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Crescentiella, a new name for "*Tubiphytes*" *morronensis* CRESCENTI, 1969: an enigmatic Jurassic – Cretaceous microfossil

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ABSTRACT

Several organisms or interaction of organisms have been described over a long time interval from the Late Palaeozoic to Cretaceous as Tubiphytes*, with the type species being* T. obscurus *MASLOV, 1956. Palaeozoic* Tubiphytes *were revised by SENOWBARI-DARYAN & FLÜGEL (1993). Triassic representatives still need to be revised. For Jurassic (extremely abundant in upper Jurassic) and Cretaceous organisms, known as* "Tubiphytes" morronensis *CRESCENTI, 1969, we propose here the genus name* Crescentiella*. Differences between* Crescentiella *nov. gen. and* Tubiphytes *MASLOV are discussed. The systematic position of* Crescentiella *as a foraminifera, interaction of foraminifera and cyanophyceans or as a special kind of oncolite is discussed. It is interpreted as symbiosis or encrustation between cyanobacteria and a nubecularid foraminifera, uncertain tube or rarely, other biogenic components. Comments on similar associations, e.g. the genus* Labes *ELIASOVA, are provided.*

Keywords: *Crescentiella*, *Tubiphytes*, *Labes*, Cyanobacteria, Foraminifera, systematics, Jurassic, Cretaceous.

1. INTRODUCTION

RAUSER-CHERNOUSSOVA (1950) introduced the genus name *Shamovella* for the fossil, later described by MASLOV (1956) as *Tubiphytes*. According to ELIAS (1959), OTT (in KRAUS & OTT, 1968), and CRONEIS & TOOMEY (1965), the name *Shamovella* is a *nomen imperfectum* but RIDING (1993), pleads that *Tubiphytes* is a junior synonym of the genus *Shamovella*. Later, the name *Shamovella* was used by subsequent authors (e. g. LE MONE, 1995; RIDING & BARKHAM 1999; WEIDLICH; 2001). VACHARD et al. (2001) introduced *Shamovella* as a synonym of *Tubiphytes* and mentioned that according to CHUVASHOV et al., (see VACHARD et al. 2001) two forms of *Tubiphytes* exist: "*Tubiphytes obscurus shamovella* RAUSER CHERNOUSSOVA" and "*Tubiphytes obscurus obscurus* MASLOV". In this paper the popular name *Tubiphytes* is still used.

Tubiphytes with the type species *T. obscurus* MASLOV (1956) was described from the Permian of the Ural Mountains. Two years later, the same organism was reported from the Permian of the Guadalupe Mountains in Texas and New Mexico as *Nigriporella* (with two species as *N. magna* and *N. minima*) by RIGBY (1958). *Tubiphytes* and morphologically similar organisms are the most abundant problematic microfossils known over a long time interval from the Carboniferous to the Cretaceous in shallow water carbonates (RIDING & GUO, 1992; SENOWBARI-DARYAN & FLÜGEL, 1993). Most references are published from Permian deposits, describing or illustrating the species *Tubiphytes obscurus* MASLOV and the Upper Jurassic species of "*Tubiphytes*" *morronensis* CRESCENTI.

An overview of the Palaeozoic *Tubiphytes*, including the type species *T. obscurus* MASLOV, and other species, as well as similar organisms, is given by SENOWBARI-DARYAN & FLÜGEL (1993). All three "species" of *Tubiphytes* (*T. tubularis, T. polyvesica, T. spinalis*), described by WU (1991) from the Permian of Xiangbo, China are considered younger synonyms of *T. obscurus* MASLOV.

"*Tubiphytes*" and similar morphotypes are abundant in the Mesozoic, particularly in Ladinian-Carnian reefs of the Tethyan realm. A revision of Triassic "*Tubiphytes*" is in preparation by Senowbari-Daryan.

Differences (see below) concerning the internal cavity and structure of the surrounding "cortex" between Palaeozoic *Tubiphytes* and the Jurassic-Cretaceous microfossil, known as "*Tubiphytes" morronensis* CRESCENTI justify the separation and establishment of an independent genus with the generic name *Crescentiella* nov. gen. for the latter.

Crescentiella morronenis (CRESCENTI, 1969) nov. comb. described originally from the Jurassic of the central Apennines (southern Italy), is very abundant in Upper Jurassic epicontinental deposits of Europe, (southern Germany and time equivalent deposits in other countries including Romania, Poland, Portugal), or in the Alpine-Tethyan realm of Austria and other countries. It is extremely abundant in Bavaria or in Svabia (southern Germany) in the Upper Jurassic (Middle Kimmerigian), "Plattenkalk of Treuchtlinger Marmor". "Treuchtlinger Marmor" is used as a popular building material for hall floors, windowsills, stairs etc., particularly in southern Germany.

Crescentiella morronenis (CRESCENTI) nov. comb. is also abundant in Upper Jurassic, open marine, Tethyan shallow water limestones. All illustrated type material of CRESCENTI (1969) represents individual specimens. In Upper Jurassic (Tithonian) reefs of Piano di Battaglia in the Madonie Mountains, Sicily, *C. morronensis* occurs not only as abundant individual specimens, but also as "colonial" forms building micro-constructions several cm in diameter. Such "colonial" forms are also abundant in Upper Jurassic reefs and platform carbonates in the Shotori Mountains, northeast Iran, and are here described as *Crescentiella morronensis* forma *colligaris* nov. forma.

2. MATERIAL AND METHODS

The studied and illustrated material was investigated in polished slabs and numerous thin sections from different localities (see below), as well as in SEM. Material for SEM-investigations was treated and etched for several hours with 3–5% "Titriplex III–Solution". The investigated materials come from the following countries:

Austria. Thin-section material derives from the Upper Jurassic – Early Cretaceous (Kimmeridgian – Lower Berriasian) Plassen Formation or Plassen Carbonate Platform of the Northern Calcareous Alps, mainly from occurrences in the Austrian Salzkammergut (e.g., GAWLICK et al. 2004, 2006; SCHLAGINTWEIT et al. 2005) and the resedimented Barmstein Limestones (GAWLICK et al. 2005, 2006).

Germany. The investigated material of the "Treuchtlinger Marmor" with *Crescentiella morronenis* forma *morronensis* (CRESCENTI) from Germany comes from a quarry south of the village of Treuchtlingen, near the Mörenbach River. A detailed section of this region is given by KOTT (1989, fig. 3) and a general overview of the occurrence of Upper Jurassic deposits is represented by MEYER & SCHMIDT-KAHLER (1984). The age of the investigated material is Upper Jurassic (Kimmeridgian).

Iran. The illustrated material from Iran was collected from the Upper Jurassic (Oxfordian-Kimmeridgian) Esfandiar platform exposed in a hill, approximately 800 m south of the village of Korond in the southern Shotori Mountains (FÜRSICH et al., 2003a).

Italy (Sicily). The Sicilian material comes from the Upper Jurassic (Tithonian), coral rich reef limestone exposed at Pizzo Carbonara in the Madonie Mountains, representing the marginal zone of the Panormide Carbonate platform (CATALANO et al., 1974; ABATE et al., 1988). The calcareous algae of this locality were investigated by SENOWBARI-DARYAN et al. (1994), the foraminifera by BUCUR et al. (1996).

Poland. The Upper Jurassic sediments of the Kraków-Wieluń Upland (South Poland), belong to the microbial megafacies, a belt stretching along the northern shelf of Tethys (GWINNER, 1971; MATYSZKIEWICZ, 1997a, 1999), including numerous microbial-sponge carbonate buildups and thick bedded limestones which are mostly microbial-sponge biostromes. The Upper Jurassic microbial megafacies developed mainly on the northern shelf of the Tethys, and on shelves of the newly opened North Atlantic. The investigated material comes from the Upper Jurassic bedded limestones of the Liban quarry in Kraków (southern part of the Kraków–Wielun Upland). The bedded limestones are of Upper Oxfordian – (?)Lower Kimmeridgian age and developed as thick-bedded facies with cherts in which microbialites are the principal rock-forming components (MATYSZKIEWICZ, 1989; KRAJEWSKI, 2001).

Romania. In Romania, *Crescentiella morronensis* was found in Upper Jurassic limestones developed in the Stramberk type facies from the following massifs: Haghimas Massif (DRAGASTAN, 1969, 1975) (East Carpathians); Piatra Craiului Massif (BUCUR, 1978), Vânturarița Massif (UȚĂ & BUCUR, 2003) (South Carpathians); Trascău Mountains (SĂSĂRAN et al., 2000, 2001) and Bihor Mountains (BUCUR & ONAC, 2000) (Apuseni Mountains).

The age of all the localities is Upper Jurassic – Lower Cretaceous (Oxfordian to Early Berriasian).

3. DIFFERENCES BETWEEN *TUBIPHYTES* MASLOV AND *CRESCENTIELLA* NOV. NOM.

The type material of MASLOV (1956) from the Permian of Ural Mountians and also specimens from Palaeozoic of other localities in the world are characterized by the following criteria:

a) The Palaeozoic species *Tubiphytes obscurus* and also *T. carinthiacus* (FLÜGEL, 1966) are composed of spherical, subspherical or mostly tongue-like segments, usually arranged one above the other, but also irregularly. Each segment contains a separate internal cavity that can be a chambered foraminifera or a cylindrical tube, pear-shaped, globular or even an irregular object which can be placed in the middle, lower, upper, or at the peripheral part of the segment (see MASLOV, 1956, pl. 25, figs. 1, 3; pl. 26, pl. 27, figs. 1–2; RIGBY, 1958; RIDING & GUO, 1992; SENOWBARI-DARYAN & FLÜGEL, 1993; VENNIN et al., 1997). Tubes or chambered foraminifera may pass through several segments. The younger segments may overgrow the older segments, so that the former are not visible from the outside.

In contrast to specimens of *Tubiphytes obscurus*, the specimens of *Crescentiella morronensis* (CRESCENTI) nov. comb. are tapered and cylindrical. The different growth stages in *C. morronensis* may appear as segments, but certainly segmented specimens, like *Tubiphytes*, do not occur. Segmentation or branching is falsely suggested by overgrowth of several specimens as shown from computer-based reconstructions in connection with serial sectioning (SCHMID & HENSSEL, 2001; HENSSEL et al., 2002).

b) The surrounding "envelope" or "cortex" of Palaeozoic *Tubiphytes* composed of a network of hair-like elements named "trichomes" by MASLOV (1956) or "flocculent microfabric" by RIDING & GUO (1992) or "clotted micrite" by PRATT (1995, p. 88). For details of these elements see for example MASLOV (1956, pl. 26, pl. 27, fig. 3), RIDING & GUO (1992, text-fig. 1) and SENOWBARI-DARYAN & FLÜGEL (1993, text-figs. 2, 7). These elements were compared with the spongin protein of demosponges and *Tubiphytes* was interpreted as a sponge by WANG et al. (1994). As shown by SENOWBARI-DARYAN & FLÜGEL (1993) this "flocculent microfabric" belongs to primary mineralized elements and can hardly be compared with the spongin of sponges. Such elements are also known from another enigmatic Triassic microfossil called *Plexoramea* (MELLO, 1977) which is interpreted as a fungus by FLÜGEL et al. (1988). It is noteworthy that such "trichomes" or "flocculent microfabric" are totally lacking in Jurassic – Cretaceous *Crescentiella*. The "cortex" of *Crescentiella* is instead composed of oblique running laminae produced by the alternation of small and large crystals (Pl. 6, Figs. a–b, d; Pl. 7, Figs. d–e). PRATT (1995, p. 92) named it as "dense micrite around foraminiferal tubes".

c) Pustule-like protuberances (see SENOWBARI-DARYAN & FLÜGEL, 1993, pl. 1, figs. 2–4, text-figs. 2, 7) at the surface of the Palaeozoic *T. obscurus* were never observed in the Jurassic *C. morronensis.*

d) The oblique lamination, a characteristic feature of *C. morronensis* (CRESCENTI) nov. comb. may occur in some representatives of Triassic "*Tubiphytes*", but it is totally lacking in Palaeozoic representatives, at least in *T. obscurus*. Also FLÜGEL (1981, p. 133) mentioned that the apparent concentric structures, observable in cross sections of *C. morronensis* are lacking in *T. obscurus*.

e) The internal cavity (foraminifera or tube of uncertain affinity) of *C. morronensis* passes through the whole body and is not limited to individual segments as in most specimens of Palaeozoic *T. obscurus* or *T. carinthiacus*.

These differences justify the establishment of an independent genus for the Jurassic – Cretaceous microfossil, originally described as "*Tubiphytes*" *morronensis* by CRESCENTI (1969) introduced here as *Crescentiella* n. gen.

Crescentiella n. gen.

Derivatio nominis: In honour of Dr. Uberto Crescenti who described this fossil for the first time.

Diagnosis: "Corpo calcareo micritico di forma grossolanamente cilindrica, internamente percorso da un´esile cavita con diametro variabile e con strozzature poste a intervalli irregolari. In sezione sottile il corpo cilindrico (tubo), a diametro variabile e a contorni esterni mal delimitati, presenta un aspetto denso e scuro; ad un´analisi dettagliata mostra di essere costituito da sottilissimi strati micritici all´apparenza concentrici, fortemente ravvicinati tra loro" (Generally cylindrical (*single or gregarious colonies grown together*) micritic calcareous bodies, internally crossed by a thin cavity of variable diameter and with narrowed zones located at uneven intervals. In thin sections, the cylindrical body (*the tube*) of variable diameter and poorly-delimited external outline appears as a dense and dark-coloured material; when investigated in detail, it consists of thin, densely packed micritic layers (*produced by layers of small and large crystals*) with a concentric display". This diagnosis was given by CRESCENTI (1969, p. 35) for the species *T. morronensis*, which is also valid for the genus *Crescentiella* with some additional criteria, added here (see italics), as partly observed by SEM.

SENOWBARI-DARYAN et al. (2007) introduced the genus *Crescentina*, as a new name for "*Tubiphytes*" *morronensis*. This is considered an invalid name because there is no appropriate reference to its basyonym.

Type species: *Tubiphytes morronensis* CRESCENTI, 1969.

Crescentiella morronensis forma *morronensis* (CRESCENTI 1969) nov. comb.

(Figs. 1–3, 8; Pl. 1, Figs. a–i; Pl. 2, Figs. a–h; Pl. 3, Figs. a–g; Pl. 4, Figs. b–h; Pl. 5, Figs. b, d–h; Pl. 6, Figs. a–h)

Selected synonymy [for further synonymy before 1969 see SCHMID (1996)]:

1969 *Tubiphytes morronensis* n. sp. – CRESCENTI, p. 35–37, figs. 10, 20–22

1969 Mikro-Onkolithe – DRAGASTAN, pl. 21, fig. 1–3; pl. 22, figs. 1–4

1972 *Nodophthalmidium* – WAGENPLAST, pl. 16, fig. 4

1975 Mikro-Onkolithe – DRAGASTAN, pl. 18, fig. 2; pl. 21, fig. 2; pl. 22, fig. 1; pl. 24, fig.2; pl. 25, fig. 1; pl. 33, fig. 1

1975 Onkoide – MEYER, figs. 8–10

1979 *Tubiphytes obscurus* MASLOV – MIŠÍK, pl. 1, figs. 13–15

1979 *Tubiphytes morronensis* CRESCENTI – CHIOCCHINI & MANCINELLI, pl. 3, fig. 3; pl. 6, figs. 1–2

1980 *Tubiphytes obscurus* MASLOV – MIŠÍK & SYKORA, pl. 1, fig. 11
1981 *Tubiphytes morronensis* CRESCENTI – FLÜGEL, p. 131, figs. 1–10
1981 Oncoid with nodophthalmid foraminifera – FLÜGEL & STEIGER, figs. 17F–G
1986 *Tubiphytes morronensis* CRESCENTI – ELIASOVA, p. 28, pl. 1, fig. 1; pl. 2, fig. 1 (synonymy)
1984 *Tubiphytes* sp. – STEIGER & JANSA, fig. 6–2
1985 *Tubiphytes* sp. – HÜSSNER, p. 154, pl. 17, figs. 4–6
1986 *Tubiphytes morronensis* CRESCENTI – BRACHERT, p. 243, pl. 42, figs. 2–3; pl. 43, fig. 7
1987 *Tubiphytes morronensis* CRESCENTI – BARATTOLO & PUGLIESE, pl. 7, figs. 2–4, 7, 10; pl. 32, pl. 37, pl. 38, fig. 1; pl. 40
1989 *Tubiphytes morronensis* CRESCENTI – LANG, p. 232, pl. 60, figs. 7–8
1989 Composite oncoid cf. *Tubiphytes* sp. – MATYSZKIEWICZ, pl. 9, fig. 5
1989 *Tubiphytes morronensis* CRESCENTI – POMONI-PAPAIOANNOU et al., pl. 58, figs. 5–6 (also fig. 7).
1990 *Tubiphytes morronensis* CRESCENTI – KEUPP et al., p. 155, pl. 21, figs. 4–5.
non 1990 *Tubiphytes* cf. *obscurus* MASLOV – KUSS, p. 68, pl. 20, fig. 2; pl. 21, fig. 9.
1991 *Tubiphytes morronensis* CRESCENTI – BARATTOLO, pl. 1, figs. 4–5
1991 *Tubiphytes morronensis* CRESCENTI – ALTINER, pl. 6, figs. 4–8
1992 *Tubiphytes* – BRACHERT, pl. 43, fig. 4; pl. 44, fig. 10
1992 *Tubiphytes* – MATYSZKIEWICZ & FELISIAK, pl. 38, figs. 2–4; pl. 39, fig. 1; pl. 40, fig. 1, 2
1992 *Tubiphytes morronensis* – LEINFELDER, pl. 23, figs. 1, 5–6
1993 *Tubiphytes morronensis* CRESCENTI – LEINFELDER et al., p. 205, pl. 49, fig. 4; pl. 40, fig. 4; pl. 41, figs. 5–7
1994 *Tubiphytes morronensis* CRESCENTI – DRAGASTAN et al., pl. 3, fig. 6
1994 *Tubiphytes morronensis* CRESCENTI – LUPERTO SINNI & MASSE, pl. 1, figs. 5–6
1994 *"Tubiphytes" morronensis* CRESCENTI – KOCH et al., pl. 22, figs. 3, 5–6
1994 *Tubiphytes* sp. – MATYSZKIEWICZ & SŁOMKA, pl. 2, fig. 3; pl. 4, fig. 4; pl. 7, fig. 2
1994 *Tubiphytes morronensis* CRESCENTI – SENOWBARI-DARYAN et al., p. 235, pl. 11, figs. 9–11
1995 *Tubiphytes* – PRATT, fig. 45.D–E
1996 *Tubiphytes* – MATYSZKIEWICZ & KRAJEWSKI, fig. 10e
1995 *Tubiphytes morronensis* CRESCENTI – SCHMID, p. 306, figs. 5–13
1996 *Tubiphytes morronensis* CRESCENTI – SCHMID, p. 188, figs. 63–64, 96–97, 113 (non 105–112, 116) (Synonymy)
1996 *Tubiphytes morronensis* CRESCENTI – SANTANTONIO et al., fig. 15
1997 "*Tubiphytes" morronensis* CRESCENTI – FLÜGEL & FLÜGEL-KAHLER, pl. 24, figs. 4–5, 8
1997b *Tubiphytes* – MATYSZKIEWICZ, fig. 4
1998 *Tubiphytes morronensis* CRESCENTI – CARRAS & GEORGALA, pl. 42, fig. 2.
1999 *Tubiphytes morronensis* CRESCENTI – RICHTER et al., pl. 1, fig. 1, 9
1999 *Tubiphytes morronensis* CRESCENTI – DUPRAZ & STRASSER, pl. 12, fig. 3
1999 *Tubiphytes* sp. – SCHEIBNER & REIJMER, pl. 16, fig. 2–3
1999 *Tubiphytes obscurus* MASLOV – BLOMEIER & REIJMER, pl. 20, fig. 5
1999 "*Tubiphytes" morronensis* CRESCENTI – SCHLAGINTWEIT & EBLI, pl. 2, fig. 5; pl. 4, fig. 7; pl. 12, figs. 4–5
2000 *Tubiphytes morronensis* CRESCENTI – SCHMID & HENSSEL, p. 50, figs. 4–5, 7–10
2000 "*Tubiphytes" morronensis* CRESCENTI – BUCUR & ONAC, p. 15, pl. 2, fig. 9
2000 "*Tubiphytes" morronensis* CRESCENTI – SĂSĂRAN et al., p. 453–456, pl. 2, fig. 5
2000 *Tubiphytes* – KRAJEWSKI, fig. 11
2001 *Tubiphytes morronensis* CRESCENTI – HELM & SCHÜLKE, p. 101, figs. 2–4
2001 "*Tubiphytes" morronensis* – KRAJEWSKI, fig. 10
2001 *Tubiphytes* – NEUWEILER, MEHDI & WILMSEN, pl. 39, figs. 4–5
2001 "*Tubiphytes" morronensis* CRESCENTI – SĂSĂRAN et al., p.37, 39, 40, pl. 10, fig. 4
2001 *Tubiphytes morronensis* CRESCENTI – VOLK et al., pl. 10, fig. 3/2; pl. 13, fig. 1–2
2002 *Tubiphytes* – DUPRAZ & STRASSER, fig. 14.D
2002 "*Tubiphytes" morronensis* CRESCENTI – SCHERZE & HÖFLING, p. 194, pl. 1, fig. 5
2003 *Tubiphytes morronensis* CRESCENTI – BURZA & DRAGASTAN, pl. 1, fig. 2
2003 *Tubiphytes morronensis* CRESCENTI – DRAGASTAN & RICHTER, pl. 1, fig. 5t
2003a *Tubiphytes* – FÜRSICH et al., pl. 35, fig. 5T
2003b *Tubiphytes* – FÜRSICH et al., pl. 31, fig. 7–8
2003 *Tubiphytes* – OLÓRIZ et al., fig. 11.G
2003 "*Tubiphytes" morronensis* CRESCENTI – SCHLAGINTWEIT & GAWLICK, pl. 2, fig. 1–2
2003a „*Tubiphytes" morronensis* CRESCENTI – SCHLAGINTWEIT et al., pl. 3, fig. 8; pl. 4, fig. 15
2003b „*Tubiphytes" morronensis* CRESCENTI – SCHLAGINTWEIT et al., pl. 1, fig. 3; pl. 2, fig. 7
2003 "*Tubiphytes" morronensis* CRESCENTI – UTA & BUCUR, pl. 3, fig. 1–2, 5
2004 *Tubiphytes morronensis* CRESCENTI – FLÜGEL, pl. 99, figs. 7
2004 *Tubiphytes* sp. – MATYSZKIEWICZ et al., pl. 6, fig. 1/T
2004 "*Tubiphytes" morronensis* CRESCENTI – SCHLAGINTWEIT, pl. 1, fig. 9/2; pl. 2, fig. 2
2005 "*Tubiphytes" morronensis* CRESCENTI – GAWLICK et al., fig. 11.3

2005 "*Tubiphytes*" *morronensis* CRESCENTI – HELM, p. 80, pl. 8, fig. 1
2005 "*Tubiphytes*" *morronensis* CRESCENTI – RADOIČIĆ, p. 33, pl. 9, fig. 7
2005 "*Tubiphytes*" *morronensis* CRESCENTI – SCHLAGINTWEIT et al., p. 80, fig. 18c (pars), fig. 31 (pars), fig. 70b, 77a–c
2006 "*Tubiphytes*" *morronensis* CRESCENTI – GAWLICK & SCHLAGINTWEIT, fig. 4e–f
2006 "*Tubiphytes*" *morronensis* CRESCENTI – GAWLICK et al., fig. 10.4, 11.9
2006 *Tubiphytes* sp. – MATYSZKIEWICZ et al., fig. 5b

Description: A detailed description of *Crescentiella morronensis* is given by CRESCENTI (1969), FLÜGEL (1981) and particularly by SCHMID (1995). A reconstruction of *C. morronensis* is given by SCHMID (1995) and a similar reconstruction by LEINFELDER et al. (1996).

The thickness of the "cortex" or "envelope", respectively the difference between the outer and inner diameter of *C. morronensis* seems to depend on the light as presented by SCHMID (1995) and one more by LEINFELDER et al. (1996), but not confirmed by other studies (DUPRAZ & STRASSER, 2002, p. 463). Here the general characteristics and additional observations are briefly summarized.

Morphologically, the length of *C. morronensis* is a few mm (maximum 10 mm, Fig. 1), usually single (Fig. 2; Pl. 1, Figs. a–e; Pl. 4, Figs. b–c, f–h), rarely dichotomously "branched" (Pl. 3, Fig. g), with a diameter of about 0.4–1.3 mm. According to HENNSEL et al. (2002), the branched specimens are in fact individual specimens of foraminifera that formed as a consequence of overgrowth. This statement corresponds to our observations.

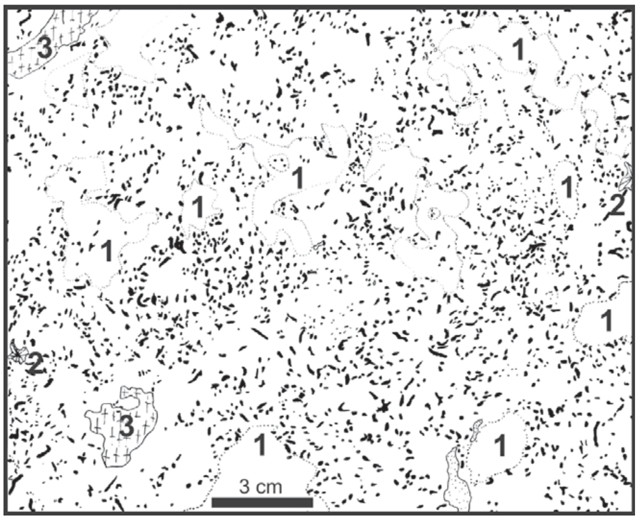

Figure 1: Section through numerous specimens of *Crescentiella morronensis* forma *morronensis* (CRESCENTI) showing the abundance of this fossil. Drawn from a polished slab of "Plattenkalk" from southern Germany. The largest specimen of *Crescentiella morronensis* forma *morronensis* is less than 10 mm. Specimens of *Tubiphytes* are embedded without any recognizable orientation in micritic sediment. Areas within dotted lines and marked with a number 1 are micritic areas without *Tubiphytes*, areas marked with a number 2 are cement, and areas marked with a number 3 are sponge fragments.

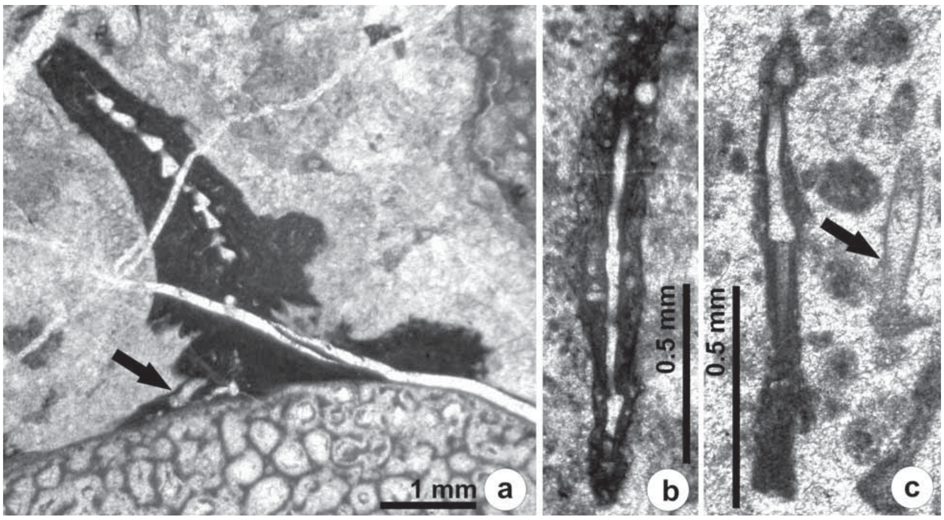

Figure 2: *Crescentiella morronensis* forma *morronensis* (CRESCENTI) from the Upper Jurassic of the Northern Calcareous Alps.
a) Axial longitudinal section through a specimen showing several, amphora-like chambers of internal foraminifera that grows lying on the substrate during the junior stage (here: actinostromarid "stromatoporoid") and later becomes erect. The initial chambers (arrow) do not show encrustations by cyanobacteria. The oblique lamination of the surrounding "cortex" is barely recognizable. Compared with fig. c the amphora-like chambers and also their "necks" are very short.
b) Axial longitudinal section through a specimen showing the internal tube or poorly chambered(?) foraminifera surrounded by a dark "cortex". Within the "cortex" numerous small, mainly spherical fragments are embedded.
c) Longitudinal section through a specimen showing the amphora-like chambered foraminifera with a long neck and without distinct encrustation by cyanobacteria. Arrow indicates a specimen of worm tube *Merciella*? *dacica* DRAGASTAN. Note that specimens a and b are from platform margin deposits, contradicting the trend of depth-decreasing width of the "cortex" proclaimed by SCHMID (1996).

PLATE 1

a–i *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic Plassen Carbonate Platform and Barmstein Limestones of the Northern Calcareous Alps, Austria

a Longitudinal section showing the internal object cut marginally and the surrounding "cortex". Numerous inclusions are within the "cortex".

b Longitudinal section illustrating the internal foraminifera with amphora-like chambers and the surrounding finely laminated "cortex". In the basal portion there seems to be another coiled foraminifera.

c Longitudinal section through a similar specimen to fig. b.

d Longitudinal to oblique section exhibiting the small foraminifera with amphora-like chambers in the centre surrounded by a very thick laminated "cortex". The "cortex" shows different generations, recognizable by a different contrast and structure. Some globular inclusions are embedded within the laminated "cortex". The large globular inclusion (sponge rhaxe) is located at the surface of the foraminifera and embedded within two crust generations.

e Longitudinal section through a specimen exhibiting the foraminifera as a core. The foraminifera was growing in a recumbent position during the initial stage, but erect and growing upward during the latter stage. Note the very thick laminated "cortex" and a spherical inclusion at the end of the foraminifera. The contrast within the encrustation indicates two generations for the formation of the "cortex".

f Sections through several specimens. The specimen in the centre shows *Tubiphytes* at the edges of the aggregate with crescent-like objects (foraminiferal chambers?) within the encrustation.

g Oblique cross section showing the calcite filled core in the centre and the thick encrustation with polygonal formed inclusions (bryozoans?) within the encrustation.

h Section through a specimen with an annulated large object (foraminifera?) and surrounding encrustation. An echinid spine is embedded as an inclusion within the encrustation.

i Cross section through a specimen showing some small spherical elements and two sessile foraminifera embedded within the cyanophycean crust.

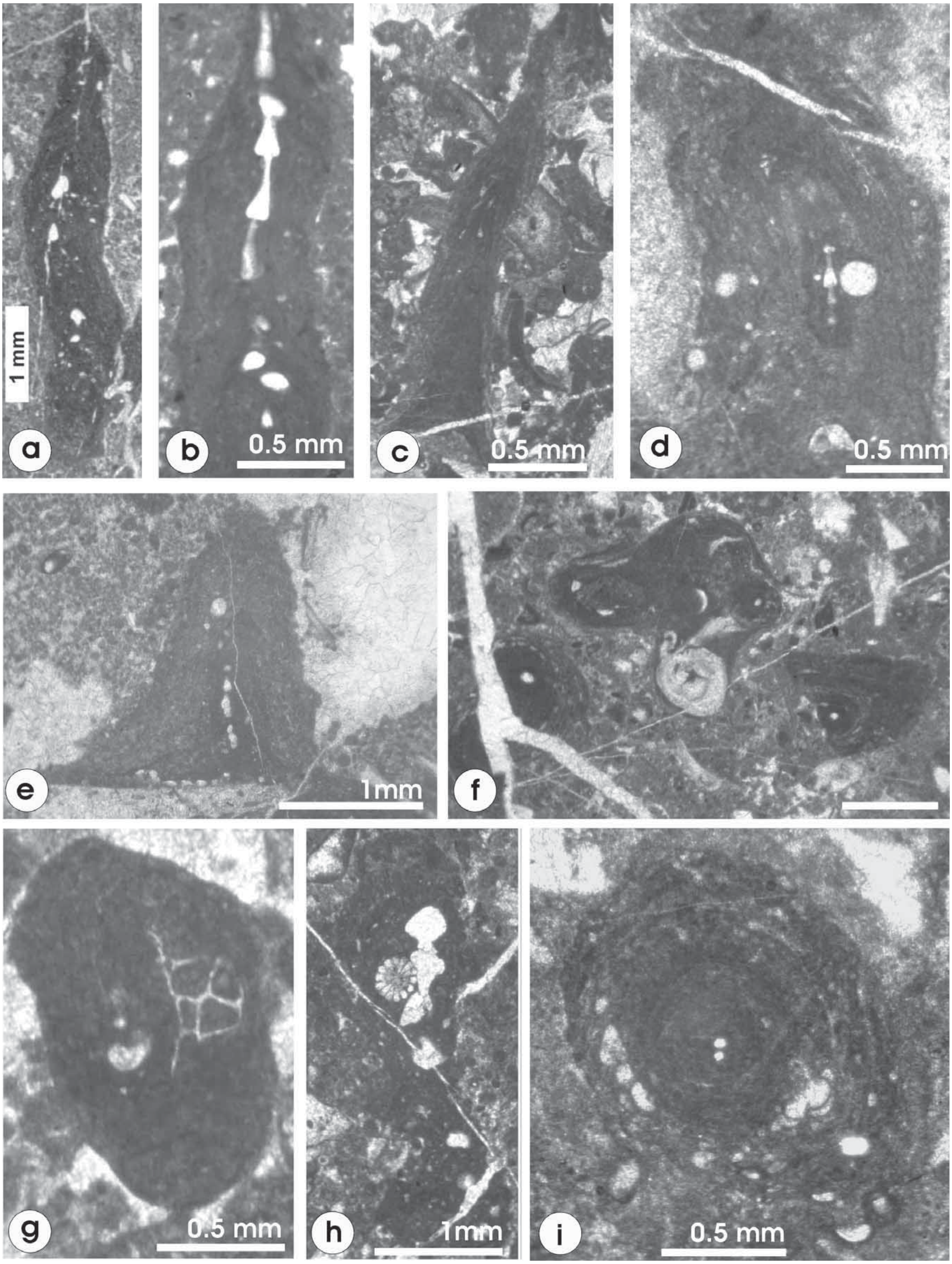
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PLATE 2

a–h *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic of Poland

a Encrustation of a siliceous sponge fragment (right) with *Crescentiella* (small cavity left and encrustation with darker contrast) and another undeterminable fragment (large cavity left) by further cyanophyceans.

b Encrustation of foraminifera – (small cavity in the center) with some undeterminable fragments embedded as inclusions within the "cortex". The oblique running lamination in longitudinal section appears (here in cross section) as weakly concentric lines.

c A specimen exhibiting the foraminifera with amphora-like chambers in the centre. *Crescentiella* is colonized by other organisms (foraminifera, bryozoans) (for magnification see fig. d).

d Magnification from fig. c shows the foraminifera with a recognizable wall in the centre and encrustation of the foraminifera by a cyanophycean. The second foraminifera (arrow) is embedded at the margin of the encrustation.

e A specimen cut in cross section surrounded by bryozoans. Without a recognizable boundary the cyanophycean crust continues around the bryozoans and penetrates partly into the bryozoan cavities.

f Oblique cross section shows two chambers of foraminifera in the axial region encrusted by cyanophyceans. Numerous small and calcite filled cavities (sessile foraminifera?) and a large component (bivalve?) are embedded within the "cortex". The "cortex" is colonized by bivalves (left).

g Longitudinal section through a specimen exhibits the chambered foraminifera in the axial region and the oblique laminae of the "cortex".

h Similar to fig. g.

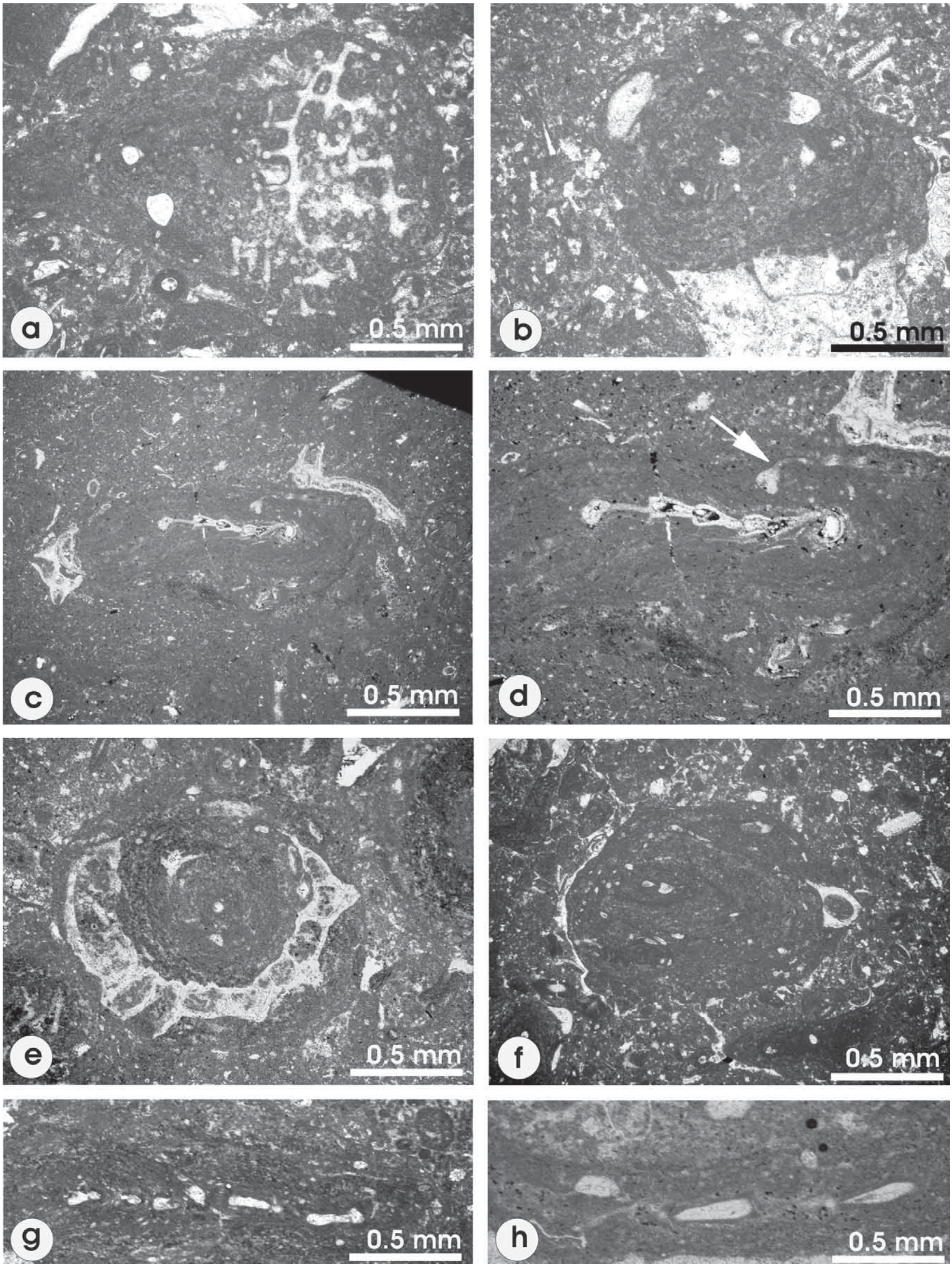
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PLATE 3

a–g *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic ("Treuchtliner Marmor") of southern Germany

a Longitudinal cross sections through several specimens of *Crescentiella morronensis* forma *morronensis*. Small arrows indicate the encrustation of other biogenic fragments (mainly thin shells) and a specimen of trocholinid foraminifera (large arrow) by most probably the same cyanophyceans.

b Encrustation (partly) of a branched object by cyanophyceans. Arrow indicates the amphora-like chamber of the encrusted foraminifera. White points indicate the boundary of *Crescentiella* with the surrounded sediment.

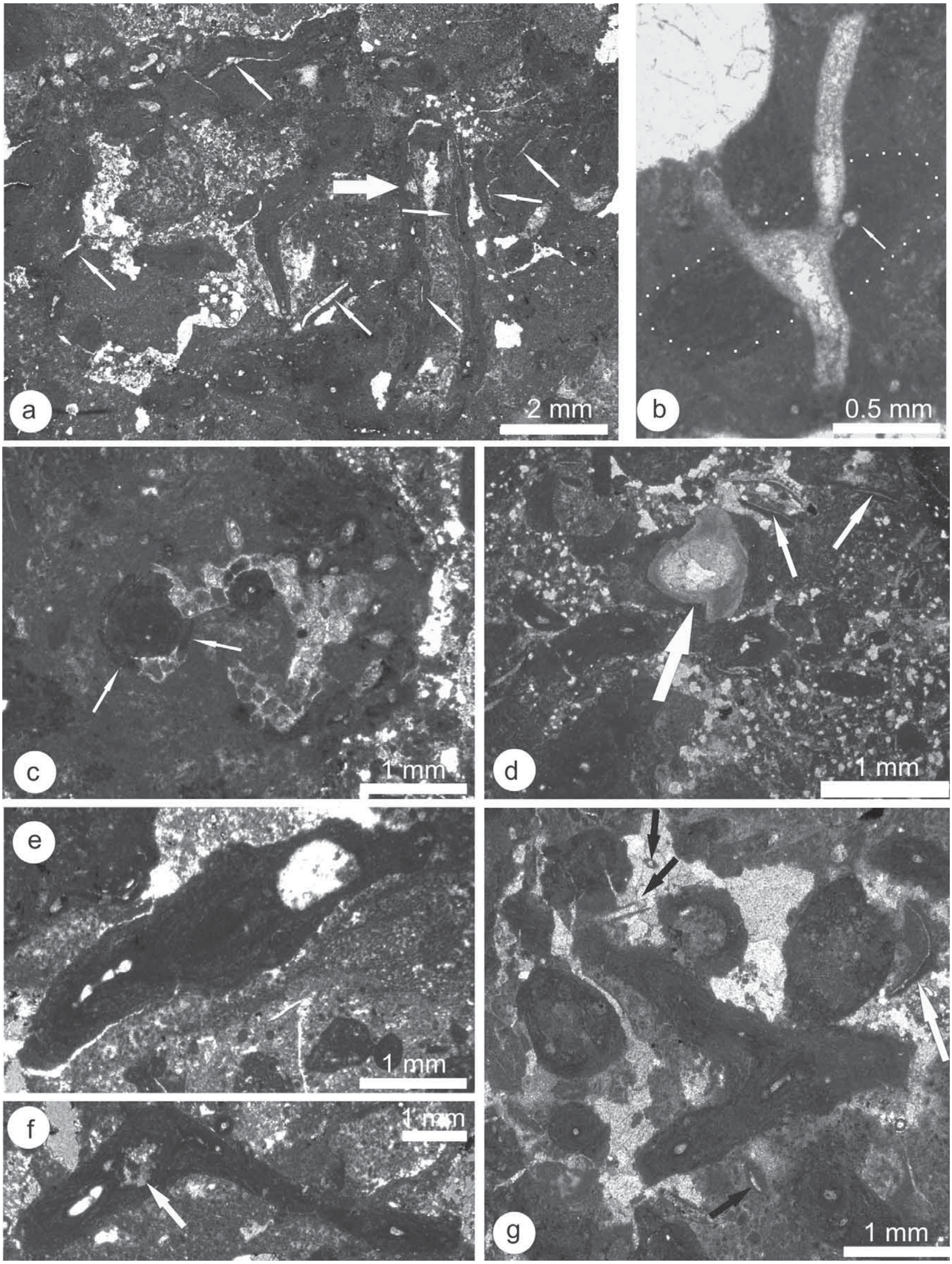
c Cross sections of two *Crescentiella morronensis* forma *morronensis* (CRESCENTI) specimens surrounded by bryozoans. Cyanobacterian crust of *Crescentiella* continues as an encrustation partly on bryozoans (arrows).

d Section through three specimens of *Crescentiella morronensis* forma *morronensis* and encrustation of other large biogenic fragments (large arrow) and small thin shells (small arrows) by identical cyanophycean crusts.

e Longitudinal to oblique section through a specimen of *Crescentiella morronensis* forma *morronensis* (CRESCENTI). The encrustation contains an amphora-like chambered foraminifera and a large (biogenic?) fragment.

f Longitudinal section through a specimen of *Crescentiella morronensis* forma *morronensis* (CRESCENTI). Arrow indicates a biogenic fragment encrusted by the cyanophyceans.

g Several cross and a longitudinal section through a dichothomously "branched" specimen of *Crescentiella morronensis* forma *morronensis* (CRESCENTI) with clearly recognizable oblique laminations. White arrow indicates a shell fragment encrusted by identical cyanophyceans. Black arrows indicate incomplete or non encrusted tubes with the same diameter as the totally encrusted tubes within the *Crescentiella*.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C. morronensis is composed of two parts: a) internal part, usually as amphora-like chambered foraminifera or cylindrical tube, filled with calcite cement, appearing white in transmitted light, and b) a thick and oblique laminated external part, appearing dark in transmitted light.

a) The internal part was a cavity, later filled with calcite cement, representing a cylindrical tube (Fig. 2b; Pl. 4, Fig. b; Pl. 5, Figs. d–f), or usually with amphora-like chambered foraminifera (Figs. 2a–b; Pl. 1, Figs. b, d–e; Pl. 2, Figs. c–d; Pl. 3, Fig. e; Pl. 4, Figs. g–h; Pl. 6, Figs. g–h) or even bioclasts (LANG 1989, p. 32). The chamber length of the foraminifera is variable, some with a short "neck" (Fig. 2a; Pl. 2, Fig. d) and others with a long "neck" (Fig. 2c; Pl. 4, Fig. g) of the amphora-like chambers. The chambered cavity is interpreted as miliolid foraminifera "*Nodophthalmidium*" (WAGENPLAST, 1972; SCHMIDT-KAHLER, 1962; FLÜGEL, 1981; SCHMIDT, 1995), or "*Nubeculinella*" (FRITZ, 1958; LEINFELDER et al., 1996). Further interpretations of different authors are listed in FLÜGEL (1981, p. 127). Because of differences in the size of the internal foraminifera, BRACHERT (1986, p. 243) considers the possibility of a different subspecies. The cylindrical tube is of uncertain affinity.

As illustrated in Pl. 3, Figs. a, d, g, and Pl. 4, Figs. e–f, besides *C. morronensis* other objects in the same microenvironment, e. g. thin shell fragments, may be encrusted partly or completely as oncolites by a dark cortex that is identical to the cortex of *Crescentiella*. Some tubes, that may build the internal cavity of *Crescentiella*, are encrusted only on one side or are incomplete (Fig. 2c; Pl. 4, Fig. d; Pl. 5, Figs. b, e). For instance, PRATT (1955, fig. 45E) illustrated a specimen of "*Tubiphytes*" (= *Crescentiella*) together with a naked and non encrusted tube, naming it "tubular foraminifera".

The wall of the internal cavity (tube or foraminifera) is distinct and totally different from the surrounding "cortex". The boundary of the wall of the internal object (foraminifera or tube) with the external part ("cortex") is sharp, (Pl. 6, Figs. a–e, g; compare also FLÜGEL, 1981, fig. 10). The mineralogical composition of the wall of this tube or foraminifera is Mg-calcite with a microgranular structure (Fig. 3; Pl. 6, Figs. c–d). The thickness of the wall is about 30–40 μm (Pl. 6, Figs. d–e).

b) The external part ("cortex" or "envelope"), is much thicker than the internal part (cavity plus the wall of cavity), and appears dark in transmitted light. The "cortex" appears lighter than the wall of the internal part in transmitted light. The distinct structure of the "cortex" results from its obliquely oriented fine lamination ("*Micropeloidal Struktur*" of SCHMID, 1995, p. 306; or "dense micrite around a foraminiferal tube" of PRATT, 1995, p. 92), visible in thin section and also by SEM (Fig. 2a; Pl. 1, Fig. e; Pl. 2, Figs. c–d; Pl. 3, Figs. e–g; Pl. 4, Fig. h; Pl. 6, Fig. f). The lamination is produced by the different size and orientation of the crystals within the "cortex", as shown by SEM-photomicrographs (Fig. 3; Pl. 6, Fig. f). The lamination appears as concentric lines in cross sections (Pl. 2, Figs. b, e; Pl. 6, Figs. 1–2; see also FLÜGEL, 1981, fig. 2).

Specimens of *Crescentiella morronensis* from epicontinental deposits in southern Germany and other localities are

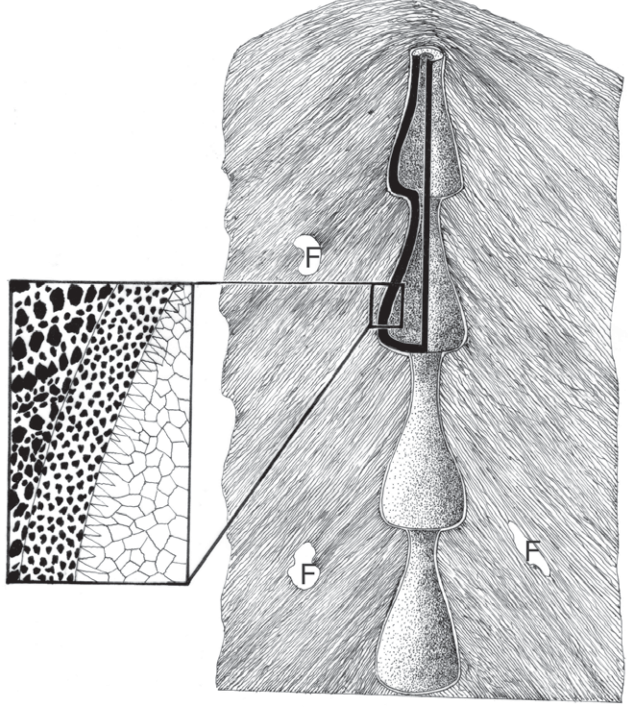

Figure 3: Section through a specimen of *Crescentiella morronensis* forma *morronensis* (CRESCENTI) and the reconstruction of the internal cavity as foraminifera (*Nodophthamidium* or *Nubeculinella*) with four chambers. The magnification shows the wall of the foraminifera and boundaries to the secondary cement of the chamber interiors and the laminated structure of the surrounding "cortex". The wall of the foraminifera is composed of small crystals (microgranular structure), without any orientation of the crystals. The surrounding "cortex" is characterized by the alternation of large and small crystals producing the oblique lamination. The white areas within the "cortex", (F) are inclusions of organisms or inorganic fragments. Because of the reduced thickness of laminae around the aperture of the foraminifera, they appear moderately darker here. Schematic, not to scale.

almost always single individuals, dichotomously "branched" specimens are very rare (Pl. 3, Fig. g). "Colonial" forms, connected with others by the external part ("cortex") are extremely rare (see FLÜGEL, 1981, fig. 3; LEINFELDER et al., 1993, pl. 41, fig. 7; SCHMID, 1995, fig. 13). However, colonial forms are abundant in open marine environments of the Tethyan realm, reaching sizes of several centimetres and are described here as *C. morronensis* forma *colligaris* nov. forma.

Crescentiella morronensis forma *colligaris* nov. forma

(Figs. 4–7; Pl. 4, Fig. a–d; Pl. 5, Fig. a, c, h; Pl. 7, Figs. a–e; Pl. 8, Figs. a–b, d–e)

1995 "***Tubiphytes" morronensis***. Kolonie in massiger Wuchsform – SCHMID, fig. 13 (same specimen as illustrated in LEINFELDER et al., 1996)

1996 "***Tubiphytes***" nodule composed of several specimens – LEINFELDER et al., pl. 41, fig. 7

Derivatio nominis: *colligo* (lat. = bind together). Because of individual specimens that are bound together by cyanophycean crusts.

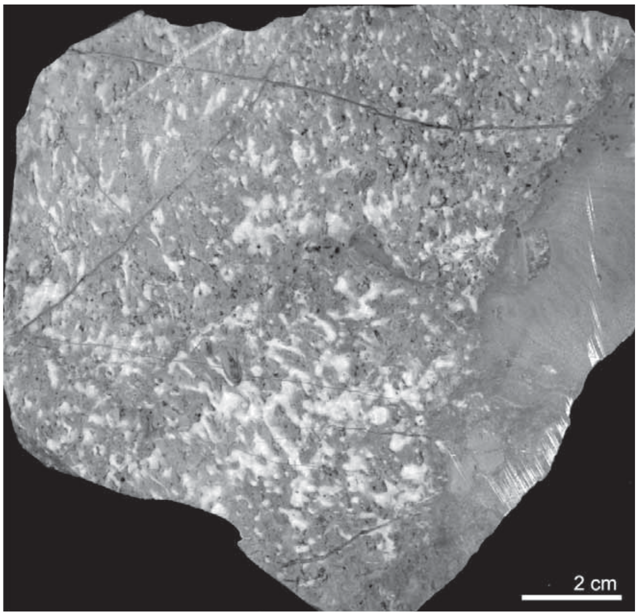

Figure 4: *Crescentiella morronensis* forma *colligaris* nov. forma from the Upper Jurassic (Oxfordian – Kimmeridgian) Esfandiar Formation in the Shotori Mountains, Iran. The grass-like colonies of gregarious and individual specimens are in life position. They are mainly bridged by cyanophycean crusts. Polished slab (for thin section photographs see Pl. 4, Figs. a–d).

Figure 6: *Crescentiella morronensis* forma *colligaris* nov. forma from the Upper Jurassic (Tithonian) of the Madonie Mountains, Sicily. Longitudinal section from the colony shows the growth stages and the kind of bridging of the individual specimens by the cyanophycean crusts. Dark areas are without encrustation or are totally recrystallized areas within the cyanophycean crusts (drawn from Pl. 5, Fig. c).

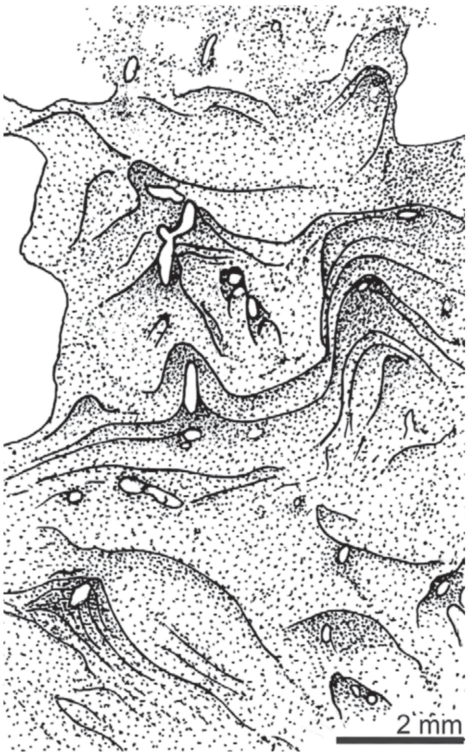

Figure 5: *Crescentiella morronensis* forma *colligaris* nov. forma from the Upper Jurassic (Tithonian) of the Madonie Mountains, Sicily. The longitudinal section shows several tubes as a core, bridged by cyanophycean crusts. The tubes are covered by crust laminae passing through several tubes in a lateral direction. The tubes of the uppermost part are weak and incompletely encrusted and no distinct laminae are recognizable. The distance between the individual cores (tubes) is more than 2 mm. The encrustation around the cores is stronger than between the cores (drawn from Pl. 5, Fig. a).

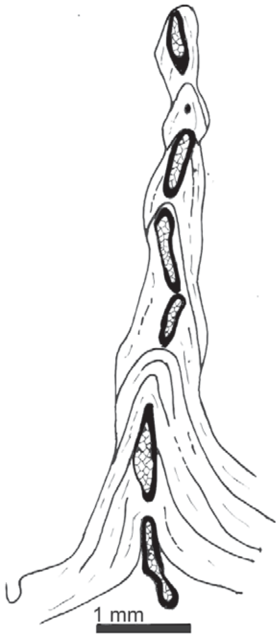

Figure 7: *Crescentiella morronensis* forma *colligaris* nov. forma from the Upper Jurassic (Tithonian) of the Madonie Mountains, Sicily. Section of an individual specimen shows the growth stages and the core, its wall (dark) and the blocky cement within the core (drawn from Pl. 8, Fig. d).

Diagnosis: Colonial form of *Crescentiella morronensis* (CRESCENTI). The individual specimens are connected with each other by bridging of the same cyanophycean crusts forming the "cortex". The distance between individual specimens may be more than ten times the diameter of individual specimens.

PLATE 4

a–d *Crescentiella morronensis* forma *colligaris* nov. forma

Upper Jurassic (Oxfordian-Kimmeridgian) Esfandiar Formation of the Shotori Mountains, NE Iran

a Longitudinal to oblique section through numerous specimens that are connected with others by bridging of cyanophycean crusts. The internal cavities are composed of tubes of uncertain affinity. Some tubes (arrows) are not or incompletely encrusted by cyanophyceans. The polished slab of the same colony is illustrated in Fig. 4.

b Magnification of a "specimen" or "branch" from the same "colony" in fig. a showing the internal cavity composed of cylindrical and non chambered tube of uncertain affinity.

c Longitudinal section exhibiting several tubes or chambered foraminifera as a core encrusted by cyanobacteria. Small arrows indicate a curved tube which is encrusted only on one side. Large arrows show the interruption of *Crescentiella* by a large calcitic object.

d View of two tubes (from the same thin section in fig. a or b) with or without incomplete encrustation by cyanobacteria. Diameter of the tube corresponds to the tubes illustrated in figs. a–b.

e–h *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic "Treuchtlinger Marmor" of southern Germany

e Sections through a few specimens of *Crescentiella morronensis* forma *morronensis* (in the centre and the right side) and numerous oncolites. The cores of the oncolites are fragments of thin shells. There are no differences in encrustation between the oncolites and *Crescentiella*; only the cores are different.

f Section through numerous individual specimens of *Crescentiella morronensis* forma *morronensis* with almost the same size, but without bridging by cyanophyceans as in *C. morronensis* forma *colligaris* nov. forma. White arrows indicate oncolites with encrustation of shell fragments on both or only one side.

g Longitudinal section through a specimen with clearly recognizable amphora-like chambered foraminifera. Compared with the specimen illustrated in Fig. 2a, the height of the amphora-like chambers or the "necks" of the chambers are longer.

h Section through a longitudinal specimen growing on another specimen of *Crescentiella morronensis* forma *morronensis*. The core of the upright growing specimen seems to be broken in the middle.

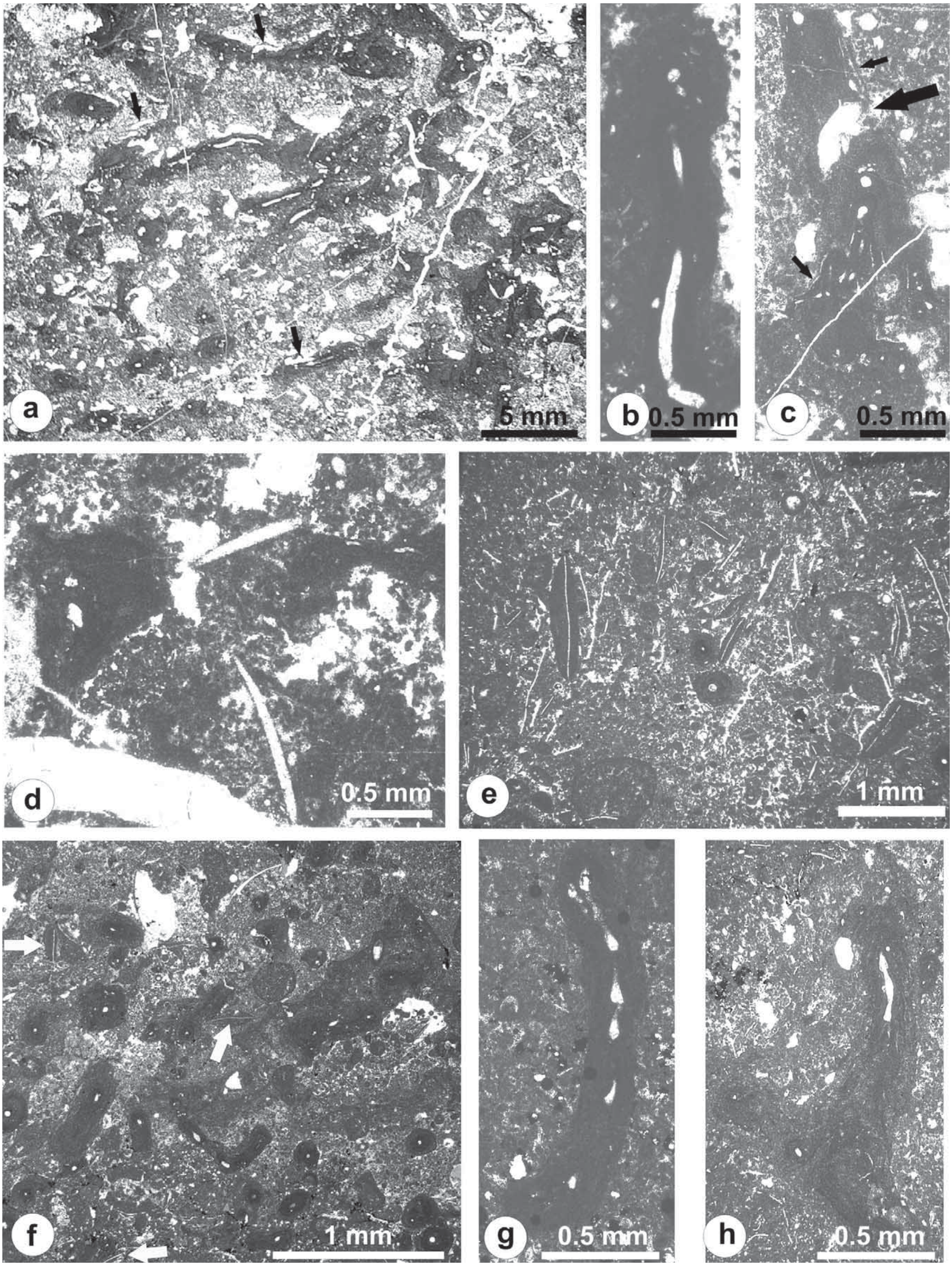
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PLATE 5

a–c *Crescentiella morronensis* forma *colligaris* nov. forma

Upper Jurassic reef limestones of the Madonie Mountains, Sicily

a Longitudinal section through a colony exhibiting several tubes surrounded and bridged by cyanophycean crusts. Differences in contrast indicate the growing stages of the crust building organisms. Black arrows indicate the tubes without or incompletely encrusted by cyanophyceans. For SEM-photomicrographs see Pl. 7. Compare also Fig. 5.

b Section through several specimens. Arrows indicate the tubes without or incomplete encrustation by cyanophyceans. The cores of *Crescentiella* are cylindrical tubes and not chambered foraminifera.

c Longitudinal to oblique section through numerous tubes encrusted and bridged by cyanophyceans. The clearly recognizable laminae are interpreted as growth stages of cyanophyceans and possibly tubes. Arrows indicate the tubes without encrustation, but with the same size as those with encrustation.

d–h *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic reef limestones of the Madonie Mountains, Sicily

d Longitudinal section through a specimen showing the internal tube with thick encrustation on the lower part, but with a thin wall (without encrustation) on the upper part.

e Section through one (or two) tube(s) with weak encrustation on the upper part, but with complete encrustation on the lower part.

f Section through a specimen with at least five different growth stages (or types) of encrustation reflected by the different contrast marked by small arrows. The encrustation of younger stages is weak or incomplete. Within the last two encrustation stages the tube is either lacking or has not been bisected.

g Similar section to fig. f showing at least two growth stages. Arrows indicate the tubes without encrustations.

h Cross section through several individual specimens grown together by the bridging of cyanphyceans. The contrast variation of encrustations indicates the growth stages. Arrows indicate the tubes, still without encrustation.

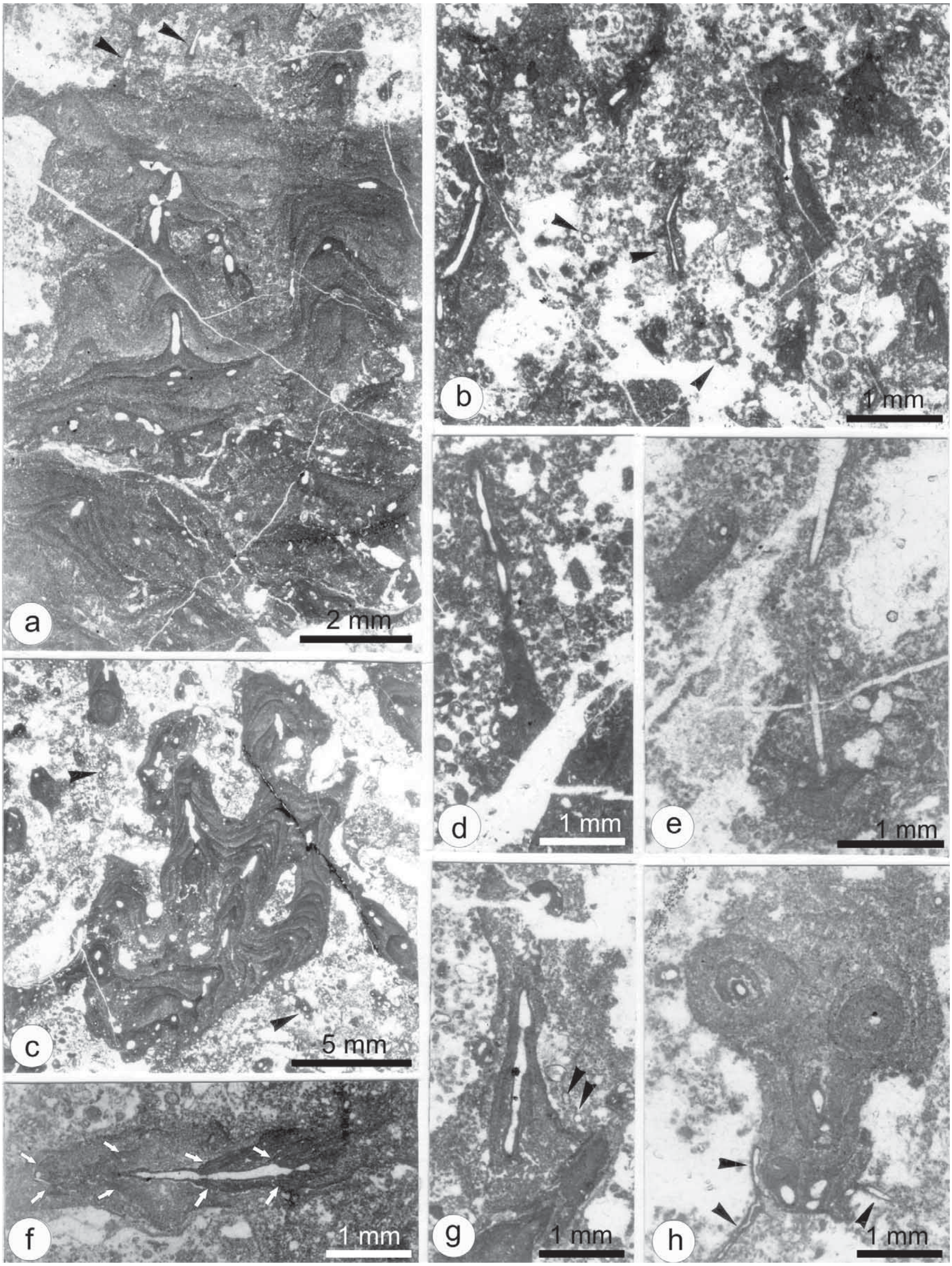
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PLATE 6

a–h SEM-photomicrographs of *Crescentiella morronensis* forma *morronensis* (CRESCENTI)

Upper Jurassic "Treuchtinger Marmor" of southern Gemany.

- **a** Cross section of a specimen showing the small axial core and the thick external part ("cortex" or "envelope"). Laminations in cross section, appearing as concentric laminae, are barely recognizable. For magnification of the axial region see fig. c.
- **b** Similar section to fig. a. The concentric laminae are clearly recognizable. For magnification see fig. d.
- **c** Magnification of fig. a showing the axial part (core) with a large calcite crystal within the internal object (most probably a foraminifera). The wall of the internal object is relatively thick (about 15 μm, see scale) and is composed of small crystals (microcrystalline).
- **d** Magnification from fig. b showing the wall of the axial object (most probably a foraminifera) composed of crystals of approximately 2 μm. The boundary of the wall to the internal calcite cement filling and the outer "cortex" is distinctly sharp. For magnification see fig. e.
- **e** Magnification from fig. d showing the wall of the internal object composed of small and equal sized crystals (microcrystalline structure).
- **f** Longitudinal section of part of a specimen showing the oblique lamination with alternating layers of large and small crystals.
- **g** Magnification from fig. h shows the chambered object (most probably a *Nodophthalmidium* foraminifera), the microcrystalline wall of the foraminifera and the lamination of the surrounding cortex.
- **h** Oblique section through a specimen showing the chambered internal object (most probably a foraminifera) and the poorly recognizable laminated thick cortex. For magnification see fig. g.

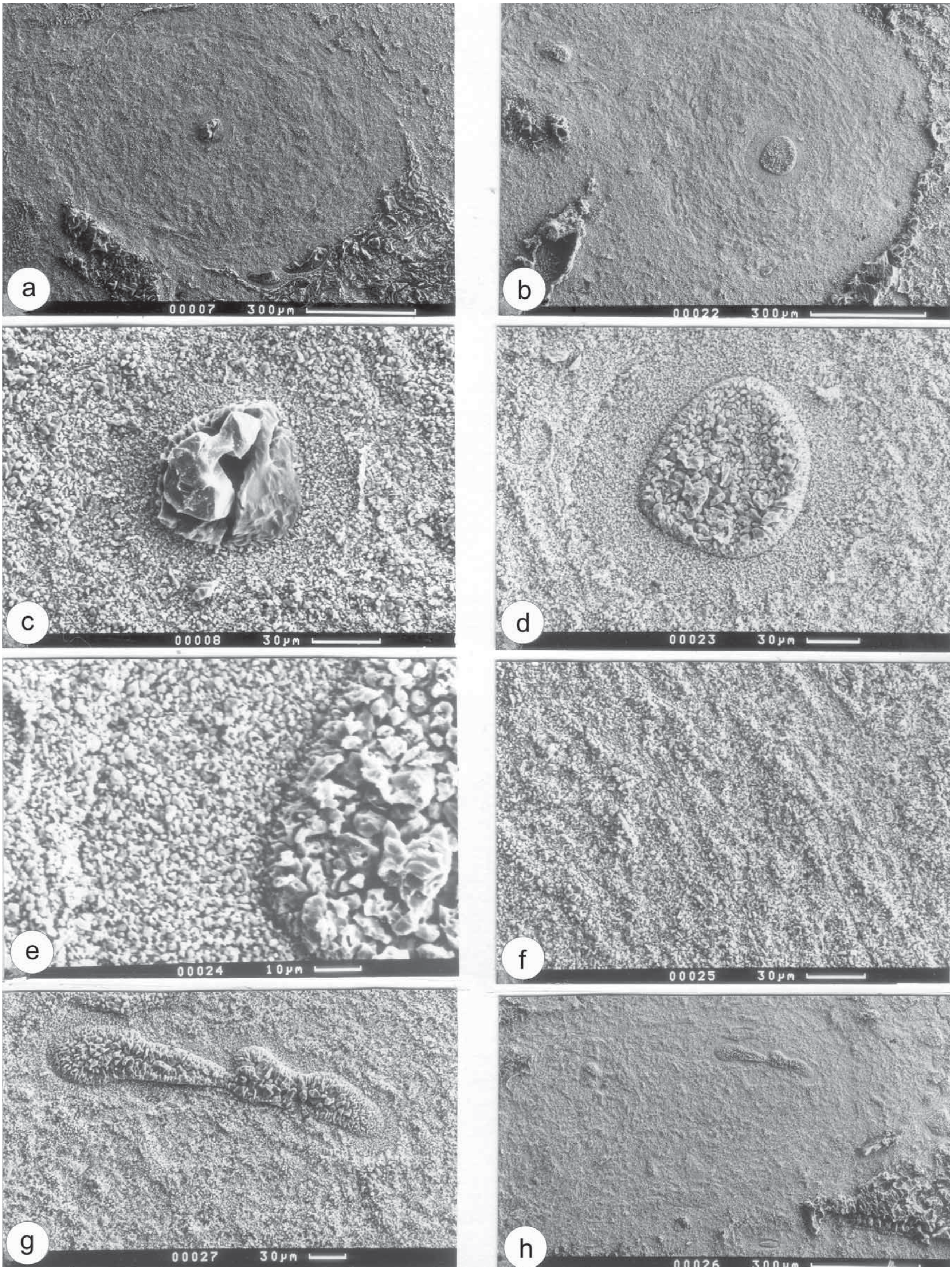
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PLATE 7

a–e SEM-photomicrographs of *Crescentiella morronensis* foma *colligaris* nov. forma

Upper Jurassic reef limestones of the Madonie Mountains, Sicily.

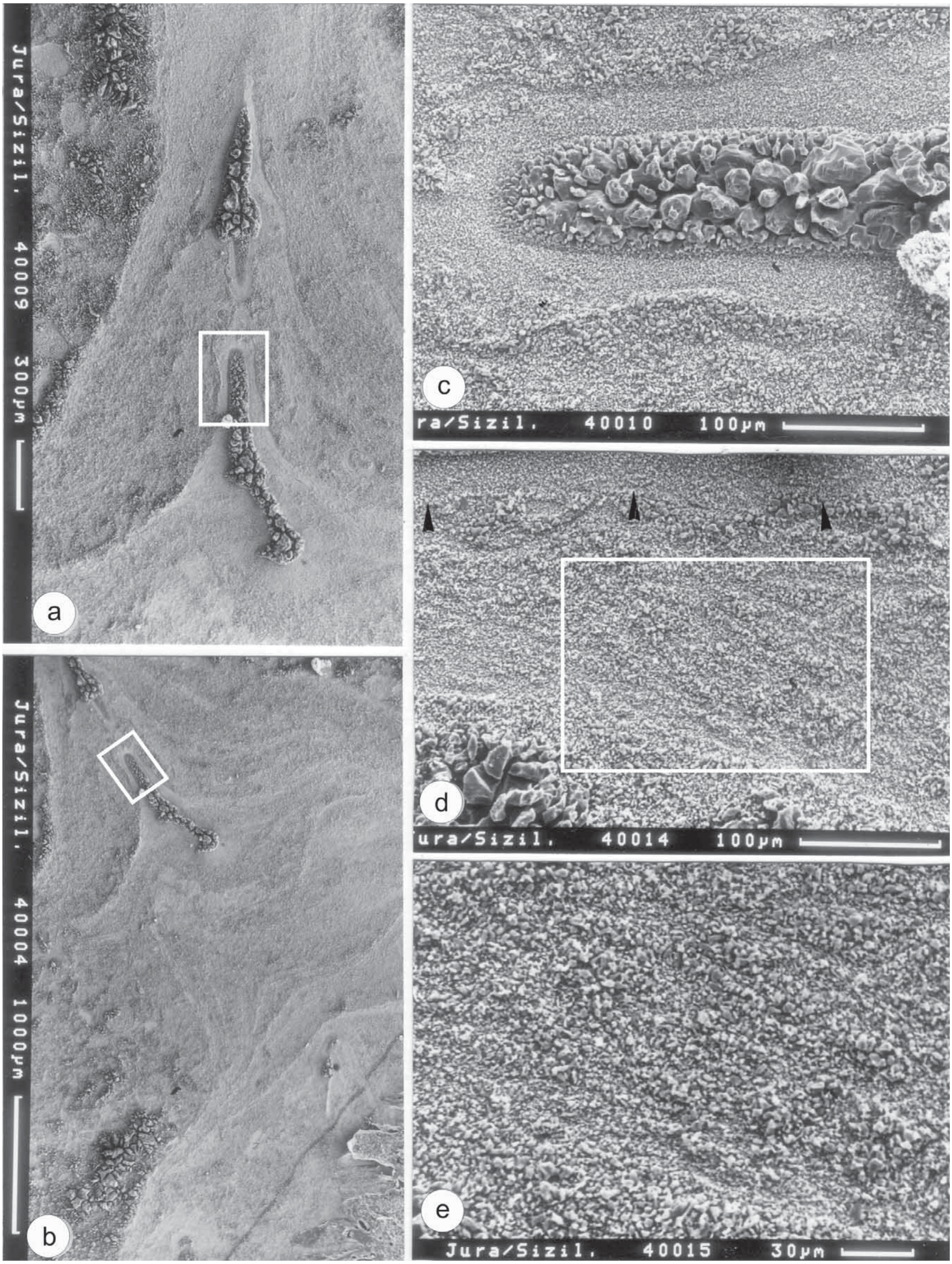
a Magnification from fig. b showing the tube surrounded by cyanophyceans. The different growth stages are easily recognizable. For magnification of the area marked with a white quadrangle see fig. c.

b Magnification from the specimen illustrated in Pl. 8, Fig. d. Section through a "member" of a colonial form showing the different growth stages of cyanophyceans and the internal tube. In the lower part (right in the photograph) there are only the cyanophyceans (for magnifications see figs. a, d–e, for the area marked with white quadrangle see fig. c).

c Magnification from fig. b (or a: quadrangle) shows the microcrystalline wall of the tube (foraminifera?) having a thickness of about 30–40 μm. The crystal sizes of the wall are smaller than that of the cortex.

d Magnification from fig. b shows the tube wall with small crystals (upper part of the photograph, marked with arrows) and the laminated structure of the cortex, produced by the different crystal sizes (compare fig. e).

e Magnification of the area, marked with quadrangle in fig. d showing the individual laminae with different sized crystals.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ura/Sizil. 40014 100µm
e
Jura/Sizil. 40015 30µm

PLATE 8

a–b, d–e *Crescentiella morronensis* forma *colligaris* nov. forma

Upper Jurassic reef limestones of the Madonie Mountains, Sicily

a Magnification of the area marked with a quadrangle in the top of fig. d shows the end stage of the specimen.

b Longitudinal to oblique section shows several internal tubes encrusted and bridged together by cyanophyceans. The colony grows upon another organism.

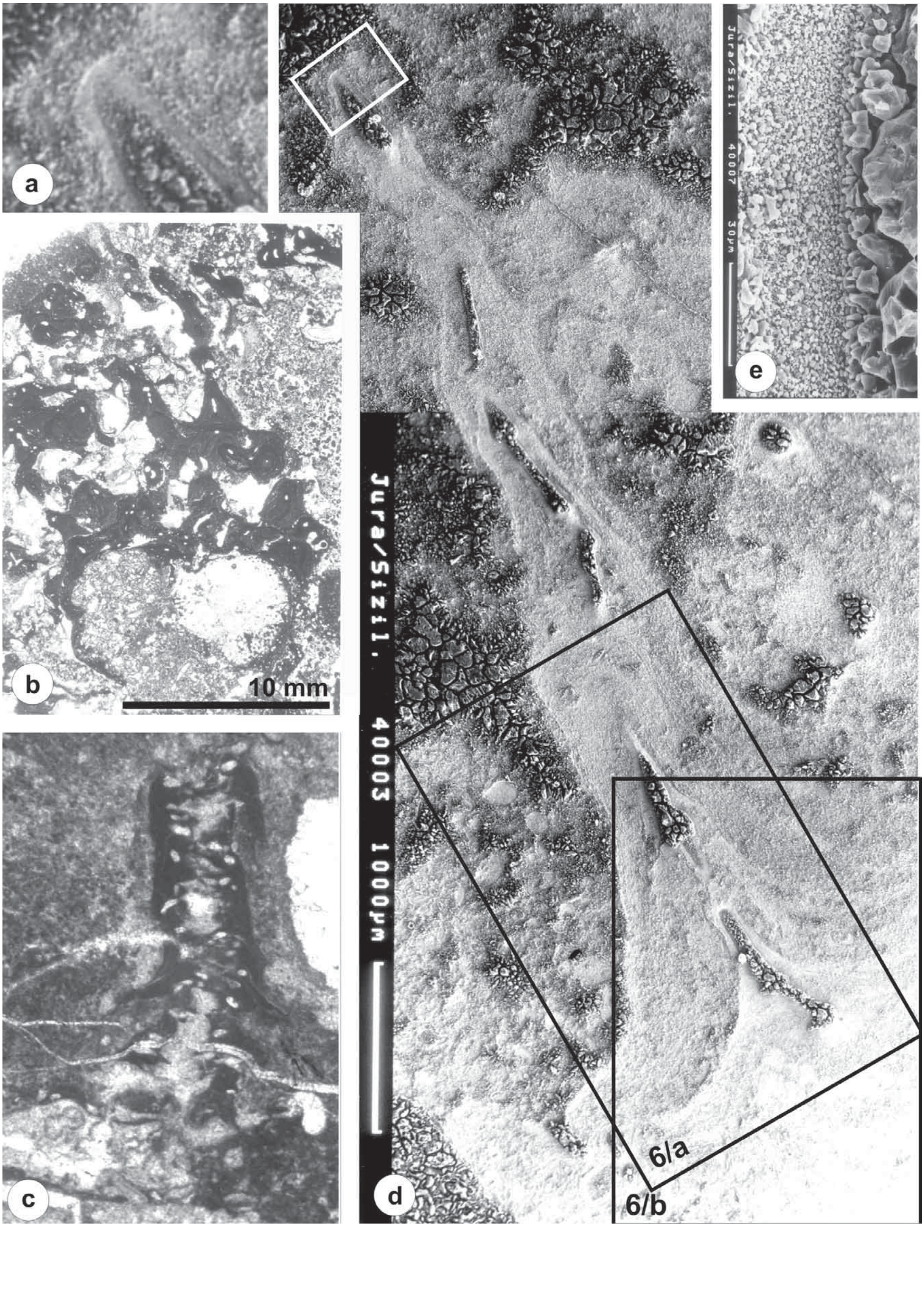
d SEM-microphotograph of a "member" of the same colony illustrated in Pl. 5, Fig. a showing the internal tube and laminated cortex. For magnification of areas marked with a black quadrangle see Pl. 6, with a white quadrangle see fig. a and also fig. e (compare also Fig. 7).

e Magnification of the wall of the specimen illustrated in fig. d showing the small crystals of the tube wall and the large crystals of the tube interior.

c *Labes atramentosa*

Upper Jurassic of the Northern Calcareous Alps

c *Labes atramentosa* ELIASOVA. Longitudinal section showing the coiled tube(s) and the internal cavity filled with cement. This specimen is atypical. Very long, usually low conical forms are prevalent.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Description: The gregarious specimens of this *Crescentiella morronensis* forma *colligaris* are composed of several individual specimens building nodule-like colonies of several centimetres in diameter (up to 10 cm and more). The individual specimens are connected with each other by continuation of the finely laminated cyanophycean crust forming the "cortex" (Figs. 4–6; Pl. 4, Fig. a; Pl. 5, Figs. a, c). The distance of the individual internal cavity, bridged by cyanophyceans, may be several millimetres. The individual layer of the cyanophycean crusts ("cortex") may run down, building "mini-tepee-like" structures (Figs. 5–7; Pl. 7, Figs. a–b; Pl. 8, Fig. d). The "cortex" between two neighbouring specimens is not formed by internal foraminifera or tubes, because a line, produced by growing together is totally lacking. The walls of the internal tube or foraminifera (fine micritic crystals: Pl. 7, Fig. c; Pl. 8, Figs. a, e) and the laminated microstructure of the cortex (Pl. 7, Figs. d–e) are the same as previously described for *C. morronensis* forma *morronensis* (CRESCENTI).

Discussion: According to LEINFELDER et al. (1996) the outer diameter of *Crescentiella* (diameter of "cortex") is dependent mainly on light for the algal symbiosis. According to these authors in water depths of about 5–40 m (inner ramp), the cortex is very thick, in depths of about 40–80 m (middle ramp) the thickness is moderate, while at depths of 80–120 m (outer ramp) the thickness is thin and in depths of more than 120 m the internal foraminifera is without the "cortex" (compare also SCHMID, 1996, fig. 119). This statement of LEINFELDER et al. (1996) was not confirmed by DUPRAZ & STRASSER (2002, p. 463).

According to SCHMID (1995) the "colonial" forms reflect the ecological conditions growing in low energy environments on soft substrates (see also LEINFELDER et al., 1996). This statement can not be confirmed for open marine Upper Jurassic reef environments where both forms of *Crescentiella* ("colonial" and individual) occur together, with corals and other reef builders in the Madonie Mountains, Sicily and the Shotori Mountains, Iran. In both localities the gregarious and "colonial" *Crescentiella*, (reaching a nodular size of up to 10 cm and more), are abundant (Fig. 4). The core (axial cavity) of such *Crescentiella* are usually tubes (Pl. 4, Figs. a, d; Pl. 5, Figs. a–c), chambered foraminifera are usually in individual forms (Pl. 5, Figs. f–g). SEM-investigations of both types of *Crescentiella* from Upper Jurassic epicontinental carbonates (southern Germany: Pl. 6, Figs. a–h), and open marine Upper Jurassic deposits (Sicily: Pl. 7, Figs. a–e), show the same microstructure of the wall of the internal core (tube or foraminifera) and the surrounding crust ("cortex"). We found a similar microstructure of both environmental types from the Upper Jurassic of Sicily and southern Germany. Also there are no differences between the wall structure of the cylindrical tube and the chambered cavity (foraminifera).

Occurrence: The stratigraphic range of *Crescentiella morronensis* (CRESCENTI) is given as being from the Middle Jurassic to the Upper Cretaceous, or possibly the Palaeocene, by SCHMID (1996, p. 189). The Late Cretaceous or even Palaeocene occurrences are questionable and cannot be confirmed here. It is an abundant fossil in Upper Jurassic shallow water carbonates, particularly in epocontinental environments of the Tethyan realm. It occurs throughout the Cretaceous deposits, but not as abundant as in the Jurassic (MOUSSAVIAN, 1992). *Crescentiella* is known from numerous Upper Jurassic localities of northwest and central Tethys (see synonymy). SCHEIBNER & REIJMER (1999) reported its occurrence in the Lower Jurassic of Morocco.

Interpretation: The systematic position of *Tubiphytes* Maslov is much disputed in the literature. It is variously interpreted as: Cyanophyceans (MASLOV, 1956; CRONEIS & TOOMEY, 1965; FLÜGEL & FLÜGEL-KAHLER, 1980), Rhodophyceans (FLÜGEL, 1966; KOCHANSKY-DEVIDÉ, 1970); algae of uncertain systematic position (JOHNSON, 1963; HOMANN, 1972), sponges (OTT, in KRAUS & OTT, 1968; RIDING & GUO, 1992; WANG et al., 1994) and Hydrozoans (RIGBY, 1958). VACHARD et al. (2001) interpreted *Tubiphytes* Maslov "as a free cyanobacterium or alga developed symbiosis with other organisms". BABCOCK (1986, p. 13) interpreted *Tubiphytes* as problematicum "that may belong to an extinct phylum".

PAYNE et al. (2006) described the abundance of "*Tubiphytes*" in the Middle Triassic (Anisian) reef complex from Guizhou Province, southwest China. The authors illustrated numerous specimens of a "*Tubiphytes* framework", and in fig. 18 several cross sections of "*Tubiphytes*" with the "presence of small spore-like structures (~50–75 μm diameter) contained within larger spheres (~500 μm diameter)". The small spheres are interpreted as "algal sporangia" by PAYNE et al. (2006) and consequently "*Tubiphytes*" as alga. Such small spheres are also described in *Anisophytes aggtelekensis* (SCHLOZ) by SENOWBARI-DARYAN & VELLEDITS (2007). "*Tubiphytes*" of PAYNE et al. (2006) and also those of LEHRMANN et al. (1998) from the same Province can not be assigned to *Tubiphytes sensu* MASLOV (1956). Discussion about the assignment of such "*Tubiphytes*" is given by SENOWBARI-DARYAN & VELLEDITS (2007) and a revision of Triassic *Tubiphytes* is in preparation by Senowbari-Daryan.

The systematic position of *Crescentiella morronensis* (CRESCENTI) – like *Tubiphytes* or similar organisms – is also uncertain. For interpretation of the whole organism (internal cavity and surrounding "cortex") as favoured by BERNIER (1984), for "microoncolites" see DRAGASTAN (1969), MEYER (1975), KOTT (1989) and FLÜGEL & STEIGER (1981). Oncolites are defined as the encrustation of biogenic or abiogenic fragments by other organisms, mainly cyanobacteria (for a detailed definition see FLÜGEL, 2004, p. 100). The interpretation of MEYER (1977), FLÜGEL (1981), and LEINFELDER et al. (1993), that the whole organism represents a symbiosis between foraminifera and cyanobacteria or encrusting of foraminifera by algae or cyanobacteria during the life time of the internal object, is different to the interpretation as microoncolites. This definition does not justify the classification of *Crescentiella* as a "special oncolite".

SCHMID (1995) recognized the laminated structure of the "cortex" naming it as "micropeloidal". Based on such "micropeloidal" structure of the "cortex" SCHMID (1995) excluded a cyanophycean nature for the formation of the "cortex". Another reason for Schmid to exclude such an interpretation of the "cortex" was that no other components except *Crescentiella morronensis* (CRESCENTI) became encrusted. Our observations contrast Schmid´s statement (see below).

In summary, SCHMID (1995) interpreted *Crescentiella morronensis* as the symbiosis of foraminifera with endobiotic algae (possibly Dinophyceans, Rhodophyceans or Cyanophyceans) which are responsible for the formation of the external wall ("cortex").

The following criteria are contraindicative to the statement of SCHMID (1995):

1. The SEM photomicrographs of the "cortex" in both individual and colonial forms of *Crescentiella* (Fig. 3; Pl. 6, Figs. a–b, f; Pl. 7, Figs. d–e) show that the "Mikropeloide" (micropeloids) of SCHMID (1995) in reality represent large crystals alternating with small crystals, thereby producing the finely laminated structure of the "cortex". We interpret the large crystals as being abiogenic, the small crystals as biogenic, as produced by cyanophyceans.

2. We can not confirm the statement of SCHMID (1995, p. 307), that "*Außerdem umhüllt die mutmaßliche "Cyanobakterie" nie etwas anders als* "T." morronensis, *wie etwa Bioklasten"* (in addition the presumable cyanobacteria never encrusted objects other than "*T.*" *morronensis*, e.g. bioclasts). As shown in our material (Pl. 1, Figs. d, f–i; Pl. 2, Figs. a–f; Pl. 3, Figs. a–g; Pl. 4, Fig. e), there are not only encrustations of foraminifera by cyanophyceans, but also of other biogenic fragments, such shell fragments, sponges, bryozoans, echinoderm remains, etc. by the same or similar cyanophycean activity. Encrustation of tubes of uncertain taxonomic position is also abundant. Fragments of thin shells are also mostly encrusted by cyanophyceans, building the microoncolites of MAYER (1975) and KOTT (1989). The "microoncolite" interpretation (DRAGASTAN, 1969; KOTT, 1989) of *Crescentiella morronenis* was denied by SCHMID (1995), because the cyanobacteria do not surround the apertures of foraminifera and it (cyanobacterium) does not occur alone. In fact, the cyanobacteria do not occur alone or almost usually with foraminifera or tubes, because as a symbiont they need a substrate to grow on. Foraminiferal tubes and shells serve as a substrate for the encrustation of cyanobacteria. Foraminifera particularly seem to be the most favoured substrate. Fig. 8 shows the possibile growth process between the chambered foraminifera and the encrusted cyanophyceans.

3. Also inclusion of biogenic and abiogenic components (e. g. Coccolithophorids, see FLÜGEL, 1981, fig. 8; possibly "Calcispheres", see VOLK et al., 2001, pl. 13, fig. 1; different biogenic components, see Fig. 2.b; Pl. 1, Figs. d–h; and foraminifera, Pl. 1, Fig. i) embedded within the "cortex", do not support Schmid´s interpretation of the "cortex" as the external wall of the foraminifera.

4. We observed not only the inclusion (or agglutination in foraminiferal terminology) of detrital bioclasts but also encrusting foraminifera between the micritic sheets of the "cortex" obviously reflecting the life position during the time of laminae formation (Pl. 1, Fig. i).

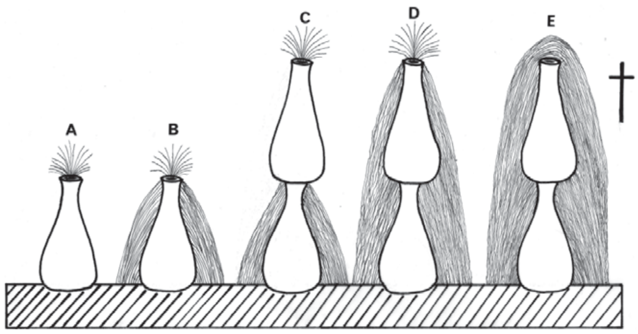

Figure 8: Possible formation process of *Crescentiella morronensis* forma *morronensis* (CRESCENTI) by interaction between the two symbionts (foraminifera and cyanophyceans). After formation of the first chamber of the foraminifera and its encrustation by the cyanophyceans, the formation of the second chamber and its encrustation follows. This process continues to build *Crescentiella*, composed of multichambered foraminifera as a core and a surrounding crust produced by cyanophyceans. After the death of the foraminifera the whole test is encrusted by the cyanophyceans. Schematic, not to scale.

5. The extremely thick "cortex" (Pl. 5, Figs. a, c; Pl. 7, Figs. a–b; Pl. 8, Fig. d; compare Figs. 5–6) and its strongly downward turning do not support its formation by the internal organism (foraminifera or tube).

6. The fine lamination of the "cortex" indicates that the individual laminae were formed successively one after the other. Such permanent formation of the wall also argues against its formation by the internal foraminifera, tube or other object.

7. The encrusting of different objects (foraminifera, tubes, shells etc.) by a thick crust ("cortex") in the same environment, as shown e.g. in Pl. 4, Figs. e–f, is in contrast to the interpretation of the whole organism as a foraminifera as done by SCHMID (1995). Instead, these criteria support the participation of a second organism for the formation of the cortex of *Crescentiella*. This organism is of a cyanophycean nature.

The complete encrustation of tubes or shells as an internal part of *Crescentiella* supports the interaction of different objects and cyanophyceans. The oblique lamination of the "cortex", produced by different crystal sizes, does not indicate the formation of different layers at the same time, but successively. This observation also supports the interpretation of *Crescentiella* as the interaction of two different organisms: foraminifera, tube or shells serving as a core or substrate for cyanobacteria. The crusts of cyanobacteria serve as a stabiliser and support the internal object in a growth position and enable its successive growth (see Fig. 8). We interpret the cortex of *Crescentiella morronensis* as crusts of cyanophyceans and the whole body as representing a symbiosis between a foraminifera or indeterminable tubes and cyanophyceans. Foraminifera, tubes or other objects serve as a substrate for the growth of cyanophyceans. The crust of cyanophyceans stabilizes and enables the further growth of the foraminifera or tube of uncertain systematic position.

***Labes atramentosa* ELIASOVA, 1986**
(Pl. 8, Fig. c)

1986 *Labes atramentosa* n. gen., n. sp. – ELIASOVA, p. 110, pl. 1–2, pl. 2 (synonymy)
1986 „Nubeculinellen-Riffchen" – BRACHERT, pl. 42, fig. 1
1996 "*Tubiphytes*"-Kamin (*Tubiphytes* chimney) – SCHMID, figs. 102–112
1996 "*Tubiphytes*" *morronensis* colony – LEINFELDER et al., fig. 4
2005 *Labes atramentosa* ELIASOVA – SCHLAGINTWEIT et al., p. 75, fig. 69a., b, fig. 70a

Remarks: Because this organism is mentioned in the literature as "Nubecullinellen-Riffchen" or as "*Tubiphytes*"-Kamin (chimney), it should be described here briefly and the differences to *Crescentiella* emphasized. The problematic distinction between the former "*Tubiphytes*" *morronensis* and *Labes atramentosa* is best reflected in the literature by terms such as "*Tubiphytes* like structure, described as *Labes atramentosa*" (UTA & BUCUR, 2003, pl. 4, fig. 4). SCHMID (1996) illustrated material from the Stramberk Limestones, the type formation of *Labes atramentosa*, as "*Tubiphytes* chimneys" without commenting on the latter taxon.

Description: The aggregates of this cylindrical to mostly conical shaped organism reach heights of up to 5 mm, with a basal diameter of up to 3 mm. It is characterized by an internal cavity of up to 0–8 mm in diameter surrounded by a micritic "cortex" containing the tube(s) of about 0.09 mm to 0.155 mm in diameter. The transverse to oblique sections of the tubes are arranged mostly between lateral protrusions of the central tube, and are set rather close to it. In contrast to *Crescentiella*, the cortex of *Labes* is made up of dense micritic laminae separated by very thin darker lines, (see SCHLAGINTWEIT et al., 2005, fig. 70a) also lacking incorporated bioclasts. The tube (or several tubes) coil around an internal cavity similar to *Isnella* described recently from Ladinian – Carnian reef limestones of several localities in the Tethyan realm by SENOWBARI-DARYAN (2007). As previously mentioned, the "central tube" shows lateral protrusions or spines and in some specimens reaches higher than the surrounding "cortex", suggesting a biogenic origin (perhaps sponges), in contradiction to *Isnella*, which is assumed to lack a central organism. Therefore *Labes* can be interpreted as a real epibiont. A detailed description of Late Jurassic *Isnella*- and *Labes*-type microfossils and their interpretation is in preparation by Schlagintweit.

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REFERENCES

ABATE, B., RENDA, P. & TRAMUTOLI, M. (1988): Note illustrative della carta geologica dei monti di Termini imerese e delle Madonie occidentali (Sicilia centro-settentrionale). – Mem. Soc. Geol. Ital., 41, 475–505.

ALTINER, D. (1991): Microfossil biostratigraphy (mainly foraminifera) of the Jurassic – Lower Cretaceous carbonate succession in northwestern Anatolia (Turkey). – Geol. Rom., 27, 167–213.

BABCOCK, J.A. (1986): The puzzle of alga-like problematica, or rummaging around in the algal wastebasket. – In: HOFFMAN, A. & NITECKI, M.H. (eds.): Problematic Fossil Taxa. Oxford University Press, New York – Clarendon Press, Oxford, 12–26.

BARATTOLO, F. (1991): Mesozoic and Cenozoic Marine Benthic Calcareous Algae with Particular Regard to Mesozoic. – In: RIDING, R. (ed.): Calcareous Algae. Springer, 505–540.

BARATTOLO, F. & PUGLIESE, A. (1987): Il Mesozoico dell´Isola di Capri. – Academia Pontaniana, 8, 1–172.

BERNIER, P. (1984): Les formations carbonatées du Kimmeridgien et du Portlandien dans le Jura méridional. Stratigraphie, micropaleontologie, sédimentologie. Documents des Laboratoires de Géologie Lyon, 92, 1–803.

BLOMEIER, D.P.G. & REIJMER, J.J.G. (1999): Drowning of a Lower Jurassic Carbonate Plattform: Jbel Bou Dahar, High Atlas, Morocco. – Facies, 41, 81–110.

BRACHERT, TH.C. (1986): Kontinuierliche und diskontinuierliche Sedimentation im süddeutschen Oberjura (unteres Kimmeridge; Ludwag/Oberfranken, Nördliche Frankenalb). – Facies, 15, 233–284.

BRACHERT, TH.C. (1992): Sequence Stratigraphy and Paleo-Oceanography of an Open-marine Mixed Carbonate/Siliciclastic Succession (Late Jurassic, Southern Germany). – Facies, 27, 191–216.

BUCUR, I.I. (1978): Microfaciesurile calcarelor albe din partea nordică a masivului Piatra Craiului. Consideraţii biostratigrafice. – Dări de seamă ale şedinţelor, Institutul de Geologie şi Geofizică, 64/4(stratigrafie)(1976–1977), 89–105.

BUCUR, I.I. & ONAC, P.B. (2000): New data concerning the age of the Mesozoic limestones from Scărişoara (Bihor Mountains). – Studia Universitatis Babeş-Bolyai, Geologia, 45/2, 13–20.

BUCUR, I.I., SENOWBARI-DARYAN, B. & ABATE, B. (1996): Remarks on some foraminifera from the Upper Jurassic (Tithonian) reef limestone of Madonie Mountains (Sicily). – Boll. Soc. Paleont. Ital., 35/1, 65–80.

BURZA, D.-F. & DRAGASTAN, O. (2003): Biostratigraphic data concerning the Upper Jurassic – Lower Cretaceous Limestones from the Pojoga area (Southern Apuseni Mts.). – Ann. Univ. Bucuresti, Geol. Specil. Publ., 1, 129–144.

CARRAS, N. & GEORGALA, D. (1998): Upper Jurassic to Lower Cretaceous Carbonate Facies of African Affinities in a Peri-European Area: Chalkidiki Peninsula, Greece. – Facies, 38, 153–164.

CATALANO, R., D´ARGENIO, B. & DE CASTRO, P. (1974): Rripporti tra le facies di piattaforma carbonatica del Giurasico e del Cretacico delle Madonie orientali (Sicilia). – Boll. Soc. Natur. Napoli, 83, 1–37.

CHIOCCHINI, M & MANCHINELLI, A. (1979): *Protopeneroplis trochangulata* Septfontaine, 1974 (Foraminiferida) nel Cretaceo Inferiore dell´area del Gran Sasso D´Italia (Abruzzo). – Studi Geol. Camerti, 5, 17–38.

CRESCENTI, U. (1969): Biostratigrafia delle facies mesozoiche dell'Appennino centrale. Corelazioni. – Geol. Rom., 8, 15–40.

CRONEIS, C. & TOOMEY, D.F. (1965): Gunsight (Virgilian) Wewokellid sponges and their depositional environment. – J. Paleont., 39/1, 1–16.

DRAGASTAN, O. (1969): "Micro-oncolithes" dans le Jurassique de la valleé du Bicaz (Carpates orientales, Roumanie). – Bull. Soc. Geól. France, 11/5, 655–659.

DRAGASTAN, O. (1975): Upper Jurassic and Lower Cretaceous microfacies from the Bicaz Valley bassin (East Carpathians). – Mém. Inst. Géol. Géophy., 21,1–87.

DRAGASTAN, O., GIELISCH, H., RICHTER, D.K., GREWER, T., KAZIUR, TH., KUBE, B. & RADUSCH, CH. (1994): Jurassic algae of the Perachora-Peninsula: Biostratigraphical and paleontological implications. – Beitr. Paläont.Wien, 19, 49–81.

DRAGASTAN, O. & RICHTER, D.K. (2003): Calcareous algae and foraminifers from Neocomian Limestones of Methana Peninsula, Asprovouni Mts. (Greece) and from south Dobrogea (Romania). – Ann. Univ. Bucuresti, Geol. Spec. Publ., 1, 57–128.

DUPRAZ, CH. & STRASSER, A. (1999): Microbialites and micro-encrusters in shallow coral bioherms (Middle to Late Oxfordian, Swiss Jura Mountains). – Facies, 40, 101–130.

DUPRAZ, CH. & STRASSER, A. (2002): Nutritional Modes in Coral-Microbialite Reefs (Jurassic, Oxfordian, Switzerland): Evolution of Trophic Structure as a Response to Environmental Change. – Palaios, 17/5, 449–471.

ELIAS, M.K. (1959): Facies of Upper Carboniferous and Artinskian deposits in the Sterlitamak-Ishimvaevo region of the Pre-Urals, based on a study of fussulinids. – Internat. Geol. Rev., 1/2, 39–88.

ELIÁŠOVÁ, H. (1986): A new binding microorganism of shallow-water limestones. – Vést. Ustř. Úst. Geol., 61, 109–111.

FLÜGEL, E. (1966): Algen aus dem Perm der Kanischen Alpen. – Carinthia II, Sonderheft 25, 1–76.

FLÜGEL, E. (1981): „Tubiphyten" aus dem fränkischen Malm. – Geol. Bl. NO-Bayern, 31/1–4, 126–142.

FLÜGEL, E. (2004): Microfacies of Carbonate Rocks, Analysis, Interpretation and Application. – Springer, 976 p.

FLÜGEL, E. & FLÜGEL-KAHLER, E. (1980): Algen aus den Kalken der Trogkofel-Schichten der Karnischen Alpen. – Carinthia II, 36, 113–182.

FLÜGEL, E. & FLÜGEL-KAHLER, E. (1997): Der rote Korallenkalk in der Hethiter-Mauer von Bogazköy (Anatolien): Mikrofazies und Herkunft. – Geol. Bl. NO-Bayern, 47/1–4, 321–338.

FLÜGEL, E., RIEDEL, P. & SENOWBARI-DARYAN, B. (1988): *Plexoramea cerebriformis* Mello, ein häufiges Mikrofossil in triadischen Flachwasserkalken: Alge oder Pilz?. – Mitt. Ges. Geol. Bergbaustud. Österr., 34/35, 263–277.

FLÜGEL, E. & STEIGER, T. (1981): An Upper Jurassic Sponge-Algal buildup from the Northern Frankenalb, West Germany. – SEPM Spec. Publ., 30, 371–397.

FRITZ, G.K. (1958): Schwammstotzen, Tuberolithe und Schuttbreccien im Weißen Jura der Schwäbischen Alb. – Arb. Geol. Paläont. Inst. Stuttgart, N.F., 13, 1–113.

FÜRSICH, F.T., WILMSEN, M., SEYED-EMAMI, K., SCHAIRER, G. & MAJIDIFARD, M.R. (2003a): Platform-Basin Transport of a Middle to Late Jurassic Large-Scale Carbonate Platform System (Shotori Mountains, Tabas Area, East-central Iran). – Facies, 48, 171–198.

FÜRSICH, F.T., WILMSEN, M., SEYED-EMAMI, K. & MAJIDIFARD, M.R. (2003b): Evidence of Synsedimentary Tectonics in the Northern Tabas Block, East-Central Iran: The Callovian (Middle Jurassic) Sikhor Formation. – Facies, 48, 151–170.

GAWLICK, H.J. & SCHLAGINTWEIT, F. (2006): Berriasian drowning of the Plassen carbonate platform at the type-locality and its bearing on the early Eoalpine orogenic dynamics in the Northern Calcareous Alps (Austria). – Inter. J. Earth Sci. (Geol. Rundschau), 95, 451–462.

GAWLICK, H.-J., SCHLAGINTWEIT, F., EBLI, O. & SUZUKI, H. (2004): Die Plassen-Formation des Krahstein (Steirisches Salzkammergut, Österreich) und ihre Unterlagerung: neue Daten zur Fazies, Biostratigraphie und Sedimentologie. – Zbl. Geol. Paläont. Teil 1 (2003), 3/4, 295–334.

GAWLICK, H.J. & SCHLAGINTWEIT, F. & MISSONI, S. (2005): Die Barmsteinkalke der Typlokalität nordwestlich Hallein (hohes Tithonium bis tieferes Berriasium; Salzburger Kalkalpen) – Sedimentologie, Mikrofazies, Stratigraphie und Mikropaläontologie: neue Aspekte zur Interpretation der Entwicklungsgeschichte der Ober – Jura Karbonatplattform und der tektonischen Interpretation der Hallstätter Zone von Hallein – Bad Dürrenberg. – N. Jb. Geol. Paläont. Abh., 236/3, 351–421.

GAWLICK, H.J., SUZUKI, H. & SCHLAGINTWEIT, F. (2006): Die Ober-Trias- und Jura-Sedimentgesteine der Sarsteinalm und ihre Bedeutung für die tektonische Gliederung des Dachstein-Blockes (Salzkammergut, Nördliche Kalkalpen, Österreich). – N. Jb. Geol. Paläont. Abh, 239/1, 101–160.

GWINNER, M.P. (1971): Carbonate rocks of the Upper Jurassic in SW-Germany. – In: MÜLLER, G. (ed): Sedimentology of parts of Central Europe. Guidebook 8th Int. Sediment. Congr., 193–207.

HELM, C. (2005): Riffe und fazielle Entwicklung der florigemma-Bank (Korallenoolith, Oxfordium) im Süntel und östlichen Wesergebirge (NW-Deutschland). – Geol. Beitr. Hannover, 7, 3–339.

HELM, C & SCHÜLKE, I. (2001): „*Tubiphytes*" *morronensis* aus der Malm-Gruppe (Korallenoolith, Niedersächsisches Becken) des Ith (Nordwest-Deutschland). – Ber. Naturhist. Ges. Hannover, 143, 99–107.

HENSSEL, K., SCHMID, D.U. & LEINFELDER, R.R. (2002): Computergestützte 3D-Rekonstruktionen in der Paläontologie anhand von Serienschnitten. – Mathematische Geologie, 6, 131–142.

HOMANN, W. (1972): Unter- und tief-mittelpermische Kalkalgen aus den Rattendorfer Schichten, dem Trogkofel-Kalk und dem Treßdorfer Kalk der Karnischen Alpen (Österreich). – Senckenbergiana Lethaea, 53/3–4, 135–313.

HÜSSNER, H. (1985): Jurassische Karbonate des westlichen Hohen Atlas (Marokko): Mikrofaziesanalyse und plattentektonischer Rahmen. – Facies, 12, 141–218.

JOHNSON, J.H. (1963): Pennsylvanian and Permian algae. – Colorado Schoool Mines, Quart., 58/3, 1–211.

KEUPP, H., KOCH, R. & LEINFELDER, R. (1990): Steuerungsprozesse der Entwicklung von Oberjura-Spongiolithen Süddeutschlands: Kenntnisstand, Probleme und Perspektiven. – Facies, 23, 141–174.

KOCH, R., SENOWBARI-DARYAN, B. & STRAUSS, H. (1994): The Late Jurassic ´Massenkalk Fazies´ of Southern Germany. Calcareous Sand Piles rather than organic Reefs. – Facies, 31, 179–208.

KOCHANSKY-DEVIDÉ, V. (1970): Permische Mikrofossilien der Westkarawanken. – Geologija, 13, 174–256.

KOTT, R. (1989): Fazies und Geochemie des Treuchtliner Marmors (Unter- und Mittel-Kimmeridge, Südliche Frankenalb). – Berliner geowiss. Abh., A, 111, 1–115.

KRAJEWSKI, M. (2000): Lithology and morphology of Upper Jurassic carbonate buildups in the Będkowska Valley, Kraków region, Southern Poland. – Ann. Soc. Geol. Polon., 70, 151–163.

KRAJEWSKI, M. (2001): Upper Jurassic chalky limestones in the Zakrzówek Horst, Kraków, Kraków-Wieluń Upland (South Poland). – Ann. Soc. Geol. Polon., 71, 43–51.

KRAUS, O. & OTT, E. (1968): Eine ladinische Riff-Fauna im Dobratsch-Gipfelkalk (Kärnten, Österreich) und Bemerkungen zum Faziesvergleich von Nordalpen und Drauzug. – Mitt. Bayer. Staatssamml. Paläont. hist. Geol., 8, 263–290.

KUSS, J. (1990): Middle Jurassic Calcareous Algae from the Circum-Arabian Area. – Facies, 22, 59–86.

LANG, B. (1989): Die Schwamm-Biohermfazies der Nördlichen Frankenalb (Urspring; Oxford, Malm): Mikrofazies, Palökologie, Paläontologie. – Facies, 20, 199–274.

LEHRMANN, D.J., WEI, J. & ENOS, P. (1998): Controls of facies architecture of at large Triassic carbonate platform: The great bank of Guizhou, Nanpanjiang Basin, south China. – J. Sediment Research, 68/2, 311–326.

LEINFELDER, R.R. (1992): A Modern-Type Kimmeridgian Reef (Ota Limestone, Portugal): Implications for Jurassic Reef Models. – Facies, 26, 11–34.

LEINFELDER, R.R., NOSE, M., SCHMID, D.U. & WERNER, W. (1993): Microbial Crusts of the Late Jurassic: Composition, Palaeoecological Significance and Importance in Reef Construction. – Facies, 29, 195–230.

LEINFELDER, R.R., WERNER, W., NOSE, M., SCHMID, D.U., KRAUTTER, M., LATERNSER, R., TAKACS, M. & HARTMANN, D. (1996): Paleocology, Growth Parameters and Dynamics of Coral, Sponge and Microbiolite Reefs from the Late Jurassic. – In: REITNER, J., NEUWEILER, F. & GUNKEL, F. (eds.): Global and Regional Controls on Biogenic Sedimentation. I. Reef Evolution. Research Reports. Göttinger Arb. Geol. Paläont., Sb2, 227–248.

LE MONE, D.V. (1995): The role of *Shamovella* (“*Tubiphytes*”) in bioherms. – In: GRABER, R. A. & LINDSAY, R.F. (eds.): Wolfcampian-Leonardian shelf-margin facies of the Sierra Diablo. Seismic scale models for subsurface exploration. Annual Field Guidebook. West Texas Geol. Soc. Publ., 95–97, 135–144.

LUPERTO SINNI, E. & MASSE, J.P. (1994): Precisazioni micropaleonotologiche sulle formazioni di piattaforma carbonatica del Giruassico Superiore e del Cretaceo basale del massiccio del Gargano (Italia Meridionale) e implicazioni stratigrafiche. – Paleopelagos, 4, 243–266.

MASLOV, V.P. (1956): *Fossil calcareous algae of the URSS*. – Trudy Geologicheskii Nauk Institut URSS, Moskow, 160, 301 p. [in Russian].

MATYSZKIEWICZ, J. (1989): Sedimentation and diagenesis of the Upper Oxfordian limestones in Piekary near Kraków. – Ann. Soc. Geol. Polon., 59, 201–230.

MATYSZKIEWICZ, J. (1997a): Microfacies, sedimentation and some aspects of diagenesis of Upper Jurassic sediments from the elevated part of the Northern peri-Tethyan Shelf: a comparative study on the Lochen area (Schwäbische Alb) and the Cracow area (Cracow-Wieluń Upland, Poland). – Berl. Geowiss. Abh., E21, 1–111.

MATYSZKIEWICZ, J. (1997b): Stromatactis cavities and stromatactis-like cavities in the Upper Jurassic carbonate buildups at Młynka and Zabierzów (Oxfordian, southern Poland). – Ann. Soc. Geol. Polon., 67, 45–55.

MATYSZKIEWICZ, J. (1999): Sea-bottom relief versus differential compaction in ancient platform carbonates: a critical reassessment of an example from Upper Jurassic of the Cracow-Wieluń Upland. – Ann. Soc. Geol. Polon., 69, 63–79.

MATYSZKIEWICZ, J. & FELISIAK, I. (1992): Microfacies and Diagenesis of an Upper Oxfordian Carbonate Buildup in Mydlniki (Cracow Area, Southern poland). – Facies, 27, 179–190.

MATYSZKIEWICZ, J. & KRAJEWSKI, M. (1996): Lithology and sedimentation of Upper Jurassic massive limestones near Bolechowice, Kraków-Wieluń Upland, south Poland. – Ann. Soc. Geol. Polon., 66, 285–301.

MATYSZKIEWICZ, J., KRAJEWSKI, M. & KĘDZIERSKI, J. (2006): Origin and evolution of an Upper Jurassic complex of carbonate buildups from Zegarowe Rocks (Kraków-Wieluń Upland, Poland). – Facies, 52, 249–263.

MATYSZKIEWICZ, J., KRAJEWSKI, M., TYC, A., KRÓL, K., KĘDZIERSKI, J., JĘDRYS, J. & ŚWIĄDER, J. (2004): Facial development of the Upper Jurassic complex of the Zegarowe Rocks near Smoleń (Kraków-Wieluń Upland; southern Poland) [in Polish with English summary]. – In: PARTYKA, J. (ed): Zróżnicowanie i przemiany środowiska przyrodniczo-kulturowego Wyżyny Krakowsko-Częstochowskiej. Ojcowski Park Narodowy, Spec. Publ. 1, 35–42.

MATYSZKIEWICZ, J. & SŁOMKA, T. (1994): Organodetrital conglomerates with ooids in the Cieszyn Limestone (Tithonian – Beriasian) of the Polish Flysch Carpathians and their paleographic significance. – Ann. Soc. Geol. Polon., 63, 211–248.

MELLO, J. (1977): *Plexoramea cerebriformis* n. gen., n. sp. and some other microproblematics and microfossils from Triassic limestones of the West Carpathians. – Zapadne Karpaty, ser. Paleont., 2–3, 189–202.

MEYER, R.K.F. (1975): Mikrofazielle Untersuchungen in Schwamm-Biohermen und -Biostromen des Malm Epsilon (Ober-Kimmeridge) und obersten Malm-Delta der Frankenalb. – Geol. Bl. NO-Bayern, 25, 149–177.

MEYER, R.K.F. (1977): Mikrofazies im Übergangsbereich von der Schwammfazies zur Korallen-Spongiomorphiden-Fazies im Malm (Kimmeridge – Tithon) von Regensbrug bei Kelheim. – Geol. Jb., A37, 33–69.

MEYER, R.K.R. & SCHMIDT-KAHLER, H. (1984): Erdgeschichte sichtbar gemacht: Ein geologischer Führer durch die Altmühltal. – Bayer. geol. Landesamt, München, 260 p.

MIŠÍK, M. (1979): Jurassic and Cretaceous algae (Dasycladales excepted) from the West Carpathians. – Bull. Cent. Rech. Explor. – Prod. Elf-Aquitaine, 3/2, 705–712.

MIŠÍK, M. & SYKORA, M. (1980): Jura der Silica-Einheit, rekonstruiert aus Geröllen, und oberkretazische Süsswasserkalke des Gemerikums. – Geol. Zbornik – Geol. Carpatica, 31/3, 239–261.

MOUSSAVIAN, E. (1992): On Cretaceous bioconstructions: composition and evolutionary trends of crust-building associations. – Facies, 26, 117–144.

NEUWEILER, F., MEHDI, M. & WILMSEN, M. (2001): Facies of Liassic sponge Mounds, Central High Atlas, Morocco. – Facies, 44, 243–264.

OLÓRIZ, F., REOLID, M. & RODRIGUEZ-TOVAR, F.J. (2003): A Late Jurassic Carbonate Ramp Colonized by Sponges and Benthic Microbial Communities (External Prebetic, Southern Spain). – Palaios, 18/6, 528–545.

PAYNE, J.L., LEHRMANN, D., CHRISTENSEN, S., WIE, J. & KNOLL, A.H. (2006): Environmental and biological controls on the initiation and growth of a Middle Triassic (Anisian) reef complex on the Great Bank of Guizhou, Guizhou Province, China. – Palaios, 21, 325–343.

POMONI-PAPAIOANNOU, F., FLÜGEL, E. & KOCH, R. (1989): Depositional Environments and Diagenesis of Upper Jurassic subsurface Sponge- and *Tubiphytes*-Reef Limestones: Altensteig 1 Well, Western Molasse Basin, Southern Germany. – Facies, 21, 263–284.

PRATT, B.R. (1995): The origin, biota and evolution of deep-water mudmounds. – International Association of Sedimentologists, Spec. Publ., 23, Blackwell Science 49–123.

RAUSER-CHERNOUSSOVA, D.M. (1950): *Facies of Upper Carboniferous and Artinskian deposits in the Sterlitamak-Ishimbaevo region of the Pre-Urals, base on a study of fusulinids.* – Trudy Inst. Geol. Nauk Akad. Nauk SSSR, Trans. 119, 43, 1–108 [in Russian].

RADOIČIĆ, R. (2005): New Dasycladales and microbiota from the lowermost Valanginian of the Mirdita Zone. – Ann. Géol. Pénins. Balk., 66 (2004–2005), 27–53.

RAMALHO, M. (1971): Contribution à l´étude micropaléongologique et stratigraphique du Jurassique supérieur et du Crétacé inférieur des environs de Lisbone (Portugal). – Serv. Geol. Portugal, Mem. 19, 1–212.

RICHTER, D.K., DRAGASTAN, O., KUBE, B., BECK, T. & ZUHL, H. (1999): Fazies und Biostratigraphie des finalen Stadiums der obertriadischen Karbonatplattform von Hydra (Kap Kastello/Westrand des Pelagonikums/ Griechenland). – In: RICHTER, D.K. & WURTH, G. (eds.): Beiträge zur Sedimentologie von Griechenland. Bochumer Geol. Geotech. Arbeiten, 53, 127–147.

RIDING, R. (1993): *Shamovella obscura*: the correct name for *Tubiphytes obscurus* (Fossil). – Taxon, 42, 71–73.

RIDING, R. & BARKHAM, S. (1999): Temperate water *Shamovella* from the Lower Permian of West Timor, Indonesia. – Alcheringa, 23, 21–29.

RIDING, R. & GUO, L. (1992): Affinity of *Tubiphytes*.- Palaeontology, 35&1, 37-49.

RIGBY, J.K. (1958): Two new Upper Paleozoic Hydrozoans. – J. Paleont., 32, 583–586.

SANTANTONIO, M., GULLZZO, F. & GILL, G. (1996): Anatomy and paleobathymetry of a Jurassic pelagic carbonate platform/basin system. Rossa Mts, Central Apennines (Italy). Geological Implications. – Palaeopelagos, 6, 123–169.

SĂSĂRAN, E., BUCUR, I.I. & PRICA, I. (2001): Microfacies and microfossils in the Upper Jurassic limestones from Cheile Turenilor. – Studia Universitatis Babeş-Bolyai, Geologia, 46/2, 35–52.

SĂSĂRAN, E., HOSU, A., SPĂLNĂCAN, R., & BUCUR, I.I. (2000): Microfacies, microfossils and sedimentary evolution of the Sănduleşti limestone Formation in Cheile Turzii (Apuseni Mountains, Romania). – Acta Palaeont. Romaniae, 2 (1999), 453–462.

SCHEIBNER, CH. & REIJMER, J.J.G. (1999): Facies Patterns within a Lower Jurassic Upper Slope to inner Platform Transect (Jbel Bou Dahar, Morocco). – Facies, 41, 55–80.

SCHERZE, E. & HÖFLING, R. (2002): Growth habits of encrusting organisms in Late Jurassic oncoids of eastern Spain (Prov. Valencia). – In: BUCUR, I.I. & FILLIPESCU, S. (eds.): Research advances in calcareous algae and microbial carbonates. University Press, Cluj, 191-200.

SCHLAGINTWEIT, F. (2004): *Iberopora bodeuri* Granier & Berthou 2002 (*incertae sedis*) from the Plassen Formation (Kimmeridgian-Berriasian) of the Tethyan Realm. – Geol. Croat., 57/1, 1–13.

SCHLAGINTWEIT, F. & EBLI, O. (1999): New Results on Microfacies, Biostratigraphy and Sedimentology of Late Jurassic – Early Cretaceous platform carbonates of the Northern Calcareous Alps. – Abh. Geol. B.-A., 56/2, 379–418.

SCHLAGINTWEIT, F. & GAWLICK, H.-J. (2003): Mikrobolithe und Mikroinkrustierer aus der Plassen-Formation (Kimmeridgium-Berriasium) der Nördlichen Kalklapen. – In: WEIDINGER, J.J., LOBITZER, H. & SPITZBART, I. (eds.): Beiträge zur Geologie des Salzkammerguts. Gemundner Geo-Studien, 2, 107–114.

SCHLAGINTWEIT, F. & GAWLICK, H.-J., EBLI, O., RÜNSTLER, H. & SUZUKI, H. (2003a): Die Plassen-Formation (Kimmeridgium) des Krahstein (Steirisches Salzkammergut, Österreich) und deren Unterlagerungen: Neue Daten zur Fazies, Biostratigraphie und Sedimentologie. – In: WEIDINGER, J.J., LOBITZER, H. & SPITZBART, I. (eds.): Beiträge zur Geologie des Salzkammerguts. Gemundner Geo-Studien, 2, 87–96.

SCHLAGINTWEIT, F., GAWLICK, H.-J. & LEIN, R. (2003b): Die Plassen-Formation der Typlokalität (Salzkammergut, Österreich) – neue Daten zu Fazies, Sedimentologie und Stratigraphie. – Mitt. Ges. Geol. Bergbaustud. Österr., 46, 1–34.

SCHLAGINTWEIT, F., GAWLICK, H.-J. & LEIN, R. (2005): Mikropaläontologie und Biostratigraphie der Plassen-Karbonatplattform der Typlokalität (Ober-Jura bis Unter-Kreide, Salzkammergut, Österreich). – Journal of Alpine Geology (Mitt. Ges. Geol. Bergbaustud. Österreich), 47, 11–102.

SCHMID, D.U. (1995): „*Tubiphytes*“ *morronensis* – eine fakultativ inkrustierende Foraminifere mit endosymbiotischen Algen. – Profil, 8, 305–317.

SCHMID, D.U. (1996): Marine Mikrobiolithe und Mikroinkrustierer aus dem Oberjura. – Profil, 9, 101–251.

SCHMID, D. & HENSSEL, K. (2001): Die rätselhaften Tubiphyten der Treuchtinger Marmors. – Mitt. Bayer. Paläont. Staatssamml., Jahresbr. 2000, 45–54.

SCHMIDT-KAHLER, H. (1962): Stratigraphische und tektonische Untersuchungen im Malm des nordöstlichen Ries-Rahmens. – Erlanger Geol. Abh., 44, 1–51.

SENOWBARI-DARYAN, B. (2007): *Isnella misiki* nov. gen., nov. sp., kein „*Tubiphytes*“, aber eine mögliche Foraminifere, Wurmröhre oder Cyanophycee aus den ladinisch-karnischen Riffkalken der Tethys. – J. Alpine Geol. (Mitt. Ges. Geol. Bergbaustud. Österr.), 48, 45–56.

SENOWBARI-DARYAN, B., BUCUR, I.I. & ABATE, B. (1994): Upper Jurassic Calcareous Algae from the Madonie Mountains, Sicily. – Beitr. Paläont. Wien, 19, 227–259.

SENOWBARI-DARYAN, B., BUCUR, I.I., SCHLAGINTWEIT, F., SĂSĂRAN, E. & MATYSZHKIEWICZ, J. (2007): *Crescentina*, new generic name for „*Tubiphytes*“ *morronensis* Crescenti, 1969. – In: GRGASOVIĆ, T. & VLAHOVIĆ, I. (eds.): 9th International Symposium on Fossil Algae, Field-Trip Guidebook and Abstracts. Croatian Geological Survey, Zagreb, 251-252.

SENOWBARI-DARYAN, B. & FLÜGEL, E. (1993): *Tubiphytes* Maslov, an Enigmatic Fossil: Classification, Fossil Record and Significance through Time. Part I: Discussion of Late Paleozoic Material. – In: BARATTOLO, F., DE CASTRO, P. & PARENTE, M. (eds.): Studies on Fossil Benthic Algae. Boll. Soc. Paleont. Ital., Special Vol. 1, 253–382.

SENOWBARI-DARYAN, B. VELLEDITS, F. (2007): *Axopora aggtelekensis* Schloz 1972, originally described as Hydrozoa, is attributed to the new genus *Anisophytes* (Canophyta?). – Riv. Ital. Paleont. Stratigr., 113/3, 357–368.

STEIGER, T. & JANSA, L.F. (1984): Jurassic limestones of the seaward edge of the Mazagan carbonate platform, northwest African continental margin, Morroco. – Intitial Rep. Deep Sea Drilling Proj, 79, 449–491.

UTA, A. & BUCUR, I.I. (2003): Microbial structures and microencrusters in the Upper Jurassic – Lower Cretaceous deposits from Buila-Vanturarita Massif (South Carpathians). – Studia Univ. Babes Bolyai, Geol., 48/2, 3–14.

VACHARD, D., HAUSER, M., MARTINI, R. & ZANINETTI, L., MATTER, A. & PETERS, T. (2001): New algae and problematica of algal affinity from the Permian of the Aseelah unit of the Batain Plain (East Oman). – Geobios, 34/4, 375–404.

VENNIN, E., VACHARD, D. & PROUST, J.-N. (1997): Taphonomie et synécologie du genre *Tubiphytes* dans les bioconstructions deTratau et de Nizhni-Irginsk (Permien inférieur de l´Oural, Russie). – Géobios, 30/5, 635–649.

VOLK, H., KOCH, R. & FRANZ, M. (2001): Fazieskartierung in „Massenkalken" des Weißjura delta 1 bis zeta 1 (ki2.2 bis ki4). Ein Beispiel aus dem Oberen Donautal (Westliche Schwäbische Alb). – Geol. Bl. NO-Bayern, 51/3–4, 274–332.

WAGENPLAST, P. (1972): Ökologische Untersuchungen der Fauna aus Bank- und Schwammfazies des Weißen Jura der Schwäbischen Alb. – Arb. Geol. Paläont. Inst. Stuttgart, N.F., 67, 1–99.

WANG, S., FAN, J. & RIGBY, J.K. (1994): *Archaeolithoporella* and *Tubiphytes*: Affinities and Paleoecology in Permian Reefs of South China. – Science in China, Ser. B, 37/6, 723–743.

WEIDLICH, O. (2001): Middle and Late Permian reefs – Distribution patterns and reservoir potential. – SEPM Spec. Publ., 72, 339–390.

WU, Y.SH. (1991): Organisms and communities of Permian reef of Xiangbo, China. – Intern. Acad. Public., Beijing, 192 p.

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