Revision of the coral genera *Neocoenia* and *Helladastraea* from the Cretaceous of Greece

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Abstract

The two Cretaceous scleractinian coral genera *Neocoenia* and *Helladastraea* are revised on the basis of the type material of their respective type species. The type material of the type species of both genera come from the Greek locality Panourgias (former Dremisa) originally dated as Cenomanian in age. Regarding the geological outcrop situation, this age is only valid for part of the samples, which come from different coral bearing layers. *Neocoenia* is a plocoid form closely related to *Columastrea* and probably a senior synonym of *Stephanaxophyllia*. *Helladastraea*, originally established as a subgenus of *Aspidiscus* and long-time considered a junior synonym of this genus is indeed very closely related to this genus, but differs by its conical monticules.

Keywords: Corals, Greece, Cretaceous, taxonomy, Scleractinia.

Zusammmenfassung

Die beiden Korallengattungen *Neocoenia* und *Helladastraea* werden auf der Basis der Typen ihrer Typusarten revidiert. Das Typusmaterial beider Gattungen kommt von der griechischen Lokalität Panourgias (früher Dremisa), die ursprünglich als Cenoman (Kreide) datiert wurde. Die Aufschlusssituation zeigt, dass dieses Alter nur für einen Teil der Proben zutrifft, da die Proben der ursprünglichen Aufsammlung aus verschiedenen korallenführenden Schichten stammen. *Neocoenia* ist eine plocoide Form, die eng mit *Columastrea* verwandt und wahrscheinlich ein älteres Synonym von *Stephanaxophyllia* ist. *Helladastraea*, ursprünglich als Untergattung von *Aspidiscus* aufgestellt und über lange Zeit als synonym mit dieser betrachtet, ist in der Tat sehr eng mit *Aspidiscus* verwandt, aber unterscheidet sich durch konische Monticulen.

Contents

1. Introduction

The central study area of the Swiss geologist Carl Renz was the geology of Greece. He not only produced a large amount of geological literature but also brought a rich fossil collection to Basel. This collection includes a Cretaceous coral fauna from Central Greece. Renz (1930, 1931) described only a small part of it, while the larger part of the coral fauna was systematically investigated by Hackemesser (1936). Though the fauna was adequately described and illustrated at the time, some determinations call for precision, and some taxa need profound revision on the basis of thin sections, which were not widely used during Hackemesser's time. Renz and Hackemesser each described a new coral genus, *Neocoenia* and *Helladastraea*. Their revision is the intention of this short contribution.

Acknowledgements

I am grateful to Walter Etter and Olivier Schmidt (Basel) who made the collection of the Naturhistorisches Museum Basel available for study, as well as to Didier Merle, Jean-Michel Pacaud and colleagues gave access to the type collection of the Muséum National d'Histoire Naturelle in Paris. For grammatical correction I would like to thank Brian Hallmark (Tucson, Arizona). The paper was enhanced by a review by Jacob Leloux (Leiden). Financial support was provided by an UNAM DGAPA/PASPA project.

2. Material and methods

The studied material comes from an outcrop area around Panourgias (Nomo Fokída, Greece). The locality was first mentioned by Renz (1930, 1931) under the name Dremisa. Hackemesser (1936) gives a detailed description of the coral fauna. A Cenomanian age was assumed by Renz and Hackemesser. The labels in the collection of C. Renz (Naturhistorisches Museum Basel) indicate two sample locations: "Aufstieg zur Vrysis Manika" (ascension to the Vrysis Manika) and "südlich von Dremisa" (south of Dremisa), often adding "Lesesteine" (fragments of bedrock). The area was later (1994–1997) examined by Th. Steuber and the author, and numerous corals

and rudists were collected at approximately 20 sampling points around Panourgias. The fossils mainly derive from ophiolite conglomerats without banking. According to the collected rudist bivalves, there exist four horizons with corals: (?Early) Aptian, Late Albian and/or Early Cenomanian, Late Turonian to Santonian. The corals described by Hackemesser (1936) come from different horizons as well. The coral material forms part of the Coll. Renz at the Naturhistorisches Museum Basel (NMB). Hackemesser prepared only slabs, no thin sections. Thin sections from numerous samples were later prepared but remained unpublished.

Microphotographs for illustration purposes were obtained using an Epson Perfection V750-M Pro transparency scanner with an optical resolution of 6400 dots per inch. Scanned images were transferred to grey scale bit maps. To amend their quality and contrast, histogram contrast manipulation (contrast stretching) was applied. Measurements and calculations were carried out using the computer program PaleoTax/Measure (http://www.paleotax.de/measure).

3. Systematic palaeontology

The classification used here is mainly based on the traditional scheme first introduced by Alloiteau (1952, 1957) and later improved by, among others, Roniewicz (1976) and Morycowa & Roniewicz (1995). The use of morphological terms follows Alloiteau (1952, 1957).

Order Scleractinia Bourne, 1900
Suborder Faviina Vaughan & Wells, 1943
Family Columastraeidae Alloiteau, 1952

Genus *Neocoenia* Hackemesser, 1936

Type species: *Neocoenia renzi* Hackemesser, 1936, by subsequent designation in Alloiteau (1952).

Included species: Originally included species are *Neocoenia renzi* Hackemesser, 1936 and *Neococoenia subpolygonalis* Hackemesser, 1936. *Neococoenia subpolygonalis* shows isolated trabeculae in its coenosteum and has less developed paliform lobes. It is therefore assigned to the genus *Paraplacocoenia* Beauvais, 1982.

Stratigraphic range: The stratigraphic range is unknown. *Stephanaxophyllia*, which is probably a junior synonym of *Neocoenia*, occurs from the Late Turonian to Maastrichtian. Material that compares to *Neocoenia* is known only from the same time period.

Diagnosis. – Plocoid colony. Calicular outline circular. Calices small. Calicular centres slightly depressed, margins slightly elevated. Septa compact. Microstructure of medium sized trabeculae, septa with a median zigzag dark line. Septa (and costae) in cross section in the wall thick, thinner towards the centre. Symmetry of septa radial and regularly hexameral. Cycles of septa regular. Septal cycles differ in length and thickness. First two septal cycles reach to the centre of the calice, further cycle is shorter. Septa of the first two cycles occasionally connected to each other in the centre of the calice, those of the third cycle occasionally connected to those of older cycles. Septal upper margin unknown, lateral face with thorns, inner margin smooth. Paliform lobes irregular on the first two cycles. Costae present but short, may be confluent or not, surface unknown. Synapticulae absent. Columella styliform to lamellar, generally free. Endotheca not easily observable but dissepiments exist. Wall present, compact, paraseptothecal. Coenosteum narrow, consisting of costae and (?) exothecal dissepiments. Budding extracalicinal.

Remarks. – The material is well-preserved but not well enough to understand the formation of the paliform lobes. Their formation is irregular. The same concerns the formation of the columella; it can be styliform or lamellar. In places it cannot be distinguished from the septa.

Comparison. – The genus is very similar to *Columastrea* d'Orbigny, 1849. It differs in the presence of paliform lobes. *Columastrea* has pali that are regularly developed and always have a styliform columella. Also closely related and probably a junior synonym is *Stephanaxophyllia* Alloiteau, 1957. Thin sections have been prepared from the type (Muséum National d'Histoire Naturelle R10967) of its type species *Stephanaxophyllia casterasi* Alloiteau, 1957, but they are not available. In the thin section collections of the same museum there exist correspondingly labelled thin sections from the type locality but they are unnumbered and not clearly marked as being obtained from the type.

Neococoenia renzi Hackemesser, 1936
Pl. 1, Figs. 1–9

*v 1936 *Neocoenia renzi* n. gen. n. sp.– Hackemesser, p. 24, pl. 3, figs. 4–6.
non 1991 *Neocoenia renzi* Hackemesser. – Moosleitner, pl. 2, fig. 3. [= *Cryptocoenia* sp.]
non 1991 *Neocoenia renzi* Hackemesser. – Moosleitner, pl. 3, fig. 8.

Holotype: NMB D6127, holotype by original designation; Hackemesser (1936) indicated the type in the figure caption.
Paratypes: NMB D6124, D6331, D6332, D6333.
Dimensions: See Tab. 1.

Remarks. – The type species was included in the synonymy of *Heliastrea ortiva* Stoliczka, 1873 by Prinz (1991). *Heliastrea ortiva*, which was available for study, has much larger dimensions (diameter of the lumen 4.5–6 mm) and has no pali and columella. Its systematic position is unknown because thin sections are not available.

Tab. 1. Dimensions of *Neocoenia renzi* HACKEMESSER, 1936, holotype NMB D6127, *Paraplacocoenia subpolygonalis* (HACKEMESSER, 1936), holotype NMB D6128, *Helladastraea felixi* (RENZ, 1930), syntype NMB D2943; n, number of measurements; min-max, minimal and maximal measured values; μ, arithmethic mean; σ, standard deviation; v, coefficient of variation according to K. PEARSON; μ ± σ, first interval. All values in mm, except v (%).

Species – sample	**n**	**min–max**	**μ**	**σ**	**v**	**μ ± σ**
Neocoenia renzi HACKEMESSER, 1936 – D6127						
lumen diameter	15	1.567–2.154	1.884	0.154	8.1	1.72–2.03
distance of calicular centres	15	2.178–3.488	2.754	0.386	14.0	2.36–3.14
Paraplacocoenia subpolygonalis (HACKEMESSER, 1936) – D6128						
lumen diameter	15	1.986–2.573	2.352	0.156	6.6	2.19–2.50
distance of calicular centres	15	2.136–3.523	2.846	0.412	14.5	2.43–3.25
Helladastraea felixi (RENZ, 1930) – D2943						
distance of monticules	20	2.447–4.425	3.287	0.520	15.8	2.76–3.80

Genus *Paraplacocoenia* BEAUVAIS, 1982

Type species: *Placocoenia orbignyana* REUSS, 1854.

Paraplacocoenia subpolygonalis (HACKEMESSER, 1936)
Pl. 2, Figs. 1–3

*v 1936 *Neocoenia subpolygonalis* n. g. n. sp. – HACKEMESSER, p. 25, pl. 3, figs. 7, 8.
? 1991 *Neocoenia subpolygonalis* HACKEMESSER. – MOOSLEITNER, pl. 2, fig. 7, text-fig.
non v 1997 *Neocoenia subpolygonalis* HACKEMESSER, 1936. – BARON-SZABO, p. 64, pl. 5, fig. 2, pl. 6, fig. 2. [= *Paraplacocoenia* sp.]
non v 2002 *Neocoenia subpolygonalis* HACKEMESSER 1936. – MORYCOWA & MARCOPOULOU-DIACANTONI, p. 48, figs. 30a–c. [= *Placocolumastrea* sp.]
v 2002 *Neocoenia subpolygonalis* HACKEMESSER 1936. – MORYCOWA & MARCOPOULOU-DIACANTONI, p. 48, fig. 30d.

Holotype: NMB D6128, holotype by monotypy.
Dimensions: See Tab. 1.
Occurrence: Cretaceous of Panourgias (Kiona massif, Fokída, Greece).

Description. – Plocoid colony. Calicular outline circular. Calicular centres slightly depressed, margins slightly elevated. Septa compact. Microstructure of septa made of medium sized trabeculae. Septa (and costae) in cross section in the wall thick, thinner towards the centre. Symmetry of septa radial and regularly hexameral. Cycles of septa regular. Three cycles. Septal cycles differ in length and thickness. First septal cycle reaches 40 % of the calicular diameter, further cycles are shorter. Septa of the third cycle are rarely connected to those of the first cycle. Septal lateral face with thorns, inner margin slightly swollen in places. Paliform lobes in places on the first cycle. Some septa of the first cycle are rarely attached to the columella. Costae present, sub-confluent to non-confluent. Synapticulae absent. Columella lamellar. Endotheca made of thin tabulae. Wall present, compact, paraseptothecal. Coenosteum narrow, consisting of costae, isolated trabeculae and exothecal dissepiments. Budding extracalicinal.

Remarks. – The material differs slightly from the type species in having a higher density of calices and shorter costae. The material depicted by BARON-SZABO (1997) belongs to *Paraplacocoenia* but has larger dimensions. The material depicted by MORYCOWA & MARCOPOULOU-DIACANTONI (2002) belongs to a different genus because it has very short costae.

Suborder Microsolenina MORYCOWA & RONIEWICZ, 1995
Family Leptophylliidae VAUGHAN, 1905

Genus *Helladastraea* AVNIMELECH, 1948

Type species: *Aspidiscus felixi* RENZ, 1930, by original designation in AVNIMELECH (1948).
Included species: *Helladastraea felixi*, *Helladastraea semhae* (KOSSMAT, 1907), *Helladastraea sinaiticus* AVNIMELECH, 1948.
Stratigraphic range: Albian to Cenomanian.

Diagnosis. – Hydnophoroid colony with circular outline. Monticules conical with small centres. Distance of monticules moderate. Septa irregularly perforated, more common at their inner margin. Microstructure of large trabeculae. Septa in cross section equal in thickness in the whole septum. No septal symmetry, but septal generations. Number of septa low. Septa free. Septal lateral face with pennulae and thorns, inner margin smooth. Pali or paliform lobes absent. Costae absent. Synapticulae present, rare. Columella difficult to distinguish from the perforate septal inner margins, probably consisting of isolated trabecules. Endotheca consists of numerous dissepiments. Wall absent. Coensteum absent. Budding extracalicinal.

R e m a r k s . – The genus was originally introduced as a subgenus of *Aspidiscus*. Today it is generally considered a junior synonym of this genus (e. g. Gill & Lafuste 1987). *Helladastraea* differs from *Aspidiscus* in having conical monticules whereas *Aspidiscus* has polygonal monticules, in some species mixed with conical monticules. The illustration of *Aspidiscus* in Wells (1956, fig. 280.7) actually shows not an *Aspidiscus* sensu stricto but a *Helladastraea*.

Helladastraea felixi (Renz, 1930)
Pl. 2, Figs. 4–6

*v 1930 *Aspidiscus felixi* Renz (nov. spec.). – Renz, p. 9, pl. 2, figs. 2, 5, 6.
v 1931 *Aspidiscus felixi* Renz. – Renz, p. 3, pl. 1, figs. 1–9.
non 1937 *Aspidiscus Felixi* Renz 1930. – Bataller, p. 174, fig. [= *Helladastraea sinaiticus*]
1943 *Aspidiscus felixi* Renz. – Vaughan & Wells, pl. 17, fig. 7.
v 1948 *Aspidiscus (Helladastraea) felixi* C. Renz. – Avnimelech, p. 297, figs. 4–6. [refig. Renz 1930]
v 1954 *Thamnastraea decipiens* (Michelin) 1845. – Kolosváry, p. 93, pl. 8, figs. 13, 14.
1956 *Aspidiscus felixi* Renz. – Brunn, p. 117.
1956 *Aspidiscus felixi* Renz. – Wells, p. 387, fig. 280.7.
v 1987 *Aspidiscus felixi*. – Gill & Lafuste, p. 926, text-fig. 3e. [refig. Renz 1930]
1991 *Aspidiscus felixi* Renz. – Moosleitner, pl. 3, fig. 10.

S y n t y p e s : NMB D2932–D2943. The syntypes seem to be conspecific.

D i m e n s i o n s : See Tab. 1.

O c c u r r e n c e : Cretaceous of Kiona massif, Panourgias (Fokída, Greece). Early Cenomanian of Nea Nikopolis (Kozani, Greece). Albian to Cenomanian of Pénzeskút (Zirc, Bakony, Veszprém Megye, Hungary).

4. Conclusions for the stratigraphy

The species originally assigned by Hackemesser (1936) to *Neocoenia* are typical forms of the Columastraeidae. This family has its roots in the Middle Jurassic. The Jurassic, Early and early Late Cretaceous (Berrias-Cenomanian) members (*Plesiocoenia*, *Placocolumastrea* = *Columnocoenia* sensu lato) are characterised by small, densely packed calices and short, non- or subconfluent costae whereas the Late Cretaceous forms (from the Late Turonian on) show less dense calices, longer and often confluent costae. The Jurassic and Early Cretaceous are poor in genera (*Placocolumastrea*, *Pseudocoeniopsis*) whereas the Late Cretaceous has more genera (*Columastrea*, *Plesiastreopsis*, *Polystephanastraea*, *Stephanaxophyllia*, *Proplesiastraea*). Closely related are the exclusively Late Cretaceous Brachyphylliidae and Placocoeniidae. Regarding its relatively broad coenosteum, the *Neocoenia* material from Greece tends to be of Late Cretaceous age.

Helladastraea is a genus related to *Apsidiscus,* which has a comparable short range in time: *Aspidiscus* is only known from the Late Albian to Cenomanian (Löser 2005). *Helladastraea sinaiticus* has the same distribution (Löser et al. 2002). *Helladastraea felixi* is only known from two places outside of its locus typicus: the poorly dated locality in Hungary and well-dated sediments in northern Greece. It is very probable that *Helladastraea* has more or less the same distribution as *Aspidiscus*.

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Plate 1

Neocoenia renzi Hackemesser, 1936, holotype NMB D6127, thin section.

Fig. 1. General view.
Fig. 2. Microstructure.
Fig. 3. Formation of costae.
Figs. 4–9. Details of calices.

Scales: 0.5 mm.

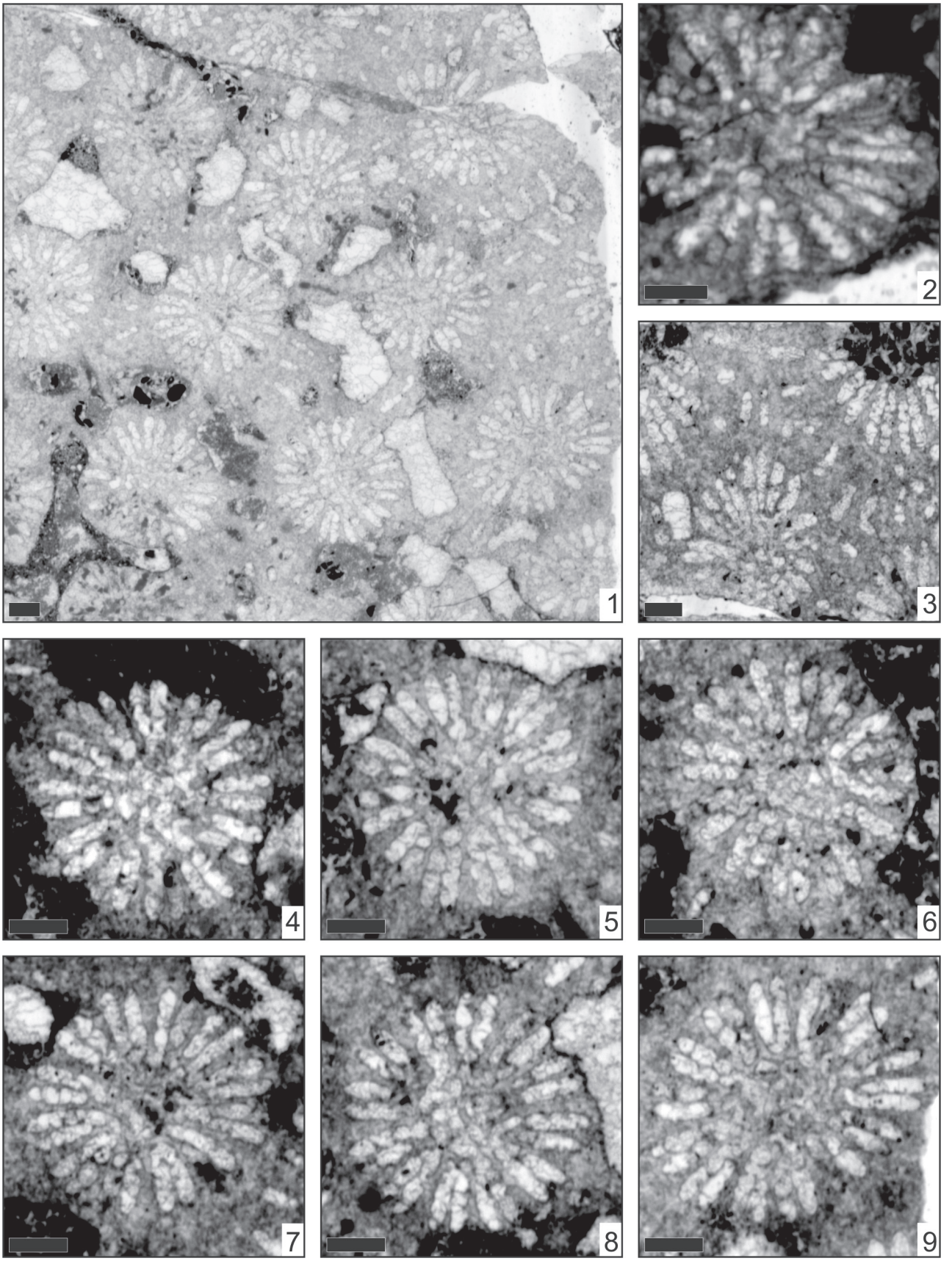
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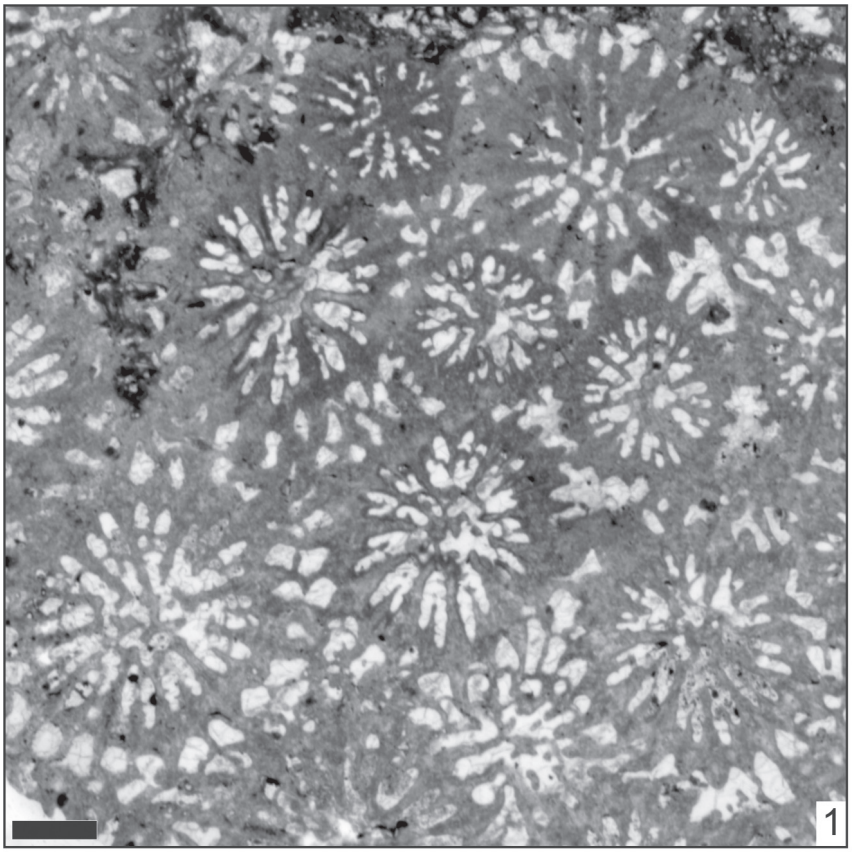
Plate 2

Figs. 1–3. *Paraplacocoenia subpolygonalis* (Hackemesser, 1936), holotype D6128, thin section.
Fig. 1. General view. – Scale: 1 mm.
Figs. 2–3. Details. – Scales: 1 mm.

Figs. 4–5. *Helladastraea felixi* (Renz, 1930), syntype NMB D2943, thin section.
Fig. 4. General view. – Scale: 5 mm.
Fig. 5. Detail. – Scale: 1 mm.

Fig. 6. *Helladastraea felixi* (Renz, 1930), syntype NMB D2933, thin section, detail. – Scale: 1 mm.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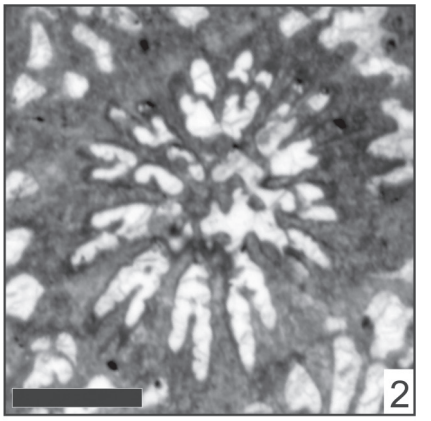
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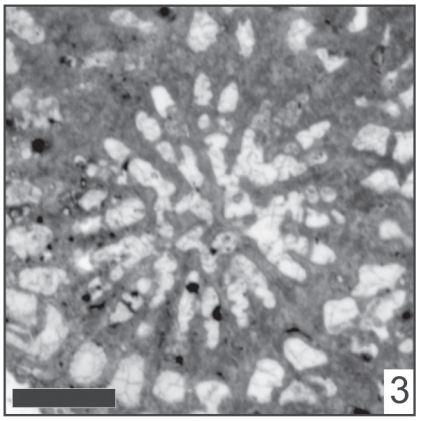
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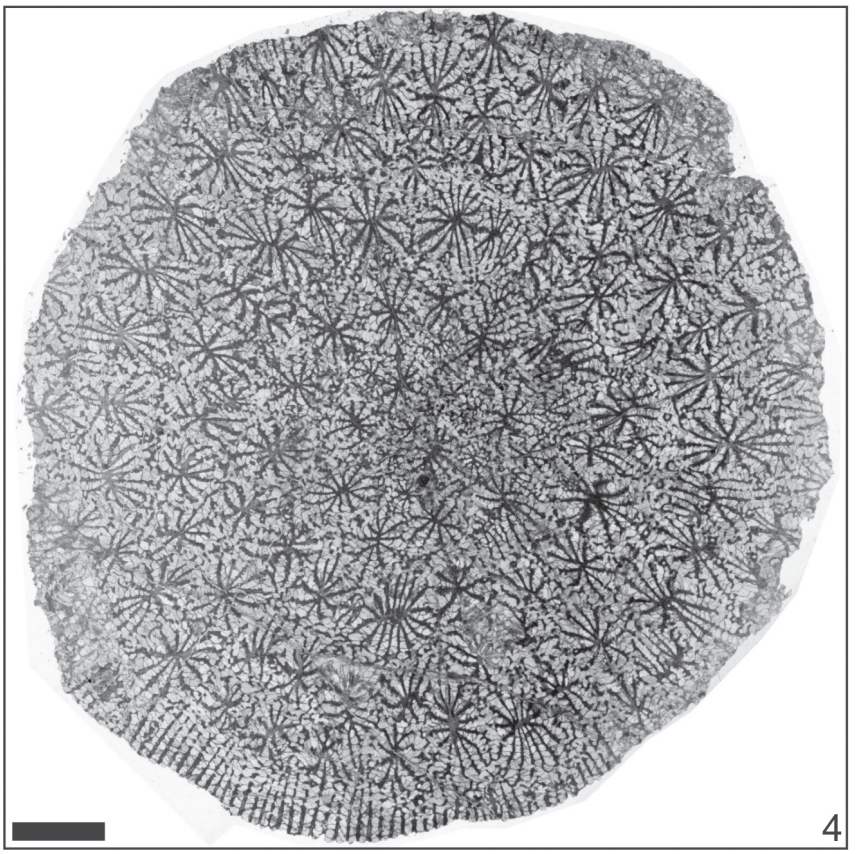
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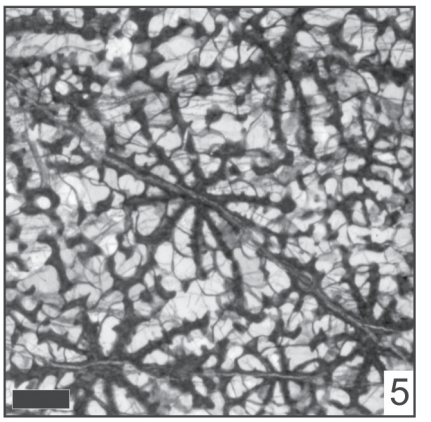
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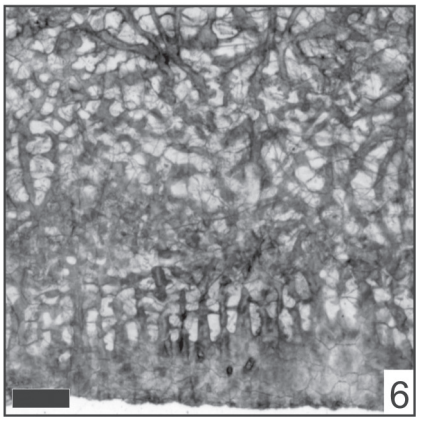
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