

REVISION OF THE SCLERACTINIAN CORAL GENUS *DIPLOCOENIA* AND RE-DESCRIPTION OF THE CRETACEOUS SPECIES

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Abstract. The Cretaceous species of the coral genus *Diplocoenia* are revised, mainly on the basis of sample material. This genus is characterised by polygonal calices in a cerioid arrangement, compact septa in a regular symmetry and a dissepimental ring with the appearance of a second inner wall. Of the 18 Cretaceous species reported in the literature, five are confirmed, four are synonyms and nine do not belong to this genus. The species with the widest geographic and stratigraphic distribution is *Diplocoenia dollfusi* Prever, 1909, originally described from the Monti d'Ocre complex in the Abruzzi region. The genus occurs in the Cretaceous only in the central Tethys and in the Boreal, and ranges from the Middle Jurassic to the Aptian (?early Albian). Only about 50 samples from the Cretaceous exist or are known from the literature, making *Diplocoenia* rather rare in the Cretaceous.

Riassunto. Sulla base di materiale raccolto prevalentemente sul terreno, vengono revisionate le specie cretache del corallo appartenente al genere *Diplocoenia*. Questo genere cerioide è caratterizzato da calici poligonali, setti compatti arrangiati secondo una simmetria regolare, ed un anello dissepimentale apparentemente simile ad una seconda muraglia interna. Delle 18 specie riportate in letteratura, cinque sono confermate, quattro sono sinonimi e nove risultano non appartenere a questo genere. La specie che presenta la distribuzione geografica e stratigrafica più ampia è *Diplocoenia dollfusi* Prever, 1909, originariamente descritta nel complesso dei Monti d'Ocre, in Abruzzo. Durante il Cretacico, il genere si sviluppò solo nella Tetide centrale e nella fascia boreale, arrivando fino all'Aptiano (?Albiano inferiore). In letteratura sono noti solo 50 esemplari del Cretacico, suggerendo che questo genere fosse piuttosto raro.

Introduction

The genus *Diplocoenia* was established by de Fromentel (1857) on the base of a single specimen from the early Hauterivian of St. Dizier (Haute-Marne, France).

De Fromentel provided an exact definition and a good illustration for his time. However, as was usual for the period, fine septal structures were not described. Further material and new species were therefore assigned to the genus according to the general structure of the coral genus. At present, 18 species are described from the Cretaceous (Löser 2000) and about 30 species from the Jurassic (Lathuilière 1989).

The genus has experienced several considerations (Alloiteau 1958; Beauvais 1964; Morycowa 1964) but unfortunately, the type specimen of the type species was lost before or during this process (Morycowa 1997). Topotypical material could not be collected at the exact type locality because that locality is no longer accessible (personal observation). However, two large specimens were found in a nearby outcrop of the same age (Gy-l'Évêque, Yonne) which yielded comparably good thin sections. This material, type material of almost all *Diplocoenia* species, along with newly collected material from localities in France, Greece and Spain, allows the present revision of the genus and its Cretaceous species.

Abbreviations. The following abbreviations are used:

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

GIN, Geologicheskij Institut, Tbilisi, Georgia;

MB, Naturkundemuseum der Humboldt-Universität Berlin, Germany;

MGSB, Museo Geológico del Seminario de Barcelona, Spain;

MHNG, Muséum d'Histoire Naturelle de la Ville de Genève, Switzerland;

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

MV, Vinseum, Vilafranca del Penedés, Spain;

PU, Università degli Studi di Torino, Dipartimento di Scienze della Terra, Italy;

UJ, Jagiellonian University, Instytut Nauk Geologicznych, Kraków, Poland;

c, calicular diameter;

cn, calicular diameter of the inner calice;

ccd, distance of calicular centres;

s, number of septa;

sk, septa which reach the centre of the calice;

sy, septal symmetry.

The abbreviations used in the synonymy lists follow Matthews (1973):

*, earliest valid publication of the species name;

?, the assignation of this description to the species is doubtful;

non, the described material does not belong to the species concerned;

p, the described material belongs only in part to the species concerned;

v, the specimen was observed by the author.

Material. The material comes from various localities. Most of them are listed, commented and provided with additional references in Löser et al. (2005). Only details not reported in this publication are mentioned here. If no sample number is given, the material from the locality concerned was not available for study. Each sample number refers to only one specimen.

France

Haute-Marne, St. Dizier (F.430). Marne bleue, early Hauterivian. Details are available from Bertrand (1953).

Haute-Savoie, Bonneville, Reignier (F.780). Late Barremian to early Aptian. Sample: MHNG 4831.

Vaucluse, Les Gardettes (F.3159). Late Barremian to early Aptian. Details are available from Morycowa & Masse (1998).

Vaucluse, Sault (F.566). Early Aptian. Sample: MNHN M03609. Details are available from Morycowa & Masse (1998).

Vaucluse, Vaucluse Mts, Rustrel (F.874). Early Aptian. Details are available from Morycowa & Masse (1998).

Yonne, fields NW of Gy-l'Évêque (F.2732). Calcaire à *Spatangus*, early Hauterivian. Samples: BSP 2003 XX 6520, 6659. For details see Löser (2001).

Yonne, Morancourt (F.531). Calcaire à *Spatangus*, early Hauterivian.

Georgia

Kartli, Ali (GE.1180). Early Barremian. For details see Sikhariulidze (1985).

Greece

Viotía, Aliartos, Chiarmena (GR.537). Evangelistria-Schichten, latest Aptian to (?) early Albanian. The coral fauna was revised by Abdel-Gawad & Gameil (1995), further details on the locality are provided by Löser & Raeder (1995). Sample: BSP 2003 XX 6193.

Viotía, Arachova (GR.976); Evangelistria-Schichten, early Aptian. For details see Baron-Szabo & Steuber (1996). Samples: BSP 2003 XX 5495; MB K611, K417.

Viotía, Levadia, Perachorion, sample location 2; Evangelistria Schichten, early Aptian. Sample location 2 is a locality about 500 m NWW from sample location 1 (GR.539) on a recultivated area. The samples were collected in 1997 by the author. For details see also Löser & Raeder (1995). Samples: BSP 2003 XX 5738, 5742, 5771, 5774, 5788.

Italy

Abruzzi, L'Aquila, Monti d'Ocre; late Aptian (I.171). The rich coral fauna was revised by Prever (1909). For details on the stratigraphy

see Löser (2005, 2006). Various sample locations are distinguished as follows (Parona 1909):

Fossa Agnese (I.1735). Samples: BSP 2003 XX 5294, 5304, 5310, 5311; PU 17976.

Fossa Mezzaspada (I.1732). Samples: PU 17973, 17979, 17980, 17984, 17985.

Fossa Cerasetti (I.1734). Samples: PU 17974.

Poland

Malopolskie, Wadowice, Lanckorona, Jastrzebia (PL.1170). Grodziszczce Sandstones, early Aptian. For details see Morycowa (1964, 1997). Sample: UJ 4 P 28.

Malopolskie, Zakopane, Tatry Mts, Giewont (PL.2175). Wysoka Turnia Limestone Formation, early Aptian. For details see Morycowa & Lefeld (1966).

Romania

Suceava, Haghimas area (RO.2639). Early Aptian.

Suceava, Pojorita area, Cimpulung-Moldovenesc, Valea Izvorul Alb (RO.827). Wildflysch, early Aptian. For details see Morycowa (1971).

Serbia

Zljbine (SE.126). Early Aptian. Details are provided by Turnšek & Mihajlović (1981).

Spain

Cataluña, Lérida, Com. Alt Urgell, Mun. Cabó, Senyús section (E.2273). Senyús Formation, early late Aptian. For details see Schöllhorn (1998). Sample: BSP 2003 XX 4000.

Cataluña, Tarragona, Com. Baix Penedés, Mun. Sant Martí Sarroca, Can Grau (E.834). Late Aptian.

Systematic description

Order Scleractinia Bourne, 1900

Suborder Faviina Vaughan & Wells, 1943

Family Faviidae Milne-Edwards, 1857

Genus *Diplocoenia* de Fromentel, 1857

Type species: *Diplocoenia mirabilis* de Fromentel, 1857, by monotypy

Diagnosis: Cerioid colony with polygonal calices. Colony surface flat, with the central part of the calice slightly depressed. Septa compact, free or attached to each other. They show regular ornamentation at their distal borders and granulation at their lateral faces. Septal distal border with regular small granular ornamentation. Septa always in a regular radial symmetry, arranged in a varying number of systems (six, eight and ten are known). Septa unify partly in the centre of the calice. Their inner margins can be swollen. Septa sub- or non-confluent. The endotheca forms a pronounced and regular dissepimental ring in about half the radius of the calice. About half of the septa (usually the first and second cycle) reach to the centre of the calice, whereas further cycles only reach the ring. In this way, a sort of inner calice is formed. Dissepiments generally abundant, but a dissepimental stereozone does not exist. The wall is septothecal. The columella is not well defined. In the type species it varies, ranging from styliform to lamellar or even parietal, in the latter case probably made of paliform lobes; in other species it appears lamellar or substyliform. The columella can be thickened by the swollen inner margins of the septa and may appear solid and large. Budding extracalicular preferred in the corner between three calices. No pali or synapticulae.

Remarks. The diagnosis and description given herein are mainly based on topotypical material since the holotype of the type species is probably lost. It may contradict to the general accepted diagnosis of the genus, but the latter is not based on type material. There does not exist a solid dissepimental zone or even a stereozone as proposed by former authors. There exists one regular dissepimental ring, and dissepiments can be abundant between the ring and the wall. There exist samples (for instance MB K 417; Baron-Szabo & Steuber 1996) where the septothecal wall does not exist or is fragmentary and indeed in these samples there exists a dissepimental stereozone. But it remains unclear whether this material can be assigned to *Diplocoenia*.

The genus *Diplocoeniella* Morycowa, 1997 is comparable to *Diplocoenia* in its general appearance, but differs by its septal and wall structure. The septa of *Diplocoeniella* show a typical rhipidogyrid microstructure and the wall is septoparathecal, whereas it is strictly septothecal in *Diplocoenia*. Moreover, the septa are always non-confluent in *Diplocoeniella*, which gives the colonies a more plocoid appearance.

Species. Species are distinguished on the basis of their calicular diameter, septal symmetry and number. Different methods of measuring the calicular diameter have caused some confusion. Instead of indicating the total calicular diameter, often only the diameter of the inner calice is indicated because the limits of the poorly defined marginal zone of the calices. This confusion led to a high number of species. The literature gives 18 species of *Diplocoenia* in the Cretaceous. About half of them really belong to this genus, the rest to other genera, and there exist numerous synonymous species. The few Cretaceous species can be easily distinguished by their respective septal symmetry, septal number and calicular diameter (Fig. 1). In some samples, the external part of the septa is thickened as in *Diploastrea*, which is not the case in the type species. There are samples (such as PU 17973; pl. 1, fig. 1, 2) that show that these processes might be of a secondary nature caused by diagenetical processes.

Because the type material of the Jurassic species was not studied, this revision extends only to the Cretaceous species. A revision based solely on the literature is not possible due to the poor illustrations in many

publications. It cannot be assured that all the Jurassic species actually belong to this genus.

The description of the Cretaceous species in this study is based on the appropriate type material so far available. When possible, thin sections or peels were used for illustration purpose. Where the state of preservation did not allow to obtain neither thin sections or peels, or museum rules did not permit to obtain some, no illustration is given since it would not have improved much the knowledge. The original calicular dimensions published by the authors of the species differ in some cases from those presented herein because by some authors only the inner calices has been understood as the essential calice. In order not to cause confusion, these historic measurements are not repeated herein.

Systematic position. Due to the absence of studies on proper type or topotypical material the systematic position of the genus was always a matter of discussion. Eliášová (1990) placed the genus in the family Placophyllidae (suborder Rhipidogyrina) but the examined topotypical material lacks the typical rhipidogyrid microstructure (see for instance Roniewicz 1976). Morycowa & Masse (1998) assigned the genus to the Isastraeidae family which is considered a junior synonym of the Montlivaltiidae family. *Diplocoenia* lacks the typical montlivaltiid microstructure (e.g. Gill 1970). *Diplocoenia* is assigned to the Faviidae family on the base of the compact septa, and the ornamentation of the septal distal border and septal faces.

Range. Middle Jurassic to early Albian. The early Albian is questionable. There is only one locality (Chiarmena in Greece), which allows the extension of the genus into the Albian. *Diplocoenia* has not been found in any other firmly dated Albian locality. This might also be an indication that the age of the Chiarmena locality, which age is not well constrained, does not reach the Albian as already assumed by Löser & Raeder (1995).

***Diplocoenia dollfusi* Prever, 1909**

Pl. 1, figs 1-4

*v 1909 *Diplocoenia Dollfusi* Prever, p. 125, pl. 13, figs. 2-7
v 1909 *Diplocoenia Saltensis* - Prever, p. 126, pl. 13, figs. 8-16
? 1966 *Diplocoenia* sp. - Morycowa & Lefeld, p. 530

Species	Septal systems	Number of septa	Calicular diameter (mm)	Inner calicular diameter (mm)	Stratigraphic range
<i>picteti</i>	6	24	3.5	2.1 - 2.5	Late Barremian to Early Aptian
<i>saltensis</i>			4.0 - 5.0	1.8 - 2.2	Late Barremian to Aptian
<i>dolfusi</i>		24 (- 26)	2.5 - 3.0	1.2 - 1.6	Aptian to (?) Early Albian
<i>mirabilis</i>			3.5 - 4.5	2 - 2.2	Basal Hauterivian
<i>hegyesina</i>	8	64	3.0	2.0	Early Aptian

Fig. 1 - *Diplocoenia* species with their calicular diameters, symmetry, and number of septa.

- 1971 *Diplocoenia saltensis major* Morycowa, p. 87, pl. 15, fig. 2
 1981 *Diplocoenia saltensis major* Morycowa 1971 - Turnšek & Mihajlović, p. 21, pl. 17, figs. 1-4
 1985 *Diplocoenia etalloni* Sikharulidze, p. 34, fig. 5, pl. 15, fig. 3
 v 1991 *Diplocoenia calzadai* Reig Oriol, p. 18, pl. 5, figs. 3, 4
 v 1995 *Diplocoenia* sp. - Abdel-Gawad & Gameil, p. 14, pl. 13, figs. 1, 2
 v 1998 *Diplocoenia dollfusi* Prever, 1909 - Schöllhorn, p. 87, pl. 18, figs. 1-3

Types: In the collection of the PU (Torino) various syntypes of *D. dollfusi* are present: PU 17973, 17974, 17976, 17979 and 17980. All belong to the same species. Sample PU 17973 (plate 13, fig. 2, 2a in Prever 1909) is selected here as the lectotype because it is the largest and best preserved specimen. The remaining specimens become paralectotypes. Holotype of *Diplocoenia saltensis major* Morycowa, 1971 is UJ 124 P 93 by original designation. Holotype of *Diplocoenia etalloni* Sikharulidze, 1985 is GIN 405/77 by original designation. The holotype of *Diplocoenia calzadai* Reig Oriol, 1991 is MV 13545 and fixed by original designation.

Dimensions

c	2.5 - 3.0 mm
ccd	1.8 - 2.8 (3.5) mm
cn	(0.9) 1.2 - 1.6 (1.8) mm
s	6 s1 + 6 s2 + 12 s3 + s4 (24 - 26)
sk	12

Description. Small cerioid colonies. Calices polygonal. Septa are very regularly arranged in three cycles. The first two cycles reach the centre where they might be connected to each other. The third cycle remains short and only slightly passes the dissepimental ring. The third cycle septa can be connected to older septa. The beginning of a fourth cycle may exist. The columella is indeed small and probably substyliform, but appears very large because it cannot be distinguished from the septa connected to it. Septal ornamentation unknown. Dissepimental ring regular but differs in its diameter. Endotheca with thin dissepiments. Columella small, substyliform.

Remarks. *Diplocoenia calzadai* Reig Oriol, 1991, *Diplocoenia etalloni* Sikharulidze, 1985, and *Diplocoenia saltensis major* Morycowa, 1971 are considered synonymous with *Diplocoenia dollfusi*. *Diplocoenia saltensis major* Morycowa, 1971 shows slightly larger calicular dimensions, at least according to its author. Thin sections of this subspecies have never been illustrated and were not to hand. *Diplocoenia dollfusi* is a very common coral in the type locality and is generally the most widely distributed *Diplocoenia* species in space and time within the Cretaceous.

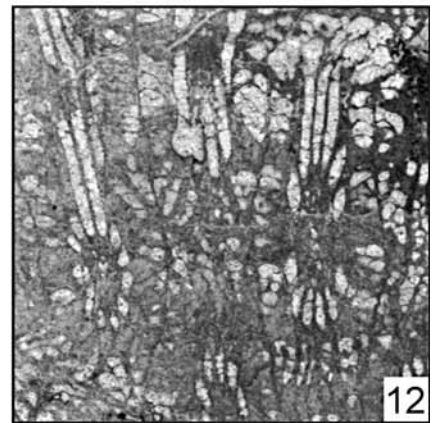
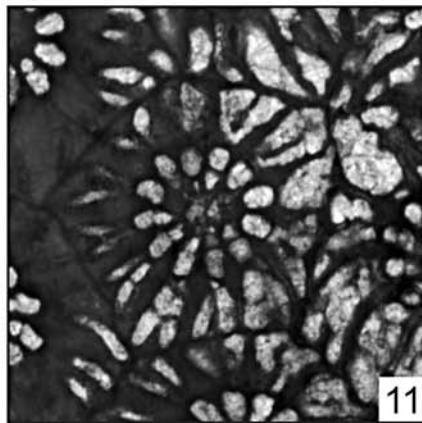
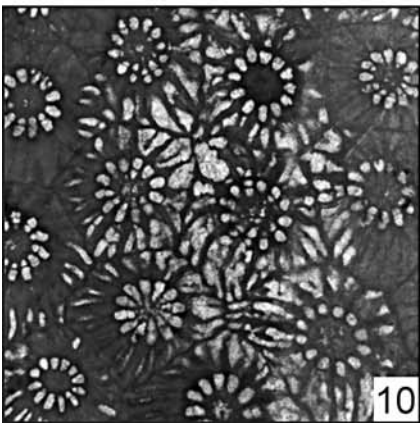
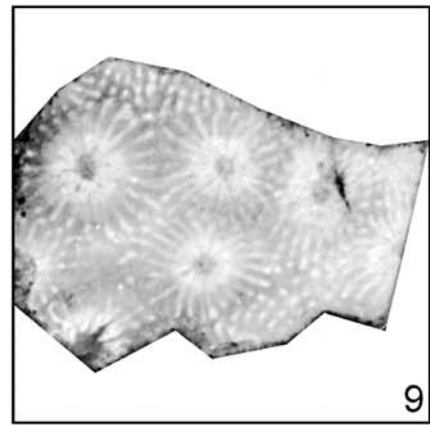
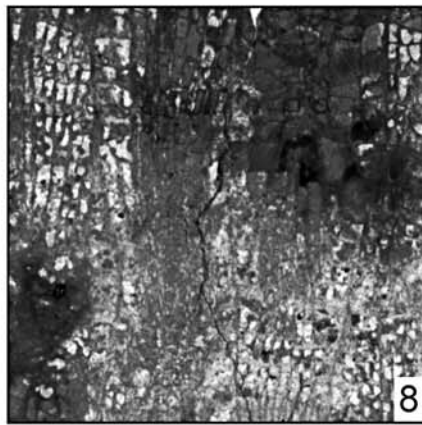
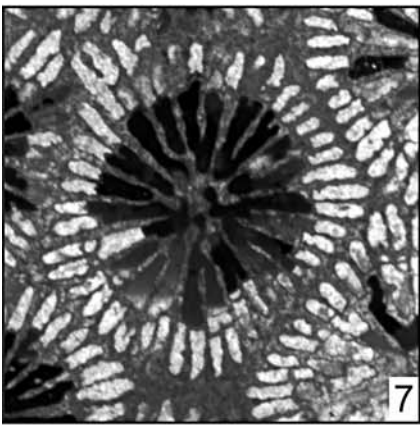
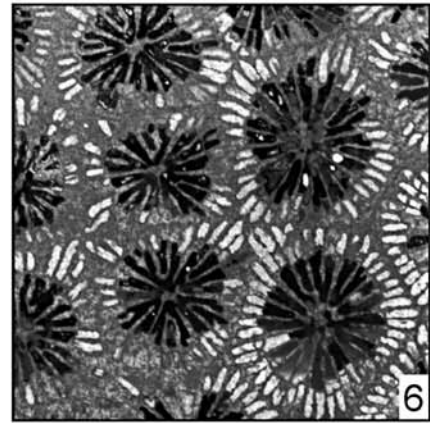
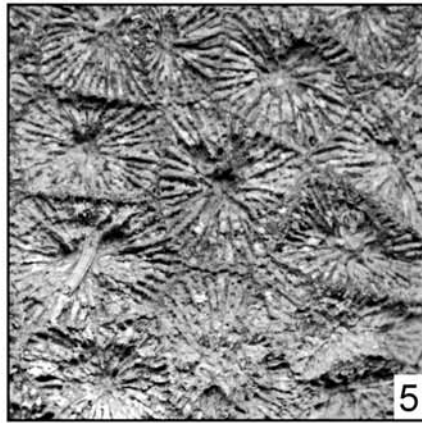
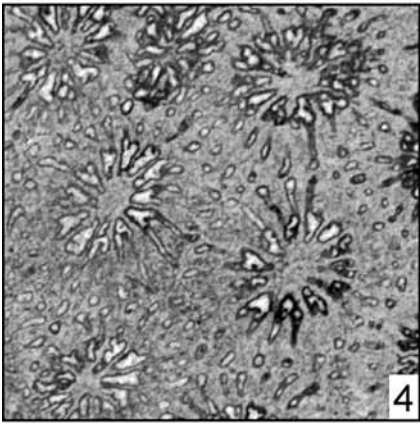
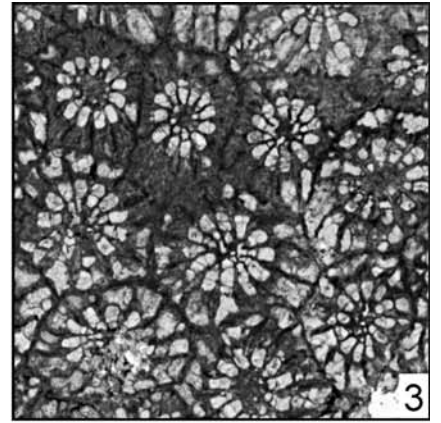
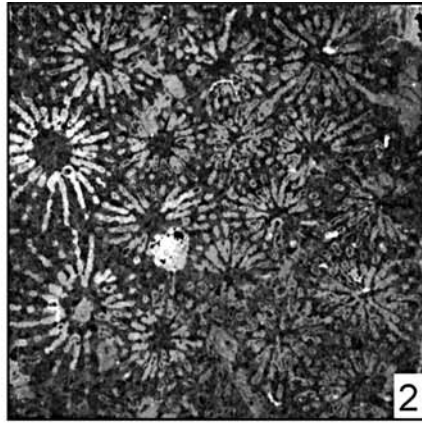
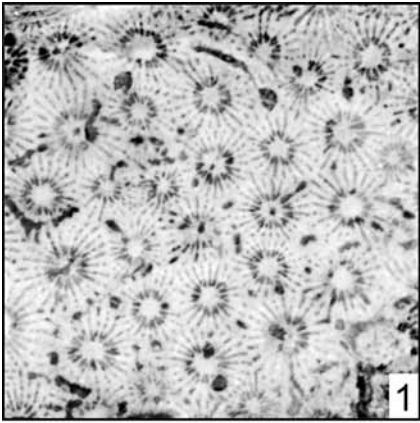
Material and occurrence. Early Barremian: Ali (Kartli, Georgia). Early Aptian: roadcut near Perachorion NW Levadia (Levadia, Viotía, Greece; BSP 2003 XX 5771, 5774); Arachova (Viotía, Greece; BSP 2003 XX 5495, MB K611); Pojorîta area, Cîmpulung-Moldovenesc, Valea Izvorul Alb (Suceava, Romania); Zljebine

(Serbia); Tatry Mts, Giewont (Zakopane, Malopolskie, Poland). Early late Aptian: Senyús section (Mun. Cabó, Com. Alt Urgell, Lérida, Cataluña, Spain; BSP 2003 XX 4000). Late Aptian: Monti d'Ocre, Fossa Cerasetti (L'Aquila, Abruzzi, Italy; PU 17974), Monti d'Ocre, Fossa Agnese (BSP 2003 XX 5294, 5304, 5310, 5311; PU 17976), Fossa Mezzaspada (PU 17973, 17979, 17980, 17985). Late Aptian: Can Grau (Mun. Sant Martí Sarroca, Com. Baix Penedés, Tarragona, Cataluña, Spain; MV 13545, MV 2130). Latest Aptian to (?) early Albian: Aliartos, Chiarmena (Viotía, Greece; BSP 2003 XX 6193).

Range. Barremian to (?) early Albian.

PLATE 1

- Fig. 1 - *Diplocoenia dollfusi* Prever, 1909. Polished slab. Late Aptian of Fossa Mezza Spada, Monti d'Ocre, L'Aquila, Italy. PU 17973 (lectotype of *Diplocoenia dollfusi* Prever, 1909). x 4.
 Fig. 2 - *Diplocoenia dollfusi* Prever, 1909. Acetate peel (negative). Late Aptian of Fossa Mezza Spada, Monti d'Ocre, L'Aquila, Italy. PU 17973 (lectotype of *Diplocoenia dollfusi* Prever, 1909). x 8.
 Fig. 3 - *Diplocoenia dollfusi* Prever, 1909. Transversal thin section. Early Aptian of Perachorion, Levadia, Viotía, Greece. BSP 2003 XX 5774. x 7.
 Fig. 4 - *Diplocoenia dollfusi* Prever, 1909. Transversal thin section. Late Aptian of Fossa Agnese, Monti d'Ocre, L'Aquila, Italy. BSP 2003 XX 5304. x 10.
 Fig. 5 - *Diplocoenia mirabilis* de Fromentel, 1857. Colony surface. Basal Hauterivian of Gy-l'Evêque, Yonne, France. BSP 2003 XX 6520. x 3.3.
 Fig. 6 - *Diplocoenia mirabilis* de Fromentel, 1857. Transversal thin section. Basal Hauterivian of Gy-l'Evêque, Yonne, France. BSP 2003 XX 6659d. x 5.
 Fig. 7 - *Diplocoenia mirabilis* de Fromentel, 1857. Transversal thin section, detail of fig. 6. Basal Hauterivian of Gy-l'Evêque, Yonne, France. BSP 2003 XX 6659d. x 9.
 Fig. 8 - *Diplocoenia mirabilis* de Fromentel, 1857. Longitudinal thin section. Basal Hauterivian of Gy-l'Evêque, Yonne, France. BSP 2003 XX 6659b. x 5.
 Fig. 9 - *Diplocoenia saltensis* de Fromentel, 1862. Polished slab. Late Aptian of Fossa Mezzaspada, Monti d'Ocre, L'Aquila, Italy. PU 17985 (holotype of *Diplocoenia roberti*). x 6.
 Fig. 10 - *Diplocoenia saltensis* de Fromentel, 1862. Transversal thin section. Early Aptian of Perachorion, Levadia, Viotía, Greece. BSP 2003 XX 5742c. x 5.3.
 Fig. 11 - *Diplocoenia saltensis* de Fromentel, 1862. Transversal thin section, detail of fig. 10. Early Aptian of Perachorion, Levadia, Viotía, Greece. BSP 2003 XX 5742c. x 11.
 Fig. 12 - *Diplocoenia saltensis* de Fromentel, 1862. Longitudinal thin section. Early Aptian of Perachorion, Levadia, Viotía, Greece. BSP 2003 XX 5742b. x 5.3.



Diplocoenia hegyesina Volz, 1903

* 1903 *Diplocoenia hegyesina* Volz, p. 14, pl. 3, figs 1-4

Type: The collection of Wilhelm Volz, held at the former Natural History Museum in Breslau (now: Muzeum Geologiczne im. Henryka Teisseyre, Instytut Nauk Geologicznych Uniwersytetu Wrocławskiego, Wrocław) was almost completely destroyed during WWII. The type(s) of *Diplocoenia hegyesina* - as all scleractinian corals described by Volz - must be considered as lost, according to A. Pacholska (written comm. 2002). A neotype has not yet been selected. Topotypical material was not available through a later revision (Morycowa 1971).

Dimensions (according to Volz 1903)

c 3 mm
 ccd 3-3.5
 cn 2 mm
 sy 8
 s 8 s1 + 8 s2 + 16 s3 + 32 s4
 sk 8

Remarks. Volz (1903: 14-15) provided a very detailed description, including the microstructure of septa and wall that confirms the correct position of this species in *Diplocoenia*. The species is distinguished from all other species by its high number of septa.

Occurrence. Early Aptian: Haghimas area (Suceava, Romania).

Range. Early Aptian.

Diplocoenia mirabilis de Fromentel, 1857

Fig. 2; Pl. 1, figs 5-8

* 1857 *Diplocoenia mirabilis* de Fromentel, p. 39, pl. 5, figs. 6-8

1879 *Diplocoenia mirabilis* - de Fromentel, p. 509, pl. 127, fig. 1
 non 1960 *Diplocaenia mirabilis* Fromentel - Kuzmicheva, p.

136, pl. 5, fig. 2a

1960 *Diplocaenia mirabilis* Fromentel - Kuzmicheva, pl. 5, fig. 2b [refiguration of de Fromentel 1857]

1997 *Diplocoenia mirabilis* de Fromentel - Morycowa, fig. 6g [refiguration of de Fromentel 1857]

Type: The type specimen (from St. Dizier, Haute-Marne, France) is obviously lost. It is not available at the MNHN, and was never mentioned by authors who revised the genus (Alloiteau 1957, 1958; Beauvais 1964), except for Morycowa (1997: 299), who claimed having seen the holotype, but this reference could also refer to the material observed by Alloiteau (1958) coming from Morancourt (Yonne).

Dimensions

c 3.5 - 4.5 mm
 ccd 4.0 - 5.0 (7.0) mm
 cn 2.0 - 2.2 mm
 sy 6
 s 6 s1 + 6 s2 + 12 s3 + 8 - 24 s4 = 32 - 48
 sk 6

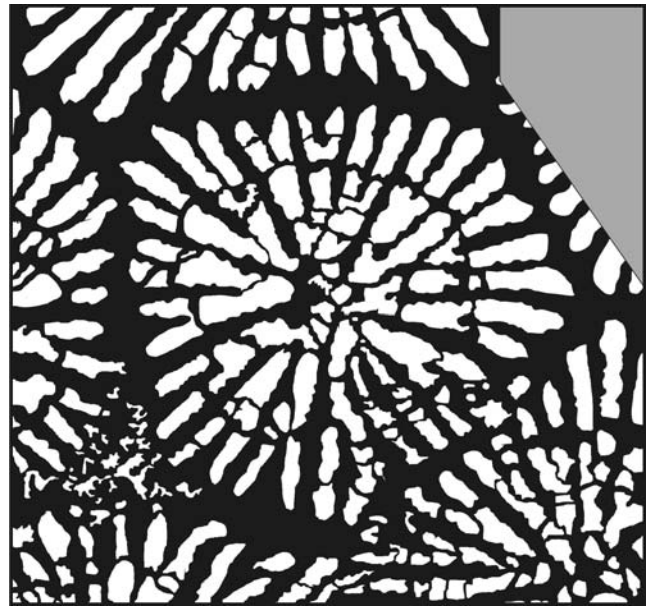


Fig. 2 - *Diplocoenia mirabilis* de Fromentel, 1857. Drawing after a transversal thin section. Early Hauterivian of Gy-l'Evêque, Yonne, France. BSP 2003 XX 6659a. x 15.

Description. Massive circular colony. Calices polygonal with sharp elevated borders. Calices slightly depressed, inner calices more depressed. Columella not visible. Calices generally with four to six borders. Septa in a regular symmetry of six. The first cycle reaches the columella and is attached to it and to other septa of the first cycle. Septal tips swollen. The septa of the second cycle are slightly shorter and slightly thinner than those of the first cycle. They can be free or attached (often by means of dissepiments) to the septa of the first cycle or to the columella. The septa of the third cycle are slightly shorter than those of the second cycle and are often connected to septa of the second cycle. Septa of the first through third cycles have almost the same thickness. Those of the following cycles remain short and reach only the dissepimental ring, often being attached to it. The fifth cycle is very rarely complete. The thickness of the septa of the fourth and fifth cycle is equal or less than those of the septa of the third cycle. The distal borders of all septa are regularly ornamented with small granules. All septa are ornamented with granules at their lateral faces. The columella is very variable; it is a small solid substyliform or lamellar element or consists of a few circular elements, partly attached to dissepiments and partly to the septa of the first cycle. The wall is septothecal, made of the slightly thickened external parts of the septa, probably including some rudimentary septa of the fifth cycle. The endotheca forms a regular dissepimental ring in the calice. Dissepiments also common in the central part of the calice.

Remarks. The unique type (which is lost) was obtained from the Marne bleue of St. Dizier (Haute-

Marne, France; Early Hauterivian). The author visited the locality in 1997, but it was found inaccessible and it was not possible to obtain sediments from this lithostratigraphic unit. The examined sample comes from the Calcaire à *Spatangus* of Gy-l'Evêque (Yonne, France), a lithostratigraphic unit that lays above the Marne bleue and which is considered only slightly younger in age. The sample fits well into the dimensions and septal counts given by de Fromentel (1857) with the exception that de Fromentel gave eight systems instead of six. He also mentioned only 32 septa which contradicts the illustration in de Fromentel (1857) where the total number of septa can be counted and is greater than 32. De Fromentel (1957: 40) mentioned also a range of 4-9 mm for the "space between the external walls" which does coincide with the illustration (de Fromentel 1857: pl. 5, fig. 8) where this value covers a range of 3.5-7mm. Alloiteau (1958) observed a topotype from Morancourt (Haute-Marne; Calcaire à *Spatangus*), which was not on hand for this study. The species is rare in the Calcaire à *Spatangus*. Though thousands of specimens were reviewed from the fossil rich localities around Auxerre (Yonne, France), only two specimens of *Diplocoenia mirabilis* were found.

Material and occurrence. Early Hauterivian: St. Dizier (Haute-Marne, France), fields NW of Gy-l'Evêque (Yonne, France; BSP 2003 XX 6659 with four thin section, BSP 2003 XX 6520), Morancourt.

Range. Early Hauterivian.

***Diplocoenia picteti* Koby, 1896**

*v 1896 *Diplocoenia Picteti* Koby, p. 24, pl. 5, figs. 7, 8

? v 1996 *Stylina elegans* (d'Orbigny, 1850) (non Eichwald, 1865) - Baron-Szabo & Steuber, p. 6, pl. 1, fig. 2

Types: Two syntypes are available (MHNG 4831) which belong to the same species.

Dimensions

c 3.5 mm
 ccd 3.5 - 4 mm
 cn 2.1 - 2.5 mm
 sy 6
 s 6 s1 + 6 s2 + 24
 sk 12-16

Remarks. The material was on hand but was not sectioned and no thin sections were obtained. An updated description cannot be given therefore. The material described by Baron-Szabo & Steuber (1996) does not belong to *Stylina* because it does not show any auriculae. This material differs from *Diplocoenia* by its fragmentary septothecal wall.

Material and occurrence. Late Barremian to early Aptian: Bonneville, Reignier (Haute-Savoie,

France; MHNG 4831). (?) early Aptian: Arachova (Viotía, Greece; MB K417)

Range. Late Barremian to early Aptian.

***Diplocoenia saltensis* de Fromentel, 1862**

Pl. 1, figs 9-12

*v 1862 *Diplocoenia saltensis* de Fromentel, p. 430

v 1879 *Diplocoenia Saltensis* - Fromentel, p. 511, pl. 127, fig. 2

v 1909 *Diplocoenia polygonalis* Prever, p. 126, pl. 13, fig. 17

v 1909 *Diplocoenia Roberti* Prever, p. 127, pl. 13, fig. 18

v non 1909 *Diplocoenia Saltensis* - Prever, p. 126, pl. 13, figs. 8-16 [= *D. dollfusi*]

? 1933 *Diplocoenia saltensis* From. - Bonchev, p. 223, pl. 1, fig. 3

? 1937 *Diplocoenia saltensis* Fromentel 1862 - Bataller, p. 97

v 1964 *Diplocoenia* aff. *coespitosa* (Etallon, 1862) - Morycowa, p. 58, text-fig. 9, pl. 13, fig. 3

v 1997 *Diplocoenia saltensis* de Fromentel - Morycowa, fig. 6f

1998 *Diplocoenia saltensis* Fromentel, 1857 - Morycowa & Masse, p. 750, figs. 12.6-8

Types: The species was created without a figure. The specimen figured by de Fromentel (1879) is considered the holotype (MNHN M03609). Holotype of *Diplocoenia polygonalis* is PU 17984 by monotypy. Holotype of *Diplocoenia roberti* is PU 17985 by monotypy.

Dimensions

c 4 - 5 mm
 ccd (2.5) 3 - 5 mm
 cn (1.6) 1.8 - 2.2 (2.3) mm
 sy 6
 s 6 s1 + 6 s2 + 12 s3
 sk 12

Remarks. The type material was available, but it was not possible to make sections or thin sections. A good description is provided by Morycowa & Masse (1998) which needs no comments. *Diplocoenia roberti* Prever, 1909, and *Diplocoenia polygonalis*, Prever, 1909 are considered junior synonyms. The holotype of *Diplocoenia polygonalis* (PU 17984) is poorly preserved. The material briefly described by Bataller (1937) from Spain was searched in the MGSB (Barcelona), but not found. It is not registered in the files and, according to Sebastian Calzada, this is likely an indication that the material is not in the collection (Barcelona, pers. comm. June 2007). *Diplocoenia saltensis* has comparable dimensions but differs from *Diplocoenia mirabilis* in its lower number of septa.

Material and occurrence. Late Barremian to early Aptian: Les Gardettes (Vaucluse, France). Early Aptian: Sault (Vaucluse, France; MNHN M03609, assumed holotype of *Diplocoenia saltensis*); roadcut near Perachorion NW Levadia (Levadia, Viotía, Greece; BSP 2003 XX 5738, 5742, 5788); Lanckorona, Jastrzebia (Wadowice, Malopolskie, Poland; 4 P 28); Vaucluse Mts, Rustrel (Vaucluse, France). Late Aptian: Monti d'Ocre, Fossa Mezzaspada (L'Aquila, Abruzzi, Italy;

PU 17984, holotype of *Diplocoenia polygonalis*, PU 17985, holotype of *Diplocoenia roberti*.

Range. Late Barremian to Aptian.

Other species

Only five *Diplocoenia* species are accepted for the Cretaceous. The remaining species are synonymous (*D. calzadai*, *D. etallonii*, *D. polygonalis*, *D. roberti*, *D. saltensis major*), are nomina nuda (*D. polygonalis* Kuzmicheva, 1962 non Prever, 1909) or do not belong to this genus.

Diplocoenia decaseptata Kuzmicheva, 1967 belongs, according to the illustration, to *Placocoenia*.

Diplocoenia klogsdorfensis Trauth, 1911 comes from a locality that is considered Cainozoic in age (Löser 2005). The species established by Trauth belongs to a Paleogene genus such as *Astreopora*, *Antiguastrea* or *Tarbellastraea*.

Diplocoenia nicolaui Reig Oriol, 1994 belongs to *Tricassastraea* Alloiteau, 1966.

Diplocoenia occidentalis Gregory, 1927 lacks the inner dissepimental ring and does not belong to *Diplocoenia*.

Diplocoenia octoseptata Kuzmicheva, 1967 belongs, according to the illustration, to *Placocoenia* or *Columnocoenia*.

Diplocoenia parvistella Alloiteau, 1958 is not recognisable from the illustration. The type was not found at the MNHN.

Diplocoenia splendida Prever, 1909 belongs to *Diploastrea* Matthai, 1914.

The material described by Baron-Szabo (2000) as *Diplocoenia* cf. *parvistella* Alloiteau, 1958 lacks the dissepimental zone and has a large styliform columella. It therefore does not belong to *Diplocoenia*.

The material originally described by Morycowa (1964) as *Diplocoenia stellata* (Etallon, 1859) was later assigned to *Diplocoeniella gerochi* Morycowa, 1997 by herself. The same applies to the material refigured by

Roniewicz & Morycowa 1993 as *Diplocoenia stellata*.

Summary

Five *Diplocoenia* species are distinguished within the Cretaceous (Fig. 3). Most of them occurred during the early Aptian, where four of the five species are found. Two species co-occur in the late Aptian of Italy (*D. dollfusi*, *D. saltensis*) and two in the early Aptian of Greece (*D. picteti*, *D. saltensis*). The species *D. mirabilis* and *D. hegyesina* are endemic in one region. The most widely distributed species – both geographically and stratigraphically – is *D. dollfusi*. *Diplocoenia* is a rare genus and occurs in the Cretaceous only as isolated samples, except for the early Aptian of Greece and the late Aptian of the Monti d'Ocre complex where *Diplocoenia* species were frequently found. For the Cretaceous the genus is restricted to the central Tethys and Boreal Europe (Paris Basin). It is unknown in the Caribbean. From Asia there exists only one questionable and imprecisely dated indication (*D. ogawaensis* from the Tithonian to Berriasian of Ogawa, Takaoka-gun, Kochi prefecture, Japan; Löser & Mori 2002). The sample is poorly preserved and its assignation to *Diplocoenia* is not sure. The genus disappeared during the early or middle Albian together with many other Mesozoic coral genera (see Löser 2005 for details), very probably caused by the oceanic anoxic event 1b and / or 1c (Erba 2004).

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Species	Hauterivian		Barremian		Aptian			Albian
	Early	Late	Early	Late	Early	E.Late	L.Late	Early
<i>dollfusi</i>					█	█	█	
<i>hegyesina</i>					█			
<i>mirabilis</i>	█							
<i>picteti</i>				█	█			
<i>saltensis</i>				█	█			

Fig. 3 - Stratigraphic distribution and commonness of *Diplocoenia* species. The thickness of the bars indicates the number of localities in which the species concerned was found.

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