

The Cretaceous corals from the Bisbee Group (Sonora; Late Barremian - Early Albian): Solenocoeniidae

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Abstract

The current work constitutes the third part of the systematic revision about the corals from the Bisbee Group (Late Barremian to Early Albian) and deals with the Solenocoeniidae. This family taxon is applied instead of the poorly defined Cyathophoridae. The family has three genera in the Cretaceous of Sonora: *Confusaforma*, *Cryptocoenia*, and *Cyathophoropsis*. To distinguish samples within the Sonoran fauna and species of this genus, systematic measurements of the corals were taken and statistically analysed. From the Bisbee Group, two *Confusaforma*, six *Cryptocoenia*, and one *Cyathophoropsis* species are here described and illustrated. Most are common Early Cretaceous species with a wide geographic and stratigraphic distribution.

Keywords: corals, Scleractinia, Early Cretaceous, Bisbee Group.

Resumen

El presente trabajo constituye la tercera parte de la revisión sistemática de los corales del Grupo Bisbee (Barremiano temprano a Aptiano tardío), la cual trata sobre la familia Solenocoeniidae, que se ha aplicado en lugar de la familia Cyathophoridae la cual se encuentra mal definida. La familia tiene tres géneros en el Cretácico de Sonora: *Confusaforma*, *Cryptocoenia* y *Cyathophoropsis*. Para distinguir las muestras dentro de la fauna y las especies del género se hicieron mediciones sistemáticas de los corales y se analizaron estadísticamente. Del Grupo Bisbee se describen e ilustran dos especies del género *Confusaforma*, seis especies del género *Cryptocoenia*, y una especie del género *Cyathophoropsis*. La mayoría de ellas son especies comunes en el Cretácico Temprano con una distribución geográfica y estratigráfica amplia.

Palabras clave: corales, Scleractinia, Cretácico Temprano, Grupo Bisbee.

1. Introduction

Building off the first part of the series (Löser, 2011), which introduced the Early Cretaceous (Late Barremian to Albian) coral fauna from the Bisbee Basin, this third part deals with material traditionally assigned to the very common coral family Cyathophoridae Vaughan and Wells, 1943. After re-examination of relevant material of the type from the type species of *Cyathophora*, *Cyathophora richardi* Michelin, 1843, it was concluded that the family Cyathophoridae, based on this genus, could no longer be used because the type material is poorly preserved and

contradicts its ascribed characteristics. Instead of the Cyathophoridae, the family Solenocoeniidae Roniewicz, 2008 is applied here. The definition of the subfamily Cyathophorinae Vaughan and Wells, 1943 and its later elevation into the range of a family by Alloiteau (1952) was not accompanied by a diagnosis based on the correct type material.

Four genera belonging to this family occur in the study area: *Confusaforma* Löser, 1987, *Cryptocoenia* Orbigny, 1849, *Cyathophoropsis* Alloiteau, 1946, and *Holocystis* Lonsdale, 1849. The latter genus was revised in Löser (2006), and Sonoran material was included (*Holocystis*

dupini, *Holocystis elegans*). Three of the four genera were reported in previous studies (Baron-Szabo and González-León, 1999, 2003), but newly collected material allows for an increase in the number of species. Details on the study area, lithology, stratigraphy, and outcrops are reported in Löser (2011). Details on the sample locations cited in the occurrence section in the systematic description are given in Löser (2011: tab. 1).

2. Material

The material varies in its state of preservation. Samples from marly layers are slightly better preserved than samples from carbonates. For the latter, it was more difficult to obtain good thin sections for the purpose of exact measurements and illustrations. Colony surfaces are rarely well preserved. Only thin sections were used for the determination. All specimens described here are kept at the Universidad Nacional Autónoma de México, Instituto de Geología, Estación Regional del Noroeste in Hermosillo, Sonora, México (ERNO). The material described by Baron-Szabo and González-León (1999, 2003) was available for study and, for many specimens, further thin sections were prepared to specify the morphology and taxonomy of species described by the two authors.

3. Methods

3.1. Sample preparation

Thin sections were prepared, all from well-preserved samples in both transversally and longitudinally oriented directions, where possible. The thin sections were scanned using a flatbed scanner with an optical resolution of 6400 dpi. The images were saved as 8-bit grey scale JPG files without compression. To increase the quality of the images, contrast stretching was applied. The images were used to prepare illustrations and to systematically record calicular dimensions.

3.2. Species separation

Traditionally, species separation in *Cryptocoenia* is based on the calicular diameter and the number of septal cycles that occur in a general hexamerous symmetry. The number of septa within one specimen is relatively constant, and the (smaller) calicular diameter shows a low variation (the larger calicular diameter shows a slightly larger variation) in one colony. The differentiation of species is difficult. Statistical analyses yield groups that are not well separated. The definition of the morphologic range of a species depends much on subjective decisions. The number of existing taxa is, therefore, extremely high: the Mid-Jurassic to early Late Cretaceous coral genus *Cryptocoenia*

and its synonyms equal, according to the literature, up to 150 species (Lathuilière, 1989; Löser, 2000). Here, species are separated by cluster analysis using the small calicular diameter and the number of septal cycles. About 400 specimens from the Late Jurassic to early Late Cretaceous were included; among them were 64 type specimens. The analysis resulted in 31 species. The definition of what constitutes a species or how large or small the groups are is highly subjective.

Cyathophoropsis is morphologically comparable to *Cryptocoenia* and differs only by a trimeral instead of hexamerous symmetry. However, this genus is rarer and more restricted in its stratigraphical distribution. Only about 25 specimens were available, resulting in three species: the type species, *C. ramosa* Hackemesser, 1936, and a yet unnamed species. The same applies to *Confusaforma*; for this genus, 20 specimens were available resulting in three species: the type species and two yet unnamed species. The unnamed species are also represented by Sonoran material, but it does not allow for the establishment of a new species due to its poor state of preservation. *C. carpathica* Kolodziej, 1995 was not included because it shows the presence of a main septum, which is a characteristic unknown from the type species.

3.3. Distribution data

The distribution data (as reflected in the synonymy lists) are entirely based on well-examined material. Material only mentioned in the literature and material not available for study has not been taken into account. To obtain better insight into the distribution patterns of the corals from Sonora, additional unpublished material – indicated by a collection acronym and sample number in parenthesis – was included.

4. Systematic description

4.1. Abbreviations

Collection abbreviations are as follows:

- BSPG, Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany;
- CGS, Česká geologická služba, Praha, Czech Republic;
- ERNO, Universidad Nacional Autónoma de México, Instituto de Geología, Estación Regional del Noroeste, Hermosillo, Mexico;
- IGM, Instituto de Geología, Ciudad de México, Mexico.
- IRScNB, Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium;
- MGSB, Museo Geológico del Seminario de Barcelona, Spain;
- MNHN, Muséum National d'Histoire Naturelle,

- Paris, France;
- MV, Vinseum, Vilafranca del Penedès, Spain;
 - NHM, The Natural History Museum, London, England;
 - NHMW, Naturhistorisches Museum, Wien, Austria;
 - PU, Museo di Geologia e Paleontologia dell'Università di Torino, Italy;
 - SAZU, Paleontoloski institut Ivana Rakovca, Ljubljana, Slovenia;
 - SMF, Senckenbergmuseum, Frankfurt, Germany;
 - TUM, The Tohoku University Museum, Sendai, Japan;
 - UP, Université de Provence, Marseille, France.

The following abbreviations are used describing the dimensions of the corals:

- ccd, distance between calicular centres;
- cl max, large lumen;
- cl min, small lumen;
- s, number of radial elements in adult calices.

The following abbreviations are used describing the statistical data:

- n, number of measurements;
- min-max, absolute range (mm);
- μ , arithmetic mean (mm);
- s, standard deviation (mm);
- cv, coefficient of variation (%);
- $\mu \pm s$, first interval (mm).

The abbreviations used in the synonymy lists follow Matthews (1973): *: earliest valid publication of the species name; p: the described material belongs only in part to the species concerned; v: the specimen was observed by the author.

4.2. Taxonomy

Order Scleractinia Bourne, 1900
Suborder ?Stylinina Alloiteau, 1952
Family Solenocoeniidae Roniewicz, 2008

Remarks. Here, it is proposed that the family Cyathophoridae should no longer be used, for the following reasons. The name-giving genus *Cyathophora* is based on *C. richardi* Michelin, 1843. The type material of the species was not available for long; observations on the genus were made on topotypical material (e.g., Alloiteau, 1948). In 2009, the type and figured specimen of *C. richardi* was discovered (MNHN A32288). The specimen was later observed (Zaman and Lathuilière, 2014), but the new illustration is insufficient, and the description corresponds to the concept of the genus, not to the type specimen. Thin sections were not prepared from the type specimen, although it is large and would allow this type of preparation. A diagnosis of the type specimen MNHN A32288 based on the authors' observation would be as follows: Cerioid colony. Calicular outline circular, diameter 6–7 mm, centres depressed. Septa compact. Microstructure

of septa unknown. Septal outline, thickness, and symmetry unknown. Number of septa *ca.* 30 – 40. Septal length not recognisable. Septa occasionally connected to each other. Septal distal margin, lateral face, and inner margin unknown. Pali or paliform lobes, Columella, and costae unknown. Synapticulae absent. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, but structure unknown. Coenosteum absent. Budding extracalicular. Specimen MNHN A32288 corresponds in its septal patterns to the illustration in Alloiteau (1948) and contradicts the characteristics ascribed to the family, where the septa are never connected to each other. Because of this and the poor knowledge on the genus *Cyathophora*, the family Cyathophoridae can no longer be used.

The family taxon Pentacoeniidae with Duncan (1884) as author cannot be applied as proposed by Löser (2014) because Duncan (1884) introduced the name as an Alliance. In the nomenclatory rules, this term is not mentioned as a level of the family group and because Duncan has arranged it below the Tribus, Alliance rather denominates a generic group. This family taxon cannot be used for genera formerly assigned to the Cyathophoridae family.

For the moment, the genera currently belonging to the Cyathophoridae family are assigned to the Solenocoeniidae family. This family is based on the Late Jurassic Solenocoenia Roniewicz, 1976. The genus is closely related to *Cryptocoenia* and differs only by channel-like structures that connect neighboured calices. Lauxmann (1991) considers the genus an intraspecific morphologic variation of *Cryptocoenia* because the presence and abundance of the channels vary much within the colonies.

Systematic position. The family Cyathophoridae was traditionally assigned to the suborder Stylinina because of certain affinities to the family Stylinidae. Gill (1977) proposed to consider the family Stylinidae and suborder Stylinina in a more limited sense. Both are characterised by the presence of an ear-like ornamentation of their inner septal margin (auricula; plural auriculae). Auriculae are also present in the suborder Rhipidogyrina. Members of the Solenocoeniidae (Cyathophoridae) show auriculae only very rarely and can, therefore, not remain in this suborder. The family differs from the Stylinidae also due to the strict absence of a columella. The form of the septa, the poor ornamentation of the distal septal margins and lateral faces, and the well-developed endotheca makes the Solenocoeniidae comparable to the Eugyridae family where all genera are meandroid or hydnochoroid.

Genus *Confusaforma* Löser, 1987

Type species. *Confusaforma weyeri* Löser, 1987 by original designation.

Diagnosis. Cerioid colony. Calicular outline irregular. Septa compact. Microstructure of septa unknown. Septa in cross section thick close to the wall and of triangular outline. Symmetry of septa irregular. Number of septa

low (less than 12). Septa very short, reduced to ridges, not connected to each other. No main septum. Septal lateral face smooth, inner margin smooth. Pali or paliform lobes, costae, synapticalae, columella absent. Endotheca consists of numerous and regular tabulae. Wall compact, probably septothecal. Budding extracalicular, probably also septal.

Species. Formerly described are two species as mentioned above, but there exist more unnamed material. Löser *et al.* (2013a) described a species in open nomenclature from the Late Albian of southern Spain. This species – *C. aff. weyeri* – can be only compared to the type species but may represent a new taxon as well. The determination of species in the framework of this study is mainly based on the direct comparison of the calicular dimensions (smaller and larger diameter). Septal counts are not helpful because the formation of septa is irregular and septal numbers are always low.

Confusiforma weyeri Löser, 1987

Figs. 1A-C

v 1909 *Polytremacis glomerata* - Prever, p. 69, pl. 27: 2.

*v 1987 *Confusiforma weyeri* Löser, p. 234, pl. 1: 1-3.

v 1989 *Confusiforma weyeri* Löser 1987 - Löser, p. 104, text-fig. 10-13, pl. 22: 1-5.

v 2003 *Confusiforma weyeri* Löser, 1987 - Baron-Szabo and González León, p. 207, fig. 7B.

v 2014 *Confusiforma weyeri* Löser, 1987 - Löser, p. 46, fig. 7g.

Description. Cerioid coral colony with calices with an irregular outline. Septa almost not visible, without symmetry, in a low number. Endotheca well developed.

Material examined. ERNO 3216.

Dimensions.

(3216)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	20	0.67–1.06	0.87	0.10	12.4	0.76–0.98
cl max	20	0.93–1.32	1.12	0.10	9.4	1.01–1.22
ccd	20	0.97–1.63	1.27	0.18	14.7	1.08–1.46
s		3–7				

Occurrence in Sonora. Early Albian of Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Early Aptian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Mezza Spada; Slovenia (West Slovenia) Banskja Planota, Osojnica (SAZU P-525). Early Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis (BSPG 2003 XX 5827). Early Cenomanian (Mantelliceras dixonii Zone) of Spain (Cantabria, Santander) Cobrecos,

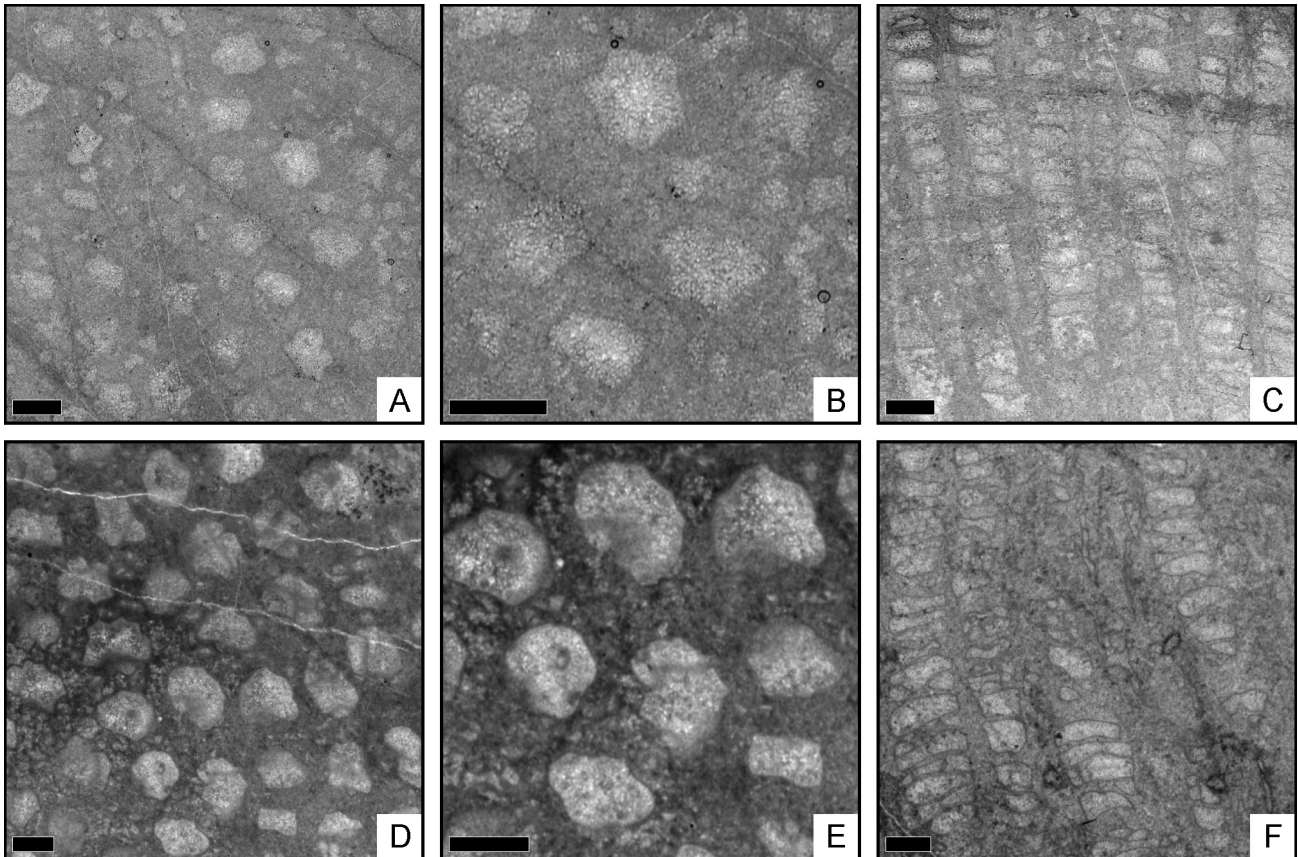


Figure 1. A-C, *Confusiforma weyeri* Löser, 1987, ERNO 3216. A, transversal thin section. B, transversal thin section, detail. C, longitudinal thin section. D-F, *Confusiforma aff. weyeri* Löser, 1987, ERNO 3214. D, transversal thin section. E, transversal thin section, detail. F, longitudinal thin section. Scale 1 mm.

Luaña playa (BSPG 2007 V 230). Late Cenomanian of the Czech Republic (Central Bohemian region) Kolín, Planany (CGS HF 2476). Late Cenomanian (Actinocamax plenus Zone) of Germany (Sachsen) Dresden-Plauen, Ratssteinbruch.

Confusaforma aff. *weyeri* Löser, 1987
Figs. 1D-F

v 2003 *Confusaforma weyeri* Löser, 1987 - Baron-Szabo and González León, p. 207, fig. 7B.

v 2013a *Confusaforma* sp. - Löser *et al.*, p. 29, pl. 9: 10-12.

Description. Cerioid coral colony with calices with an irregular, circular to rectangular outline. Septa almost not visible, without symmetry, in a low number. Endotheca well developed.

Material examined. ERNO 3179, 3214, L-4251.

Dimensions.

(3214)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	40	0.81–1.34	1.08	0.13	12.3	0.94–1.21
cl max	40	1.28–1.69	1.45	0.12	8.3	1.33–1.58
ccd	40	1.46–1.99	1.68	0.15	9.1	1.53–1.84
s	3–7					

Remarks. The material differs from the type species by larger dimensions.

Occurrence in Sonora. Early Albian of Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Early Valanginian of Spain (Andalucía, Jaén) Sierra de Cazorla, Cabañas, Puerto Llano section (ERNO L-1217079). Early Aptian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Sotto Colle Pagliare (PU 18162). Early Late Albian (Mortoniceras inflatum Zone) of Spain (Valencia, Alicante) Sierra de Llorença.

Genus *Cryptocoenia* Orbigny, 1849

Type species. *Confusaforma alveolata* Goldfuss, 1826 by monotype.

Diagnosis. Plocoid colony. Calicular outline circular. Septa compact. Microstructure of septa unknown. Symmetry of septa radial and regularly hexamer. Cycles of septa regular. Septal cycles differ in length. Septa short, not connected to each other. Septal lateral face and inner margin smooth. Pali or paliform lobes absent. Costae present, confluent or sub-confluent. Synapticulae and columella absent. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, probably parathecal. Coenosteum present, consists of costae and tabulae. Budding extracalicular.

Species. *Cryptocoenia* is – with its synonyms – one of the species-rich coral genera in the Early to early Late Cretaceous. The determination of species in the framework of this study is mainly based on the direct comparison of the calicular dimensions and septal counts of type material and

the studied material. This includes uncertainty because, for the majority of the type material, statistical values are not available. These values can only be obtained from a thin section, a peel or a large, well-preserved, polished section. Most type specimens do not have a polished section that would allow for the measuring of these values, and most institutions do not permit making large sections or obtaining thin sections that would result in any destruction of the type specimen. From Sonora, six species are distinguished.

Cryptocoenia almerai (d'Angelis d'Ossat, 1905)
Figs. 2A-C

*v 1905 *Convexastraea almerai* Angelis d'Ossat, p. 213, pl. 14: 11.

vp 2003 *Confusaforma weyeri* Löser, 1987 - Baron-Szabo and González León, p. 207, fig. 7B.

v 2013a *Cryptocoenia almerai* (d'Angelis d'Ossat 1905) - Löser *et al.*, p. 30, pl. 10: 6-7 [= here complete synonymy].

v 2014 *Cryptocoenia almerai* (Angelis d'Ossat, 1905) - Löser, p. 47, fig. 7h.

Description. Plocoid colony with circular calices. Septa very short. Septal cycles do almost not distinguish. Coenosteum narrow, with costae. Endotheca well developed.

Material examined. ERNO 2208, 3187, L-4298.

Dimensions.

(3187)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	30	1.06–1.52	1.31	0.12	9.7	1.18–1.44
cl max	30	1.29–1.69	1.46	0.11	7.9	1.34–1.58
ccd	30	1.40–1.87	1.59	0.12	8.0	1.47–1.72
s	6+6					

Occurrence in Sonora. Early Albian of Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Cretaceous of Greece (Fokída) Kiona massif, Panourgias. Hauterivian to Barremian of Chile (Atacama) Copiapo, Chañareillo, Molle-Alto. Barremian to Early Aptian of France (Bouches-du-Rhône) La Fare, Canal EDF (UP 4758.5). Barremian (*Moutoniceras moutonianum*, *Toxancyloceras vandenheckii*, *Gerhardtia sartousiana* and *Imerites giraudi* zones) of France (Drôme) Serre de Bleyton. Late Barremian to Early Aptian of Poland (Malopolskie). Aptian of Mexico (Puebla) San Juan Raya (IGM 9256). Early Aptian of Greece (Viotía) Arachova; Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Cerasetti; Mexico (Michoacán) Turitzio, Loma de San Juan (ERNO L-4878); Mexico (Puebla) San Juan Raya, Barranca Grande (ERNO L-R11696); Serbia (East Serbia) Pirot, Bela Palanka. Late Aptian of Japan (Iwate-ken) Shimohei-gun, Iwaizumi-cho, Omoto (TUM 65984). Late Aptian (*Acanthohoplites nolani* Zone) of Spain (Cataluña, Barcelona) Comarca del Garraf, Municipi de Vilanova i la Geltrú, Les Mesquites. Albian of Madagascar (Mahajanga) Ampanihy. Earlymost Albian (*Leymeriella tardefurcata* Zone) of Spain (Cataluña, Tarragona) Comarca del Baix

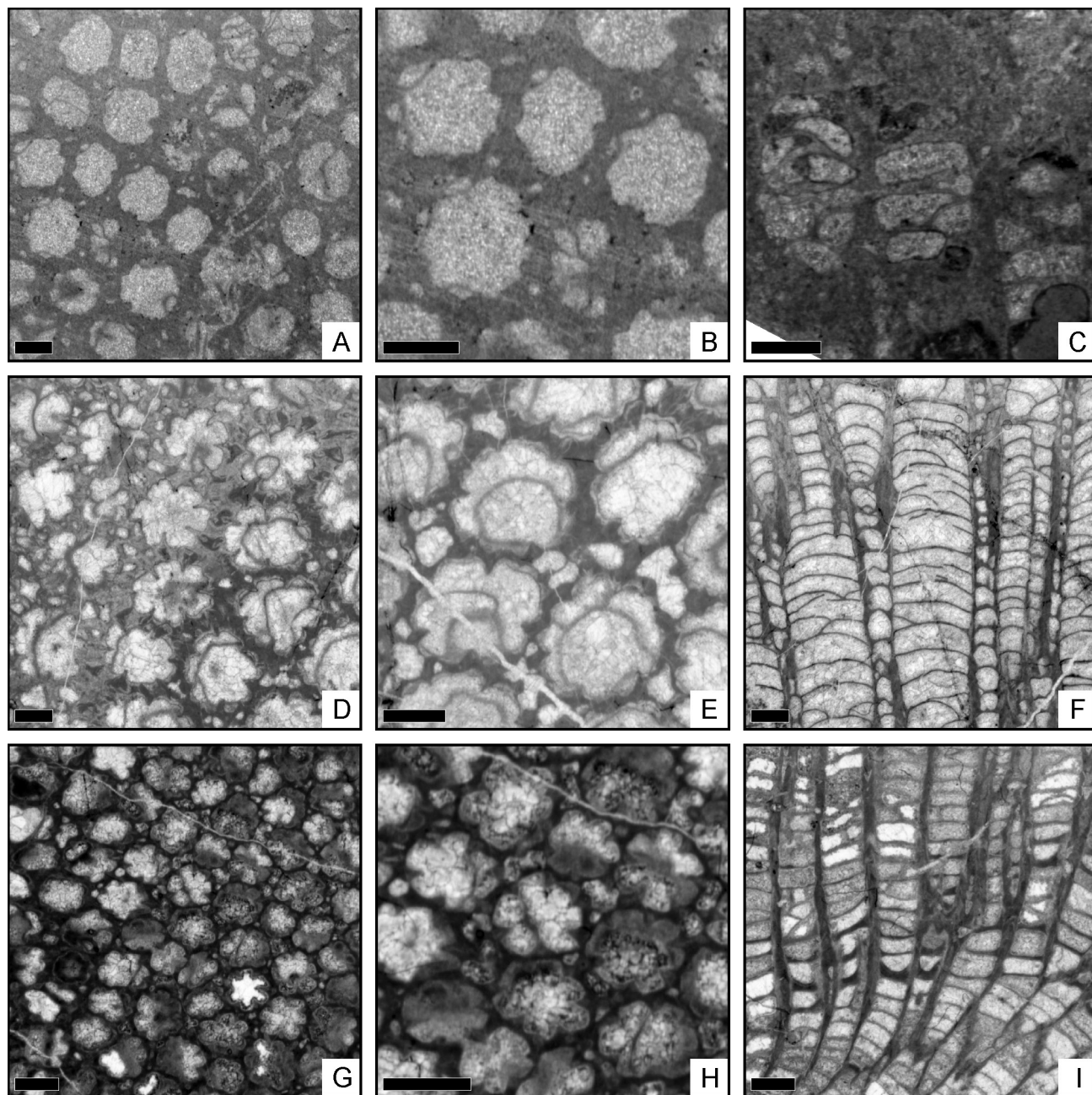


Figure 2. A-C, *Cryptocoenia almerai* (d'Angelis d'Ossat, 1905), ERNO 3187. A, transversal thin section. B, transversal thin section, detail. C, longitudinal thin section. D-F, *Cryptocoenia biedai* (Morycowa, 1964), ERNO L-4267. D, transversal thin section. E, transversal thin section, detail. F, longitudinal thin section. G-I, *Cryptocoenia dubia* (Koby, 1897), ERNO L-4305. G, transversal thin section. H, transversal thin section, detail. I, longitudinal thin section. Scale 1 mm.

Penedés, Municipi del Montmell, Marmellà, Can Xuec (BSPG 2003 XX 6221) and Municipi d'Olivella, Can Grau (MV 12751). Early Albian of Spain (Cantabria, Santander) Cabo de Ajo; Mexico (Baja California) Santo Tomás, Arroyo de la Cueva (ERNO L-1347137). Early to Middle Albian of Spain (Valencia, Alicante) Sierra de Seguili. Late Early Albian (*Douvilleiceras mammillatum* Zone) of Spain (Cantabria, Santander) Cala de Islares (ERNO L-133113). France (Aude) Padern, SE Le Crès, 1.45 km WWS Padern (SMF 75613). Early Late Albian (*Mantelliceras mantelli*

Zone) of Spain (Valencia, Alicante) Sierra de Llorença. Late Albian of Spain (Murcia) Jumilla, Sierra del Carche (BSPG 2014 XV 34). Early Cenomanian (*Mantelliceras mantelli* Zone) of Germany (Nordrhein/Westfalen) Mülheim/Ruhr, Kassenberg. Early Cenomanian of France (Charente-Maritime) Fouras (BSPG 2003 XX 1710). France (Charente-Maritime) Ile d'Aix (MNHN). Middle Cenomanian (*Mantelliceras mantelli*, *Mantelliceras dixonii*, *Cunningtoniceras inerme* and *Acanthoceras rhotomagense* zones) of Belgium (Hainaut) Tournai (IRScNB I. G. 5496

/ L16). Early Cenomanian (*Mantelliceras dixoni* Zone) of Germany (Sachsen) Meißen-Zscheila, Trinitatis church. Late Cenomanian (*Cunningtoniceras guerangeri* Zone) of Czech Republic (Central Bohemian region) Korycany (NM O 1875) and Netreba (CGS HF 1502). Late Cenomanian (*Actinocamax plenus* Zone) of Germany (Sachsen) Dresden-Plauen, Ratssteinbruch.

Cryptocoenia biedai (Morycowa, 1964)
Figs. 2D-F

*v 1964 *Adelocoenia biedai* Morycowa, 1964, p. 26, pl. 4: 2, pl. 5: 5.

v 2004 *Adelocoenia desori* (Koby, 1897) - Löser and Mohanti, p. 580, fig. 2ab.

v 2010 *Cryptocoenia ramosa* Toula, 1889 - Löser, p. 595, fig. 3.9.

v 2013 *Cryptocoenia bulgarica* (Toula, 1884) - Löser, p. 33, fig. 11de.

Description. Plocoid colony with circular calices. Septa short. Septal cycles distinguish in septal length. Coenosteum narrow, with costae and exothecal dissepiments. Endotheca well developed.

Material examined. ERNO 2201, L-4267, L-4296, L-4829.

Dimensions.

(L-4267)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	30	1.54–1.92	1.72	0.12	7.3	1.60–1.85
cl max	30	1.62–2.29	1.97	0.18	9.2	1.79–2.15
ccd	30	1.74–2.35	2.05	0.16	8.0	1.88–2.21
s		6–12				

Occurrence in Sonora. Early Albian of Municipio Arizpe, Arizpe, Cerro La Ceja; Municipio Cucurpe, Cucurpe, La Mesa; Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Barremian (*Moutoniceras moutonianum*, *Toxancyloceras vandenheckii*, *Gerhardtia sartousiana* and *Imerites giraudi* zones) of France (Drôme) Serre de Bleyton. Early Aptian of Greece (Viotía) Arachova (BSPG 2003 XX 5456); Mexico (Michoacán) Turitzio, Loma de San Juan (ERNO L-4879), Early Albian of Late Early Albian (*Douvilleiceras mammillatum* zone) of France (Aude) Padern, SE Le Crès, 1.45 km WWS Padern. Cenomanian of Greece (Fokída) Kiona massif, Panourgias (ERNO L-5904); India (Tamil Nadu) Kunnam. Early Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis (BSPG 2003 XX 5848). Early Cenomanian (*Mantelliceras dixoni* Zone) of Germany (Sachsen) Meißen-Zscheila, Trinitatis church (ERNO L-6042). Late Cenomanian (*Cunningtoniceras guerangeri* Zone) of Czech Republic (Central Bohemian region) Korycany, Netreba (CGS HF 1474).

Cryptocoenia dubia (Koby, 1897)
Figs. 2G-I

*v 1897 *Convexastrea dubia* Koby, p. 31, pl. 4: 1-3
v 1932 *Astreopora (?) leightoni* Wells, p. 254, pl. 36: 6

v 1964 *Orbignycoenia pygmaea* (Volz, 1903) - Morycowa, p. 30, pl. 4: 1, pl. 7: 1.

v 1976 *Cyathophora pygmaea* Volz 1903 - Turnšek and Buser, p. 11, 38, pl. 1: 1, 2.

Description. Plocoid colony with circular calices. Septa short but well visible. Coenosteum very narrow, with costae and some exothecal dissepiments. Endotheca well developed.

Material examined. ERNO L-4238, L-4269, L-4305, L-4369, L-4428, L-4488.

Dimensions.

(L-4305)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	50	0.72–1.12	0.91	0.09	10.7	0.81–1.01
cl max	50	0.93–1.31	1.10	0.09	8.9	1.00–1.20
ccd	50	0.80–1.37	1.05	0.14	13.7	0.91–1.20
s		6				

Occurrence in Sonora. Early Albian of Municipio Agua Prieta, E San Bernardino Valley, Cordon Caloso; Municipio Arizpe, Arizpe, Cerro La Ceja; Municipio Opodepe, Tuape, Cerro de la Espina; Municipio Ures, Cerro de Oro.

Occurrence elsewhere. Cretaceous of Slovenia (West Slovenia) Banjska planota, Kanalski Lom. Barremian of France (Doubs) Morteau. Barremian (*Moutoniceras moutonianum*, *Toxancyloceras vandenheckii*, *Gerhardtia sartousiana* and *Imerites giraudi* zones) of France (Drôme) Serre de Bleyton. Early Aptian of Spain (Murcia) Jumilla, Solano del Sopalmo (MGSB 73673); Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Agnese (ERNO L-5306); Poland (Malopolskie, Wadowice) Lanckorona, Jastrzebia. Late Aptian of Spain (Valencia, Castellón) Benicasin, La Venta (MGSB 73722). Early Albian of USA (Texas) Comal County. Early Cenomanian (*Mantelliceras mantelli* Zone) of Germany (Nordrhein/Westfalen) Mülheim/Ruhr, Kassenberg (BSPG 2003 XX 1255).

Cryptocoenia cf. kiliani (Prever, 1909)
Figs. 3A-C

v 1964 *Cyathophora minima* Etallon 1862 - Morycowa, p. 22, pl. 3: 1, pl. 5: 4.

v 1981 *Cyathophora pygmaea* Volz 1903 - Turnšek and Mihajlovic, p. 18, pl. 13: 1, 2

vp 2003 *Confusaforma weyeri* Löser, 1987 - Baron-Szabo and González León, p. 207, fig. 7B.

v 2010 *Cryptocoenia miyakoensis* (Eguchi, 1936) - Löser, p. 593, fig. 3.7.

Description. Plocoid colony with circular calices. Septa short. Coenosteum very narrow. Endotheca developed.

Material examined. ERNO 2174, 3209, L-4431, L-4950.

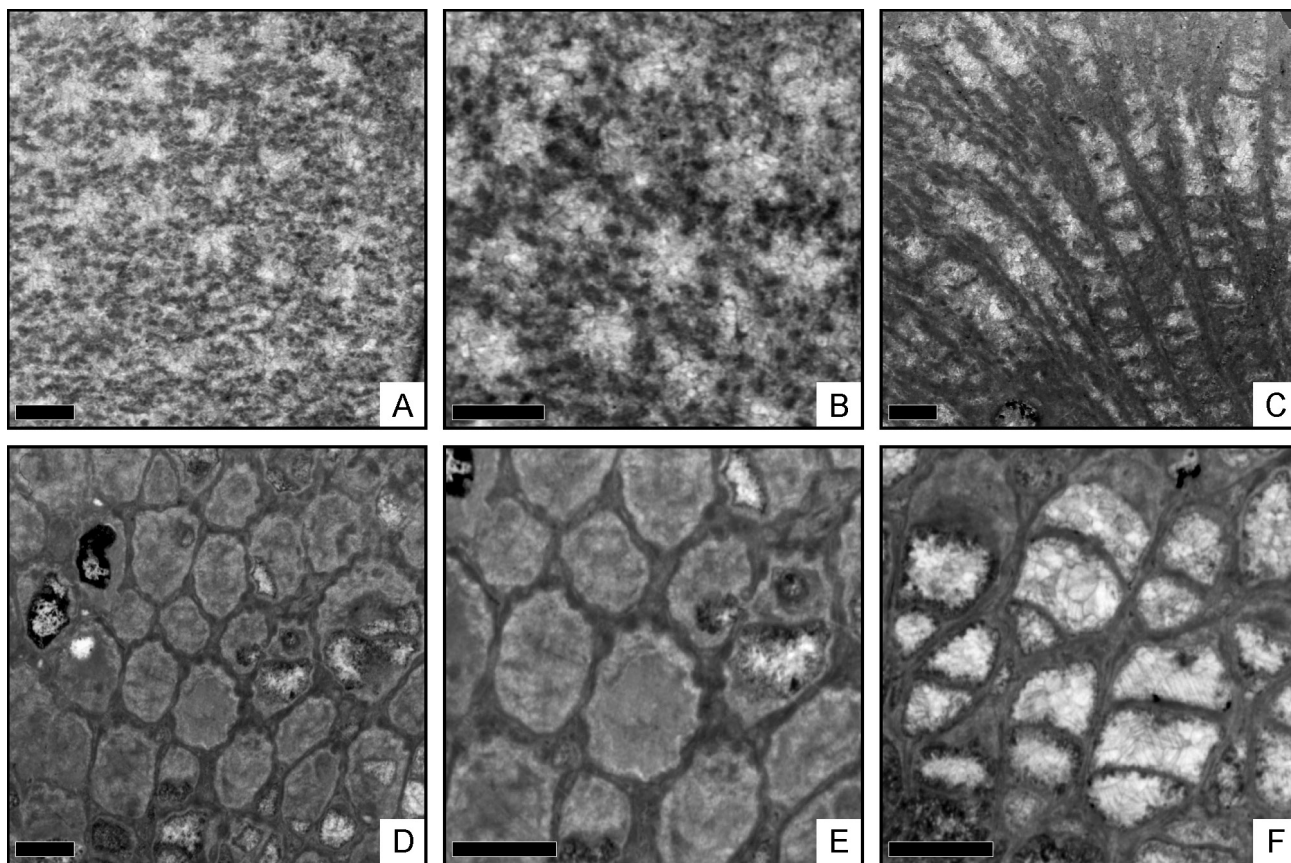


Figure 3. A-C, *Cryptocoenia kiliani* (Prever, 1909), ERNO L-4950. A, transversal thin section. B, transversal thin section, detail. C, longitudinal thin section. D-F, *Cryptocoenia reussiana* (Stoliczka, 1873), ERNO L-4299. D, transversal thin section. E, transversal thin section, detail. F, longitudinal thin section. Scale 1mm.

Dimensions.

(3209)	n	min-max	μ	s	cv	$\mu \pm s$
ccd	15	0.93–1.38	1.17	0.11	9.6	1.06–1.28
cl min	15	0.78–1.23	1.00	0.11	11.5	0.88–1.11
cl max	15	0.97–1.69	1.31	0.16	12.8	1.14–1.48
s	6					

Remarks. The material differs from *C. kiliani* by larger calicular dimensions.

Occurrence in Sonora. Early Albian of Municipio Opodepe, Tuape, Cerro de la Espina; Municipio Santa Ana, Santa Ana; Municipio Ures, Cerro de Oro.

Occurrence elsewhere. Barremian (*Moutoniceras moutonianum*, *Toxancyloceras vandenheckii*, *Gerhardtia sartousiana* and *Imerites giraudi* zones) of France (Drôme) Serre de Bleyton. Early Aptian of Poland (Malopolskie, Wadowice) Lanckorona, Jastrzebia; Serbia (East Serbia) Sopot. Early Albian of Mexico (Baja California) Santo Tomás, Arroyo de la Cueva (ERNO L-1347115). Middle Albian of Mexico (Sonora) Municipio San Pedro de la Cueva, Tepache, Lampazos area, Espinazo de Diablo (ERNO L-134211).

Cryptocoenia cf. *miyakoensis* (Eguchi, 1936)

Figs. 4AB

Description. Plocoid colony with calices of an irregular outline. Septa short. Coenosteum narrow. Endotheca well developed.

Material examined. ERNO L-4260, L-4283.

Dimensions.

(L-4260)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	20	1.21–1.46	1.35	0.07	5.4	1.27–1.42
ccd	20	1.41–2.40	1.85	0.29	16.1	1.55–2.15
s	6					

Remarks. The material differs from *C. miyakoensis* by slightly larger dimensions. The material is poorly preserved.

Occurrence in Sonora. Early Albian of Municipio Cucurpe, Cucurpe, La Mesa; Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Early Aptian of Greece (Viotia) Levidia, Perachorion (BSPG 2003 XX 5768). Aptian to Early Albian of Japan (Iwate-ken) Miyako-shi, Sakiyama, Hideshima (TUM L-NN-10). Late Aptian of Japan (Miyagi-ken) (TUM L-NN-9). Early Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis (BSPG 2003 XX 5883).

Cryptocoenia reussiana (Stoliczka, 1873)

Figs. 3D-F

*v 1873 *Astrocoenia reussiana*, Stoliczka, p. 27, pl. 5: 3, 4.

v 1947 *Cyathophora fontseriei* Bataller, p. 48, text-fig.

v 1971 *Cyathophora pygmaea* Volz, 1903 - Morycowa, p. 40, text-fig. 6 b, 6 c, pl. 5: 1.

v 1974 *Cyathophora pygmaea* Volz - Turnšek and Buser, p. 12, 33, pl. 4: 1.

v 1981 *Cyathophora pygmaea* Volz 1903 - Turnšek and Mihajlovic, p. 18, pl. 13: 1, 2.

v 1994 *Adelocoenia pygmaea* (Volz 1903) - Löser, p. 10, text-fig. 4, 5, pl. 12: 1, 2.

v 2013b *Cryptocoenia fontseriei* (Bataller, 1947) - Löser et al., p. 66, pl. 9: 7-9.

Description. Plocoid colony with circular calices. Septa extremely short, almost not visible. Septal cycles do not distinguish. Coenosteum very narrow. Endotheca developed.

Material examined. ERNO L-4236, L-4299.

Dimensions.

(L-4299)	n	min-max	μ	s	cv	$\mu \pm s$
cl min	30	0.75-1.00	0.88	0.07	9.0	0.80-0.96
cl max	15	0.99-1.40	1.22	0.14	11.7	1.07-1.36
ccd	30	0.85-1.40	1.06	0.14	13.9	0.91-1.21
s	6+6					

Occurrence in Sonora. Early Albian of Municipio Opodepe, Tuape, Cerro de la Espina.

Occurrence elsewhere. Late Barremian to Early Aptian of Bulgaria (Veliko Tarnovska oblast) Veliko Tarnovo (NHMW). Early Aptian of Spain (Vascongadas, Vizcaya) Bilbao, Mina Abandonada; Slovenia (West Slovenia) Banskja Planota, Osojnica; Serbia (East Serbia) Sopot. Early Aptian (*Palorbitolina lenticularis* Zone) of

Romania (Suceava) Pojorîta area, Cîmpulung-Moldovenesc, Valea Izvorul Alb. Late Albian of United Kingdom (Devonshire) Exeter, Haldon Hill (NHM R54423); India (Tamil Nadu) Karai. Early Cenomanian (*Mantelliceras mantelli* Zone) of Germany (Nordrhein/Westfalen) Mülheim/Ruhr, Kassenberg. Early Cenomanian of France (Charente-Maritime) Fouras (ERNO L-5593). Middle Cenomanian (*Mantelliceras mantelli*, *Mantelliceras dixonii*, *Cunningtoniceras inerme* and *Acanthoceras rhotomagense* zones) of Belgium (Hainaut) Tournai (IRScNb I. G. 6852 / L 17). Early Cenomanian (*Mantelliceras dixonii* Zone) of Spain (Cantabria, Santander) Cobreces, Luaña playa (BSPG 2007 V 064). Middle Cenomanian of Germany (Bayern) Roßstein-Almen.

Genus *Cyathophoropsis* Alloiteau, 1946

Type species. *Cyathophoropsis hupei* Alloiteau, 1946 by original designation.

Diagnosis. Plocoid colony. Calicular outline circular, diameter generally less than two millimetres, pit depressed. Septa compact. Microstructure of septa unknown. Septa in cross section thick close to the wall, thinner toward the centre. Symmetry of septa radial and regularly trimeral. Cycles of septa regular. Septal cycles differ in length. Septa short, not connected to each other. Septal distal margin unknown, lateral face smooth, inner margin with auriculae in places. Pali or paliform lobes absent. Costae present, sub-confluent to non-confluent, surface unknown. Synapticulae and columella absent. Endotheca consists of regular tabulae and occasional dissepiments. Wall present, compact, probably parathecal. Coenosteum narrow, consists of costae and tabulae. Budding extracalicular.

Species. Formerly described is only the type species; the here presented species was originally assigned to the genus *Heterocoenia*.

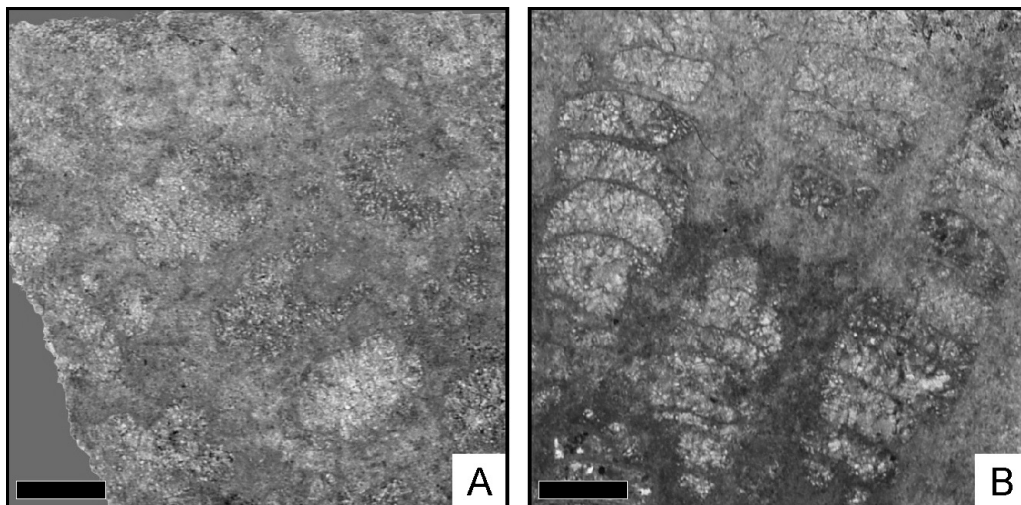


Figure 4. A-B, *Cryptocoenia* cf. *miyakoensis* (Eguchi, 1936), ERNO L-4260. A, transversal thin section. B, longitudinal thin section. Scale 1mm.

Cyathophoropsis ramosa Hackemesser, 1936
Fig. 5A-C

v* 1936 *Heterocoenia decipiens* Prv. var. *ramosa* n. var. Hackemesser 1936, p. 29, pl. 4: 3.

v 1999 *Cyathophora miyakoensis* (Eguchi, 1936) - Baron-Szabo and González-León, p. 478.

Description. Plocoid colony with irregularly formed calices. Septa short. Two septal cycles in a trimeral symmetry. Coenosteum and endotheca well developed.

Material examined. ERNO 2177.

Dimensions.

(2177)	n	min-max	μ	s	cv	μ±s
cl min	20	1.77-2.37	2.14	0.15	7.4	1.98-2.30
cl max	20	2.17-2.80	2.50	0.19	7.6	2.30-2.69
s	3+3					

Remarks. This specimen is the first indication of the genus in the Western Hemisphere, and also the oldest

indication at all. All other known material is from the Late Aptian to Early Albian with a questionable indication in the Cenomanian.

Occurrence in Sonora. (? Late Barremian to) Early Aptian of Municipio Ures, Cerro de Oro.

Occurrence elsewhere. Cretaceous of Greece (Fokída) Kiona massif, Panourgias.

5. Discussion

The Sonoran species of the genera *Confusaforma* and *Cryptocoenia* show a long stratigraphical (Fig. 6) and wide palaeogeographical distribution. For the *Cyathophoropsis* species, ranges are not available because of the uncertainty of the type locality's stratigraphy. Most of the species occur from the Aptian and reach into the Cenomanian. Both genera have their last occurrence in the Late Cenomanian; therefore, no younger occurrence exists. Geographically, the

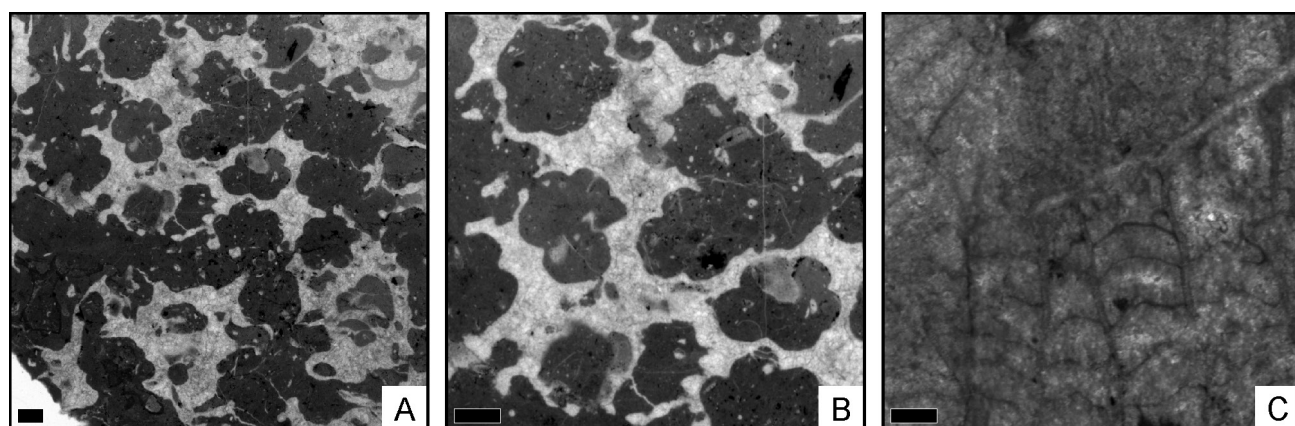


Figure 5. A-C, *Cyathophoropsis ramosa* Hackemesser, 1936, ERNO 2177. A, transversal thin section. B, transversal thin section, detail. C, longitudinal thin section. Scale 1mm.

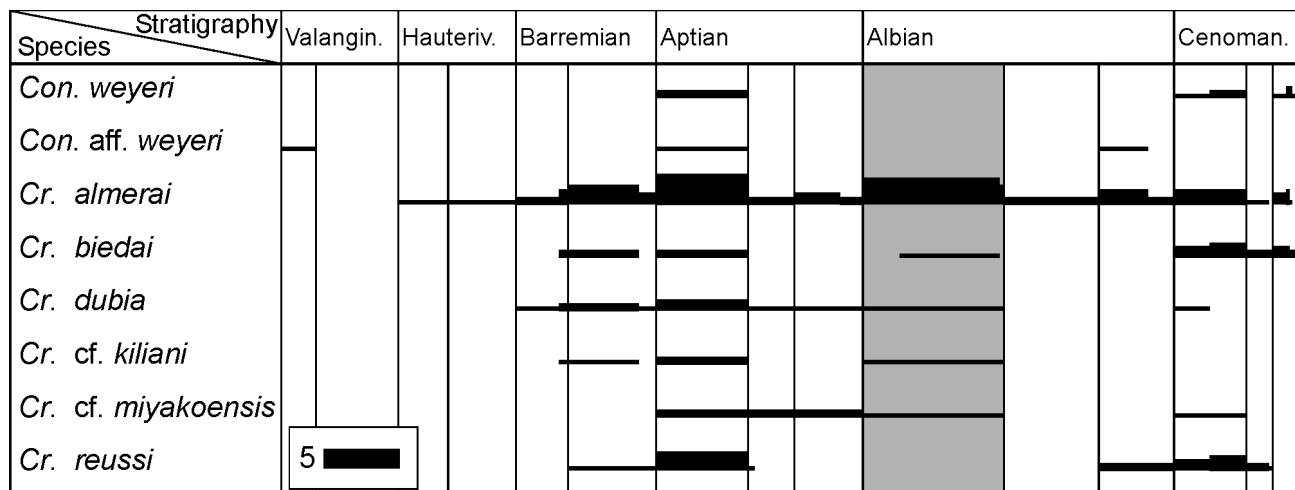


Figure 6. Stratigraphic distribution and commonness of species. The thickness of the bars indicates the number of localities in which the species concerned was found. Grey area marks the study area (Upper Mural Formation).

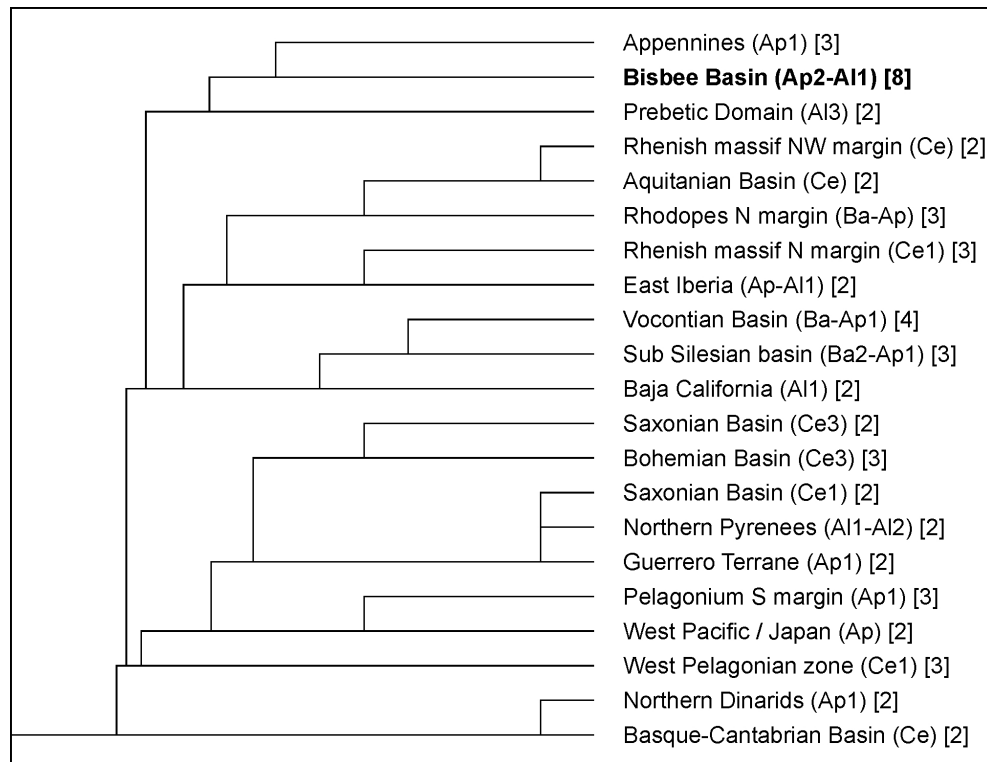


Figure 7. Correlation of provinces with joint species of the study area. Provinces with only one joint species are suppressed. The Correlation Ratio coefficient was applied. For details of calculation see Löser and Minor (2007).

Sonoran species of the Solenocoeniidae family only show a relationship to Western and Central Tethyan faunas (Fig. 7). The species almost do not co-occur in nearby localities, such as the Texas Platform, Baja California, or the Puebla Basin. *Confusaforma* and *Cryptocoenia* are unknown from the (Late Barremian? to) Early Aptian Cerro de Oro Formation in Sonora, and *Cyathophoropsis ramosa* is unknown to the Mural Formation.

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