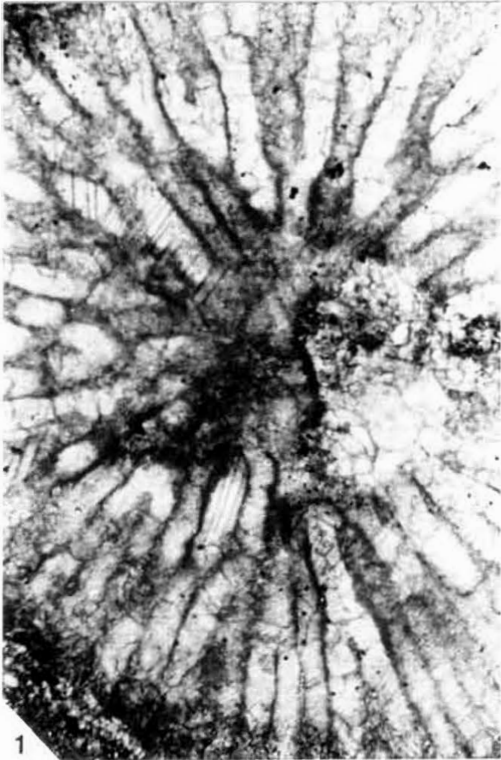
The situations above listed in 1-4, though not much frequent, are alien with the radial symmetry of the dasyclads and with the longitudinal continuity of the stem-lodging central cavity of their skeleton.

The following other situations (5-6), though believed of lesser weight, seems to enhance the perplexities about the *Anthracoporella* systematic position.

5 - In accordance with Pia (1920), a "cuticle" envelops very often the *A. spectabilis* skeletons (Pl. 3, figs. 3-5); Kochansky & Herak (1960) report, in particular, that it is preserved rarely. The presence of the "cuticle" has been recently confirmed and documented by Flügel & Flügel-Kahler (1998). This character

EXPLANATION OF PLATE 3

- Figs. 1-5 - *Anthracoporella spectabilis* Pia. 1) Detail of the pl.1, fig.10 (transverse section). The skeleton central zone is occupied by a calcareous body in which more dense sheath originate. $\times 57$ (thin section A.3653.4).
2) Detail of the pl.1, fig.8 (transverse section). A pore-bearing calcareous strip similar in structure to *Anthracoporella* skeleton occupies the skeleton central zone; this strip joins opposite parts of the skeleton inner surface. $\times 58$ (thin section A.3653.4).
3) Detail of a transverse section showing the pore-ends (usually open in dasyclads) covered by a thin micritic film (cuticle inner layer); in the right part of the section the cuticle is missing due to abrasion. $\times 60$ (thin section A3653.8).
4) Detail of a transverse-oblique section showing that the pores are covered by a thin three-layered film (cuticle): an inner and an outer both micritic layers and a middle sparitic one. $\times 60$ (thin section A3653.6).
5) as; detail of an axial section. In some points the pore-ends underlay a thin three-layered film (cuticle). The encrusting organism (?) overlying the cuticle supports the hypothesis of its primary origin. $\times 55$ (thin section A.3653.7).



is recorded in living *Bornetella* only by Cramer (1891) and Solms-Laubach (1893); it has been not more confirmed in living dasyclads by subsequent authors (e.g. Egerod, 1952; Valet, 1969; Berger & Kaever, 1992). With the reservation suggested by possible diagenetic modifications and by the scarce number of measurements that I have carried out on the studied material, the cuticle seems to be about 16-28 microns thick and is maybe three-layered: the outer and the inner layer are both dark and very thin; the middle one is thicker and white. The cuticle very often is not quite observable or is reduced to the inner layer only; the partial or total lack seems due to abrasion. For this reason the inner layer remains more easily than the others.

Most of the authors (e.g. Elliott, 1968) however do not mention the cuticle. Some others do not agree with its primary origin; Bebout & Coogan (1964), in particular, attribute it to encrusting organisms as *Tubiphytes* sp. (= *Shamowella*; see Riding, 1993).

6 - The skeleton-wall thickness (hence the pore length) can widely vary but without any relation as regards to the inner/outer diameter ratio, i.e. small wall-thickness may occur even if the skeleton outer diameters are very great (refer Pl. 2, figs. 1-3). What has been reported in the present (6) paragraph and in the preceding number 1, was interpreted by Pia (1920, p. 16) supposing that the skeleton might randomly fray inwards but never reaching the thallus stem.

Most pores of *A. spectabilis* are acrophore along most off length; in the end part can retain the same thickness (acrophore laterals) or more often can widen slowly. In some cases they seems widen in proximal part. Rarely short alternances (meaningless local deformities?) of slight swellings and narrowings seem to occur. Also Kochansky & Herak (1960, p. 67), in the careful description of this species, pointed out "The pores are generally uniform, but in the longitudinal section somewhat irregular.....On each specimen their diameter is nearly constant".

SOME MEASUREMENTS

The following biometrical parameters have been measured: D (outer diameter), d (inner diameter), T

(wall thickness of the skeleton), pm (proximal to middle thickness of the pores), pt (distal thickness of the pores), g (sheath thickness between adjoining pores). In each segment more measurements of pm, pt, and g have been taken but the various values pertinent to each parameter have been after replaced by the average.

Table 1 is based on about thirty specimens (cylindrical segments of a skeleton) in thin section. As regards to pm, pt and g, the statistical values min (minimum), avg (average), max (maximum), std (standard deviation) refer to the averages of the previous mentioned averages; for this reason, by side of min and max, the lowest and greatest values measured (non-deducible from the averages) are respectively quoted between brackets. All measurements are given in mm. The last column (n°) indicates the number of measured segments.

The table data do not refer to all the segments present in the studied thin sections neither, as regards to pm, pt and g, to all possible measurements but only to the ones believed more meaningful. Therefore the furnished statistical analysis is merely approximate.

Anthracoporella spectabilis is recorded in the shallow platform facies of the Permo-Carboniferous times but more often from Upper Carboniferous to Lower Permian. Refer on this subject to Flügel & Flügel-Kahler (1998) and to concise and careful inventory of fossil dasyclads of Granier & Grgasovic (2000). Some occurrences however, either because non-confirmed or poorly documented should be re-examined. Perplexities about some of them have been indeed expressed, by Vachard (1980, p. 346) and are also marked by "?" in the *A. spectabilis* synonyms listed by Granier & Grgasovic (2000) and Flügel (1966).

CONCLUSIONS

The variable distance of the proximal pore-end from the skeleton axis, together with the calcified material in the central-cavity space, moreover the irregularity in the position and modality of pore branching and the presence of a cuticle, allow us to consider unlikely (though the skeleton shows remarkable similarities to dasyclad one) the systematic position until now assigned to *Anthracoporella spectabilis* and consequently to *Anthracoporella*.

	Min	avg	max	std	n°
D (outer diameter of the skeleton)	1,16	1,96	3,08	0,46	37
d (inner diameter of the skeleton)	0,34	0,98	2,34	0,38	36
T (wall-thickness of the skeleton)	0,16	0,49	0,89	0,18	36
pm (prox.-middle thickness of pores)	0,054 (0,039)	0,068	0,079 (0,103)	0,006	29
pt (distal thickness of pores)	0,056 (0,045)	0,075	0,087 (0,073)	0,008	27
g (sheath thickness between pores)	0,014 (0,011)	0,021	0,036 (0,090)	0,005	29

Tab. 1 - Biometrical data from about 30 specimens of *A. spectabilis*. (Measures are given in mm).

Growth types, able to explain, *but only in part*, the above quoted characters are well known e.g. among the living cyanophyta and cladophoracean green algae and in the fossil thaumatoporellaleans (refer to De Castro, 1990).

All pertaining the irregularity in the position and modality of pore branching might be interpreted hypothesizing growth types similar to of the now-quoted in part aegagropylous algae and cyanophyta; namely grew modes in which, during the life of the parent organism, calcified sheaths grew outwards while their older inner parts disintegrated. According to this hypothesis, when the sheath-disintegration prevailed over the growth, the sheaths were shorter (thin-walled skeletons) and therefore along their length the branching points might not be present. On the contrary when the growth prevailed, the sheaths were longer (thick-walled skeletons) and along their length one or more branching points might be present.

The presence of calcareous primary material, structureless or perforated, in the central cavity is more difficult to explain. Certainly its origin is like that one of the sheaths because these may grade or plunge in it; the formation modality of this material, however, has not been still understood. Similar structures occur inside the mother colonies of the thaumatoporellaleans, during the vegetative reproductions, and represent young daughter colonies; moreover a "cuticle" envelops the skeletons of both taxa. These resemblances however are believed, until now, inadequate for hypothesize whether phylogenetic relationships or similar growth-types between *Anthracoporella*, thaumatoporellaleans or other organisms.

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