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THE SCLERACTINIAN CORAL GENUS *GLENAREA* (BOHEMIAN CRETACEOUS BASIN)

HANNES LÖSER
Estación Regional del Noroeste, Instituto de Geología, Universidad Nacional Autónoma de México, Blvd. Luis Donaldo Col. Los Arcos, Colosio S/N y Madrid, 83250 Hermosillo, Sonora, Mexico; e-mail: hloeser@gmx.net

JAN SKLENÁŘ
Palaeontological Department, Natural History Museum, National Museum, Václavské náměstí 68, 115 79 Praha 1, Czech Republic; e-mail: jan_sklenar@nm.cz

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Abstract. The enigmatic Cretaceous coral genus *Glenarea* is revised on the basis of the type specimen of its type species *Glenarea cretacea* Počta, 1887. The provenance of the large silicified specimen is discussed. *Glenarea* has an unusual morphology and resembles the Eocene coral genera *Triphyllocoenia* and *Ewaldocoenia*. Both the latter genera are revised here as well, resulting in synonymisation of *Ewaldocoenia* with *Triphyllocoenia*. *Glenarea* shows fewer than 10 thick, unconnected septa that lack any symmetry in their arrangement. Skeletal elements such as columella, pali and endotheca are absent. The genus is only known from the type specimen. For the coral material that was assigned to *Glenarea* after 1991, the genus *Sakalavastraea* Alloiteau, 1958 with the type species *S. collignoni* from the Callovian of Madagascar is applied. Another three species are assigned to the genus, one of which is new. The range of *Sakalavastraea* is considerably extended from Callovian to Cenomanian; the genus is distributed worldwide.

■ Scleractinia, Bohemian Cretaceous Basin, Late Cretaceous, Taxonomy, Fossil Corals, near-shore fauna

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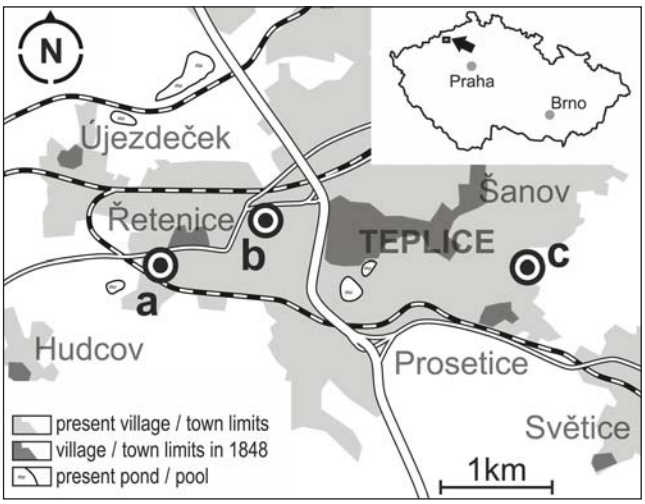
Introduction

The Bohemian palaeontologist Filip Počta established in 1887 the Scleractinian coral genus *Glenarea* with the type species *Glenarea cretacea* (by monotypy) from the lower Upper Cretaceous of the Bohemian Cretaceous Basin (BCB). Počta applied very advanced methods for the time and prepared numerous thin sections from the corals he described. These thin sections formed the basis for drawings of fine skeletal structures of the corals that were finally published. For the genus *Glenarea* and the new species Počta provided an image of a part of the surface of the colony and a smaller drawing that has the appearance of a polished or a thin section (Počta labelled this drawing 'Durchschnitt', or intersection). The provided diagnosis is comprehensive. There were no more species assigned to the genus until Krasnov (1964) established *Glenarea jurensis* from the Upper Jurassic of the Crimean Mts (Ukraine). This species belongs to *Acanthogyra* Ogilvie, 1897 (thin sections of the type material were available to HL). Kuzmicheva (1987) established a further species; later, in Kuzmicheva (2002) this species was assigned to *Polypetalum* Kuzmicheva, 2002. From 1989 on, Eliášová revised the corals of the Bohemian Cretaceous systematically. This task was rather difficult because the type material of all the species established by Reuss (1844, 1846) was unavailable as it was probably lost during the Soviet intervention in Budapest in 1956. The only accessible type specimens of Počta (1887) were kept at the National Museum in Prague, with a few exceptions. The holotype of *Glenarea cretacea* could not be found. Eliášová (1991) established therefore a neotype based on upper Cenomanian material from Korycany, a Central Bohemian locality different from the type locality. Simultaneously, she established a new *Glenarea* species using material from the same site. The neotype and the new species remained questionable. Whereas the coral illustrated by Počta (1887) has only a few rudimentary septa without any septal symmetry, unconnected to each other in the calicular centre, and lacking a columella, the material presented by Eliášová (1991) shows a subregular hexameral symmetry with numerous septa fused in the centre of the calice forming a week columella. Eliášová (1991) did not explain these obvious differences from the Počta material. Between 2004 and 2011 the palaeontological collections of the National Museum were moved to a research centre in the suburban zone of Prague. During the following rearrangement of the collection, previously lost type material of species established by Počta (1887) was found. Among these type specimens is also the holotype of *Glenarea cretacea* that answers old questions and raises new ones.

The type locality of *Glenarea cretacea*

The correct geographic position of the type locality of *Glenarea cretacea* calls for discussion. Počta (1887) indicated that the single *G. cretacea* specimen comes from



Text-fig. 1. Geographic situation of the source area of the *Glenarea cretacea* holotype. a, Řetenice locality of A. E. Reuss, b, Teplice-Stínadla locality, c, Teplice-Písečný vrch locality. For detail, see 'type locality of *Glenarea cretacea*' chapter.

'a Cenomanian hornstone that fills fissures in porphyry near Settenz' (today called Řetenice) and noted that the specimen had been sent to the museum (i.e. NM in Prague) by 'Mr. Fassel'. J. Fassel was a skilled private collector who prospected the area for many years.

Řetenice (or Settenz) itself offers two options. The most likely original location is a former outcrop described by A. E. Reuss (1840) in the western vicinity of Řetenice (see Text-fig. 1a). The position of this place is marked in Text-fig. 1a following the indications provided by Reuss. He described the outcrop as 'the fill of fissures in porphyry' (compare also with Počta 1887), with sediment partially silicified, passing upward into a planar layer of hornstone of a dark-grey colour permeated with greyish or greenish to brown iron containing quartz veins (translated into more up-to-date terminology). This description matches the *Glenarea* specimen character as well. The walls of the fissure were encrusted with barite crystals (typical of the Teplice-Stínadla locality described below where they are still collected by hobby mineralogists). This Řetenice locality was situated at an altitude very close to that of Stínadla, although the whole area is affected by tectonics. Reuss describes the fossils coming from the fissures as predominantly indistinguishable, mostly 'Terebrateln' (a broad denomination of rhynchonelliform brachiopods, see Reuss 1846) and 'Plagiostomen' (bivalves of unclear characteristics, probably ranking within Reuss's concept of *Lima*). This note on the fossil assemblage cannot result in even a rough stratigraphic conclusion. There are no other contemporary sources reporting on the fossils from this locality, except Laube (1884), who noted they were 'of the same kind' as those found at Stefanshöhe (= Písečný vrch at eastern edge of Teplice). The Reuss locality is likely to have been exploited by Fassel even in the second half of the nineteenth century and it is probable that it was called 'Settenz' because of its position close to the former village. The locality perished during porphyry quarrying prior to World War I (Zahálka 1914), and the spot was subsequently covered with a housing estate.

The second spot which probably yielded the type specimen is Teplice-Stínadla, N–NW of the present-day Teplice sports arena, and about 1 km geodetic distance E–NE from Řetenice (see Text-fig. 1b). The name in earlier German literature is 'Kopfhügel'; its literal translation is 'Head Hill', referring like the Czech name Stínadla to a medieval execution hill. From the beginning of the nineteenth century, this locality was well-known for its 'rocky-coast' near-shore fauna with predominating corals, rudists, rhynchonelliform brachiopods and cidaroid echinoids (Macák 1966). Generally, the fossils are silicified, often brown-red in colour with iron oxides and resembling the *G. cretacea* holotype in preservation. The marine sediments are situated right on the abraded ignimbrite basement. Ignimbrite also forms the clastic components of the basal conglomerates in the same area. Unequivocal biostratigraphical markers are missing and the relative position of these 'rocky-coast' facies to the surrounding Cretaceous sediments is unknown (Macák 1966). The fossil assemblage of the Teplice-Stínadla locality is typical of the early Late Cretaceous of the Bohemian Cretaceous Basin (BCB), but the exact age is under discussion (see below). The locality was set in relation to other near-shore localities in its vicinity (Písečný Vrch or Řetenice; the latter in Soukup (1963) without closer specification). Although some of the contemporary authors (e.g. Frič 1869) refer to the Stínadla locality as 'Kopfhügel near Vřetenice' (i.e. Řetenice), it is rather improbable that the local collector Fassel would call the locality just 'Settenz' [= Řetenice] suppressing the exact 'Kopfhügel' spot. Although the locality is still accessible, the fossiliferous portions of the outcrop are not.

The age and/or relations of sediments of the 'rocky-coast' localities situated at the so-called 'Lahošť–Teplice porphyry ridge' (Řetenice of Reuss, Stínadla and Písečný vrch in particular) have been a common subject of discussion since the end of the eighteenth century (F. A. Reuss 1790). The problem has not been satisfactorily resolved because of the lack of distinct markers and the absence of micropalaeontological records due to subsequent alteration. The localities are not accessible anymore or they are not accessible in the sections pivotal for solution of the puzzle. The relationship between these 'rocky-coast' spots and hemipelagic facies remains in most cases uncertain, although Zahálka (1914) demonstrates the sedimentation is contemporary with the marl/limestone sedimentation known from the close vicinity. The age of the 'rocky-coast' localities was reported to be Cenomanian (Frič 1911a, b, Soukup 1963), early Turonian (Soukup 1963), early to middle Turonian (Fencl and Záruba 1956), or even late Turonian (e.g. Zahálka 1914). The general transgression/regression history of the BCB is no help, as the sedimentation of the Teplice area was strongly affected by movements along the Labe-Železné Hory Fault zone. The local tectonic uplift of the so-called Most-Teplice Palaeohigh is reflected in adjacent accommodation areas during late early to middle Turonian and late Turonian to Coniacian (Uličný et al. 2009). The sedimentation or rather burial of the former palaeorelief infill was thus a result of the combination of not only relative regional and eustatic sea-level changes, but also the very local tectonic activity. Considering all the above-mentioned facts, the most probable age span of the *Glenarea cretacea* holotype is late Cenomanian, early Turonian or late Turonian.

Apart from the above considered localities in the BCB, there is also the possibility that the coral comes from a completely different area and is a contamination attributed to Řetenice by mistake. As the coral was provided by a local collector and its habitus matches the preservation of fossils from 'rocky-coast' localities of the area, this eventuality constitutes a minor probability. The only circumstantial evidence for this origin stems from the taxonomical position of the genus. The *G. cretacea* holotype slightly resembles silicified corals from the Klokočov locality near Příbor (Moravian-Silesian region, Czech Republic; Trauth 1911), but is not pale like the Klokočov fossils. In this locality the coral fossils are redeposited in younger conglomerates of Late Cretaceous (Senonian) to Palaeogene age. The corals are considered to have a Cenomanian to Santonian age (based on the taxonomic composition; Eliášová 1989), which was doubted in Löser (2005) where a Cenozoic age was assumed. As explained in greater detail below, *Glenarea* shows stronger affinities to Eocene than to Cretaceous coral genera, which may support the hypothesis that the holotype derives from the Klokočov area.

The type specimen of *Glenarea cretacea* and taxonomic implications

The holotype of *Glenarea cretacea* (NM-O7541, by monotypy) is a large fragment of a silicified coral colony that does not show signs of having been cut. The schematic drawing presented by Počta (1887: fig. 10) is not based on a polished surface. The difficult lithology may be a reason why Počta did not elaborate thin sections from the specimen. The specimen corresponds completely to the illustration given by Počta.

Glenarea cretacea has a strong skeleton. The septa are short and thick close to the wall and have a triangular form. Their symmetry is irregular. They do not meet in the centre of the calice and are not connected to each other. The columella and endotheca are absent. Although thin sections were not prepared, the systematic position of the genus is quite clear. At first glance, it compares indeed to *Acanthogyra*, but this genus has a regular septal symmetry, and a lamellar columella. The type specimen of *Glenarea cretacea* is most closely related to the genera *Triphyllocoenia* Orbigny, 1849 and *Ewaldocoenia* Oppenheim, 1921. Both genera are monospecific and were originally restricted to the upper Eocene. Alvarez Pérez (2009) reported *Ewaldocoenia* from the middle to upper Eocene of Spain. Topotypical material of *Alveopora ataresensis* Altuna et al., 2007 from the upper Eocene of Jaca (Spain) was available to HL and also belongs to one of these genera. The records from Spain extend the range of *Ewaldocoenia* into the Middle Eocene. *Ewaldocoenia* and *Triphyllocoenia* may be synonymous. Only the internal structure of the first genus is known.

The material described by Eliášová (1991) as *Glenarea* is not identical with the type specimen of *Glenarea cretacea*. It shows a different structural pattern: the septa are thin. Younger septa are often connected to older ones and the septa of the first cycle meet in the centre of the calice. A columella is present, because of septal fusion or by being lamellar. A subregular hexameral symmetry is present, and the endotheca is well developed. *Glenarea* sensu Eliášová differs clearly from *Glenarea* s.s. Eliasova (1991) included the Middle Jurassic coral genus *Melikerona* Alloiteau, 1958 into the synonymy of *Glenarea* s.l. This genus differs from *Glenarea* s.l. by septa that are not connected to each other in the centre of the calice and the clear absence of a columella. Therefore, *Melikerona* cannot be used for the material from the Bohemian and Saxonian lower Upper Cretaceous assigned by Eliášová to *Glenarea*. Therefore, the mid-Jurassic genus *Sakavalastraea* Alloiteau, 1958 is applied for this material.

Systematic part

The aim of the systematic part is on the one hand the description of *Glenarea* sensu stricto and possibly related genera, and on the other, the description of the material named *Glenarea* by Eliášová (1991) and later authors and determination of its systematic position.

Material

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

Bosnia and Herzegovina

Canton Tuzla, Lukavac community, between Gacko and Lukavac; Late Eocene, Priabonian. NHM-R22349. The locality is only mentioned by Oppenheim (1921).

Czech Republic

Central Bohemian region, Korycany, Netřeba, Kopeč (CZ.3063); Peruc-Korycany Fm., Korycany Mbr.; upper Cenomanian. CGS-HF1700, 1701, 1703, 1704, 2402, 2405, 2412.

Central Bohemian region, Korycany, Netřeba (CZ.1746); Peruc-Korycany Fm., Korycany Mbr.; upper Cenomanian. CGS-HF1706, 1710, 1712, 2339, 2478, BSPG-2003XX4727.

Ústí nad Labem region, Teplice, Řetenice [= Teplitz, Settenz in older publications] (CZ.733); lithostratigraphical position unclear; lower Upper Cretaceous. NM-O7541.

France

Haute Alpes, Ancelles, Cases de Faudon; Priabonien; upper Eocene, Priabonian. MB-K2491. Cases de Faudon or only Faudon is a very important French Eocene coral locality. For details see Barta-Calmus (1973).

Haute Alpes, Ancelles; upper Eocene, Priabonian. MNHN-B24232. This very general location name may refer to Faudon as well.

Germany

Bayern, Bad Reichenhall, Hallturm. Eisenrichterstein; upper Eocene, lower Priabonian. A detailed description of the locality and coral fauna was provided by Darga (1992).

Sachsen, Dresden-Plauen, Ratssteinbruch, southern quarry (D.756); Dölzschen Fm.; upper Cenomanian. BSPG-2009XVII19, 110, SNSD-MMG-SaKL303. A recent description of the coral fauna is provided by Löser (2014).

Greece

Kozani district, town of Kozani, Nea Nikopolis (GR.2090); lower Cenomanian. BSPG-2003XX5811, 5858. A revision of the coral fauna is under preparation by the first author.

Viotía district, Aliartos, road cut 2 km east of Korónia (GR.2179); Lower Cretaceous. MNHN-R10752. Beauvais (1972) described corals from this locality as Jurassic. However, given the geological situation, the outcrop cannot be Jurassic, but Lower Cretaceous. It is possible that it is identical to the close Diakopi plateau (Löser and Raeder 1995). An early Aptian age is possible.

Mexico

Michoacán, Turitzio, Loma de San Juan; Cumburindio Fm.; Early Aptian. ERNO-L4875. The locality is described in Filkorn and Pantoja-Alor (2009), but the electronic publication does not constitute a valid publication according to the ICZN, even if the new taxa are described later in a separate publication (Filkorn and Pantoja-Alor 2015).

Spain

Cataluña, Barcelona, Igualada Basin; Eocene. Cataluña, Lérida, Tremp-Campo Basin; Eocene. Both are imprecisely defined outcrop areas mentioned by Alvarez Pérez (2009). A middle to late Eocene age is probable.

Aragón, Jaca Basin, Atarés; upper Eocene, Priabonian. The locality and coral fauna were described by Altuna et al. (2007).

Collection abbreviations are as follows:

BSPG, Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany;
CGS, Česká geologická služba (Czech Geological Survey), Praha, Czech Republic;
ERNO, Universidad Nacional Autónoma de México, Instituto de Geología, Estación Regional de Noroeste, Mexico;
MB, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany;
MNHN, Muséum National d'Histoire Naturelle, Paris, France;
NHM, The Natural History Museum, London, UK;
NM, Národní Muzeum (National Museum), Praha, Czech Republic.

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

ccd, distance between calicular centres;
clmax, large lumen;
clmin, small lumen;
s, number of radial elements in adult calice.

The following abbreviations are used for the statistical values:

n, number of measurements;
min–max, lowest and highest measured value;
μ, arithmetic mean (average);
s, standard deviation;
cv, coefficient of variation.

Order Scleractinia Bourne, 1905
Suborder Faviina Vaughan et Wells, 1943

Remarks

The suborder Faviina is poorly defined because of nomenclatorical problems. The genus *Favia* that gives its name to the suborder Faviina and family Faviidae Gregory was originally established by Oken (1815). With a few exceptions, the taxa established in this publication are unavailable (ICZN Opinion 417; Hemming 1956). *Favia* was therefore ascribed to Milne Edwards (1857) with *Madrepora fragum* Esper, 1795 as type species (see for instance Budd et al. 2012). It is widely ignored that the genus was already used by Ehrenberg (1834). *Madrepora fragum* was not included in the list of species provided by Ehrenberg (1834) and thus cannot be type species. *Favia* Ehrenberg, 1834 is therefore without type species and hence undefined.

***Diplocoenia* group**

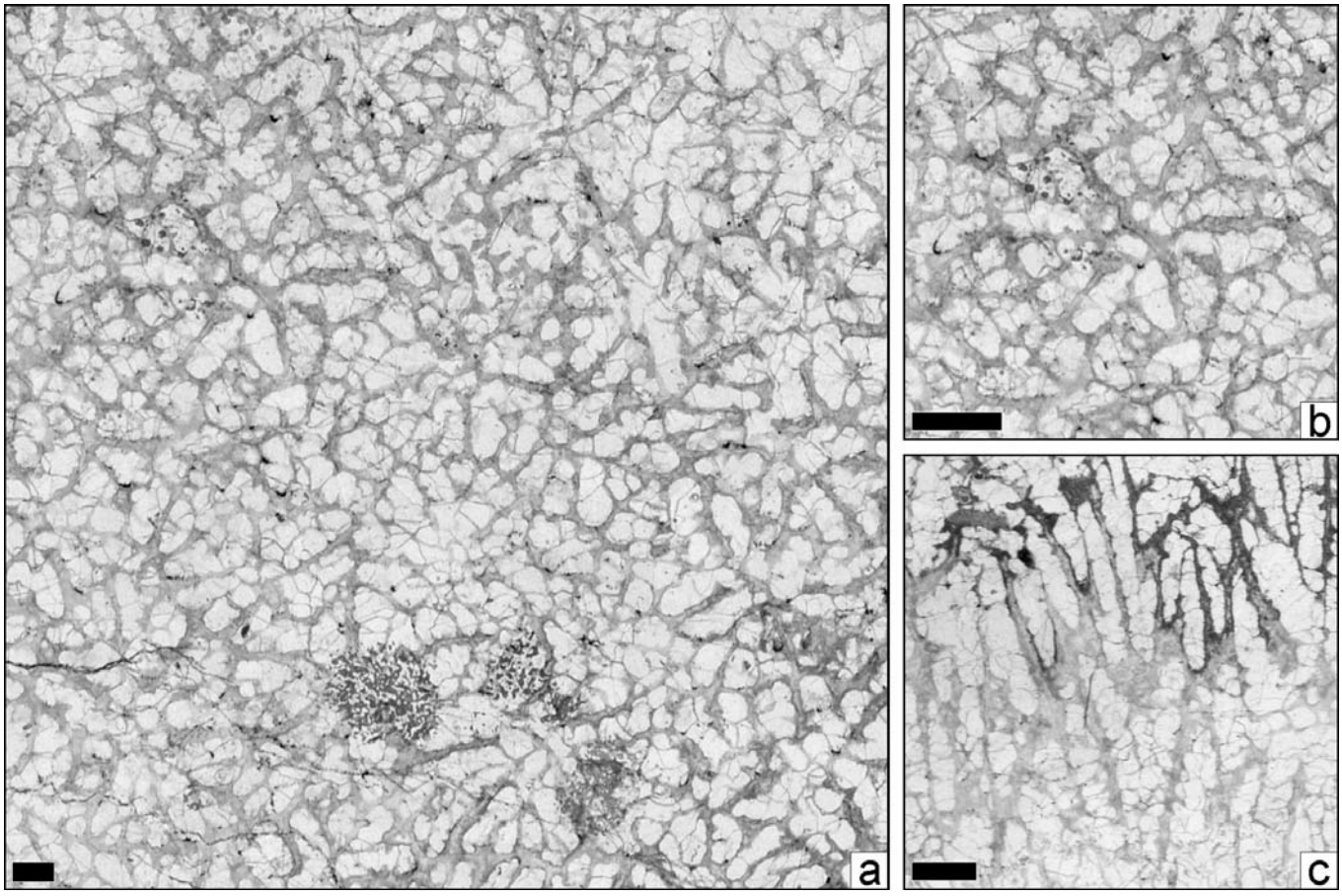
Remarks

Even if the family Faviidae were accepted in its current conceptual meaning it would be questionable whether Mesozoic coral genera could be assigned to this family. Ranges of its genera are shorter than generally published (see discussion in Löser 2005, 2013). Evolutionary changes in Scleractinian corals were – even if slow – obviously more rapid than the literature reflects and as well the ranges of families are probably shorter. The genus *Sakalavastraea* is placed here in the informal *Diplocoenia* group that encompasses Middle Jurassic to lower Upper Cretaceous (Cenomanian) cerioid corals with compact septa, medium-sized trabeculae and no synapticulae. The septa are often and mostly regularly connected to each other, and the columella is generally lamellar or formed by septal fusion. The informal group encompasses the following genera: *Bussonastraea* Beauvais, 1965; *Diplocoenia* Fromentel, 1857; *Edwardsastraea* Roniewicz, 1970; *Melikerona* Alloiteau, 1958; *Paraphyllocoenia* Reig Oriol, 1991; *Placastrea* Stoliczka, 1873; *Sakalavastraea* Alloiteau, 1958; *Septastraeaopsis* Alloiteau, 1954; *Thalamocoenia* Orbigny, 1850; *Tricassastraea* Alloiteau and Dercourt, 1966. The genera are partly synonymous.

***Sakalavastraea* Alloiteau, 1958**

Type species

Sakalavastraea collignoni Alloiteau, 1958 by original designation.



Text-fig. 2. ***Sakalavastraea clementi*** **Beauvais, 1972, CGS-HF2402, a, transversal thin section, b, transversal thin section, detail, c, longitudinal thin section. Scale bar 1 mm.**

Diagnosis

Cerioid coral colony with small (less than 5 mm) polygonal calices. Septa compact, in a subregular hexameral symmetry. Septa connected to each other. Septal lateral faces with thorns. Columella lamellar or formed by septal fusion. Endotheca well developed. Coenosteum, pali or paliform lobes, and synapticulae absent. Budding extracalicinal.

Description

Cerioid colony. Calicular outline polygonal, slightly enlarged, larger diameter less than 5 mm, calicular pit depressed. Septa compact. Microstructure of medium-sized trabeculae. Septa in cross-section slightly thicker close to the wall, becoming slightly thinner towards the centre. Septal maximum thickness ca. 200 µm. Symmetry of septa radial and irregularly hexameral. Cycles of septa subregular formed in two to three cycles. Septal cycles differ in length, less in thickness. First or first and second septal cycles reach to the centre of the calice, later cycles are subsequently shorter. Septa of the last cycle are often attached to those of the first or second cycle. Septal distal margin unknown, lateral face occasionally with medium-sized thorns, inner margin smooth. Pali or paliform lobes absent. Some septa may be attached to the columella. Costae and synapticulae absent. Columella lamellar or formed by septal fusion. Endotheca of irregular tabulae or dissepiments. Wall compact, septothecal. Coenosteum absent. Budding extracalicinal.

Species

Sakalavastraea clementi Beauvais, 1972*, Sakalavastraea collignoni* Alloiteau, 1958, *Sakalavastraea perturbata* n. sp., *Glenarea poctai* Eliášová, 1991

Range

Callovian to Cenomanian.

Distribution

Worldwide.

Sakalavastraea clementi **Beauvais, 1972**

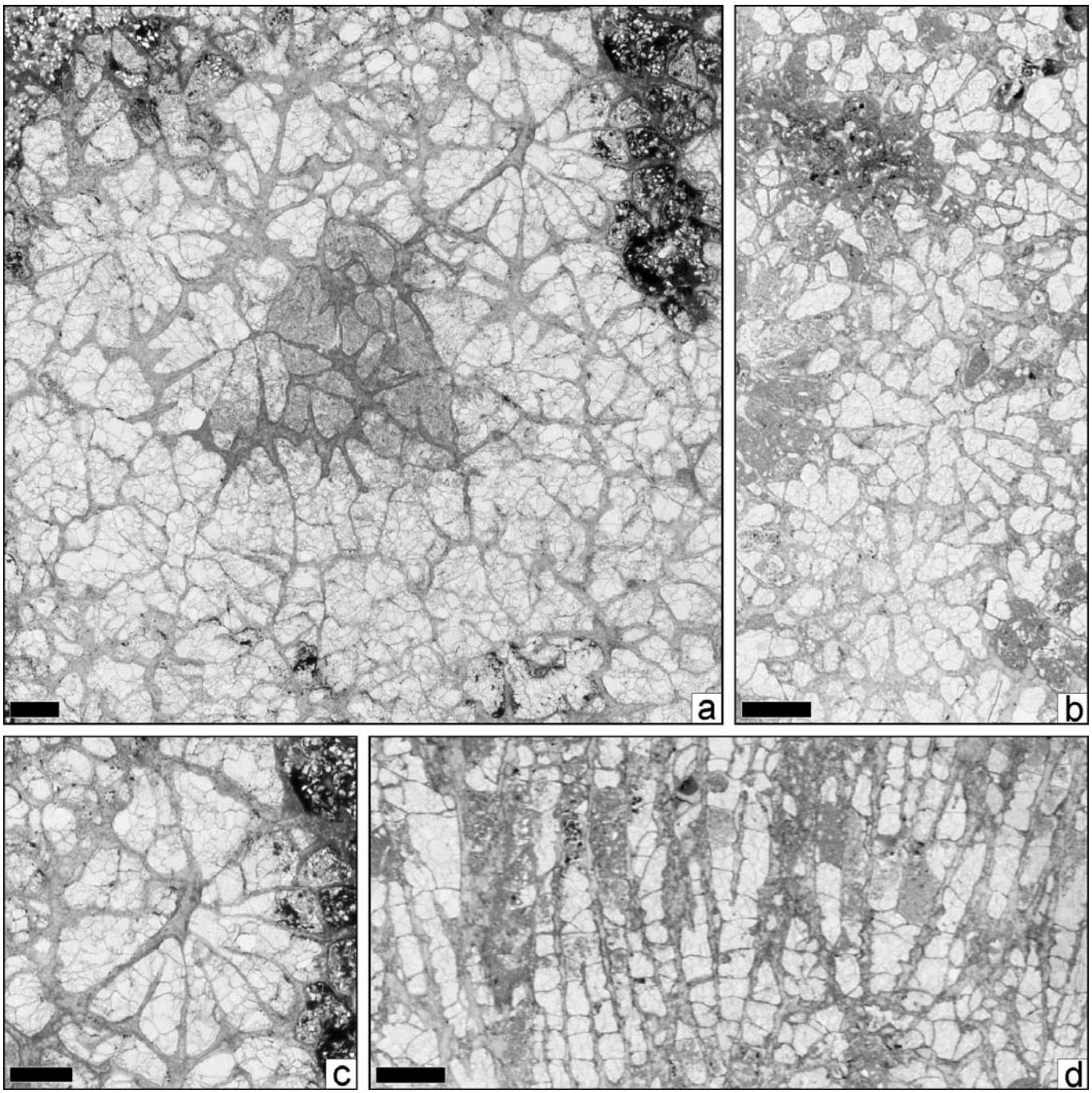
Text-fig. 2

Material

BSPG-2003XX5811, 2003XX5858, 2009XVII19, 2009XVII110, CGS-HF1701, 1704, 1710, 1712, 2339, 2402, 2405, ERNO-L4875, MNHN-R10752, SNSD-MMG-SaKL303; 19 thin sections.

Synonymy

*v	1972	*Sakalavastraea clementi* nov. sp. – Beauvais, p. 96, pl. 11: 1
v	1989	*Stephanastraea* sp. – Löser, p. 99, text-figs 4, 5.
v	2014	'*Glenarea*' sp.1 – Löser, p. 23, fig. 2g.
v	2014	'*Glenarea*' sp. 2 – Löser, p. 23, fig. 2h.



Text-fig. 3. ***Sakalavastraea perturbata*** **n. sp., a, c, holotype and invalid neotype of** ***Glenarea cretacea*** **(CGS-HF2478), transversal thin section; b, d, paratype (CGS-HF1706), b, transversal thin section, d, longitudinal thin section. Scale bar 1 mm.**

Dimensions

(MNHN-R10752)

	n	min–max	μ	s	cv	μ±s
cl min	35	1.83–2.68	2.24	0.27	12.2	1.97–2.52
cl max	35	2.51–3.93	3.16	0.34	11.0	2.81–3.51
ccd	60	1.93–3.49	2.61	0.38	14.7	2.23–3.00
s	10	17–28	22.10	3.41	15.4	19–26

(CGS-HF2402)

	n	min–max	μ	s	cv	μ±s
cl min	15	1.88–2.60	2.18	0.20	9.6	1.97–2.39
cl max	15	2.32–3.48	2.84	0.30	10.6	2.54–3.14
ccd	15	2.07–3.49	2.77	0.43	15.5	2.34–3.21
s	10	18–22	19.50	1.26	6.5	18–21

Occurrence

Lower Cretaceous (?lower Aptian) of Greece (Viotía) Aliartos, road cut 2 km east of Korónia. Lower Aptian of Mexico (Michoacán) Turitzio, Loma de San Juan (ERNO-L4875). Lower Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis (BSPG-2003XX5811, 5858). Upper Cenomanian, Guerangeri Zone, Korycany, Netřeba (CGS-HF1712), Kopeč (CGS-HF2402). Upper Cenomanian, Plenus Zone, Germany (Sachsen) Dresden-Plauen, Ratssteinbruch, southern quarry (BSPG-2009XVII110, 2009XVII19, SNSD-MMG-SaKL303).

Sakalavastraea perturbata n. sp.
Text-fig. 3
Types
Holotype CGS-HF2478, Paratype CGS-HF1706.
Diagnosis

Sakalavastraea with a larger calicular diameter of 3.5–4.5 mm, a smaller calicular diameter of 3–4 mm and 14 to 18 septa.

Comparison

The species is comparable to *S. poctai* but the number of septa is always far below 24. *S. clementi* has smaller calicular dimensions.

Derivatio nominis

(lat.) confused, in reference to the problematic taxonomic situation.

Locus typicus

Czech Republic, Central Bohemian region, Korycany, Netřeba.

Stratum typicum

Peruc-Korycany Fm., Korycany Mbr.; upper Cenomanian, Guerangeri Zone.

Material

CGS-HF1700, 1703, 1706, 2412, 2478; 12 thin sections.

Synonymy

v 1991 *Glenarea cretacea* Počta, 1887 – Eliášová, p. 99, pl. 1: 1.

Dimensions
(CGS-HF 2478)

	n	min–max	μ	s	cv	μ±s
clmin	7	2.78–4.04	3.36	0.41	12.4	2.95–3.78
cmax	7	3.42–4.60	3.93	0.47	11.9	3.46–4.40
ccd	7	2.77–5.09	3.83	0.81	21.3	3.01–4.65
s	6	14–18	15.83	1.72	10.8	14–18

Occurrence

Upper Cenomanian, Guerangeri Zone, Czech Republic (Central Bohemian region), Korycany and Netřeba localities, and Plenus zone, Kopeč locality.

***Sakalavastraea poctai* (Eliášová, 1991)**

Material
CGS-HF2479 (holotype), ERNO-L4727; 1 thin section.

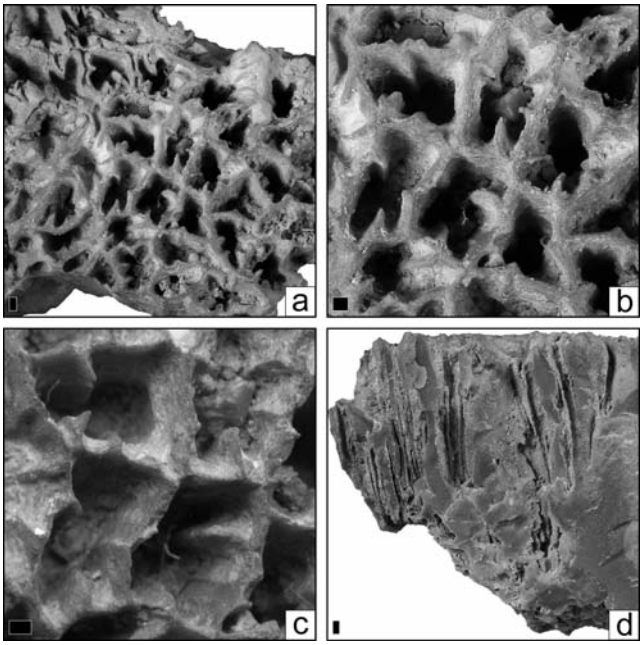
Synonymy

* 1991 *Glenarea poctai* sp. n. – Eliášová, p. 100, pl. 1: 2, pl. 2: 1, 2, pl. 3: 1, pl. 4.

v non 1998 *Glenarea poctai* Eliášová, 1991 – Baron-Szabo, p. 138, pl. 1: 4, 6 [= *Lithostrotionoides sp.*].

Dimensions
(CGS-HF2479)

clmin 2.75–3.45
clmax 3.7–4.3
s 24



Text-fig. 4. ***Glenarea cretacea* Počta, 1887, holotype (NM-O7541), a coral surface, b, c, coral surface, detail, d, longitudinal section. Photos a, b, d by L. Váchová, National Museum, Prague. Scale bar 1 mm.**

(BSPG-2003XX4727)

clmin 2.45–3.25
clmax 3.0–3.6
ccd 2.6–4.1
s 21–30

Remarks

The thin sections of the type specimen were not available for study. Measurements are according to the illustration in Eliášová (1991).

Occurrence

Upper Cenomanian, Guerangeri Zone, Korycany and Netřeba localities, and Plenus zone, Kopeč locality.

?Suborder Heterocoeniina Beauvais, 1974
***Triphyllocoenia* group**
Diagnosis

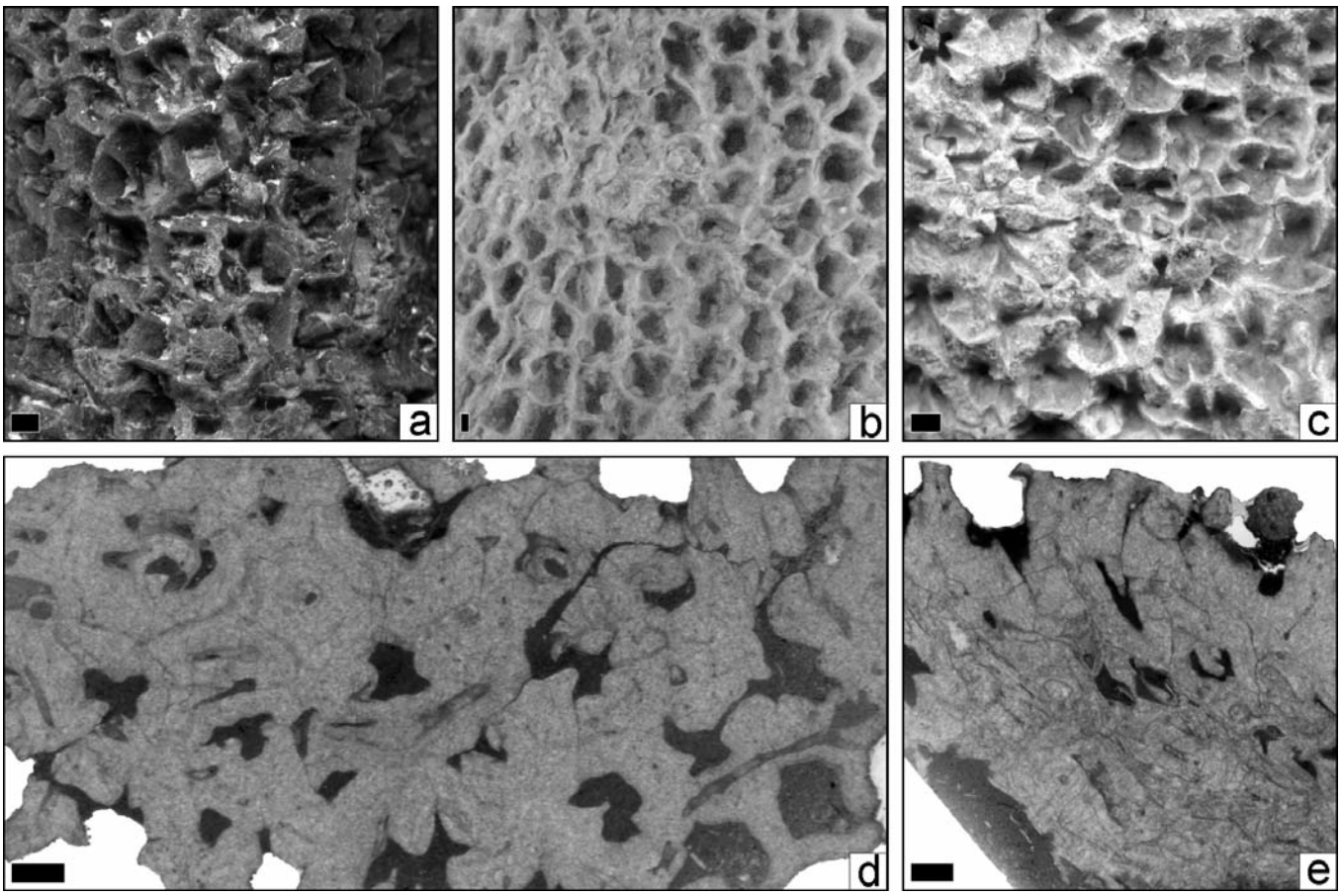
Cerioid colonies. Septa compact, thick, of low number and irregular in two generations. Microstructure lamellar, non-trabecular. Wall has the same structure like septa. Pali, columella, synapticulae, endotheca, and coenosteum absent.

Genera

Ewaldocoenia Oppenheim, 1921; *Glenarea* Počta, 1887; *Triphyllocoenia* Orbigny, 1849.

Systematic position

The systematic position of these genera is preliminary. The thick septal structures, the low number of septa and the absence of any central structures make comparison with the Heterocoeniina suborder possible. Arguing against this assignation is the absence of any septal ornamentation, the obvious non-trabecular microstructure of the septa, and the



Text-fig. 5. a, *Triphyllocoenia excavata* d'Orbigny, 1849, lectotype (MNHN-B24232), coral surface. b, *Ewaldocaenia hawelkai*, syntype (NHM-R22349), coral surface. c–e, Ewaldocaenia hawelkai, syntype (MB-K2491), c, coral surface, d, transversal thin section, e, longitudinal thin section. Scale bar 1 mm.

septal wall. The genera cannot be assigned to any family and are here gathered in an informal group.

Remarks

Calicular openings are wider than the calices in thin sections, producing differing results when measurements are taken from the calicular surface or from thin sections.

Range

Cenomanian to Eocene.

Distribution

Europe.

***Glenarea* Počta, 1887**

Type species

Glenarea cretacea Počta, 1887, by monotypy.

Description

Cerioid colony. Calicular outline polygonal and elongated, centres depressed. Septa compact. Septa in cross-section thick close to the wall, thinner toward the centre. Symmetry of septa irregular, but two generations can be distinguished. First generation reaches about 20% of the larger calicular diameter, the septa of the second generation are much shorter. Septa not connected to each other. Septal upper margin smooth, lateral face smooth, inner margin smooth. Pali or paliform lobes, costae, synapticulae, columella, and endotheca absent. Wall compact, probably septothecal. Coenosteum absent. Budding extracalicinal.

Comparison

Judging from its outer appearance, *Glenarea* is very similar to the other genera of the informal group. Its type species differs only by larger dimensions. Thin sections were not obtained from *Glenarea cretacea* because, on the one hand, the specimen is unique and, on the other, it is not very probable that the silicified material would provide much information on its fine skeletal structure.

Species

Only the type species. *Glenarea poctai* Eliášová, 1991 belongs to *Sakalavastraea*. *Glenarea jurensis* Krasnov, 1964 belongs to *Acanthogyra*. *Glenarea prozorovskii* Kuzmicheva, 1987 was later assigned to the genus *Polypetalum* Kuzmicheva, 2002. Most Late Cretaceous material assigned to the genus *Glenarea* belongs to *Lithostrotionoides* Alloiteau, 1952. *Glenarea cretacea* in Turnšek and Buser (1974) is not recognisable.

Distribution

Lower Upper Cretaceous of Bohemia (Czech Republic).

***Glenarea cretacea* Počta, 1887**

Text-fig. 4

Type

NM-O7541, holotype by monotypy.

Material
Only the type specimen.

Synonymy
*v 1887 *Glenarea cretacea* nov. spec. – Počta, p. 25, text-figs 9, 10.
1911a, b *Glenarea cretacea*, Poc. – Frič, p. 63, text-fig. 265 [= refig. Počta, 1887].
non 1974 *Glenarea cretacea* Pocta – Turnšek et Buser, pp. 20, 36, pl. 10: 2.
v non 2000 *Glenarea cretacea* Pocta, 1887 – Baron-Szabo, p. 111, pl. 4: 2 [= *Lithostrotionoides* sp.].
v non 2006 *Glenarea cretacea* Pocta, 1887 – Baron-Szabo, p. 76, pl. 15: 5, pl. 16: 3 [= *Lithostrotionoides* sp.].

Dimensions
(NM-O7541)

	n	min–max	μ	s	cv	μ±s
cl min	20	3.13–4.59	3.87	0.45	11.7	3.41–4.32
cl max	20	4.61–7.32	5.94	0.79	13.3	5.15–6.73
s	15	4–7	5.06	0.79	15.7	4–6

Occurrence
Lower Upper Cretaceous of the Czech Republic (Ústí nad Labem region), Teplice, Řetenice [= Teplitz, Settenz in older literature in the German language].

Triphyllocoenia Orbigny, 1849

Type species
Triphyllocoenia excavata Orbigny, 1849, by monotypy. Valid through combined description of a new genus and species.

Description
Cerioid colony. Calicular outline polygonal and elongated, calices small, centres depressed. Septa compact. Microstructure of septa laminar, non-trabecular. Septa in cross-section thick close to the wall, thinner toward the centre. Symmetry of septa irregular. No septal generations or cycles. Number of septa very low (< 10). First septal cycle (generation) reaches 30% of the calicular diameter, later cycles (generations) are shorter. Septa not connected to each other. Septal upper margin smooth, lateral face smooth, inner margin smooth. Pali or paliform lobes, costae, synapticulae, and columella absent. Endotheca unknown. Wall compact, structure same as septa. Coenosteum absent. Budding extracalicinal.

Systematic position
The systematic position of *Triphyllocoenia* was never fixed. Milne Edwards (1857: II, 254) put it into synonymy of *Stylocoenia emarciata,* (Lamarck, 1816). Vaughan and Wells (1943) put the genus in synonymy of *Stylocoenia* and was followed by Alloiteau (1952) and Wells (1956). Barta-Calmus (1973) did not mention the genus or the type species. *Ewaldocoenia* was assigned to the Cyathophoridae Vaughan and Wells, 1943 by Vaughan and Wells (1943); they compared it to *Heterocoenia* Milne Edwards and Haime, 1848, a genus included at the time in the Cyathophoridae. Bendukidze and Chikovani (1962) assigned the genus to the Heterocoeniidae Oppenheim, 1930, whereas Darga (1992) assigned it again to the Cyathophoridae.

Synonym
Ewaldocoenia Oppenheim, 1921 with *Ewaldocoenia hawelkai* Oppenheim, 1921 as type species by monotypy.

Species
Triphyllocoenia excavata Orbigny, 1850; *Ewaldocoenia hawelkai* Oppenheim, 1921; *Ewaldocoenia pollaplasia* Darga, 1992; *Alveopora ataresensis* Altuna et al., 2007.

Remarks on the species
Ewaldocoenia is a junior synonym of *Triphyllocoenia* Orbigny, 1849 and the type species *E. hawelkai* Oppenheim, 1921 is considered a junior synonym of *T. excavata*. All four species represent more or less the same calicular dimensions and septal counts. Exact morphometric data of *Alveopora ataresensis* Altuna et al., 2007 and *Ewaldocoenia pollaplasia* Darga, 1992 were not available for comparison. Topotypical material of *Alveopora ataresensis* available at the Museo Geológico del Seminario de Barcelona is poorly preserved and exact measurements were not possible. *Ewaldocoenia pollaplasia* is also not well preserved, and thin sections are not available.

Distribution
Upper Eocene of Bosnia and Herzegovina, between Gacko and Lukavac; France (Haute Alpes) Ancelles; Germany (Bayern) Bad Reichenhall, Hallturm, Eisenrichterstein; Middle to Upper Eocene of Spain (Aragón) Jaca Basin, Atarés, Spain (Cataluña, Barcelona) Igualada Basin, (Cataluña, Lérida) Tremp-Campo Basin.

Triphyllocoenia excavata Orbigny, 1849

Text-fig. 5
Type specimens
Holotype of *Triphyllocoenia excavata* MNHN-B24232 by monotypy. Syntypes of *Ewaldocaenia hawelkai* NHM-R22349 and MB-K2491.

Material
MB-K2491, MNHN-B24232, NHM-R22349; 2 thin sections.

Synonymy
*v 1849 *Triphyllocoenia excavata* – Orbigny, p. 7.
v 1850 *Triphyllocoenia excavata* – Orbigny, p. 404.
v 1921 *Ewaldocoenia hawelkai* – Oppenheim, p. 153, text-fig. 1.

Dimensions
(MNHN-B24232)

	n	min–max	μ	s	cv	μ±s
cl min	5	1.26–2.03	1.72	0.38	22.2	1.34–2.11
cl max	5	1.76–2.49	2.15	0.29	13.8	1.85–2.44
s	5	4–7	5.40	1.14	21.1	4–7

(NHM-R22349)

	n	min–max	μ	s	cv	μ±s
cl min	15	1.24–2.04	1.72	0.21	12.5	1.50–1.94
cl max	15	1.75–2.62	2.19	0.23	10.6	1.96–2.43
s	10	3–6	4.20	0.91	21.8	3–5

(MB-K2491)

	n	min–max	μ	s	cv	μ±s
cl min	15	0.95–2.06	1.48	0.33	22.4	1.15–1.81
cl max	15	1.42–2.89	2.19	0.38	17.3	1.81–2.57
s	10	4–6	5.20	0.63	12.1	5–6

Remarks

The measurements of both specimens of *E. hawelkai* fit perfectly in the values obtained from the type specimen of *Triphyllocoenia excavata*, type species of *Triphyllocoenia*. *Ewaldocaenia* is considered a synonym of *Triphyllocoenia*. Oppenheim (1921) discussed the relationship between *Ewaldocaenia* and *Triphyllocoenia* but because no illustration of the material of *Triphyllocoenia* was available and he had obviously no access to the type specimen, he preferred to establish a new genus.

Discussion

Although we have been able to present a morphologic and taxonomic revision of the enigmatic coral genus *Glenarea*, it is not possible to explain its phylogenetic position and relationship with other taxa. No comparable material is known from the Cretaceous. *Glenarea* is an endemic genus, a singleton. It shows similarity only with the Eocene coral genus *Triphyllocoenia*. Since thin sections from *Glenarea* are unknown, a phylogenetic relationship cannot be proven. *Glenarea* remains therefore a doubtful taxon. The Boreal lower Upper Cretaceous is well studied and taxonomically relatively well known, but the example of *Glenarea* shows that obviously more sample collection is necessary.

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