

MORPHOLOGY, TAXONOMY AND DISTRIBUTION OF THE CRETACEOUS CORAL GENUS *PARONASTRAEA* (BARREMIAN-CENOMANIAN; SCLERACTINIA)

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Received: January 12, 2005; accepted: October 4, 2005

Key words: Scleractinian corals, *Paronastraea*, Cretaceous, Systematics, Italy, France, Germany, Greece.

Abstract. The Middle Cretaceous genus *Paronastraea* Beauvais, 1977 is being revised on the basis of sample material available from Italy, France, Germany, and Greece. *Paronastraea*, a plocoid and cerioid coral similar to *Pachycoenia*, is characterised by regular secondary septal apophyses arranged in pairs. Six species are distinguished by their respective numbers of septal cycles and systems, two of them in open nomenclature and one, *Paronastraea occulta* from the Early Aptian of Greece, is newly described. The genus occurred from the Barremian to the basal Cenomanian in the central and eastern Tethys.

Riassunto. Sulla base di materiale proveniente dall'Italia, Germania e Grecia, viene revisionato il genere del Cretacico Medio *Paronastraea* Beauvais, 1977. *Paronastraea*, un corallo plocoid e cerioide simile a *Pachycoenia*, è caratterizzato da regolari paia di apofisi settali secondarie. Sei specie si possono distinguere in base ai rispettivi cicli e sistemi settali, due di queste hanno nomenclatura aperta ed una, *Paronastraea occulta* dell'Aptiano inferiore della Grecia, viene descritta per la prima volta. La distribuzione stratigrafica del genere, caratteristico della Tetide centrale ed orientale, va dal Barremiano alla base del Cenomaniano.

Introduction

Paronastraea, named after Italy's great geologist and palaeontologist Carlo Fabrizio Parona, was first introduced by Marcel Beauvais (1977) on the basis of material from the Abruzzi near Aquila described by Prever (1909). The description of the new genus, including a new family, is concise. Beauvais assigned three species to the new genus, but did not provide any illustrations. This, and the absence of all illustrations apart from those provided by Prever (1909), accounts for the fact that the genus was so little known. Since it was first

described, no species had been assigned to it, no new illustration added. Material which obviously belonged to *Paronastraea* was assigned to *Heterocoenia*, *Pachycoenia*, *Preverastraea*, or *Trochoidomeandra*. This paper describes the genus and the species in greater detail.

Abbreviations

The following abbreviations are used:

BSP, Bayerische Staatssammlung für Paläontologie und Geologie München, Germany,

MB, Naturkundemuseum der Humboldt-Universität Berlin, Germany,

MGU, Музей земледелия Московского Государственного Университета Moscow, Russia,

MNHN, Muséum National d'Histoire Naturelle Paris, France,

PIN, Paleontologicheskii institut Rossiiskoi Akademii Nauk Moscow, Russia,

PU, Università degli studi di Torino, Dipartimento di Scienze della Terra, Torino, Italy,

RLM, Ruhlandmuseum Essen, Germany,

TUM, Tohoku University Museum Sendai, Japan,

c, outer calicular diameter,

cl, inner calicular diameter (lumen),

ccd, distance of calicular centres,

sy, number of septal systems

s, number of septa.

The abbreviations applied in synonymy lists follow Matthews (1973).

Material

France. Southern France; ?Barremian.

The sample originates from the collection Michelin, no locality is given. According to the attaching rock, it seems to derive from carbonate platform facies, probably from the Barremian of southern France.

Samples: MNHN (n/n)

Germany. North Rhine-Westphalia, Mülheim/Ruhr, Kassenberg; Early Cenomanian (Mantelli zone).

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The geology is summarised in Löser (1994a), the coral fauna is revised in Löser (1994b). The stratigraphy is based on ammonites found with the corals, e.g. *Hypoturrillites carcitanensis* (Matheron).

Samples: RLM RE 551.763.310 A 902/35a.

Greece. Viotia, Arachova; Evangelistria conglomerates, early Aptian.

The locality was first mentioned in a diploma thesis (Keupp 1974, unpubl.) and is described in detail by Baron-Szabo & Steuber (1996). The stratigraphic data are based on the occurrence of *Paracokinolina* cf. *reicheli* and the rudists *Horiopleura* cf. *baylei*, *Pachytraga paradoxa*, *Polyconites distefanoi*, *Himeraelites* sp., *Offneria italica*, *O. nicolinae*.

Samples: MB. K 493 – K 495, BSP 2003 XX 5548.

Italy. Abruzzi, L'Aquila, Monti d'Ocre, Fosso Cerasetti; ?late Aptian.

The locality "Monti d'Ocre" encompasses several sample points which (as far as they were found) belong to one lithostratigraphic unit. The material described herein comes from only one point (Fosso Cerasetti). The unit was dated in Parona (1909) as Cenomanian. On the basis of rudists, Masse & Morycowa (1994) placed the locality in the upper part of the Early Cretaceous (late Aptian to Albian). According to Chiocchini et al. (1989), there is a hiatus in the whole of the Monti d'Ocre complex in the late Albian up to the lower part of the middle Cenomanian.

More recent examinations and comparisons with other faunas (Löser 1998), generally based on the occurrence of the rudist genus *Himeraelites*, mostly suggested an early Aptian age (Camoin 1983; Baron-Szabo & Steuber 1996; Alsharhan 1997; Steuber 1997, pers. comm.). Masse et al. (1998), using the genus *Himeraelites* as a reference, dated material from the Colle Pagliare (Monti d'Ocre) as Albian. It does not become clear whether this locality correlates with the other sampling localities in the Monti d'Ocre complex, but the idea that the genus *Himeraelites* represents an Albian age is clearly dropped here. Masse (2002, pers. comm.) believes that the occurrence of certain radiolite rudists, which were first found in the late Aptian, is important for dating. *Himeraelites* were recently also found in late Aptian sediments of the Arabian peninsula (Skelton 2002, pers. comm.). Steuber (2002, pers. comm.) mentioned that the rudist fauna of Monti d'Ocre lacks any typical early Aptian faunal elements (e.g. *Offneria*). A late Aptian age is therefore more probable.

Samples: PU 17995, 18051, 18053, 18055, 18056.

Turkmenistan. Krasnovodskaya oblast, Small Balkans; early Barremian

Samples: MGU 97/95 (= PIN 4768/50).

The geology and coral fauna are reported by Amanniyazov (1987) and Kuzmicheva (1987).

Systematic description

The term 'cycle' or 'septal cycle' refers to radial elements of equal width and length. The first three cycles are assumed to have formed at the same time (Milne-Edwards 1857: 45).

Order *Scleractinia* Bourne, 1900

Suborder *Heterocoeniina* Beauvais, 1974

Family *Heterocoeniidae* Oppenheim, 1930

Paronastraea Beauvais, 1977

Type species: *Paronastraea preveri* Beauvais, 1977
by original designation.

Paronastraea preveri Beauvais, 1977 was established on the basis of *Heterocenia grandis* Reuss, 1854 in Prever (1909). The type species is a junior subjective synonym of *Heterocoenia bassanii* Prever, 1909. According to the IRZN (Ride et al. 1999, Article 67.1.2) the type species remains unchanged even though it is considered a junior synonym.

Diagnosis: Cerioid or plocoid colony. Budding intercalicular. Septa compact, free, straight, not branching. Septal symmetry radial, in a tetrameral, pentameral or hexameral symmetry. Their lateral faces bear pairs of continuous vertical ridges which are considered secondary apophysal septa. The latter may be ornamented with granules. The septal inner margins may be swollen. The endotheca consists of tabulae and dissepiments. Wall unknown. No columella, no synapticulae.

Description. Colonial coral in a plocoid or cerioid calicular arrangement. The calices vary in size within a colony. The septa are compact and broad in their peripheral part, narrowing towards the centre of the calice. The inner margin may be swollen. The septa are not branching. The septal surfaces bear continuous spiny ridges (= apophysal septa, introduced by Eliášová 1973; see also Kołodziej 2003) as they do in *Tiarasmilia*. The ridges may be T-shaped at their inner end. They seem to be symmetrical at both septal lateral faces, and are not alternating. In poorly preserved specimens the tips of the apophysal septa may be broken (as in the Italian material) and only the ridges may be visible.

The septal arrangement is radial, in four, five or six systems and up to three complete septal cycles. Septa and apophysal septa may bear small thorns. The fine structure of the wall is unknown, it is narrow in both plocoid and cerioid colonies. The endotheca consists of tabulae, but may be marginally supported by vesicular dissepiments. No columella, not even a pseudo-columella. Septal microstructure unknown. The wall is compact and broad in most specimens, in rare places dissepiments are visible.

Discussion. The genus shows a certain variation in the number of septal systems. Most species have a plocoid calicular arrangement with the exception of *P. occulta* n. sp., which is a cerioid colony. The latter makes the assignment of this species to *Paronastraea* a bit uncertain. Compared with the original diagnosis by Beauvais (1977), the diagnosis is extended to include species with a septal symmetry other than four as well as a new species with a cerioid calicular arrangement.

Remarks. Beauvais (1977) refers to a lamellar coenosteum which should be granulated on its surface. No specimens of the collection Prever are well enough pre-

served to allow these features to be studied. Nor are any details of the coenosteum known from sections of the type material or thin sections of other specimens. The material to hand does not allow confirmation of a trabecular wall as claimed by Beauvais.

Comparison. The genus is very similar to *Pachycaenia* Alloiteau, 1952 (= *Canleria* Eliášová, 1996), especially to the material from the late Cenomanian of Saxony and Bohemia (see *Pachycaenia* sp. in Kołodziej 2003; *Canleria clemenci* in Eliášová 1996). *Paronastraea* does not show branching septa, the apophysal septa are regular and large, while *Pachycaenia* has only occasionally apophysal septa (?), which are short and seem to be discontinuous in vertical direction. In *Paronastraea* the inner septal margins are slightly swollen and rounded, but does not show branching septa as in *Pachycaenia*. A comparable septal ornamentation is known in *Tiarasmilia*, a late Early Cretaceous to early Late Cretaceous solitary and phaceloid coral with a large calicular diameter. Less regular apophysal septa were also found in *Preverastraea tenuiseptata* Kołodziej, 1995, and in material from the Late Aptian of Spain (described and depicted as *Comalia* sp. in Schöllhorn 1998). The genus *Preverastraea* may show some septal projections that are not as regular as in *Paronastraea* and may be considered ornamentation. In *Aulastraeopora schnauzeae* Löser, 1998 septal projections are numerous, thin, and restricted to the inner margin. In *Trochoidomeandra* the secondary septa are stronger, their formation is less regular and they are in places connected to each other. The genus *Wellsimeandra* Idakieva & Tchechmedjieva, 2003 shows what are probably apophysal septa. But the type species, *Wellsimeandra morycowae*, is insufficiently described and illustrated.

Systematic position. Beauvais (1977) assigned the genus to the new family Paronastraeidae. This does not seem a good choice as there are no other genera in this family. An exact diagnosis for this family seems to be moreover difficult to give. The systematic position proposed herein is only provisional. For the Italian type material it was not allowed to prepare thin sections, the samples from Arachova (Greece) were largely recrystallized, that from France did not show any microstructures, and the samples from Turkmenistan were not to hand. Stolarski et al. (2004) placed *Paronastraea* close to *Preverastrea* in the Aulastraeoporidae. Septal structures like those in *Paronastraea* are also known from Rhipidogyrina (see Eliášová 1973), and the varying septal thickness in septal cycles of *Paronastraea* seems to place the genus closer to the suborder Rhipidogyrina. Baron-Szabo & Steuber (1996) and Kołodziej (2003) consider apophysal septa a typical feature of the family

Aulastraeoporidae, which is assigned to the suborders Heterocoenina and Rhipidogyrina.

Distribution. *Paronastraea* seems to be an extremely rare genus, probably also on account of the fact that it is so little known. Although the author has seen almost all large Cretaceous coral collections and sampled a large number of Early to early Late Cretaceous localities worldwide, he did not find much material belonging to *Paronastraea* in addition to the material presented herein. The genus occurs from the Barremian to the early Cenomanian and is only found in five localities.

Species. Three species were assigned by Beauvais (1977) to *Paronastraea*: *P. preveri* Beauvais, 1977, *Heterocoenia bassanii* Prever, 1909, and *Heterocoenia serrata* Prever, 1909. They are distinguished by the number of septal systems, the number of septal cycles and the calicular diameter.

***Paronastraea balkhanensis* (Kuzmicheva, 1974)**

* 1974 *Heterocoenia balkhanensis* Kuzmicheva, p. 231, pl. 2, fig. 6.

1987 *Heterocoenia balkhanensis* - Kuzmicheva, p. 225, pl. 2, fig. 1.

1987 *Heterocoenia balkhanensis* - Sokolov & Ivanovskij, pl. M-7, fig. 6, pl. M-12, fig. 7.

2002 *Pachycaenia balkhanensis* - Kuzmicheva, p. 130, pl. 9, fig. 2.

Dimensions

c	cl	ccd	sy	s
2.5-3.5 mm	1.5-2 mm	3.5-4.5 mm	6	12

Description. Plocoid colony, calices round and irregular in size. Septa in a hexameral symmetry. Those of the first cycle are large and reach the centre of the calice; those of the second cycle are short. Endotheca unknown. Coenosteum consists of numerous dissepiments.

Remarks. All material depicted since the species was first described shows one and the same specimen. The material was not available. According to Irina Bugrowa (1999, pers. comm.) it is kept at Kuzmicheva's home and access is difficult.

Occurrence and material. Early Barremian: Small Balkans (Krasnovodskaya obl., Turkmenistan)

***Paronastraea bassanii* (Prever, 1909)**

(= *Heterocoenia serrata* Prever, 1909; *Paronastraea preveri* Beauvais, 1977)

Fig. 1, 2, Pl. 1, figs 1, 2

- * v 1909 *Heterocoenia Bassanii* Prever, p. 132, pl. 15, fig. 1.
 v 1909 *Heterocoenia serrata* Prever, p. 132, pl. 14, fig. 18, 19.
 v 1909 *Heterocoenia grandis* Reuss - Prever, p. 132, pl. 14, fig. 17.
 v 1977 *Paronastraea preveri* nov. sp. (= *Heterocoenia grandis* Prever non Reuss) Beauvais, p. 274.

Dimensions

c	cl	ccd	sy	s
3.5-4.5 mm	2-3 (4) mm	(3) 4-5 (7) mm	4	8-12

Description. Plocoid colony. Calices round, varying in size. Septa free, compact, broad in their peripheral part, appearing in two complete cycles and the beginning of a third cycle in four systems. The septa of the first cycle are thick and reach almost the centre of the calice. At their inner margins they are swollen. At their lateral faces they bear three pairs of short apophysal septa. The last pair closest to the centre of the calice may be short. The apophysal septa are generally short and point towards the centre of the calice. The septa of the second cycle are thinner, slightly shorter and bear only two pairs of apophysal septa. The incomplete third cycle is marked by ridgelike structures.

Endotheca and coenosteum consist of tabulae and dissepiments. Wall unknown.

Occurrence and material. ?Late Aptian: Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fosso Cerasetti – PU 18051 (holotype of *Heterocoenia bassanii*), PU 18053 (holotype of *Paronastraea preveri*), PU 18054 (?paratype of *Paronastraea preveri*), PU 18055/PU 18056 (syntypes of *Heterocoenia serrata*).

Paronastraea irregularis (Prever, 1909)

Pl. 1, figs 3-6

- * v 1909 *Elasmocoenia irregularis* Prever, p. 131, pl. 14, fig. 16.

Dimensions

c	cl	ccd	sy	s
4-6 mm	3-4 mm	3.5-5.5 mm	6	12

Description. Plocoid colony. Calices round, varying in size. Septa free, compact, broad in their peripheral part, appearing in two complete cycles and six systems. The septa of the first cycle are thick and almost reach the centre of the calice. At their inner margins they are swollen and connected by dissepiments. They bear three to four pairs of apophysal septa at their lateral faces. These are short in the type material and longer in the better preserved sample from Greece. In this sample they grow at first almost at right angles, then they bend towards the centre of the calice. The septa of

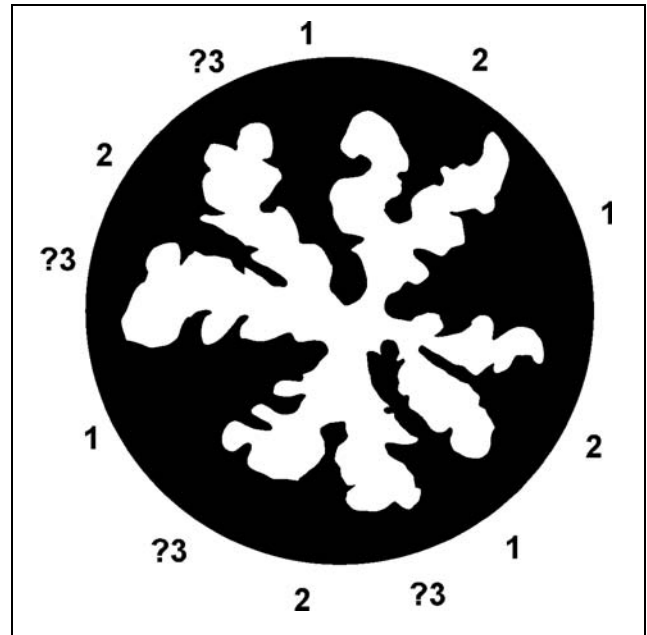


Fig. 1 - *Paronastraea bassanii* (Prever, 1909). Drawing after a peel of a transverse section. PU 18053 (= holotype of *Paronastraea preveri* Beauvais, 1977). x 16. (Numbers indicate septal cycles.)

the second cycle are thinner, shorter and bear only two pairs of apophysal septa. The endotheca consists of numerous tabulae.

Remarks. The samples from Italy are poorly preserved. The apophysal septa are short, which is probably due in part to their poor state of preservation.

Occurrence and material. Early Aptian: Greece (Viotía) Arachova - BSP 2003 XX 5548 (with one thin section).

?Late Aptian: Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fosso Cerasetti – PU 17995 (holotype of *Elasmocoenia irregularis*)

Paronastraea occulta n. sp.

Fig. 3, Pl. 1, figs 7-9

v 1996 *Preverastraea aptiana* (Turnšek, 1981) - Baron-Szabo & Steuber, p. 19, pl. 9, fig. 2, 4-6.

Derivation of name. Latin "hidden". The name alludes to the difficulty of recognising the proper genus for this material.

Holotype. MB K. 493 with three thin sections.

Paratypes. MB K. 494, MB. K. 495, each with one thin section.

Type locality. South of Arachova, close to the road between Levadia and Arachova (Viotía, Greece); WGS84 position ca. 38° 28' 35" N, 22° 36' 40" E.

Age. Evangelistria conglomerates of an Early Aptian age, identified by the occurrence of the microfossils *Dictyoconus* cf. *reicheli* and rudists (see Baron-Szabo & Steuber 1996).

Diagnosis: *Paronastraea* with a large calicular diameter (4.25-5 mm), a tetrameral septal symmetry, and three complete cycles of septa (up to 20 septa).



Fig. 2 - *Paronastraea bassanii* (Prever, 1909). Drawing after a peel of a longitudinal section. PU 18053 (= holotype of *Paronastraea preveri* Beauvais, 1977). x 16.

Comparison. *P. occulta* is the only species showing a tetrameral symmetry and three complete cycles of septa. The size of the calices differs moreover from all other species.

Dimensions

cl	ccd	sy	s
(3.5) 4.25 - 5 (5.5) mm	4.3 - 7 mm	4	16 (20)

Description. Cerioid colony with polygonal calices. Septa in four systems, compact, straight, free. The septa of the first cycle reach the centre of the calice

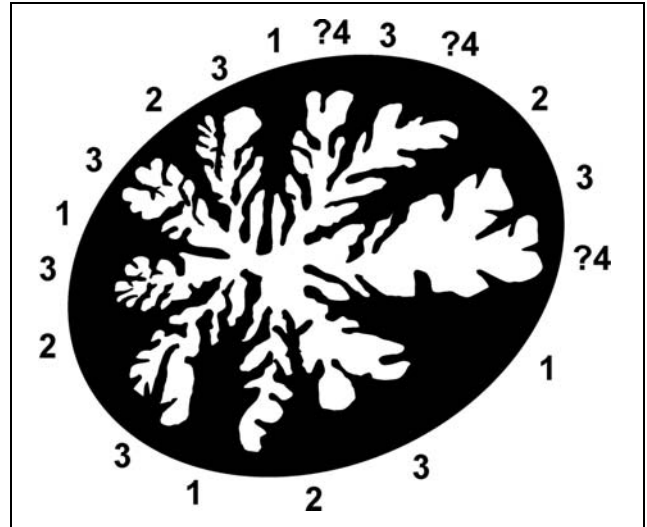


Fig. 3 - *Paronastraea occulta* n. sp. Drawing after a transverse, slightly oblique thin section. MB K. 493a. x 8. (Numbers indicate septal cycles.)

and bear up to four pairs of long apophysal septa. Those of the second cycle are slightly shorter and also bear four pairs of apophysal septa. The septa of the third cycle are shorter (15-20% of the calicular diameter) and have only one pair of apophysal septa. A fourth cycle is rudimentary and incomplete. Wall thin, supported by dissepiments, but formation unknown. Endotheca consists of regular tabulae and lateral vesicular dissepiments.

Remarks. The new species differs from the type species of the genus not only in its calicular arrangement but also in the formation of the endotheca. *Preverastraea aptiana* (Turnšek, 1981), originally assigned to *Acanthogyra*, belongs to *Preverastraea*, but the present material does not belong to this genus as claimed by Baron-Szabo & Steuber (1996). An identical septal size to that known from *Furcophyllia* was mentioned by Stolarski et al. (2004) for the material depicted by Baron-Szabo & Steuber (1996) for both the primary and secondary septa. In this species the apophysal septa are very long, but the primary septa are stronger.

***Paronastraea* sp. 1**

Pl. 1, fig. 10

2002 *Trochoidomeandra problematica* Morycowa, 1971 - Kuzmicheva, p. 135, pl. 11, fig. 1.

v 2004 *Paronastraea?* sp. - Stolarski et al., p. 537, fig. 7b.

Dimensions

cl	ccd	sy	s
10-12 mm	10-15 (18) mm	6	(22) 24 (26)

Description. Cerioid colony with polygonal calices. Septa in six systems, compact, straight, free. The septa of the first cycle are broad in their peripheral part, reach the centre of the calice and bear up to five pairs of apophysal septa. The latter are shorter than in *P. occulta*, may be rhopaloid (in the form of a T), and often bear small spines. They are bent and point to the calicular centre. Septal inner margins are swollen and ornamented with fine thorns. Those of the second cycle are slightly shorter and bear up to four pairs of apophysal septa. The septa of this cycle are not swollen at its inner margin. The septa of the third cycle are shorter (20% of the calicular diameter) and are only ornamented with fine thorns. A fourth cycle is rudimentary and incomplete. Wall thin, supported by dissepiments, formation unknown. Endotheca consists of regular tabulae.

Occurrence and material. Early Barremian: Small Balkans (Krasnovodskaya obl., Turkmenistan)
?Barremian: southern France.

Paronastraea sp. 2

Pl. 1, fig. 11

v p 1994b *Preverastraea* cf. *isseli* (Prever, 1909) - Löser, p. 15.

Dimensions

c	cl	ccd	sy	s
7 mm	6 mm	7-8 mm	5	20

Description. Plocoid colony with round calices. Septa in five systems, compact, straight, free. The septa of the first cycle reach the centre of the calice and bear up to eight pairs of apophysal septa. The latter point towards the calicular centre but join the septa at right angles. They may bear small spines. The septa of the second cycle are slightly shorter and bear up to five pairs of apophysal septa. The septa of the third cycle are shorter (20% of the calicular diameter). Wall and endotheca unknown.

Remarks. The coral material from the Kassenberg area, especially the material of the genus *Paronastraea*, is extremely soft so that it is almost impossible to prepare (thin) sections. The material originally described by Löser (1994b) belongs to two genera and species of similar appearance. The difference was only revealed by the few poorly preserved thin sections obtained.

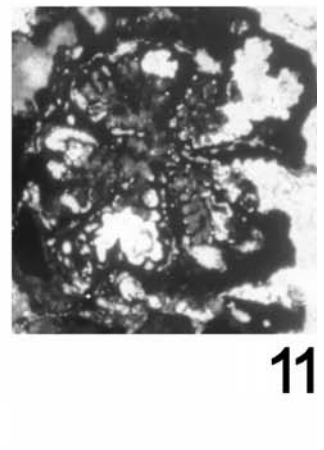
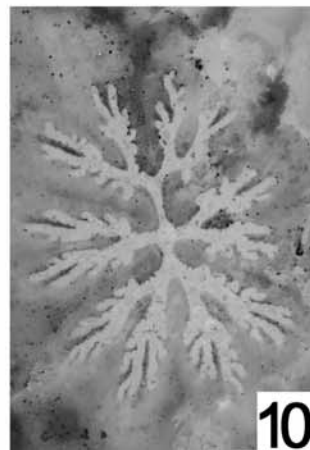
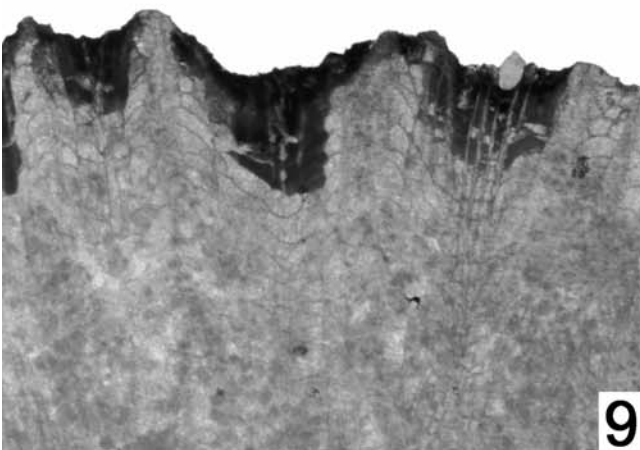
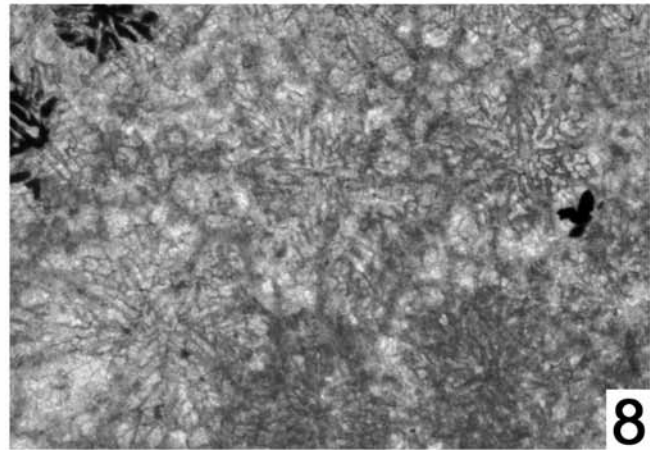
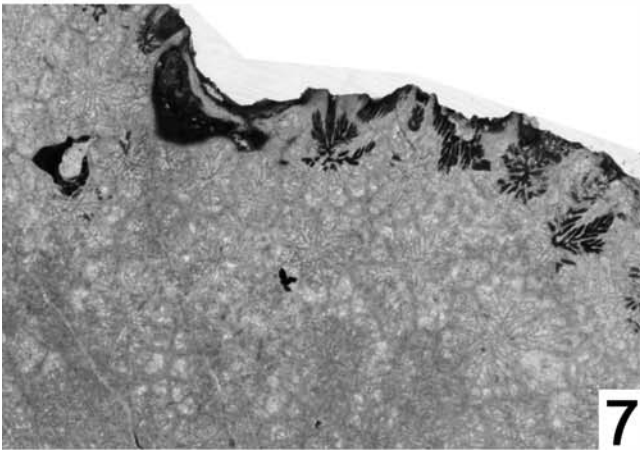
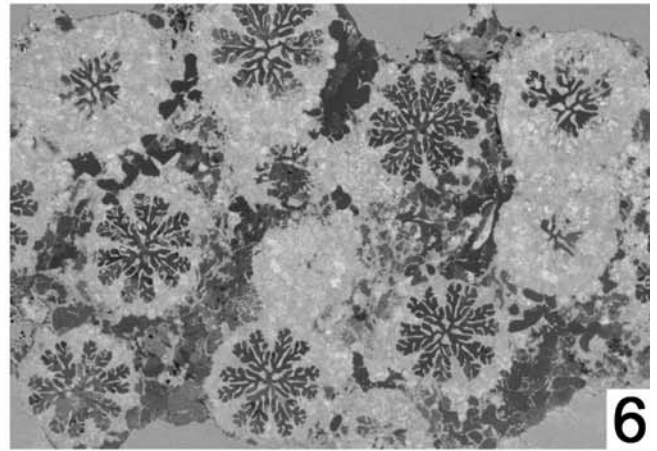
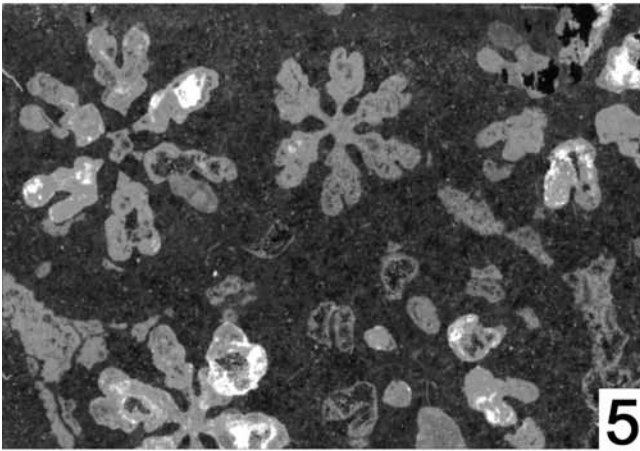
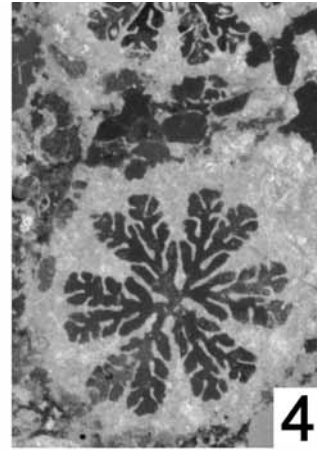
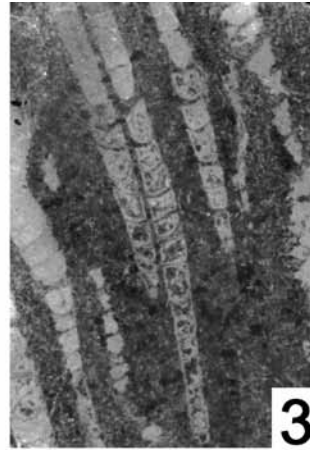
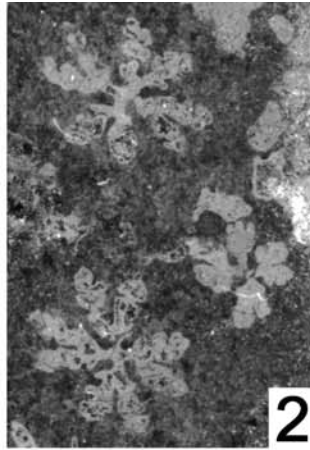
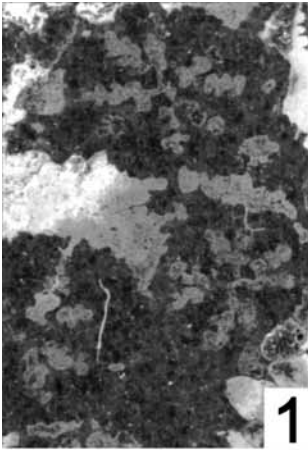
Occurrence and material. Early Cenomanian (Mantelli zone): Kassenberg in Mülheim/Ruhr (Nordrhein-Westfalen, Germany).

Discussion. *Paronastraea* differs from most genera in that it forms secondary apophysal septa, a phenomenon already discussed by Stolarski et al. (2004: 538). The apophysal septa seem to be closer in character to septa than they are to ornamentations, being granulated on their lateral faces as well. Apophysal septa are generally very regular: they appear in pairs on both sides of the septum. Their number in different septal cycles varies, but it is constant within a colony. The genus includes both cerioid and plocoid genera. Important characteristics such as microstructure or wall structure are missing in most samples due to the poor state of preservation.

Another interesting feature is the formation of a tetrameral symmetry, which is extremely rare in Scleractinian corals. Tetrameral symmetry is known from the Stylinide genera *Holocystis* and *Novakocoenia*, from two species of *Heterocoenia* (*Heterocoenia tetrasepta* Eguchi, 1951, Aptian of Japan; *Cyathophora turonensis*

PLATE 1

- Fig. 1 - *Paronastraea bassanii* (Prever, 1909). Peel of a transverse section. ?Late Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18053 (= holotype of *Paronastraea prevereri* Beauvais, 1977). x 8.
- Fig. 2 - *Paronastraea bassanii* (Prever, 1909). Peel of a transverse section. ?Late Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18054 (? = paratype of *Paronastraea prevereri*). x 8.
- Fig. 3 - *Paronastraea irregularis* (Prever, 1909). Peel of a longitudinal section. ?Late Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 17995. x 8.
- Fig. 4 - *Paronastraea irregularis* (Prever, 1909). Thin section of a transverse section. Early Aptian of Arachova, Viotía, Greece. BSP 2003 XX 5548. x 8.
- Fig. 5 - *Paronastraea irregularis* (Prever, 1909). Peel of a transverse section. ?Late Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 17995. x 8.
- Fig. 6 - *Paronastraea irregularis* (Prever, 1909). Transverse thin section. Early Aptian of Arachova, Viotía, Greece. BSP 2003 XX 5548. x 4.
- Fig. 7 - *Paronastraea occulta* n. sp. Transverse thin section. Early Aptian of Arachova, Viotía, Greece. MB K. 493a (holotype). x 2.
- Fig. 8 - *Paronastraea occulta* n. sp. Transverse thin section. Early Aptian of Arachova, Viotía, Greece. MB K. 493a (holotype). x 4.
- Fig. 9 - *Paronastraea occulta* n. sp. Longitudinal thin section. Early Aptian of Arachova, Viotía, Greece. MB K. 493b (holotype). x 4.
- Fig. 10 - *Paronastraea* sp. 1. Transverse thin section. ?Barremian of France. MNHN n/n. x 4.5
- Fig. 11 - *Paronastraea* sp. 2. Transverse thin section. Early Cenomanian of Kassenberg, Mülheim/Ruhr, Nordrhein-Westfalen, Germany. RLM RE 551.763.310 A 902/35a. x 2.



de Fromentel, 1884 in Prever 1909, ?late Aptian of Italy), and from a not as yet described species of *Enallhelia* (labelled *Enallhelia rathieri* d'Orbigny, 1850; unpublished specimen TUM without number, depository number D21L-L25, Albian of Japan).

Both coral genera with regular apophysal septa (*Paronastraea*, *Tiarasmilia*) are restricted to the time span between Barremian and Early Cenomanian. Both are rare (*Paronastraea* rarer than *Tiarasmilia*) and not restricted to any facies. A dendroid coral from the late Aptian of Spain (*Comalia* sp. in Schöllhorn 1998) shows also regular apophysal septa.

Comparable genera such as *Preverastraea*, *Trochoidomeandra* or *Pachycoenia* also show ornamentations resembling apophysal septa, but are less regular.

Septal cycles and systems	4 systems	5 systems	6 systems
2 cycles	cl=1.5-2 mm <i>balkhanensis</i>		<i>irregularis</i>
	cl=2-3 mm <i>bassanii</i>		
3 cycles	<i>occulta</i>	sp. 2	sp. 1

Tab. 1 - Species of the genus *Paronastraea*.

Summary

The late Early Cretaceous to early Late Cretaceous coral genus *Paronastraea* is being revised. This

plocoid and cerioid colonial genus is characterised by formation of regular secondary apophysal septa which are branching in pairs from the (primary) septa. The only comparable genus is *Tiarasmilia*. Six species of *Paronastraea* were distinguished (Tab. 1). One species is newly described. The genus is restricted to the interval time from the Barremian to the early Cenomanian and is only known from the central to the eastern Tethys. As all material available for studies was in a poor state of preservation, the systematic position of the genus remains unclear and its assignment to the family Heterocoeniidae is only preliminary. The family Paronastraeidae is ruled out because a sufficiently exact diagnosis for this family is not possible.

Acknowledgements. I am grateful to Franca Campanino and Daniele Ormezzano, who allowed me to examine the material of the collection P.L. Prever kept at the Università degli Studi di Torino, Dipartimento di Scienze della Terra, Italy. I also wish to thank Dieter Korn, who made it possible for me to study samples of the collection at the Naturkundemuseum der Humboldt-Universität Berlin, Germany. Ewa Roniewicz showed me the unique sample of the ?Barremian of southern France; and Jarosław Stolarski (both Warszawa, Poland) was so kind to provide an excellent scan of the section. Field work in Greece was carried out with the kind support of Thomas Steuber (Bochum, Germany). Thanks are going to Francesca Bosellini (Modena) for translating the abstract. I am especially grateful to Elbieta Morycowa, Ewa Roniewicz and Maurizio Gaetani for their critical remarks on the manuscript. For grammatical correction I would like to thank Gertraud Moss (Dresden) very much. The preparation of thin sections and travel expenses as well as field work in Greece and Italy were partly covered by project FL 42/73 of the Deutsche Forschungsgemeinschaft.

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