Rivista Italiana di Paleontologia e Stratigrafia
(*Research in Paleontology and Stratigraphy*)
vol. 124(3): 433-508. **November 2018**

CORAL COMMUNITIES, ZONATION AND PALEOECOLOGY OF AN UPPER JURASSIC REEF COMPLEX (ELLIPSACTINIA LIMESTONES, CENTRAL APENNINES, ITALY)

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To cite this article: Ricci C., Lathuilière B. & Rusciadelli G. (2018) - Coral communities, zonation and paleoecology of an Upper Jurassic reef complex (Ellipsactinia Limestones, central Apennines, Italy) . *Riv. It. Paleontol. Strat.*, 124(3): 433-508.

Keywords: Late Jurassic; Corals; Systematic; Ecology; reef; Apennines.

Abstract. This work describes and analyzes an original collection of fossil corals from the Ellipsactinia Limestones (Kimmeridgian-Tithonian), exposed in the Marsica area (central Apennines, Italy), focusing on taxonomy and paleoecology. 43 species grouped into 32 genera, 16 families and 9 suborders were identified. *Astreoidogyra giadae* nov. gen. nov. sp. (Rhipidogyridae) and *Clausastrea eliasovae* nov. sp. (Montlivaltiidae) are new taxa. Corals occur from the back reef to the reef crest, showing a marked zonation, expressed by a variation of coral cover and type, although the reef front and slope facies could not be sampled. The back reef is characterised by scattered medium-to-small colonies, with a relative high variety of colony shape, corallite arrangement types and high taxonomic diversity. *Stylosmilia*, *Calamophylliopsis*, *Intersmilia*, *Pleurophyllia*, *Bracthelia*, *Heliocoenia*, *Ogilvinella* occur here among others. The inner reef flat records the highest coral cover, with large robust branching, such as "*Pseudocoenia*", *Heliocoenia*, *Calamophylliopsis*, and large dome-shaped meandroid, such as *Psammogyra*, *Pruvostrastraea*, *Eugyriopsis*) colonies. Within the external reef flat and the reef crest the coral cover is low and the stromatoporoid-bearing mounds dominate on the isolated coral bioconstructions. Controlling factors as bathymetry, hydrodynamic disturbances, abrasive currents, background sedimentation and morphological irregularities of the depositional profile are considered to explain the observed coral zonation. High diversity and low dominance indices are interpreted to result from reef complex heterogeneity, which should have influenced the formation of different ecological niches and consequently the proliferation of a greater number of taxa in a relatively small area.

INTRODUCTION

Jurassic corals are reported as one of the main facies components of shallow water systems, developed in different depositional setting, from inner lagoon to distal slope (Roniewicz & Roniewicz 1971; Eliášová 1981, 2008; Turnšek et al. 1981; Geister & Lathuilière 1991; Leinfelder 1993; Insalaco et al. 1997; Insalaco 1999; Leinfelder 2001; Helm et al. 2003; Olivier et al. 2004; Lathuilière et al. 2005; Ivanova et al. 2008; Olivier et al. 2012; Martin-Garin et al. 2007, 2012). Moreover, Late Jurassic coral communities are systematically documented both from the northern Tethyan margin reef and from carbonate platforms of Tethyan domains (Beauvais, 1973, Roniewicz 1976; 2008; Errenst 1990; Turnšek 1997; Kołodziej 2003; 2015; Morycowa 2012; among many others). Nevertheless, comprehensive works that combine coral taxonomy and sedimentology and addicted to the paleoecological characterization of coral communities are rare (e.g. Turnšek et al. 1981; Leinfelder et al. 1996; Nose & Leinfelder 1997; Helm et al. 2003; Lathuilière et al. 2005; Ivanova et al. 2008). Paleoecological reconstruction usually are obtained from the analysis of 1D-stratigraphic logs (Leinfelder 1993; Lathuilière et al. 2005; Olivier et al. 2004, 2012; Morycowa 2012), 2D-metric-scale outcrops (e.g. Dupraz & Strasser 2002; Ricci et al. 2012) or even from reworked olistoliths (e.g. Eliášová 1981; Eliáš & Eliášová 1984; Kołodziej 2015; Hoffmann et al. 2017). In these areas, coral paleoecological reconstructions are derived from analyses of stratigraphic architecture and facies where corals are incorporated and by investigation of communities associated, e.g. microencrusters, bivalves, sponges and foraminifera. Reef complex depositional models are thus com-

Received: January 14, 2018; accepted: July 05, 2018

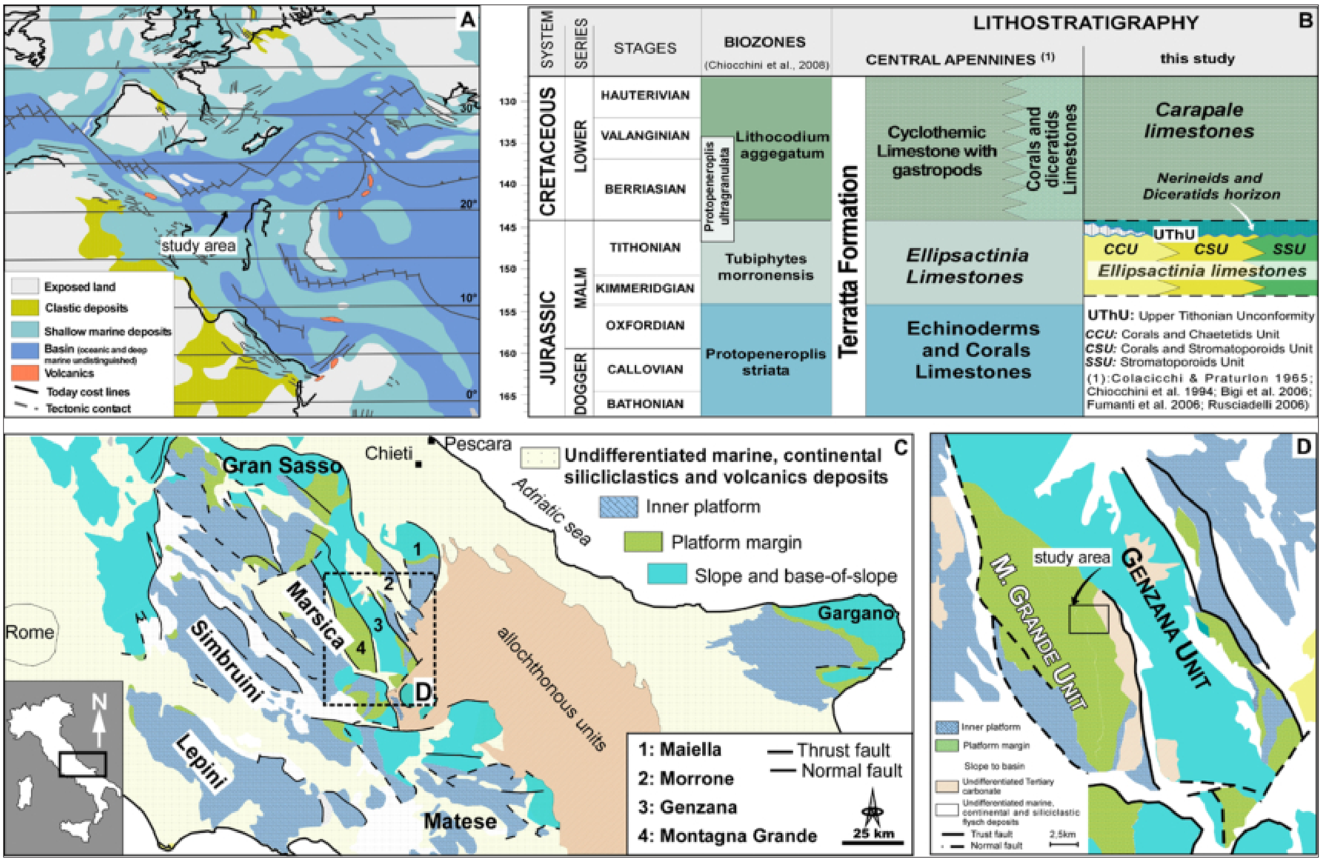


Fig. 1 - Geological framework. A) schematic paleogeographic map of Tethys during the Late Jurassic, displaying the location of the studied area (modified after Dercourt et al. 2000). The shallow water carbonates of the central Apennines belong to the Intra-Tethyan platform system, developed on the continental margins of Adria, far from continental-derived terrigenous input. B) Biozonation and lithostratigraphy of the Upper Jurassic-Lower Cretaceous platform margin of the central Apennines and of the studied area. See text for further explanation. C) Geological map of the central Apennines and the Gargano area, showing the distribution pattern of Mesozoic carbonate facies. The studied area is located in the outer sector of the central Apennines, where intraplatform basins dissect the main platform bank. Compiled from Servizio Geologico d'Italia, 1934, 1942, 1955, 2006a, b, c, d; Accordi et al. 1988; Bonardi et al. 1988; Vezzani & Ghisetti 1997. D) Simplified geological map of the Marsica area (modified after Accordi et al. 1988; D'Andrea et al. 1991). The studied area characterises the internal (western) platform margin of the Genzana intraplatform basin.

monly addressed through comparative studies of modern coral reefs, using a general uniformitarian approach (e.g. Eliášová 1981; Eliáš & Eliášová 1984; Bosence & Allison 1995; Lathuilière 2000; Lathuilière et al. 2005). Conversely, a direct observation of distribution pattern of corals along a depositional profile, where corals and their environmental and spatial context is well-constrained, is usually not the rule, because of the rareness of well-preserved large portion of reef complexes.

The coral collection presented in this work is from the Ellipsactinia Limestones of the Marsica area (Central Apennines, Italy), a well known geological region belonging to the Intra-Tethys domain, for which the sedimentological characters and the depositional model are well documented (Rusciadelli et al. 2011). The original coral collection represents a significant step forward in the knowledge of paleontological study of Jurassic corals from the Apennines, after the pioneer work of Prever (1909). The opportunity to observe, along a well constrained depositional profile, the distribution pattern of the coral community classified at the species level, leads to a better understanding of the paleoecological relationships between significant features of coral skeletons (e.g. size, external morphology, microarchitecture) and the environmental conditions influencing their growth.

This work allows the following questions to be approached: 1) How Late Jurassic corals of Intra-Tethys domain were distributed with respect to a zoned reef complex? 2) Which skeleton characters are mainly affected by changes in depositional environment? 3) Are there coral taxa significantly influenced in their distribution by changes in bathymetry, hydraulic energy and rate of sediment reworking?

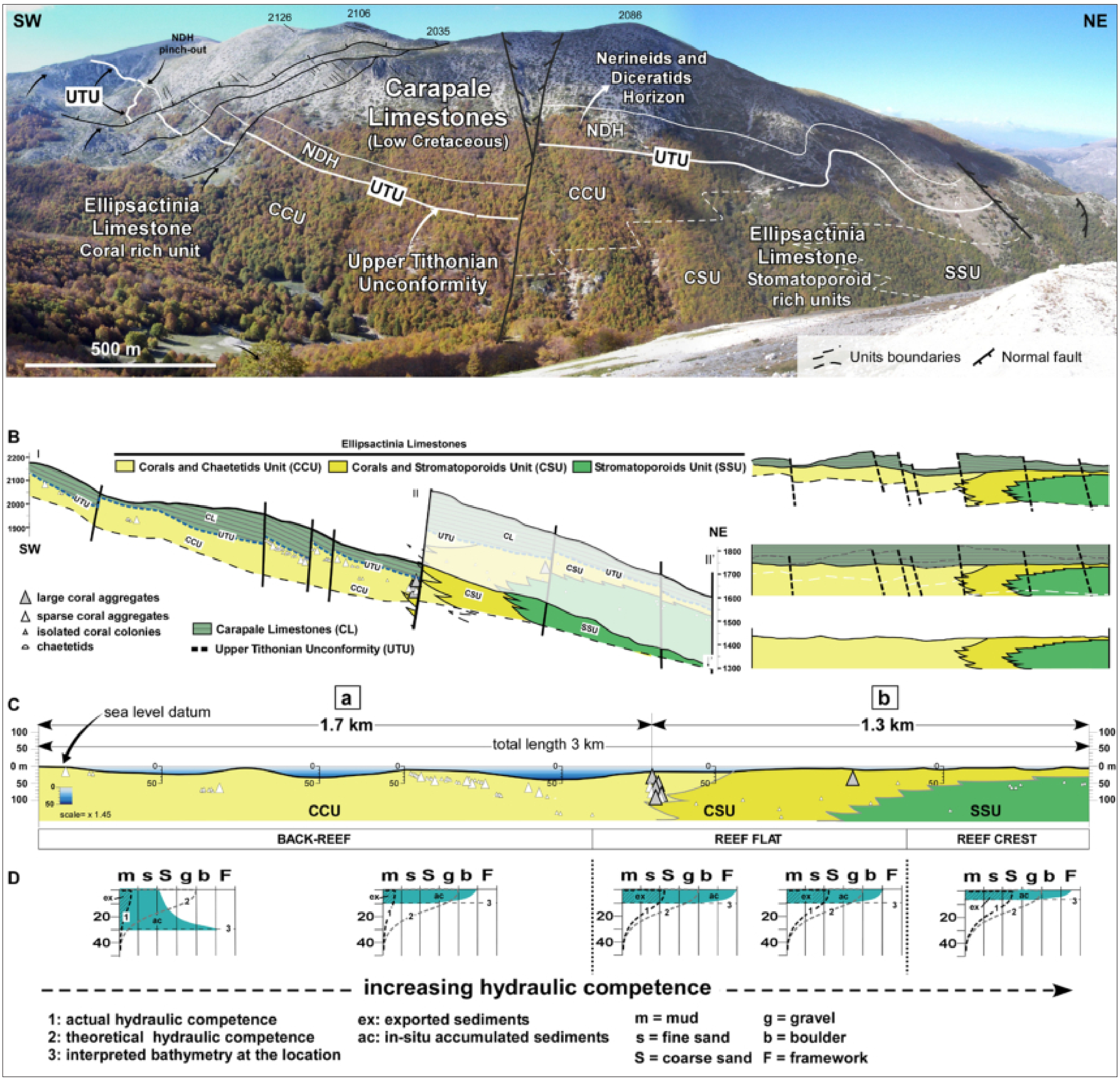


Fig. 2 - Geological section and depositional profile of Ellipsactinia Limestones. A) Panoramic view of the Serra del Carapale displaying a natural geological transect perpendicular to platform margin. It shows the vertical stratigraphic relationships between the Upper Jurassic margin succession of the Ellipsactinia Limestones and the inner platform succession of the Carapale Limestones, and the lateral relationships among the different lithostratigraphic units (CCU, CSU, SSU) of the Ellipsactinia Limestones. The Nerineids and Diceratids Horizon (NDH) and the Upper Tithonian Unconformity (UTU) mark the vertical transition between the platform margin and the inner platform successions. B and C) Depositional profile and bathymetry of the studied Upper Jurassic reef complex. The depositional profile (C) has been reconstructed through the restoration of a geological cross section (B), oriented in a SW-NE direction. The vertical exaggeration used here is 1,33. Two main sectors, displaying very different morphologies and water depths characterise the development of the depositional profile throughout the reef complex. Reef zones correspond to different sub-environments defined by distinct abiotic characteristics, peculiar biotic assemblages and characteristic hydrodynamic regime. See text for further description. D) Graphic description of depositional regime and hydraulic competence (actual and theoretical) and their effects on sediments produced. Concepts and graphics drawn on the papers of Pomar (2001) and Pomar & Kendall (2008).

GEOLOGICAL FRAMEWORK

Shallow-water carbonates of central Apennines belong to the complex system of Intra-Tethyan carbonate platforms developed on the continental margins of Adria, far from siliciclastic input, in an intermediate position between the European and African continents (Fig. 1A) (e.g. Dercourt et al. 2000; Golonka 2002; Stampfli & Borel 2002). During the Late Jurassic, these isolated platforms were rimmed by wide reef areas with highly diverse biotic communities, dominated by corals and stromatoporoids, with high debris production and poor in micrite (Leinfelder et al. 2002, 2005). These platform margin successions, which bear different formational names, are commonly and informally designated "Ellipsactinia Limestones".

In the central Apennines, the Ellipsactinia Limestones are referred to the *Crescentiella* (=*Tubiphytes*) *morronensis* biozone (Kimmeridgian-Tithonian) (cf. Chiocchini et al. 1994; 2008) (Fig. 1B), and are embedded between Middle and Upper Jurassic platform margin deposits at the base, and uppermost Tithonian-Lower Cretaceous inner platform and platform margin successions at the top (Bigi 2006; Chiocchini et al. 1994; Fumanti 2006; Rusciadelli 2006).

The study area is located in the Marsica region (Fig. 1C and 1D), which is characterised by a series of superposed tectono-stratigraphic units, stacked during the Miocene-Pliocene Apenninic orogenesis (e.g. Ghisetti & Vezzani 1997). The Ellipsactinia Limestones are here exposed over an area of ca. 6 km^2, with a thickness of approximately 200-250 m, along a natural transect about 3 km long, perpendicular to the platform margin (Fig. 1D). The lower boundary is not exposed, whereas the upper boundary coincides with a major unconformity (Upper Tithonian Unconformity) that abruptly separates the Ellipsactinia Limestones from the overlying inner platform succession (Carapale Limestones of Rusciadelli et al. 2011) (Fig. 1B, 2A, B). The latter is dominated by peritidal facies and by a basal horizon (Nerineids and Diceratids Horizon of Rusciadelli et al. 2011) a few to 20 m thick composed of bio-lithoclastic calcirudites with abundant black pebbles, large mollusks (gastropods and diceratids), some corals and algal bioconstructions (*Neoteutloporella socialis*).

Recently, Rusciadelli et al. (2011) have subdivided the Ellipsactinia Limestones into three distinct units, labelled: Corals and Chaetetids Unit (CCU), Corals and Stromatoporoids Unit (CSU), and Stromatopores Unit (SSU, here modified as Stromatoporoids Unit). These units are distributed according to lateral heteropic relationships, as unequivocally indicated by their position below the Upper Tithonian Unconformity (Fig. 2). The transition between them is quite rapid and it occurs within a few tens to hundred metres wide belt (Fig. 2).

Reef profile and reef zones

Using the Upper Tithonian Unconformity as reference surface, Rusciadelli et al. (2011) have reconstructed a tract of the reef profile about 3 km long, developed perpendicular to the platform margin (Fig. 2C). An approximate bathymetric gradient has been assessed, taking as datum the highest area along the depositional profile and evaluating the relative changes in depth along the profile. Based on morpho-bathymetric characteristics, the reef complex has been subdivided into three zones: the back reef, the reef flat and the reef crest (Figs 2C and D).

The back-reef corresponds to the deepest and most protected area, extending for about 1.7 km and showing an irregular topography, defined by deeper and higher morphological tracts, with a difference in height of roughly 20-30 m. The main reef building organisms are corals and chaetetids (cm- to dm- sized calcareous sponges, characterized by rigid cluster of tubes with a vertical development interrupted by a series of horizontal planes (tabulae), in life position or toppled, isolated or organised in structures formed by several specimens. These are poorly developed in height and scattered in bio-lithoclastic debris. Chaetetids are isolated or organised in clusters of few specimens. Skeletons are locally encrusted by thin (few mm thick) microencruster- and microbial-bearing crusts, but they are not bound. Grains are poorly sorted, ranging in size from mud (micritic matrix of packstone) to boulders (large fragments or isolated toppled corals and chaetetids), with very fine to fine grain size being prevalent.

The reef flat corresponds to the topographically more uniform tract of the depositional profile that gently slopes towards the back-reef (Fig. 2). It represents a partially protected area for a length of about 1 km, shallower than the back-reef, (Figs 2C and D). In a more inner area, adjacent to the back-reef, the biotic community is dominated by a true, but discontinuous framework, distributed along a belt a few meters wide parallel to the platform margin (Figs 2C and D). These bioconstructions characterise the more internal portion of a bioclastic sand-apron, where corals and stromatoporoids are dispersed mainly as large fragments. In correspondence with this narrow belt, coral colonies reach their maximum concentration and largest dimensions. Stromatoporoids are frequent as fragments or scattered isolated specimens. Sediment is well-washed, fairly well-sorted and reworked; thick cements are frequent. The prevailing grain size is medium- to coarse-grained sand; the finer fraction (lime mud) disappears and the very fine- to fine-grained sand only occurs within cavities of dense coral assemblages. These features suggest that hydraulic competence was able to rework and export grain sizes up to medium-sand (Figs 2C and D).

The reef crest extends for a few hundred of meters in the outermost part of the reef complex (Fig. 2). The biotic community is dominated by stromatoporoids with subordinate small chaetetids. Stomatoporoids show parallel (laminae) and perpendicular (pillars) skeletons elements in relation to the external surface, mostly represented by *Ellipsactinia* sp. and *Sphaeractinia* sp., and secondarily by small chaetetids. Other organisms are subordinate. The sediment is well-washed, sorted, coarse-grained sand; thick cements and cavities filled by cements are frequent. Hydraulic competence was sufficiently high to promote transport and dispersion of sediment up to medium/coarse-grained sands (Figs 2C and D). The highest concentration and largest dimensions of *Ellipsactinia* sp. and *Sphaeractinia* sp., in more or less densely packed clusters or as mound-shaped structures indicate shallower water, high hydrodynamism and generally elevated abrasive conditions.

MATERIAL AND METHODS

The collection contains over 103 coral samples and more than 220 thin sections. The coral collection is limited in number due to a poor state of preservation. For the same reason 79 samples of the collection are identified and described here. Coral samples and thin sections are housed at University "G. D'Annunzio" Chieti-Pescara, Laboratory of Stratigraphy (Collection Ricci C.-Rusciadelli G., Marsica corals, label: XR). Corals were found in outcrop; only three specimens were collected from recent screes and are considered not strictly in place but belonging to the same stratigraphic unit. Corals show different degrees of reworking: from corals in growth position to small coral rubbles. A thick patina of alteration or recristallisation prevents the coral identification and specimen classification in outcrops. Many corals have been discovered only after sawing. Conversely, in thin section, coral structures and microarchitectures are frequently preserved, while remains of microstructures are rather rare.

The geographic position of each collected coral was projected on the Upper Tithonian Unconformity, which marks the top of Ellipsactinia Limestones and is used as reference surface for the reconstruction of the reef profile (see Rusciadelli et al. 2011, for details). Seven corals collected are from the Nerineids and Diceratids Horizon that overlies the Ellipsactinia Limestones. They are included in the collection and described at species level, even if the coral distribution and paleoecology referred to Nerineids and Diceratids Horizon are not addressed due to low coral occurrence in this unit.

Rarefaction curves and diversity indices were performed using PAST open-source software (version 3.09, Hammer et al. 2001). Diversity indices are reported for the whole coral collection, for the Ellipsactinia Limestones and its subunits.

Remarks on coral systematic. The classification used in this work represents an integration of different schemes (Alloiteau 1952; Chevalier & Beauvais 1987; Roniewicz 1976, Stolarski & Roniewicz 2001, Stolarski & Russo 2001; Morycowa & Roniewicz 1995). Amphiastreina are included in the order Hexanthiniaria Montanaro-Gallitelli, following Roniewicz (2008), Morycowa (2012), Melnikova & Roniewicz (2012) and Kołodziej et al. (2012). The other suborders are included in the order Scleractinia Bourne. However, arguments and discussions dealing with systematic classification at high levels (order, suborder and family) are out of the aim of this work, although some insights on ambiguous or problematic taxa assignments are discussed in turn in the remarks. The characteristics of corals are illustrated following the list of terms proposed by Beauvais et al. (1993) and re-structured by Bertling (1995). The meaning of terms is not completely established (for instance compare Alloiteau 1957; Stolarski 1996 and Baron-Szabo 2014). The ambiguities are herein avoided when necessary, following the on-going collective project (see corallosphere.org, Cairns et al. 2010).

The number of references in the synonymy is shortened and restricted to the citations in which the figuration allows a comparison and at least a compatibility. For the cases of type species is lacking the synonymy list is increased.

Measurement abbreviations. Re: radial elements. d: calicular diameter expressed in millimetres. c-c: calicular distance expressed in millimeters. For both measurements the maximum (Max), minimum (Min) and mean (Mean) values are provided. The mean value corresponds to the arithmetic mean usually using more than five calices. s: number of radial elements corresponding to the sum of radial elements identified within a corallite. Ml: maximum length of radial elements observed within the colony, expressed in millimetres. ml: minimum length of radial elements observed within the colony, expressed in millimeters. Ml and ml are not necessarily derived from the same corallite. tk: thickness of radial elements measured on transverse section in a median point between the inner edge and the wall or costae peripheral edges, expressed in millimetres. dsy: density of radial elements representing the maximum number of septa per millimetre, measured in transverse section and is independent from the size order hierarchy. df: diameter of fossa; f-f: distance between adjacent fossae. trab dsy: trabecular density, in transverse section. pen dsy: density of pennulae in longitudinal section. coll-coll: distance between two collines. Moreover, "coral-size" refers to the dimension of whole skeleton or large fragments expressed as width x height, or diameter (in the cases of sub-circular colonies) observed in the field.

SYSTEMATICS

Corals samples come from two lithostratigraphic units: Ellipsactinia Limestones and Nerineids and Diceratids Horizon of the Carapale Limestones (Fig. 1B). These units yielded 79 specimens, classified into 9 suborders, 16 families, 33 genera and 46 species (Tabs 1 and 2). Ellipsactinia Limestones

Order Hexanthiniaria Montanaro-Gallitelli, 1975				**Sample**
Amphiastreina Alloiteau, 1952				
	Amphiastreidae Ogilvie, 1897			
		Amphiastrea Etallon, 1859	*Amphiastrea basaltiformis* Etallon, 1859	XR 86
		Pleurophyllia Fromentel, 1856	*Pleurophyllia cara* Eliášová, 1975	XR 114ph
		Amphiaulastrea Geyer, 1955	*Amphiaulastrea* sp.	XR19*; XR car
	Heterocoeniidae Oppenheim, 1930			
		Heterocoenia Milne Edwards & Haime, 1848	*? Heterocoenia* cf. *minutisima* Reig Oriol, 1997	XR101L
		Thecidiosmilia Koby, 1888	*Thecidiosmilia morycowae* Kołodziej, 1995	XR100; XR78
	Intersmiliidae Melnikova & Roniewicz, 1976			
		Intersmilia Eliášová, 1974	*Intersmilia* aff. *diaboli* Eliášová, 1974	XR106a
			Intersmilia sp.	XRS8.1ii
Order Scleractinia Bourne, 1900				
Stylophyllina Beauvais, 1980				
	Cyathophoridae Vaughan & Wells, 1943			
		Cyathophora Michelin, 1843	*Cyathophora bourgueti* (Defrance), 1826	XR4
			Cyathophora sp.	XR13A*, B*
			Cyathophora aff. *parva*	XR88
Caryophyliina Vaughan et Wells, 1943				
	Axosmiliidae Geyer, 1955			
		Placophyllia d'Orbigny, 1849	*Placophyllia tenuis* Roniewicz, 1976	XR99*; XR 130; XR21
			Placophyllia cf. *florosa* Eliášová, 1976	XR18*
Rhipidogyrina Roniewicz, 1976				
	Rhipidogyridae Koby, 1905			
		Bracthelia L & M. Beauvais, 1975	*Bracthelia collignoni,* Beauvais & Beauvais,1975	XR58; XR122T
			Bracthelia rutimeyeri (Koby, 1889)	XR113; XR61; XR118; XR120
		Ogilvinella Eliášová, 1976	*Ogilvinella* cf. *morycowae* Kołodziej, 2003	XR124; XR82; XR82B
		Psammogyra Fromentel in de Ferry, 1862	*Psammogyra valfinensis* Beauvais, 1964	XR8; XR5mm
		Pruvostastraea Alloiteau, 1957	*Pruvostastraea labyrinthiformis* Alloiteau, 1957	XR3
		Fromentelligyra Alloiteau, 1952	*Fromentelligyra* sp.	XRS8.1
		Astreoidogyra nov. gen.	*Astreoidogyra giadae* nov. sp.	XR55
		Gen. indet.	Gen. indet. sp. indet.	XR128B
Stylinina Alloiteau, 1952				
	Stylinidae d'Orbigny, 1851			
		Pseudocoenia d'Orbigny, 1850	*Pseudocoenia limbata* (Goldfuss, 1826)	XR 5; XR45; XR79
			Pseudocoenia decipiens (Etallon, 1864)	XR77
			Pseudocoenia sp.	XR105
		Stylosmilia Edwards & Haime, 1848	*Stylosmilia pumila* (Quenstedt, 1852)	XR93
			Stylosmilia michelini Milne-Edwards & Haime, 1848	XR92; XR101
			Stylosmilia octonaria Roniewicz, 1976	XR89
		Stylina Lamarck, 1816	*Stylina tubulosa* (Goldfuss, 1829)	XR2*
		Heliocoenia Etallon, 1859	*Heliocoenia variabilis* Etallon, 1859	XR70; XR85; XR129; XR 94; XR99t*
			Heliocoenia sp. (n 1)	XR68
			Heliocoenia sp. (n 2)	XR1
	Cladophylliidae Morycowa & Roniewicz, 1990			
		Cladophyllia Milne Edwards, 1851	*Cladophyllia* sp.	XRS9.1
	Family Incertae sedis			
		Eugyriopsis Beauvais, 1976	*Eugyriopsis sinuosa* (Ogilvie, 1897)	XR7; XR42A
Faviina Gregory, 1900				
	Montlivaltiidae Dietrich, 1926			
		Kobyphyllia Baron Szabo, 1997	*Kobyphyllia* cf. *recta* (Koby, 1884)	XR51
		Clausastrea d'Orbigny, 1849	*Clausastrea topalensis* Roniewicz, 1976	XR49
			Clausastrea eliasovae new species	XR139B; XR138B
		Thecomeandra Eliášová 1973	*Thecomeandra remesi* Eliášová, 1973	XR69
	Dermosmiliidae Koby, 1887			
		Dermosmilia Koby, 1884	*Dermosmilia laxata* (Etallon, 1864)	XR87
			Cf. *Dermosmilia* sp.	XRS 2.1
		Calamophylliopsis Alloiteau, 1952	*Calamophylliopsis flabellum* (Blainville, 1830)	XR47; XR5Nph; XR15*; XR 127; XR109; XR84
Microsolenina Morycowa & Roniewicz, 1995				
	Microsolenidae Koby, 1889			
		Microsolena Lamouroux, 1821	*Microsolena* sp.	XR81; XR83; XR107b1; XR103; XR126; XR107B2; XR108B; XR127A
		Comoseris d'Orbigny, 1849	*Comoseris* sp.	XR117; XR119; XR121
	Latomeandridae Alloiteau, 1952 emend. Roniewicz, 1976			
		Ovalastrea d'Orbigny, 1849	*Ovalastrea* sp.	XR115
		Fungiastraea Alloiteau, 1952	*Fungiastraea arachnoides* (Parkinson, 1808)	XR111; XR128A
Fungiina Duncan, 1884				
	Thamnasteriidae Vaughan & Wells, 1943			
		Thamnasteria Lesauvage, 1823	*Thamnasteria* cf *concinna* (Goldfuss, 1826)	XR87
	Haplaraeidae Vaughan and Wells, 1943			
		Diplaraea Milaschewitsch, 1876	*Diplaraea* sp.	XRS5.1
Suborder uncertain				
	Solenocoeniidae Roniewicz, 2008			
		Solenocoenia Roniewicz & Gill, 1976	*Solenocoenia sexradiata* (Goldfuss, 1826)	XR 55p

* samples occuring in Nerineids and Diceratids horizon

Tab. 1 - List of determined coral taxa from Ellipsactinia Limestones and Nerineids and Diceratids Horizon in the Marsica Region, Abruzzi, Central Apennines, Italy.

includes 72 specimens, belonging to 32 genera and 43 species, while Nerineids and Diceratids Horizon includes only 7 specimens, belonging to 6 genera and 7 species (Tab. 2). The individual-rarefaction curves for genera and species for Ellipsactinia Limestones are shown in Figure 3. Coral diversity indices are shown in Table 2 and their significance is discussed below.

The most represented suborder is Stylinina (12 species), followed by Faviina (7 species) and Rhipidogyrina (7 species and 1 species indet.), Microsolenina (4 species), Amphiastreina (7 species) and Fungiina (2 species). Stylinidae and Rhipidogyridae are the families containing the highest number of genera and species. New taxa contained in the collection are: *Astreoidogyra giadae* nov. gen. and nov. sp., *Clausastrea eliasovae* nov. sp. and a new unnamed taxon belonging to Rhipidogyridae.

Order **Hexanthiniaria** Montanaro-Gallitelli, 1975
Suborder **Amphiastreina** Alloiteau, 1952

Remarks. Despite the wide usage of the junior synonym Pachythecaliina by some recent authors (e.g. Roniewicz 2008; Morycowa 2012; Melnikova & Roniewicz 2012 and Kołodziej et al. 2012; Gretz et al. 2015, but see an opposite view in Baron Szabo 2002 or Löser 2016), in application of the principle of priority, Amphiastreina Alloiteau, 1952 in place of Pachythecaliina Eliášová, 1976 is here used. So, both Late Jurassic and Cretaceous Amphiastreidae, Heterocoeniidae and Intersmiliidae as well as Triassic and Liassic Zardinophyllidae are grouped in this suborder. We correct the spelling as Alloiteau used the usual suffix -ida in place of -ina for a suborder and used an incorrect subsequent spelling of the genus (*Amphiastræa* in place of the original spelling *Amphiastrea*) (ICZN art. 32.5.3.3).

Family Amphiastreidae Ogilvie, 1897
Genus *Amphiastrea* Étallon, 1859
Type species: *A. basaltiformis* Étallon, 1859

Amphiastrea basaltiformis Étallon, 1859
Pl. 1, fig. 1a, b, c

1859 *Amphiastrea basaltiformis* Étallon, p. 101/501.
1888 *Amphiastrea basaltiformis* - Koby, p. 433, pl. 115, fig. 1, 1a, 2a.
1957 *Amphiastrea basaltiformis* - Alloiteau, p. 355, fig. 244, 246, 247.
1964 *Amphiastrea basaltiformis* - Beauvais, p. 200, pl. 22, fig. 1, text-fig. 43.
1964 *Amphiastrea basaltiformis* - Morycowa, p. 489, pl. 22, fig. 1a-c.
1975 *Amphiastrea basaltiformis* - Eliášová, p. 6, pl. 1, fig. 1.

Material: 1 sample (XR86), 2 thin sections.
Locality: Internal zone of CCU (wp 773; M771).

Description. Massive colony, quasi cerioid arrangement of the corallites (wall not really shared between two corallites). Budding typically Taschenknospung. Inner calices sub-circular to slightly elongated, but outer wall perimeter polygonal. Two-zonal endotheca, with large vesicular dissepiments in the external zone (marginarium).

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR86	4.8	2.2	3.7	6.3	3.2	5.0
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR86	~20-23	~1.3	~0.5	0.2/0,1	5-6/mm	

Septa free, frequently lonsdaleoid. Symmetry of radial elements not observed due to the poor state of preservation. Two or three size orders; S1 septa longer and thicker than S2 and ?S3. S1 straight or rarely curved, S2 and S3 straight. Slight enlargement of the peripheral edge in S1, less evident in S2. Frequent spines on lateral faces. Wall well-distinct and prominent (thickness: 0.9-1 mm). Narrow sutures separate neighbouring corallites. In transverse section (Pl.1, fig.1c) the wall is typical for the genus. For this reason, it is assumed as a true pachytheca (*sensu* Roniewicz & Stolarski 1999). Columella absent.

Remarks. Calicular diameter, number of septa, the pattern of septa and the morphology of the main septum observed in our sample (XR86) are also close to the characters of *Amphiastrea gracilis* described by Eliášová (1975). However, because of the inability to observe the septal pattern of the holotype of *A. gracilis*, the priority of *A. basaltiformis* is preferred. Features observed are close to the description of *Amphiastrea basaltiformis* by Prever (1909), which was collected from the same region and probably from a coeval stratigraphic interval from which sample XR 86 comes. It differs for a slightly higher number of septa, suggesting a possible variability. Unfortunately, Prever did not publish figures and we had no opportunity to study his collection. *A. saccoi* Prever is rejected for the following reasons: septa are frequently joining in *A. saccoi*; 2) number of septa and dimensions are higher in XR86 specimen.

Genera							
	ELL	NDh	ELL+NDh	CCU (int)	CCU (ext)	CSU	SSU
Taxa_S	32	6	33	23	9	4	3
Individuals	72	7*	79	51	13*	4*	4*
Dominance_D	0.05	0.18	0.05	0,07	0.12	0.25	0.38
Simpson_1-D	0.95	0.82	0.95	0.93	0.88	0.75	0.63
Shannon_H	3.21	1.75	3.23	2.85	2.14	1.39	1.04
Equitability_J	0.93	0.98	0.92	0.91	0.97	1.0	0.95
Berger-Parker	0.11	0.29	0.10	0.16	0.15	0.25	0.50
Hill	0.04	0.21	0.04	0.06	0.13	0.33	0.57

Species							
	ELL	NDh	ELL+NDh	CCU (int)	CCU (ext)	CSU	SSU
Taxa_S	43	7	46	29	9	4	4
Individuals	72	7*	79	51	13*	4*	4*
Dominance_D	0,04	0,14	0,04	0,06	0,12	0,25	0,25
Simpson_1-D	0,96	0,86	0,96	0,94	0,88	0,75	0,75
Shannon_H	3,53	1,95	3,59	3,12	2,14	1,39	1,39
Equitability_J	0,94	1,00	0,94	0,93	0,97	1,00	1,00
Berger-Parker	0,77	0,14	0,10	0,16	0,15	0,25	0,25
Hill	0,00	0,17	0,03	0,05	0,13	0,33	0,33

Tab. 2 - Number of determined coral taxa and diversity indices of the original coral collection. ELL: Ellipsactinia Limestones; NDh: Nerineids and Diceratids Horizon; ELL+NDh: whole coral collection; CCU: Corals and Chaetetids Unit (internal (CCU int) and external (CCU ext) sector); CSU: Corals and Stromatoporoids Unit; SSU Stromatoporoids Unit. "*" marks units with a low number of individuals, for which the diversity indices are statistically poorly significant. Indices have been performed with PAST (version 3.09) open-source software (see Hammer et al. 2001, for formula). Hill index has been calulated apart as [1/(1-D)]/[e^H]. It consists of combination of Shannon and Simpson indices, which permits a more consistent comparison of different populations with heterogenous sampling size (see Soetaert & Heip 1990; Jin & Tang 1996; Martin-Garin et al. 2010, 2012 for details).

Genus *Pleurophyllia* Fromentel, 1856

Type species: *P. trichotoma* Fromentel, 1856

Pleurophyllia cara Eliášová, 1975

Pl. 1, fig. 2a, b, c

1975 *Pleurophyllia cara* Eliášová, p. 15, pl. 8, fig. 1-2 text fig. 9.
1976 *Pleurophyllia cara* - Roniewicz, p. 39, pl. 3, fig. 2.
1985 *Pleurophyllia cara* - Rosendahl, p. 53.
2003 *Pleurophyllia cara* - Kolodziej, p. 203, fig. 12.

Material: 1 sample (XR114), 3 thin sections.
Locality: Inner zone of CCU (wp 909).

Description. Phaceloid colony. Corallites sub-cylindrical and parallel. Low calicular packing. "Taschenknospung" budding deciphered in longitudinal section.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR114ph	7*	3.3*	5	15	7	10
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR114ph	tot:?	2.4**	0.4 (S3)	~0.4 (S1)	3/mm	

* including marginarium; ** cardinal septum

Cardinal septum reaching the calicular centre. Bilateral symmetry inferred. Three septa size orders, differing clearly in terms of length. Septa thin, free, smooth, compact, straight or tortuous. Two-zonal endotheca: external zone, corresponding to the marginarium, thick, with large vesicular dissepiments, internal zone narrow, tabuloid. Wall thick, with true pachythecal microstructure (*sensu* Roniewicz & Stolarski 1999). Subhorizontal trabecular axes densely packed and regularly distributed in the pachytheca. We use the terms "trabecular axes" because the external boundary of trabeculae is often difficult to point and then a trabecula is often difficult to define with precision, but even when the preservation is low, the axis along which a trabecula grows is often easier to trace.

Remarks. The type species is sparitized, also in the the potential zone of the marginarium.

Pleurophyllia is here really an Amphiastreidae with a marginarium based on other samples described of this genus.

Genus *Amphiaulastrea* Geyer, 1955

Type species: *Aulastraea conferta* Ogilvie, 1897

Amphiaulastrea sp.

Pl. 1, fig. 3a, b, 4a, b, c

Material: 2 samples (XR19; XR car), 4 thin sections (1: XR19; 3: XR car).

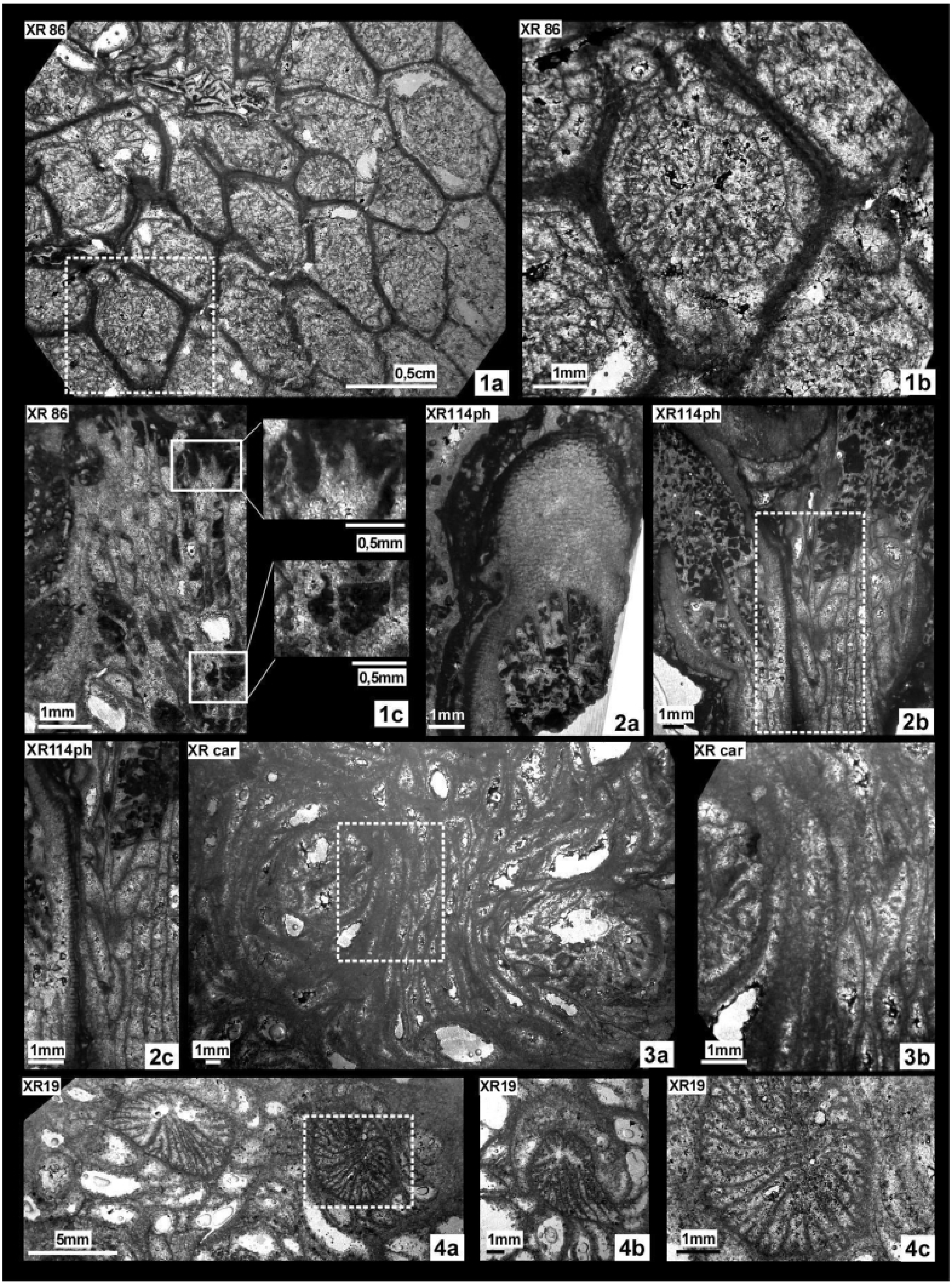


PLATE 1

Fig. 1 - Family Amphiastreidae Ogilvie, 1897. 1a, b, c: XR86*, Amphiastrea basaltiformis* Étallon, 1859; 1a: transverse section; b: zoom of 1a; 1c: longitudinal section and enlargements of lateral faces of radial elements.

Fig. 2 - XR114ph, *Pleurophyllia cara* Eliášová, 1975. 2a: pachythecal microstructure of the wall in transverse section and cardinal septum; b: longitudinal section; 2c: zoom of 2b.

Fig. 3 - XRcar, *Amphiaulastrea* sp.; 3a: transverse section; 3b: zoom of 3a on marginarium.

Fig. 4 - XR19, *Amphiaulastrea* sp.; 4a, b: transverse sections; 4c: zoom of 4a.

Localities: XR 19: Nerineids and Diceratids horizon; XR-car: Debris of M5, exernal zone of CCU.

Description. Massive colony with a cerioid arrangement of corallites of plocoid appearance due to the large marginarium. Vesicular chambers of marginarium reach 4-5 mm in size. Budding typically "Taschenknospung". Sub-circular calices (marginarium excluded), peripheral edge of the marginarium curved to polygonal.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR 19	5.5	3	4.3	12.3	11.3	12
XR car	/	~7	/	/	/	~16
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 19	48*	2.9(S1)	0.4(S4)	~0.2-0.3(S1)	5/mm	
XR car	/	/	/	/	/	

* tot:48= 6(S1)+6(S2)+12(S3)+24(S4)

Radial symmetry. Septa arranged in four size orders, differing in length, less in thickness. Septa curved, free, characterised by a slight enlargement of the peripheral edge. Radial elements density high. Columellar septum present, long (about 3.8-4 mm) and curved. Wall large, made of a multilayered structure.

Remarks. The assignation to the genus *Amphiaulastrea* Geyer is proposed based on the following reason. *Amphiaulastrea* differs from *Amphiastrea* and *Pleurostylina* by having a wide, probably permanent, marginarium made of wide vesicular dissepiments. It differs from *Aulastraea* Ogilvie by a permanent cerioid structure. Nevertheless, enough material is not available to decide whether *Mitrodendron*, *Aulastraea* and *Amphiaulastrea* are members of a continuous morphological spectrum or if they really represent phyletic genera. Further material is also needed to clarify the specific assignation. Table 3 summarizes the comparison of the nominal species recorded in the literature for this genus, suggesting the need for some synonymies.

The present species has similar dimensions with *A. rarauensis* but a much thinner wall.

Family Heterocoeniidae Oppenheim, 1930
Genus *Heterocoenia* Milne Edwards & Haime, 1848

Type species: *Lithodendron exiguum* Michelin, 1847

? ***Heterocoenia*** cf. ***minutisima*** Reig Oriol, 1997

Pl. 2

cf 1997 *Heterocoenia minutisima* Reig Oriol, p. 12, pl. 1, fig. 12.

Material: XR101 (1 sample; 2 slabs, XR101L, XR101T; 2 thin sections).

Localities: Internal zone of CCU (wp 878)

Description. Small massive irregular coral colony producing extending corallites that can produce cateniform growth forms, consisting of series of aligned corallites. The colony encrusts and grows parallel to the external lateral surface of another coral colony (*Stylosmilia michelini*). In transverse section, the corallites usually touch each other or are very poorly detached and laterally connected to the substratum by the peripheral wall. Calicular outline circular to irregular. Corallites very small, calicular diameter quite constant along the series. Nature of the budding still ambiguous. On the one hand a wide wall, with a local enlargement that recalls an intramural, extracalicinal increase, as it is known in Amphiastreina, is observed. On the other hand new corallites apparently issued from septal budding.

Species	Number of septa	Diameter of calices (outer)
Amphiaulastrea conferta Ogilvie	21-30	8-10 mm
Amphiaulastrea sp1 in Kolodziej 2003	18-24	(5) 9-12 mm
Amphiaulastrea sp2 in Kolodziej 2003	10-12	4-5 mm
Amphiaulastrea aliensis (Sikharulidze 1977)	26-30	3-3.5 mm
Amphiaulastrea keuppi Baron Szabo & Steuber	26-44	(4) 5-8 mm
Amphiaulastrea rarauensis (Morycowa 1971)	42-48	5-5.5 mm
Amphiaulastrea suprema Moryc. & Marc.	24	3-6.5 (7) mm
Amphiaulastrea minima (Prever 1909 Monte d'Ocre)	24-26	4-5 mm
Amphiaulastrea delorenzoi (Prever 1909 Monte d'Ocre)	6	3-6 mm
Amphiaulastrea guiscardii (Prever 1909 Monte d'Ocre)	24	3-4.5 mm
Amphiastrea saccoi Prever 1909 (Gran Sasso)	16-20	2.5-3.5 mm
Amphiastrea cylindrica Og. in Prever (Gran Sasso)	?	?

Tab. 3 - Nominal species recorded in the literature for *Amphiaulastrea* Geyer, 1955. Comparing the measurements the need to clarify the specific assignation.

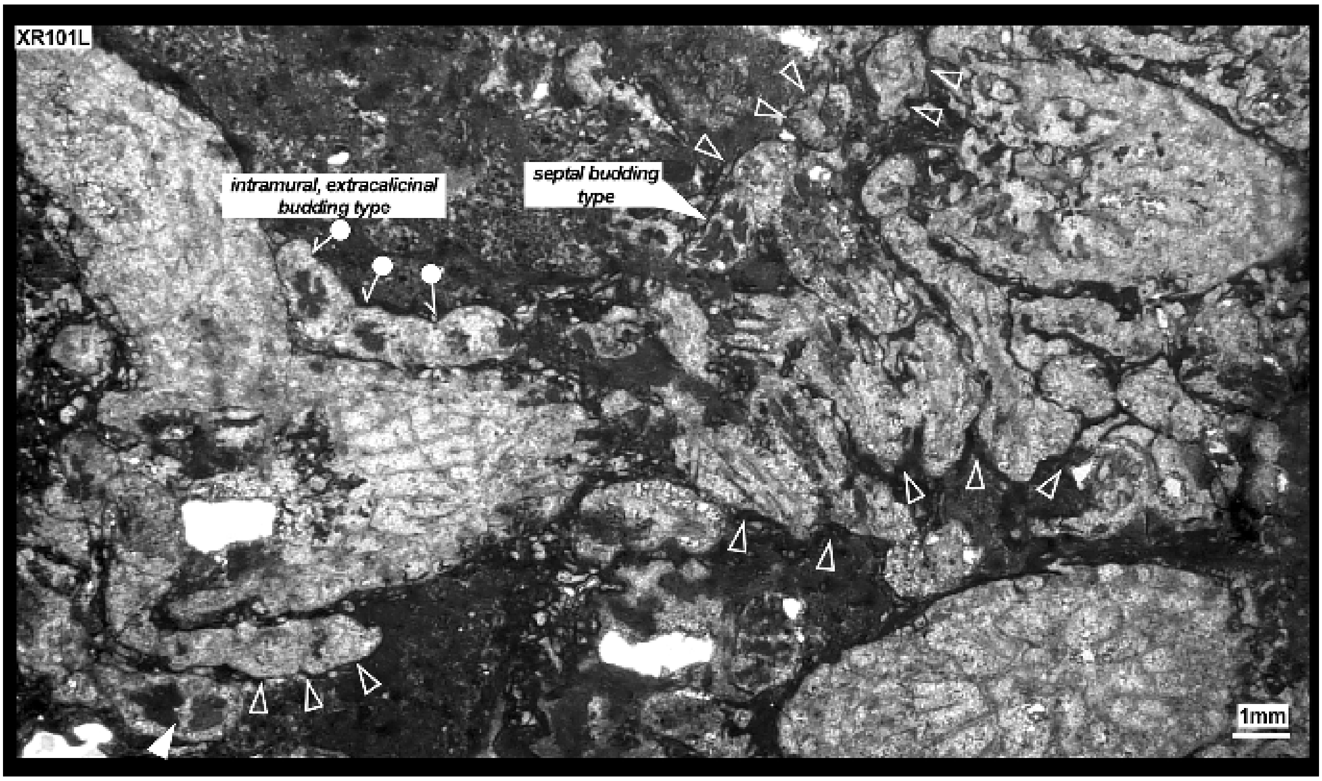


PLATE 2

? Heterocoenia cf. minutisima Reig Oriol, 1997: sample XR101, *?Heterocoenia cf. minutisima* encrusts the external surface of *Stylosmilia michelini* (three corallites of a phaceloid coral are present in the picture). Arrows (not filled) point to the boundaries of the cateniform colony; dot-arrows points to the place where intramural budding is suspected; filled white arrow points to suspected septal budding.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR101L	0.7	0.4	0.5	1.1	0.5	0.8
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR101L	tot: ?12	0.5* 0.3**	0.15	~0.11* ~0.05	~3-4/ 0.5mm	

*cardinal septa; ** main septa

Cardinal septum present, attenuated or clavate. Total number of septa variable. A maximum of about 12 septa observed within one corallite; within other corallites the total number of septa ranges from 3 to 8. Symmetry not clear, bilateral symmetry could be evoked where a cardinal septum occurs. Aside from the cardinal septa, some main septa are observed, usually curved, occasionally with a clavate morphology. Other minor septa straight, thin and very short. Remains of thin planar to curved dissepiments occur in longitudinal section. Peripheral wall thick, prominent and frequently shared by two adjacent corallites.

Remarks. Initially thought as an original new feature, the cateniform growth form is here interpreted as a character state that takes place in the normal variation of the genus *Heterocoenia* (see especially *H. exigua*, the type specimen of the type species). Accordingly, XR101L is included into the family Heterocoeniidae and with a question mark into the genus *Heterocoenia*, despite the absence of obvious spiny granules that are supposed to distinguish Heterocoeniidae from Amphiastreidae according to Kołodziej (1995). Further observations and a wider consideration of the microstructural variability of these groups are still needed to ascertain this taxonomic distinction between Amphiastreidae and Heterocoeniidae. XR101L is compared with other *Heterocoenia* species. Only *Heterocoenia minutisima* Reig Oriol has so tiny corallites (Reig Oriol 1997). An open nomenclature is kept because the material described by Reig Oriol seems to be more regular in growth form and, more importantly, the septal apparatus is presented under the formula 3S1+ 3S2, when it is much more variable in XR101L. The present species differs from *Simplexastrea archea* (Eliášová 1976c) essentially for three main characters: 1) arrangement of the corallites (external morphology): essentially dendroid

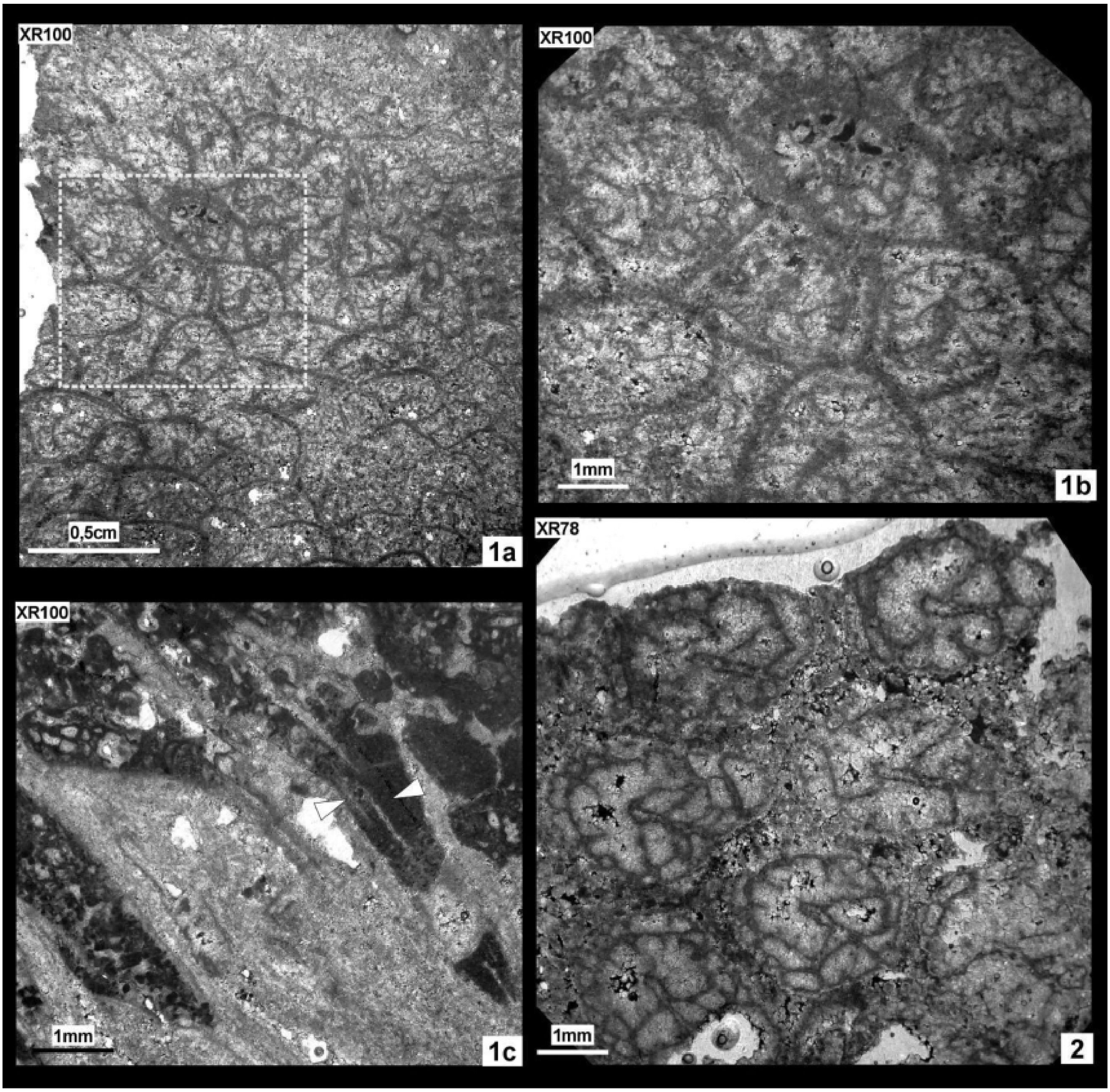


PLATE 3

Fig. 1 - XR100, *Thecidiosmilia morycowae* Kolodziej, 1995; 1a: transverse section, 1b: zoom of 1a showing cerioid arrangement and lonsdaleoid septa; 1c: roughly longitudinal section, arrows mark spines.
Fig. 2 - XR78, *Thecidiosmilia morycowae* Kołodziej, 1995, transverse section.

in *S. archea*, markedly catenifom and encrusting in XR 101L; 2) diameter of corallites: 2 to 4.8 mm in *S. archea*, less than 1 mm in XR 101L; 3) number of septa: 14-20 in *S. archea*; no more than 12 in XR 101L. Moreover, for the same characters and especially for the exclusive arrangement of corallites the sample XR 101L differs from *Hexapetalum pium* (Eliášová 1976c). The arrangement of corallites is also a distinguishing feature from the encrusting genus *Latusastrea*.

Genus *Thecidiosmilia* Koby, 1888

Type species: *T. valvata* Koby, 1888

Thecidiosmilia morycowae Kołodziej, 1995

Pl. 3, figs 1a, b, c, 2

1995 *Thecidiosmilia morycowae* Kolodziej, p. 9, fig. 5, 6.

Material: 2 samples (XR100; XR78), 4 thin sections.
Localities: Internal zone of CCU (wp 878; wp 758).

Description. Massive colony, cerioid arrangement of corallites with a wide marginarium. Calices circular to sub-circular, peripheral edge polygonal. "Taschenknospung" budding cannot be proved (see Kołodziej 1995 and Stolarski & Russo 2001), only a single corallite shows a suspected thickening of the inner sector of wall region, but the new bud is not directly observed.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR 100	2.5	1.9	2.1	3.2	2.4	2.9
XR 78	2.5	1.8	2.2	4.2	2.6	3.2
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 100	12?24*	~0.8(S1)	~0.4(S2)	0.2(S1/S2)	4-5/mm	
XR 78	12?24*	~0.9(S1)	~0.3(S2)	0.2(S1/S2)	4-5/mm	

* 12/?24: 6(S1)+6(S2)+?12(S3, rudimental)

Lonsdaleioid septa *s.s.* Bilateral symmetry marked by a major septum. Two main size orders (S1, S2), containing 6 septa respectively. A rudimentary and non-continuous third size order (S3) is observed in few corallites. S2 septa shorter than S1 septa, S1 septa usually curved, never joining. Major septum shows claviform morphology. Spines frequent on lateral faces; asymmetrical distributed with regard to the septal plane. Columellar septa belonging to different corallites show a typical common orientation, or at least, the angle among them is low. Two-zonal endotheca not detected. Wall thick, probably pachythecal *s.s.* (Roniewicz & Stolarski 1999).

Remarks. *Thecidiosmilia* appears as a massive *Latusastrea* but the respective budding modes of these genera are not well documented. Relations to *Heterocoenia* are also not yet well established (see discussion in Baron Szabo 2014). The present species differs from *Thecidiosmilia valvata* and of *Latusastrea alveolaris* by much smaller calices. The holotype of the species is known from Aptian of Poland. The samples were not placed within the genera *Pleurostylina* and *Amphiastrea* because of the general tendency of major septa to be oriented in a common direction and of the curved outline of some parts of the wall also similarly oriented.

Family Intersmiliidae Melnikova & Roniewicz, 1976

Genus *Intersmilia* Eliášová, 1974

Type species: *Intersmilia malevola* Eliášová, 1974

Intersmilia aff. ***diaboli*** Eliášová, 1974

Pl. 4, fig. 1a, b

1974 *Intersmilia diaboli* Eliášová, p. 416 pl. 2 fig. 1, 2; pl. 3 fig. 1, 2; pl. 4 fig. 1, 2.
1976c *Intersmilia diaboli* Eliášová, p. 359 fig. 3 pl. 1 fig. 1.

Material: 1 sample (XR106a), 3 thin sections.
Locality: Inner zone of CCU (wp887, M884).

Description. Phaceloid colony. Corallites sub-cylindrical and parallel. Form of calices sub-circular to slightly elliptical, calicular diameter varies considerably across the colony. Parricidal lateral budding, producing very small buds compared to the mother corallites.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR106a	5.3	2.2	3.7	7.1	3.3	4.8
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR106a	tot: ~23 20(S1+S2) +?3(S2)	1.6 (S1)	1 (S2)	~0.15 (S1)	4-5/ mm	

External surface covered by a thin epitheca. About 23 septa, arranged in radial symmetry. Two size orders differing in terms of thickness and length. About 20 radial elements in S1, S2 incomplete, with a variable number of radial elements. In transverse section, radial elements slightly curved. S1 septa occasionally joining, attenuated, rarely claviform. Strong granules along the lateral faces. Calicular center not well preserved, the presence of a columella cannot be excluded. Endotheca characterised by thick and well spaced dissepiments. Wall is of unknown nature.

Remarks. The taxon is very close to *Intersmilia diaboli* Eliášová (1974), in terms of colonial morphology, arrangement of septa and external surface. However, the calicular diameters of the present species (2.2 - 5.3 mm) seem to be shorter than the calicular diameter reported in Eliášová (1974) description (6-10 mm). Nevertheless, an accurate observation of Eliášová (1974) plates reveals a calicular diameter maximum shorter than 10 mm, with a mean value not far from 5 mm. However, for this difference and for the bad state of preservation of the sample, the open nomenclature is preferred.

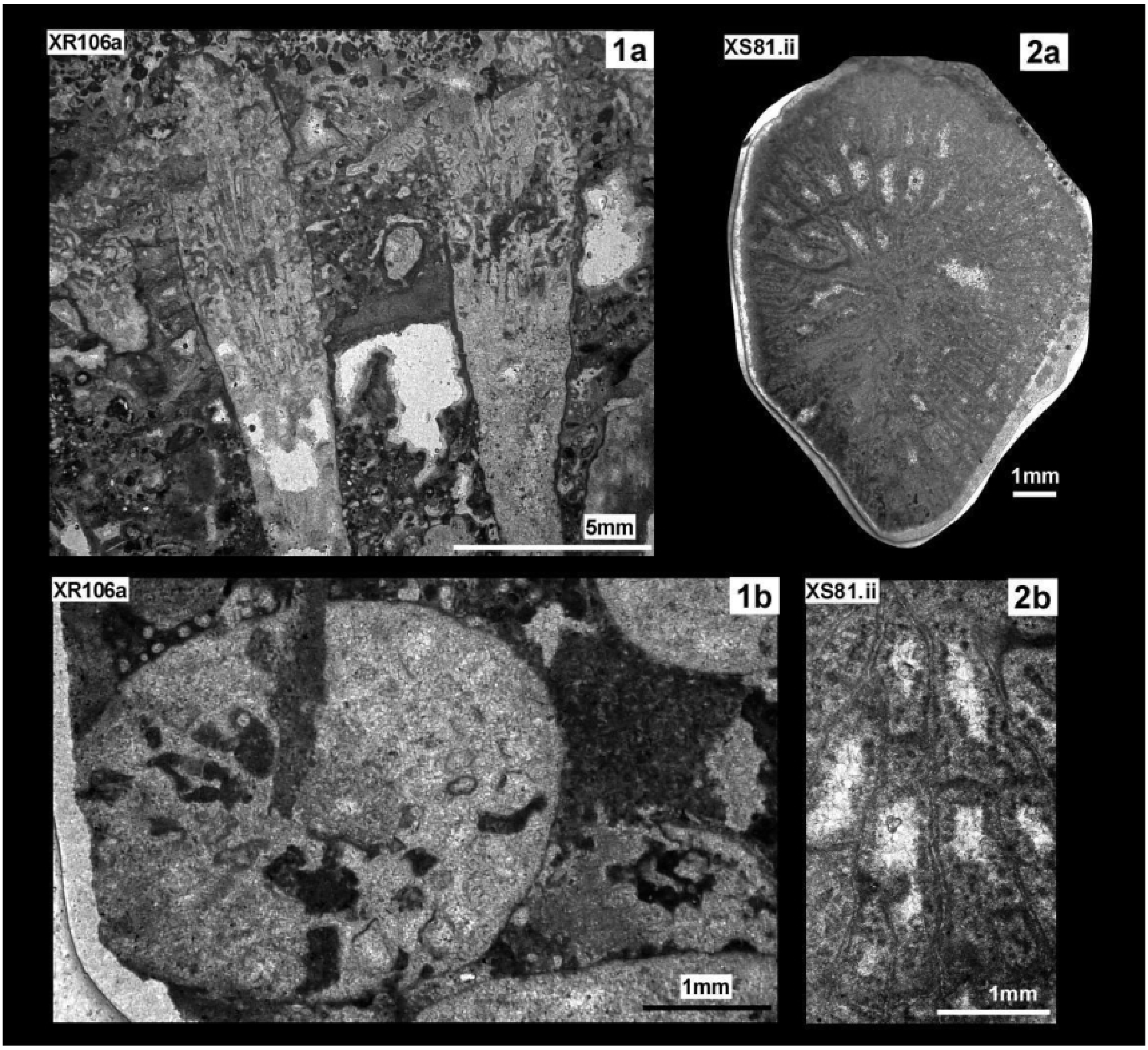


PLATE 4

Fig. 1 - XR106a, *Intersmilia* aff. *diaboli* Eliášová, 1974; 1a: parallel branches of phaceloid in roughly oblique section; 1b: transverse section.
Fig. 2 - XS8.1ii, ?*Intersmilia* sp.; transverse section of a single corallite; 2b: zoom of 2a on septa.

? ***Intersmilia*** sp.

Pl. 4, fig. 2a, b

Material: 1 sample (XS8.1ii), 1 thin section.
Locality: Unit CSU (XS 8).

Description. Solitary or broken branch of phaceloid/dendroid. Calice irregular in outline. Septa very thin, curved and tortuous, mostly free (?). Slightly clavate morphology. More than three size-order observed, differing in length, less in thickness. Endotheca made of incomplete tabulae. Peripheral wall.

Calices	**d** **long axes**	**d** **short axes**			
XS.8.1ii	10	8			
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XS.8.1ii	>50	3.6	1	<0.1	3/mm

The bad preservation of the single section does not allow a firm identification.

Order **Scleractinia** Bourne, 1900
Suborder **Stylophyllina** Beauvais, 1980

Family Cyathophoridae Vaughan & Wells, 1943

Cyathophoridae are now placed within Stylophyllina according to recent microstructural investigations of Morycowa & Roniewicz (2016).

Genus *Cyathophora* Michelin, 1843

Type species: *Cyathophora richardi* Michelin, 1843

Cyathophora bourgueti (Defrance, 1826)

Pl. 5, fig. 1a, b, c

1826 *Astrea bourgueti* Defrance, 380.
1843 *Cyathophora richardi* Michelin, 104, pl.26, fig.1.
1859 *Cyathophora claudiensis* Étallon, 479.
1875 *Cyathophora bourgueti* - Becker, 149, pl.37, fig. 5.
pars 1881 *Cyathophora thurmanni* Koby, 96, pl. 26, fig. 7.
1881 *Cyathophora bourgueti* - Koby, 99, pl. 26, fig. 1-3.
1964 *Cyathophora richardi* - Beauvais, 114, non pl. 3, fig. 5.
1966 *Cyathophora claudiensis* - Roniewicz, 178, pl.1, fig. 4.
1966 *Cyathophora richardi* - Roniewicz, 178, pl.1, fig. 3a-c.
1976 *Cyathophora claudiensis* - Roniewicz, 44, pl.4, fig. 1.
1990 *Cyathophora bourgueti* - Errenst, 166, pl.2, fig. 3a-c.
1990 *Cyathophora claudiensis* - Errenst, 167, pl.2 fig 4a-d.
1991 *Cyathophora claudiensis* - Lauxmann, 144.
1993 *Cyathophora bourgueti* - Bertling, 84, pl.1, fig.3.
2002 *Cyathophora bourgueti* - Pandey et al. 350, figs 3-8.

Material: 1 sample (XR4), 3 thin sections.
Locality: External zone of CCU (M5d).

Description. Massive colony, plocoid to cerioid arrangement of corallites. External morphology of the colony sub-circular in plan-view. Extracalicular budding. Very densely packed corallites, most of corallites in contact with adjacent ones. Morphology of corallites subcircular to polygonal. Calicular diameter quite constant.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR4	3.7	2.8	3.3	4.5	2.8	3.4
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR4	?24	~0.4	/	~0.1//0.2	3-4/mm	

Peritheca pronounced, consisting of a thick system of vesicular dissepiments. Costo-septa short attenuated and very thin. They display a radial symmetry, expressed by a total of 24 elements, however no clearly deciphered size orders because of a poor state of preservation. The septal distal edge is subvertical near the wall then subhorizontal and weakly elevated on the floor of tabulae. Endotheca characterised by thick tabulae, essentially planar or slightly convex upward, occasionally undulated. Thickness of tabulae 0.4-0.5 mm, and their density ranges from 2 to 3 per mm. Calices bound by a well distinct wall probably tabulothecal in nature.

Remarks. The generic identification is here assumed on the basis of the lectotype of the type species *C. richardi* (see Zaman & Lathuilière 2014). We assume also the species synonymy with the anterior synonym *C. bourgueti* on the basis of the tradition despite the fact that the type material was not available. In conformity with the traditional usage, we use the nominal species *C. bourgueti* to designate a taxon with a wide variability, which is defined in Pandey et al. (2002).

Cyathophora sp.

Pl. 5, fig. 2

Material: 2 samples (XR13A, XR13B), 2 thin sections.
Localities: Internal zone of Nerineids and Diceratids Horizon (detr ch).

Description. Ramose colony with vertical, sub-parallel columns, distant from 1 to 1.5 cm. Diameter of branches around 5-7 mm. Plocoid arrangement of corallites. Small corallites uniformly distributed along small branches. Calices circular, characterised by a wide and prominent wall region. Extracalicular budding.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR13A	1.6	0.9	1.3	2.6	2.3	2.5
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR13A	6(S1)+6(S2)	~1	~0.7	0.4 (S1)	2(S1)+1(S2)/mm	

Narrow and poorly preserved peritheca made of spaced dissepiments. Radial elements consist of costo-septa, with a radial symmetry. Two distinct size orders, each with 6 radial elements, for a total of 12. S1 thicker and longer than the S2, however the difference in length is low. S1 peripherally enlarged. Endotheca made up by planar to slightly convex upward tabulae. Thickness of tabulae is 0.2 mm and tabulae density ranges from 2 to less than 1 per mm, varying from bottom to the top of the branches of the colony.

Remarks. Among nominal species known in the Kimmeridgian-Tithonian interval, only *C. kobyi* Krasnov shows the combination of 12 septa and so small diameters (see graphic comparison in Pandey et al. 2002). *C. faveolata* Koby from the Oxfordian is also close to these dimensions.

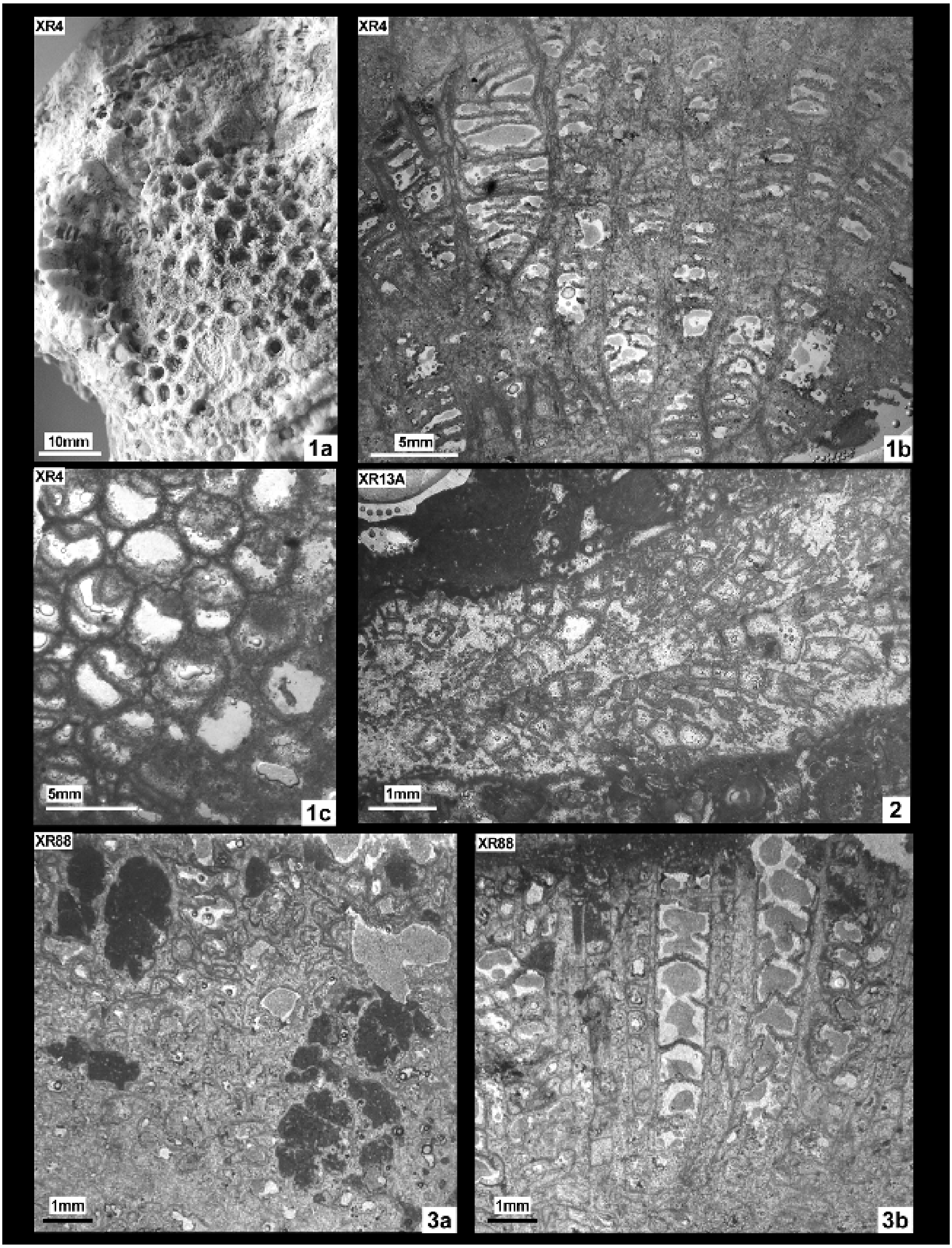


PLATE 5

Fig. 1 - XR4, *Cyathophora bourgueti* (Defrance, 1826); 1a: distal view of the natural surface of the colony; 1b: longitudinal section showing the dense set of endothecal tabulae; 1c: transverse section.

Fig. 2 - XR 13A, *Cyathophora* sp. in roughly longitudinal section of a branch.

Fig. 3 - XR88, *Cyathophora* aff. *parva*; 3a: transverse section (bad state of preservation); 3b: longitudinal section.

Cyathophora aff. ***parva***

Pl. 5, fig. 3a, b

1964 *Cyathophora parva* Babaev, p.32 pl.8 fig.1.
1967 *Cyathophora parva* - Babaev p.140.
1973 *Cyathophora parva* - Babaev p.67 pl.1 fig.2.

Material: 1 sample (XR88), 4 thin sections.
Locality: Internal zone of CCU (wp 773).

Description. Massive plocoid colony, sub-circular in plan-view. Budding extracalicular. Corallites cylindrical, long and thin. Calices with a prominent edge and a planar calicular platform. Corallites loosely packed. Calicular distances markedly variable, but in general rather wide.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR88	1.8	1.2	1.5	4.3	1.2	5.8
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR88	6(S1)+?(S2)	~0.7(S1)	~0.4 (S1)	~0.2	2/mm	

Peritheca wide, consisting of loosely spaced vesicular dissepiments. Density of perithecal dissepiments about 3 per mm. Short costo-septa distributed in two size orders: S1 contains 6 costo-septa, S2 rudimentary and hardly visible. Thick tabulae characterised the endotheca. Tabulae convex upward, subordinately planar, thickness about 0.2 mm and density about 2 per mm. Wall wide (~0.3 mm) and well distinct.

Remarks. With respect to other *Cyathophora* species*,* the differences are: (1) the wide perithecal zone (obviously plocoid and not plocoid to cerioid); (2) the reduction of the number of the septa (here are only 6 well defined); (3) the lower density of tabulae. *C. kobyi* was described by Krasnov (1964) from the Tithonian, with this corallite size and with 12 septa. *C. faveolata* Koby 1881 from the Oxfordian of Switzerland shows comparable dimensions but has more costae. *C. parva* Babaev 1964 from the Oxfordian displays only 6 septa and similar corallite dimensions (Pandey et al. 2002).

Suborder **Caryophylliina** Vaughan et Wells, 1943

Family Axosmiliidae Geyer, 1955

Genus *Placophyllia* d'Orbigny, 1849

Type species: *Lithodendron dianthus* Goldfuss, 1826

Remarks on microstructure. The microstructure of radial elements in *Placophyllia* has been the subject of different interpretations. The intricate issue derives from the fact that the radial elements of *Placophyllia* appear frequently strongly recrystallised (see plates in Eliášová 1976b; Kołodziej 2003; Roniewicz 1976) and the holotype of the type species stored in Bonn is silicified and cannot provide good thin sections. These problems make the interpretation of the microstructure in *Placophyllia* ambiguous and poorly constrained. The microstructure has been described as neorhipidacanth by Roniewicz (1976) and Kołodziej (2003), while Eliášová (1976b) reported the presence of simple or compound trabeculae of moderate size arranged along the mid-septal line and long crystal fibres, producing fascicles perpendicular to the septal plan. It is interesting to note that the same variability is observed in septa of Stylinidae (Zaman 2012), to which the genus could be tentatively assigned. However, *Placophyllia* does not show auriculae and has a peripheral wall.

In the present collection, the genus *Placophyllia* is attended with four samples and with respect to the collection presented by other authors, samples show different states of preservation, ranging from coarsely recrystallised to well preserved. Sample XR130 (in a fairly good state of preservation) and XR99 (characterised by almost pervasive recrystallisation) show both a series of convex inward growth lines within the septa. The microstructures observed in these samples are similar to the microstructures described by Stolarski (2003) for a series of scleractinian skeletons, and are interpreted as organic and mineral phase deposits of Centre of Rapid Accretion (Stolarski 2003, fig. 17).

Placophyllia tenuis Roniewicz, 1976

Pl. 6, figs 1a, b, c, 2, 3a, b, c.

1976 *Placophyllia tenuis* Roniewicz, p. 68, pl. 13, fig. 5a,b.
non 1986 *Stylosmilia tenuis* - Beauvais, p. 223, pl. 36, fig. 1.
? 1990 *Placophyllia tenuis* - Errenst, p. 196, pl. 11, fig. 5.
? 2003 cf. *Placophyllia tenuis* - Helm et al. p. 82.
non 2005 *Placophyllia tenuis* - Morycowa & Mišík, p. 420, fig. 3,6-8.

Material: 3 samples (XR99; XR 130; XR21), 9 thin sections.
Localities: XR 99: Nerineids and Diceratids horizon (Mvs3); XR 130: Internal zone of CCU; (wp 926); XR 21: CSU (M14).

Description. Phaceloid colony. Frequent intracalicular peripheral budding, producing smaller

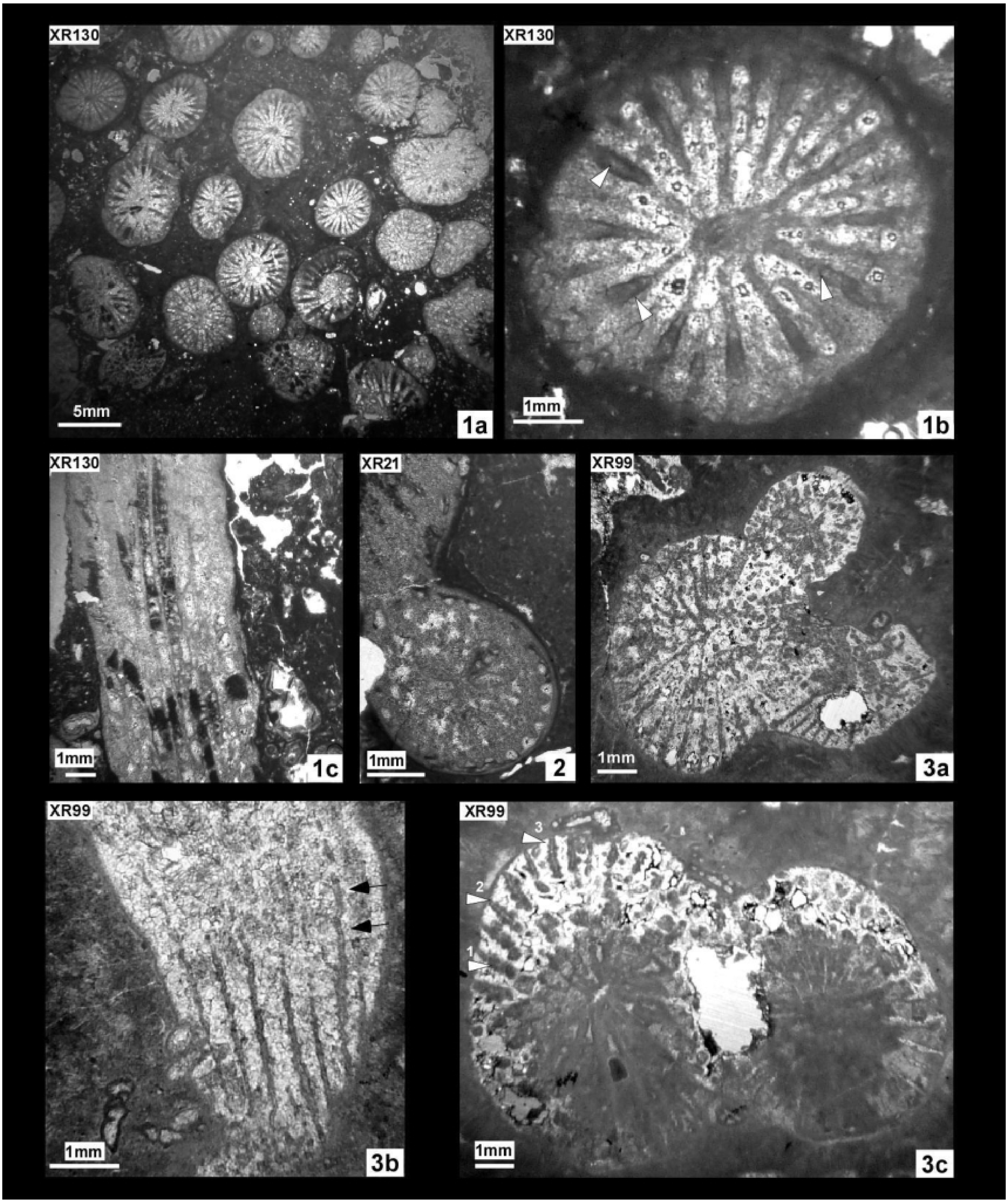


PLATE 6

Fig. 1 - XR130, *Placophyllia tenuis* Roniewicz, 1976. 1a, b: transverse sections; 1c: longitudinal sections.

Fig. 2 - XR21, *Placophyllia tenuis* Roniewicz, 1976. transverse sections.

Fig. 3 - XR99, *Placophyllia tenuis* Roniewicz, 1976. 3a, c: transverse sections; b: longitudinal sections. Arrows point different state of preservation of microstructure. In longitudinal section of XR130 and XR99, the inner structure of the septa presents a convex upward growth line. The same pattern of growth, but centripetal is observed in transverse section of sample XR 130: In XR99: median line of the septa showing irregularly distributed dots. See remarks on microstructure.

corallites than the parent corallites, which keep their original circular outline. Corallites moderately packed. Shape of calices subcircular, elliptical or lobate. Diameter variable.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min
XR 99	5.6	3.6*	5	8.5	6.4**
XR 130	7.9	1.7*	4.4	8.7	2.6**
XR 21	6.7	4.2*	5.5	8.7	3.7**
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XR 99	28	3.4	0.7	0.2/0.3	2-3/mm
XR 130	24	2.7	0.6	0.5	3/mm
XR 21	28	3.3	1.2	~0.3	3-4/mm

*(new generation); ** (excluding corallites in budding)

Based on their bicuneiform shape, radial elements considered as costo-septa, arranged in radial symmetry. In one sample (XR 130) three size orders (S1+S2+S3) containing 6, 6 and 12 elements respectively observed. S3 shorter and thinner, usually complete and not rudimental. In the samples XR 99 and XR 21 the total number of septa is about 28 and the size order hierarchy is not so well defined because of preservation. Radial elements mostly straight, occasionally curved; thin septa occasionally tortuous. Radial elements free, some major septa touch the columella. Septa of sample XR130 present sharp contact with skeletal porosity and they are very poorly ornamented. In revenge ambiguous microstructures, consisting of irregularly distributed dots, occur along the median line of the septa of sample XR99. In longitudinal section, the inner structure of the septa presents a convex upward growth line in both samples (XR130, XR 99). The same pattern of growth, but centripetal is observed in transverse section of sample XR 130. The observed microstructure is comparable to that described by Stolarski (2003, fig. 17A) and suggest that the observed structure represents the preservation of conservative early stages of the diagenesis in these calcitised skeletons. Endotheca characterised by a series of narrow “columns” composed of high vesicles delimited by continuous and regular rings of dissepiments. The outermost ring of vesicles fairly flat at the top. Lamellar columella present and generally in connection with a S1 septum of the same orientation. The long axis ranges from 0.7 mm (XR 99) to 2.0 mm (XR 21). Wall thin and peripheral.

Remarks on increase. The increase in *Placophyllia* has been usually described as “extracalicular marginal” (e.g. Beauvais 1976; Roniewicz 1976); the budding is here described as “intracalicular marginal” since the initial stage of the budding process begins within the peripheral wall, and consists in the development of a lobe in the corallites outline and of a lengthening of some of septa in this lobe.

Remarks on synonymy. Beauvais (1986) used the species name to describe a *Stylosmilia*. A potential secondary homonym is consequently created with *Stylosmilia tenuis* (Koby) initially described as a *Cladophyllia*. Morycowa & Misik (2005) used this species name for a coral that does not show clearly the characters and that fits as well to *Cladophyllia*.

Remarks on microstructure. See remarks in *Placophyllia* cf. *florosa.*

Placophyllia cf. ***florosa*** Eliášová, 1976

Pl. 7, fig. 1a, b, c

1976b *Placophyllia florosa* Eliášová, p. 339 pl. 3 fig. 1-2, text-fig. 1.

Material:1 sample (XR18), 1 thin section.
Locality: Nerineids and Diceratids horizon.

Description. Robust and densely packed phaceloid colony. Corallites touching each other, slightly compressed. Calices circular to elliptical. Extracalicular budding.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR 18	21.5	14.0	16.9	22.0	15.0	18.2
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 18	tot: ~53	7.2(S1)	1.8(S5)	~0.8(S1)	2-3/mm	

Five orders of costosepta, differing in terms of length and thickness arranged in radial hexameral symmetry. S1 and S2 are poorly differentiated, straight or poorly curved, slightly bicuneiform; S3 thinner and tortuous; S4 uncompleted, rarely joining to S3; S5 rudimental and lonsdaleoid. Microstructure not easy to interpret in terms of original versus diagenetic structure. A mid-septal line in transverse and longitudinal sections is often observed, and in some place (often but not exclusively near the wall), densely packed black dots are present. Some indices of branching trabeculae are present in longitudinal section. These features remind the septal microstructure of Stylinidae but auriculae are absent. Thin granules

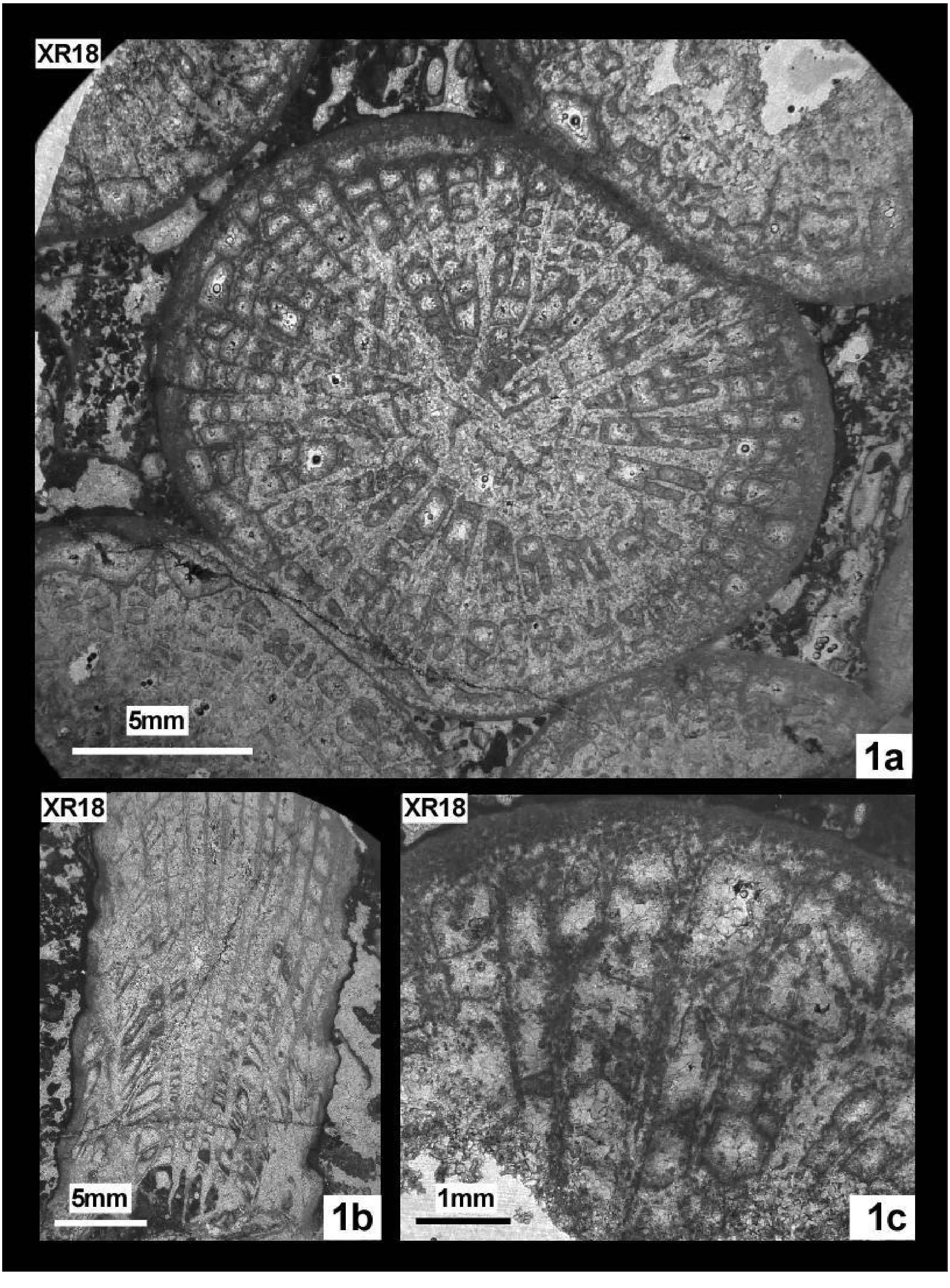


PLATE 7

Fig. 1 - XR18, *Placophyllia* cf. *florosa* Eliášová, 1976. 1a, b: transverse sections; 1c: roughly longitudinal section.

occur along the lateral faces. Lamellar columella, 3.8 mm long and 0.8 mm thick. Densely packed, quite regular tabuloid endotheca. Dissepiments thin, planar, slightly inclined or concave upward. Parathecal wall.

Remarks. The open nomenclature is preferred because of the lonsdaleoid septa that are not described in the type material of the species.

Suborder **Rhipidogyrina** Roniewicz, 1976
Family Rhipidogyridae Koby, 1905
Genus *Bracthelia* L. Beauvais & M. Beauvais, 1975

Type species: *Bracthelia collignoni* L. Beauvais & M. Beauvais, 1975

This genus is used in place of *Ironella* Starostina & Krasnov 1970 (in Krasnov & Starostina 1970), a junior homonym of a worm (see Zaman et al. in prep.). A replacement name *Starostinia* was recently proposed by Doweld (2014). This replacement name was not useful since a senior synonym exists with *Bracthelia*.

Bracthelia collignoni Beauvais & Beauvais, 1975

Pl. 8, figs 1a, b, c, d; 2a, b

1975 *Bracthelia collignoni* Beauvais & Beauvais, p. 580, pl. 1, fig. 1-3.

Material: 2 samples (XR58 and XR122), 3 thin sections.
Locality: Internal zone of CCU.

Description. Massive plocoid colony with extracalicular budding. Calices sub-circular to circular quite regular, very densely packed.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR 58	4.6	3.1	3.9	7.9	3.9	5.4
XR 122	3.9	1.9	3.2	6.6	3.2	4.5
Re	**s**	**Ml**	**ml**	**Mean tk**	**dsy**	
XR 58	tot:48 6(S1)+6(S2)+ +12(S3)+24(S4)	1.8(S1) 1.4(S2)	0.9(S3) 0.4(S4)	~0.5 (S1)	9/mm	
XR 122	tot:48 6(S1)+6(S2)+ +12(S3)+24(S4)	2.3(S1) 1.6(S2)	0.8(S3) 0.3/0.4 (S4)	~0.4 (S1)	5/mm	

The peritheca made of vesicular, very thin dissepiments (thickness less than 0.2 mm) with chamber diameter about 0.3-0.5 mm and probably also of trabecular layers. Ornamented costo-septa.

A maximum of four size orders of costo-septa clearly deciphered. They are arranged in radial symmetry and occur in multiple of six. S1, S2 and S3 costo-septa show a clavate morphology, with an enlargement of the peripheral edge. Moreover, most of costo-septa belonging to S1 and S2 present a still more enlarged shape (flabelliform auriculae of Zaman & Lathuilière 2011). S1 costo-septa slightly curved. S4 costo-septa very short, thin and straight, with a slight peripheral enlargement. Thickness of the S1 costo-septa varies from a maximum of 0.7 mm across the peripheral edge to a minimum of 0.3 mm across the internal part. Mean thickness of S2 costo-septa is about 0.3/0.2 mm. Radial elements density in general is high: 9 per mm, representing by 2 S1, 1 S2, 2 S3 and 4 S4. The microstructure of radial elements is neorhipidacanth, well preserved, with thin (0.05-0.06 mm) packed and apparently branched trabeculae that participate in the construction of the wall (Etallonotheca of Zaman & Lathuilière 2015). Parietal columella. Endotheca characterised by the presence of very thin (less than 0.2 mm), planar to sub-planar dissepiments, showing density about 5/6 per mm.

Remarks. The species was known only from the Bathonian of Madagascar.

Bracthelia rutimeyeri (Koby, 1889)

Pl. 9, figs. 1a, b, c, 2

? 1861 *Heterocoenia crassa* Fromentel, p.182.
? 1881 *Tiaradendron* cf. *germinans rotundum* Quenstedt, p. 742, pl. 172, fig 10.
1889 *Heterocoenia rutimeyeri* Koby, p.460, pl.126, fig.6, p. 128, fig.2, pl.129, fig.7.
1903 *Baryhelia hexacnema* Felix, p.182, pl.17, fig.6.
1904 *Baryhelia rutimeyeri* - Koby, p.9, pl.4, fig.2.
1955a *Heliocoenia rutimeyeri* - Geyer, p.341.
1976 *Ironella rutimeyeri* - Roniewicz, p.83, pl.21, fig.1-3.
1991 *Ironella rutimeyeri* - Lauxmann, p.137. pl. 4 fig. 6-8
2001 *Ironella rutimeyeri* - Stolarski & Roniewicz, p.1103 fig. 7.7.
2014 *Starostinia rutimeyeri* - Doweld, p. 299.

Material: 4 samples (XR113; XR61; XR118 (no in figure); XR120 (no in figure), 8 thin sections.
Localities: Internal zone of CCU.

Description. Massive colony, plocoid arrangement of corallites and extracalicular budding. Calices sub-circular to elliptical, densely packed. Calicular diameter and calicular distance vary across the colony. In the sample XR61 two groups of corallites (Cor1 and Cor2) are distinguished, according to their diameter. Cor1 mean diameter: 4 mm, Cor2 mean diameter: 2.5 mm. C1 is more frequent and contain a higher number of radial elements.

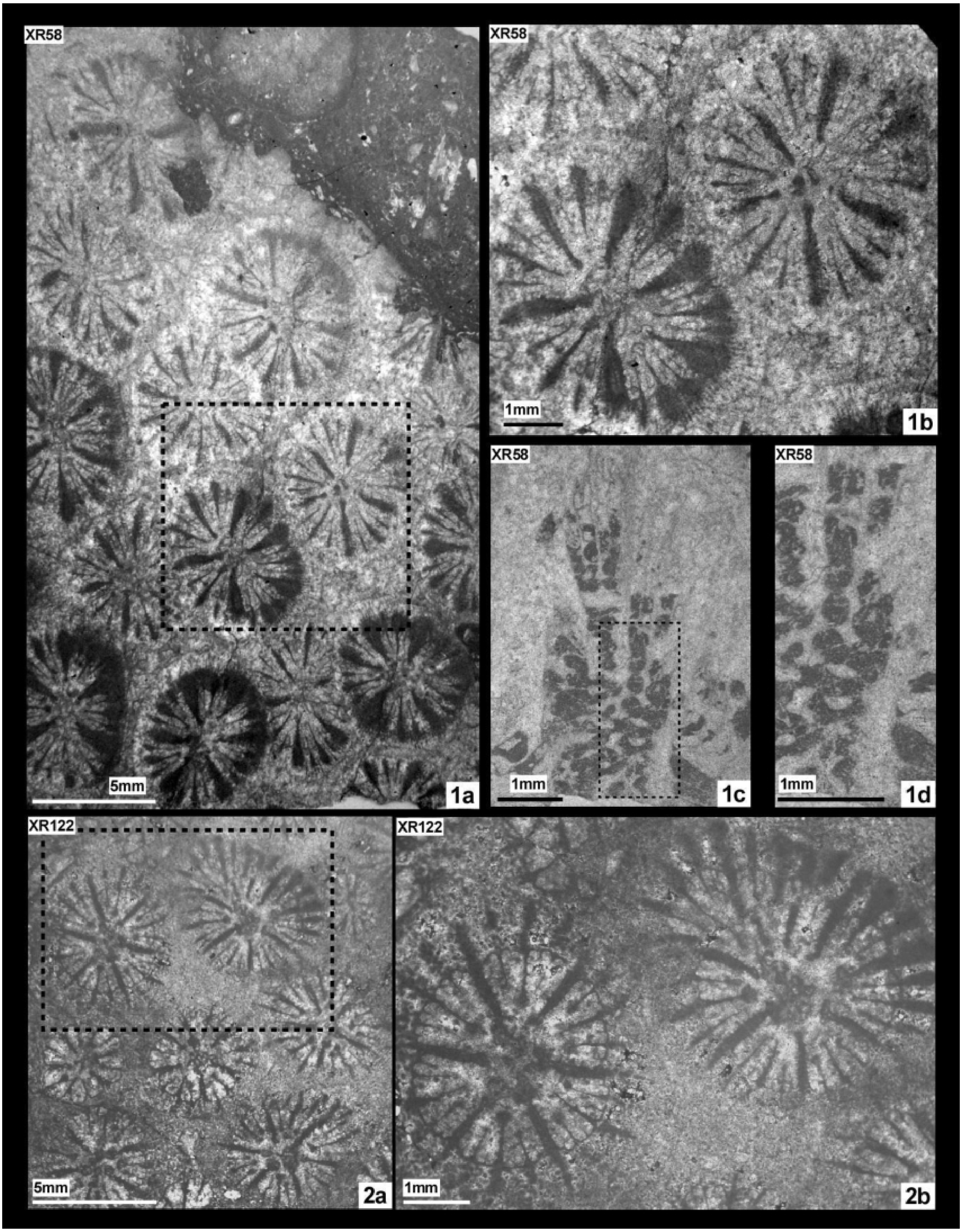


PLATE 8

Fig. 1 - XR58, *Bracthelia collignoni* Beauvais & Beauvais, 1975. 1a: transverse section. 1b: zoom of 1a; 1c: longitudinal section; 1d: zoom of 1c on radial elements and auriculae.

Fig. 2 - XR122, *Bracthelia collignoni* Beauvais & Beauvais, 1975. 2a: transverse section; 2b: zoom of 2a on flabelloid auriculae.

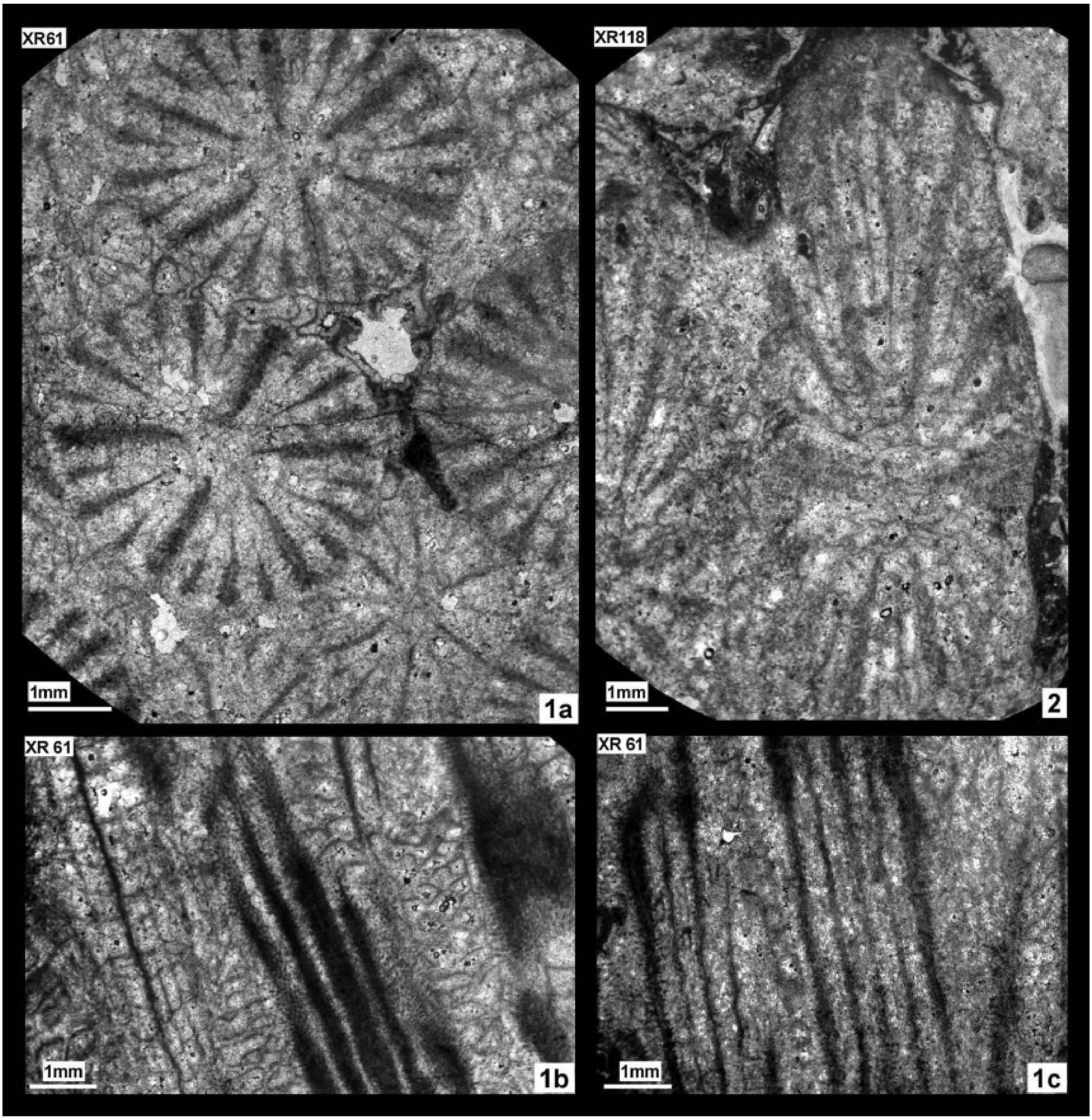


PLATE 9

Fig. 1 - XR61, *Bracthelia rutimeyeri* (Koby, 1889). 1a: transverse section; 1b, c: rhipidogyrid microstructure of radial elements and endotheca in longitudinal sections.

Fig. 2 - XR118, *Bracthelia rutimeyeri* (Koby, 1889). Oblique section.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR113	3.4	1.6	2.7	7.0	3.1	4.7
XR 61	4.56(Cor1) 3.04(Cor2)	4.0 (Cor1) 1.88(Cor2)	4.2(C1) 2.5(Cor2)	6.3	3.1	4.14
XR118	4.6	3.6	4.15	8.5	4.2	5.7
XR120	3.8	2.7	3.5	4.5	3.2	4.0
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR113	tot:24 6(S1)+6(S2)+ 24(S3)+?(S4)	2.2(S1) 2.0(S2)	1.2(S3)	~0.5(S1)	5/mm	
XR 61	Ccor1 tot:24= 6(S1)+6(S2)+ +12(S3); Ccor2 tot: 12= 6(S1)+6(S2)	2.2(S1,C1) 1.5(S1,C2)	1.0(S3,C1) 0.8(S2,C2)	~0.4 (S1, Cor1)	5/mm (S1, Cor1)	
XR118	tot:24 6(S1)+6(S2) +12(S3)	~3.3(S1)	~1.8(S3)	~0.3(S1)	5/mm	
XR120	tot:24 6(S1)+6(S2) +12(S3)	~2.7(S1)	~0.5(S3)	~0.4(S1)	4-5/mm	

Vesicular peritheca moderately packed, rarely dense, made of thin dissepiments. Ornamented costo-septa in three size orders, differing in thickness and length, very regularly arranged, frequently complete in more developed corallites. Radial elements enlarged at the peripheral edge, less obviously in S2 and S3. Tabuloid endotheca with sub-planar, oblique dissepiments. Wall thin, parathecal. Columella not clearly observed.

Genus *Ogilvinella* Eliášová, 1976

Type species: *Ogilviella elegans* Eliášová, 1973

Ogilvinella cf. ***morycowae*** Kołodziej, 2003

Pl. 10, figs 1a, b, c, d, 2a, b

2003 ?*Ogilvinella morycowae* Kołodziej, p. 211, fig. 25 A-D.

Material: 3 samples (XR124; XR82 and XR82B), 8 thin sections.

Localities: Internal zone of CCU (wp 917; M916; wp 768).

Description. Massive colony, plocoid arrangement of corallites. Corallites sub-circular to elliptical. Calicular margin poorly distinct, corallites randomly distributed, their distance varies considerably across the colony. In the elliptical corallites, the major axis reaches about 9 mm, and the minor axis is about 6 mm.

Calices	d * Max	d * Min	d* Mean	c-c Max	c-c Min	c-c Mean
XR 124	6.4 (subcir.f.) 9.07 (ell.f.)	5.8	6.4 (subcir.)	6.8	5.9	6.2
XR 82	13(D)** 6 (d)**	7.3(D) 5.38(d)	7.8(D) 5.6(d)	11.7	10.4	11
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 124	tot:48? (subcirc. Form) 6(S1)+6(S2)+ 12 (S3)+?24(S4)	~2.6(S1)	~0.9(S4)	0.4(S1) 0.12 (S3)	4-5/mm	
XR 82	tot: >36 9(S1)+9(S2)+ 18(S3)+?(S4)	~4.8(S1)	~2.7(S4)	1(S1) 0.35(S2) 0.15(S3/ S4)	4-5/mm	

* diameter is measured from the peripheral edge of one costa to the opposite one; ** In elliptical forms D is the diameter measured parallel to the elongated columella; d is the diameter measured perpendicularly to D.

Wide peritheca, characterised by broad vesicular dissepiments. Radial elements non-confluent to sub-confluent costo-septa. Hexameral symmetry in a sub-circular corallite, up to enneameral symmetry in a strongly bilateral corallite. Three, rarely four, costo-septa size orders, differing considerably in terms of thickness and length. Total number of costo-septa belonging to each size orders not clear. All radial elements bicuneiform, straight, never joining, S1 and S2 clearly rhopaloid. Lateral facies frequently ornamented by granules, showing a symmetric distribution with regards to the mid-septal plane. Flabelliform auriculae (Zaman & Lathuilière 2011) along the internal margin of the septa. Their density is high (about 2/3 per mm) and their width reaches 1 mm. Remains of rhipidogyrid microstructures observed in few longer S1 and S2, as numerous dark dots. Lamellar columella, straight or undulated, about 0.4 mm thick and about 4.5 mm long. Well-spaced dissepiments characterised the endotheca.

Remarks. Compared to *O. elegans*, the type species of the genus, the calices of the present species are much bigger. Dimensions are more comparable to ?*O. morycowae* but the septal budding was not observed here. So, the assignation to the genus is clear but the assignation to the species described by Kołodziej (2003) is less solid and justifies the open nomenclature adopted here.

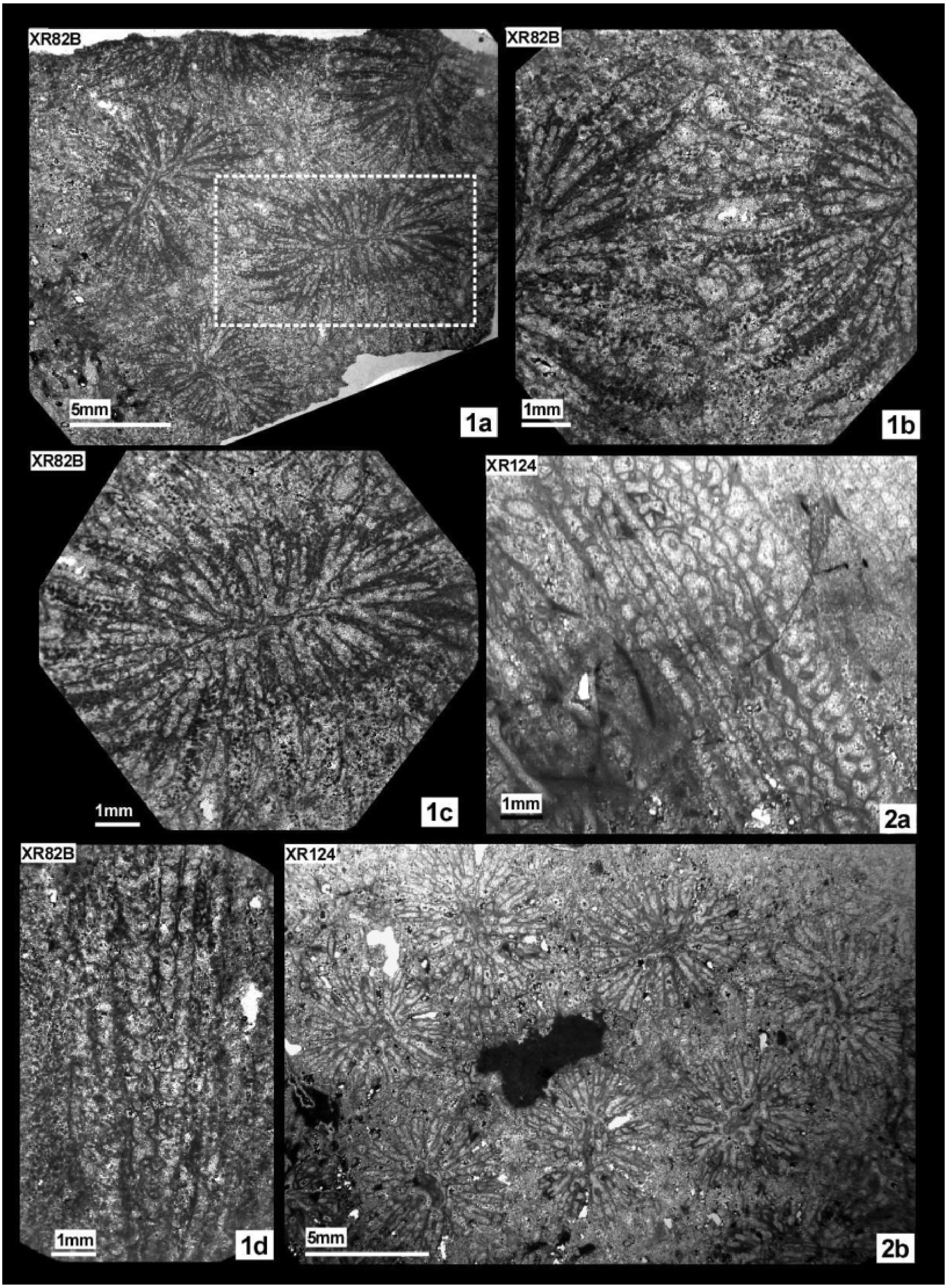


PLATE 10

Fig. 1 - XR82B, *Ogilvinella* cf. *morycowae* Kolodziej, 2003. 1a, b: transverse sections; 1c: zoom of 1d: longitudinal section of costo-septa showing the morphology of inner edges with section of flabelliform auriculae.

Fig. 2 - XR124, *Ogilvinella* cf. *morycowae* Kolodziej, 2003. 2a, b, XR124; 2a: longitudinal section, see auriculae; 2b transverse section.

Genus *Psammogyra* Fromentel *in* de Ferry, 1862

Type species: *Pachygyra cottaldina* D'Orbigny, 1850

Psammogyra valfinensis Beauvais, 1964

Pl. 11, fig. 1a, b, c, d

1964 *Psammogyra valfinensis* Beauvais, p. 190, pl. 19, fig. 4, text fig. 39a.

Material: 2 samples (XR8; XR5mm), 4 thin sections.
Localities: External zone of CCU (M5).

Description. Meandroid colony. Series long, sinuous and closed, separated by vesicular peritheca. Vesicular exotheca between costae. Radial elements compact, consisting of non-confluent to sub-confluent costo-septa. Costo-septa strongly unequal, differing in thickness, less in length. In transverse section radial elements straight to slightly curved, often claviform. In most cases septa do not touch the columella. Some septa apophysal (as remarked for the genus by Eliášová 1973: 285). Abundant and regularly distributed granules on lateral faces. Large and frequent auriculae at inner edge of the septa. The latter are not fork-shaped as in Stylinidae, their morphology in transverse section varies according to septal thickness from lozenge- to T-shape. Rhipidogyrid microstructure (cf. Roniewicz 1976). Columella thin, lamellar and sinuous. Endotheca characterised by large vesicular dissepiments. Wall septothecal.

Calices	coll-coll	c-c		
XR 8	8.2-17	?		
XR 5mm	?	?		
Re	**Ml**	**ml**	**tk**	**dsy**
XR 8	6.3	3.5-0.5 apophysal septa	~1.3(S1)	4(S1)/5mm 13/5mm (S1+S2+S3)
XR 5mm	4.3	1.4	~0.4(S1)	6(S1)/5mm

Remarks. Most of *Psammogyra* species have similar values of width of valleys and septal density. *P. valfinensis* is here identified because of its much narrower peritheca than in the type species, the surface of which could not be observed.

Genus *Pruvostastraea* Alloiteau, 1957

Type species: *Pruvostastraea labyrinthiformis* Alloiteau, 1957

Pruvostastraea labyrinthiformis Alloiteau, 1957

Pl. 11, fig. 2a, b , c

1957 *Pruvostastraea labyrinthiformis* Alloiteau p. 281, pl.13, fig.11, pl.17, fig.1, fig.195-197.
1973 *Pruvostastraea labyrinthiformis* - Eliášová, p. 276, pl.4, fig.1-3
1974 *Pruvostastraea labyrinthiformis* - Beauvais, p. 242 pl.1, fig.4, pl.2, fig. 1.
1985 *Pruvostastraea labyrinthiformis* - Rosendahl, p.72, pl.8 fig.3.
1997 *Pruvosastraea labyrinthiformis* - Turnšek, p.166.

Material: 1 sample (XR3), 4 thin sections.
Locality: External zone of CCU (M5h).

Description. Massive meandroid colony. Series long and tortuous. Along series, singles corallites not well-distinct. The distance between two collines about 8.5 mm. Intracalicular increase producing series in which only one corallite is observed in the width of a valley. Wall tortuous and often showing convexities between two adjacent septa in transverse section. In several cases the termination of a colline abruptly turns becoming a septum. Two size orders of septa detected (S1, S2). S1 septa considerably longer and thicker than S2 septa. In transverse section septa straight or curved, bifurcated, free. Often septa are not perpendicular to the wall. Claviform inner edge frequent. Septal and thecal microstructure appears as dots of different sizes, not-regularly distributed. Granules along the lateral faces and auriculae at the inner edge. In longitudinal section, auriculae are 0.7 mm spaced one from the other. Thin and lamellar columella, characterised by a median white line and dark boundary (diagenetic origin and/or original?). Endotheca characterised by densely packed vesicular steeply inclined dissepiments. Size of chambers 0.6 to 1 mm.

Calices	coll-coll	c-c		
XR 3	8.5	?		
Re	**Ml**	**ml**	**tk**	**dsy**
XR 3	3	~1 (S1-S2)	2/mm	3

Remarks. The genus *Pruvostastraea* has been attributed to the family of Amphiastreidae by Alloiteau (1957) and to the subordinate sub-family Pruvostastraeinae by Beauvais (1981). Differently Eliášová (1973) attributed *Pruvostastraea* to the sub-family Rhipidogyrinae (or family Rhipidogyridae Koby, 1905).

The analyzed sample shows some characters of Rhipidogyridae, such as lamellar columella, rhopaloid morphology of septa. However, remains of microstructure are not completely convincing. Additionally, synapomorphic characters of Amphiastreidae (marginarium and pocket budding) are not observed.

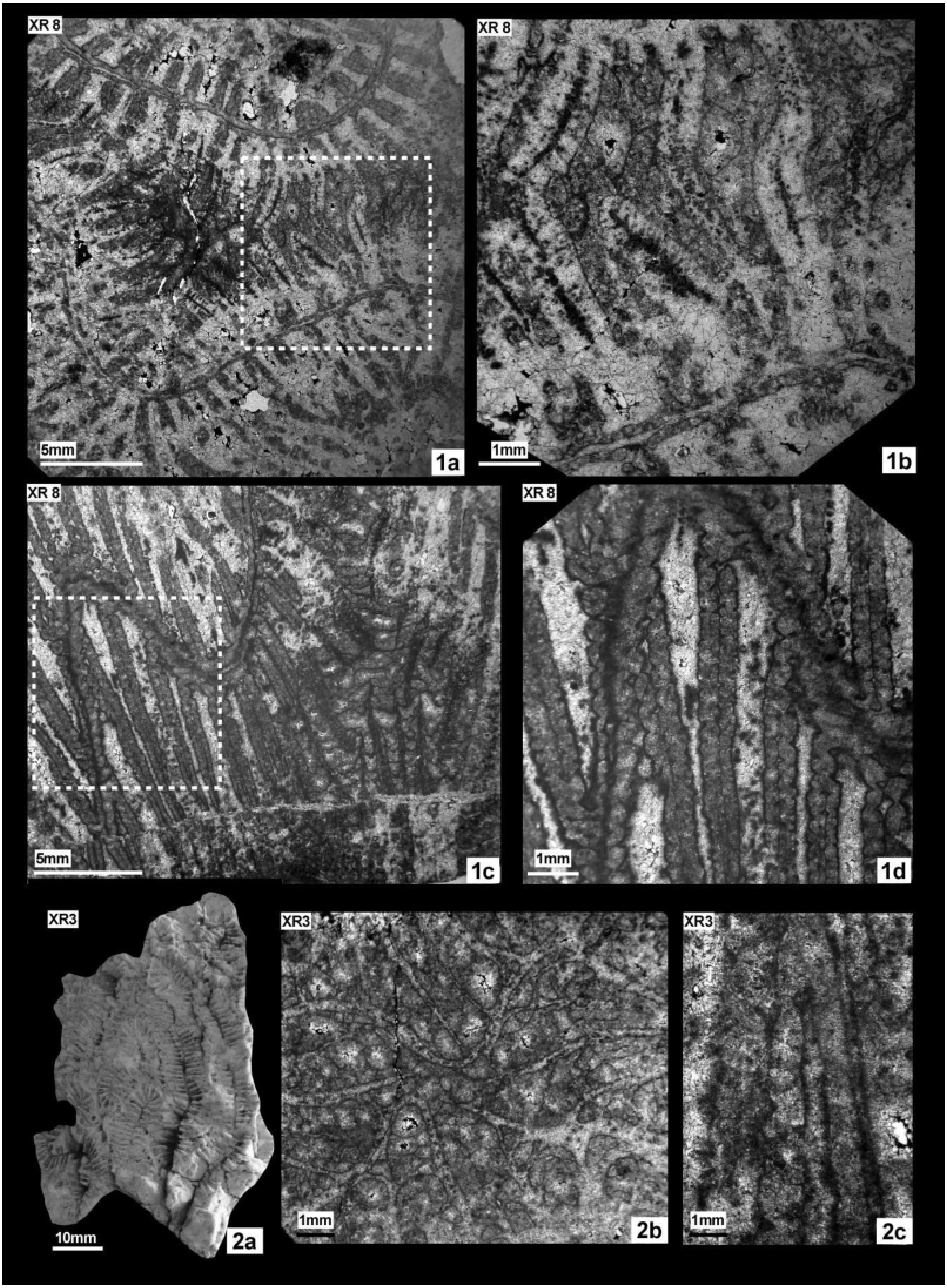


PLATE 11

Fig. 1 - XR8, *Psammogyra valfinensis* Beauvais, 1964. 1a: transverse section; 1b: zoom of 1a, showing the microstructure of radial elements; 1c: oblique, roughly longitudinal section; 1d: zoom of 1c.

Fig. 2 - XR3, *Pruvostastraea labyrinthiformis* Alloiteau, 1957. 2a: distal view of the natural surface of the specimen; 2b: nearly transverse section; 2c: transverse section.

Genus *Fromentelligyra* Alloiteau, 1952

Type species: *Stenogyra plicata* Fromentel, 1861

The genus is poorly used and is morphologically differentiated from the very close genus *Rhipidogyra* by its colonial character. It cannot be excluded that these genera were part of a single biological interbreeding unit.

Fromentelligyra sp.

Pl. 12, fig. 1

Material: 1 sample (S8.1), no thin section.
Localities: SSU.

Description. Flabelloid colony. Calice shallow. Septo-costae bicuneiform, straight and parallel and enlarged at inner edge. In the middle of the single valley, some septa curved toward the extremities of the valley suggesting the occurrence of two corallite centres. Costae long and pronounced. Three size orders (S1, S2, S3), well differentiated in terms of thickness and length. Radial elements belonging to S3 short, tortuous, with costae poorly developed or absent. Pronounced granules in S1 and S2. Endotheca not well detected, sporadic tabular dissepiments appear. Thin, lamellar columella. Wall probably parathecal.

	Colony size (cm)	s	Re Length (mm)	Re tk	Re dsy
S8.1	4.4x1.2	S1+S2: ~46 S3: ?	S1: 5-6 S2: 3-4 S3:1-1.5	~1.5 S1 in the wall region	7-8/5mm (S1+S2+S3)

Remarks. The costal density seems two times higher than in the type species *Fromentelligyra plicata*. Other nominal species recorded in this genus were never measured and are still to be revised since Fromentel (1865). For these reasons the open nomenclature is here preferred.

Genus *Astreoidogyra* nov. gen.

Type species: *Astreoidogyra giadae* nov. sp.

Derivatio nominis: *astreoido* recalls the astreoid character and *gyra* as the common ending of many rhipidogyrid genera.

Description. Massive, fungiform colony. Astreoid arrangement of calices, the external appearance looking cerioid. Extra and intracalicular increase. Calices sub-circular, slightly elongated or irregular, polygonal including the costal part. Calicular margin well distinct. Bilateral symmetry.

Radial elements bicuneiform, frequently curved and densely granulated along their lateral faces. Flabelliform auriculae at the inner edge. Branched trabeculae constitute the neorhipidacanth microstructure. Lamellar columella.

Remarks. *Astreoidogyra* clearly belongs to Rhipidogyridae by the neorhipidacant microstructure, the size of secondary trabeculae, the high contrast in thickness of radial elements of the different orders and the flabelliform auriculae. It is the only astreoid rhipidogyrid genus, this is the reason why, despite the fact the collection contains only one specimen, this new genus is created. The closest genera are *Ogilvinella* and *Bodeurina* that are clearly plocoid.

Astreoidogyra giadae nov. sp.

Pl. 12, fig. 2a, b, c, d

Derivatio nominis: The species name *giadae* is dedicated to a woman (Giada Laria) who has contributed to the work.

Material: The holotype corresponds to the sample n XR55 (1 sample; 3 thin sections, XR55T; XR55Trc; XR55L). It belongs to the collection Ricci C.-Rusciadelli G., preserved in University "G. D'Annunzio" Chieti-Pescara, Laboratory of Stratigraphy.

Locus typicus: Monte Rotondo, Scanno (Aq), Italy. Kimmeridgian-Tithonian interval. Corals and Chaetetids Unit (Rusciadelli et al. 2011).

Localities: Internal zone of CCU (wp M12).

Description. Massive, fungiform colony. Diameter of the colony about 10 cm. Astreoid arrangement of calices, the external appearance looking cerioid. Extra and intracalicular increase. Calices sub-circular, slightly elongated or irregular, polygonal including the costal part. Calicular margin well distinct.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR55	7	3.5	4/5	10.9	6	9
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR55	tot:18-29	~3.5(S1)	~0.8(S2-S3?)	0.5-0.6	3-4/mm	

Peritheca made of vesicular chambers of about 1 mm in size. Variable number of radial elements from 11 to 29; their arrangement not clearly deciphered. Bilateral symmetry expressed by elon-

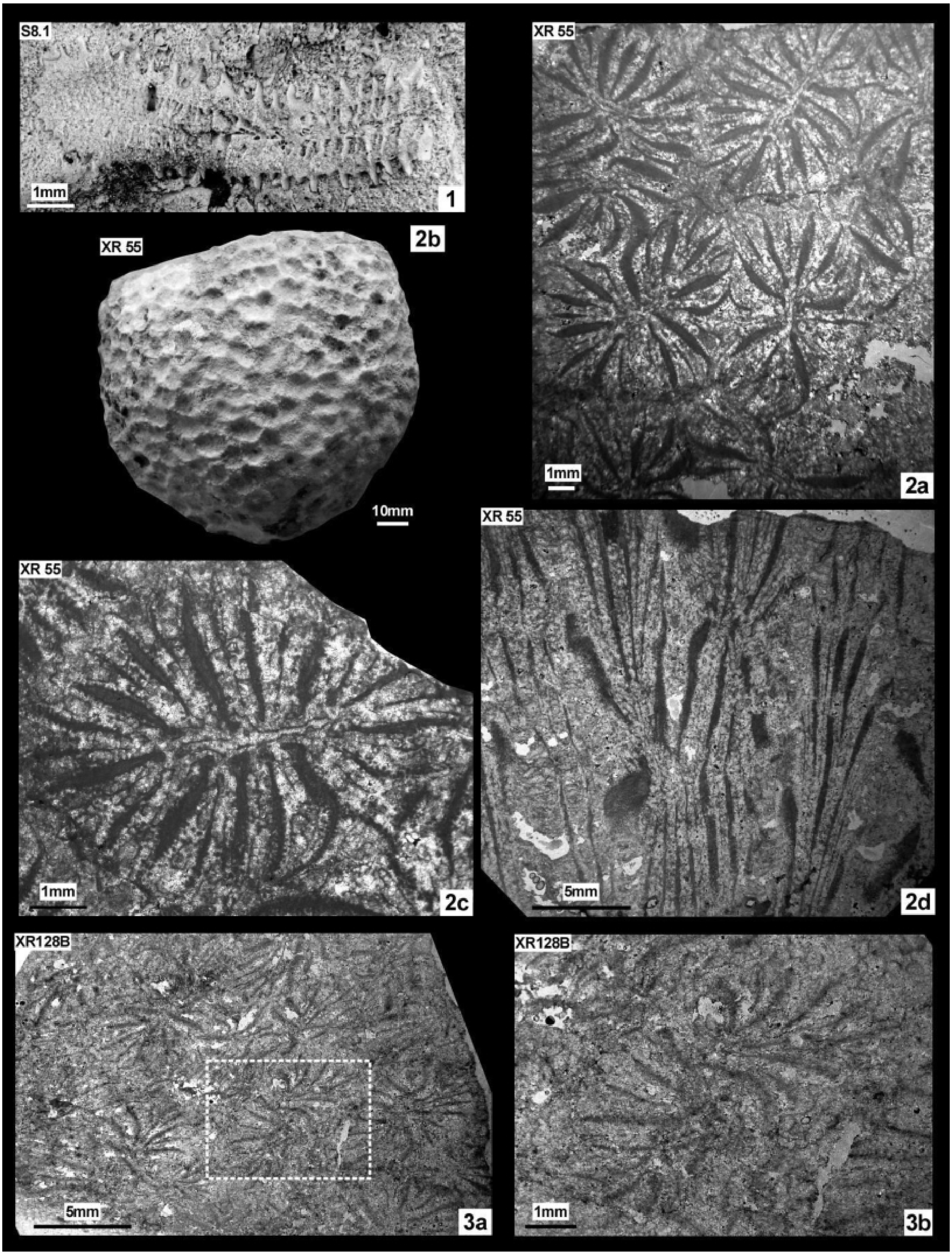


PLATE 12

Fig. 1 - XS8.1 *Fromentelligyra* sp. Distal view.

Fig. 2 - XR55, *Astreoidogyra giadae*, nov. gen. nov. sp. holotype. 2a, c: transverse sections; 2b: distal view of the colony; 2d: oblique, nearly longitudinal section.

Fig. 3 - XR128B, Rhipidogyridae Koby, 1905, gen. indet. sp. indet. 3a: transverse section; 3b: zoom of 3a.

gation of corallites and fossa and by the curvature of septa. At least three size orders distinct (S1, S2, S3), related to length and still more to thickness. Radial elements bicuneiform, frequently curved and densely granulated along their lateral faces. Flabelliform auriculae at the inner edge, 0.15 mm in size in transverse section. Their density is about 4-5 per mm. Branched trabeculae constitute the neorhipidacanth microstructure (cf. Roniewicz 1976). Secondary trabecular axes are 0.8-0.15 mm spaced one from the other in transverse section. Lamellar columella present. Endotheca and narrow peritheca made of densely packed vesicular dissepiments. No true structural wall. In external view, the boundary between calices appears elevated according to a polygonal line that joins external edges of costae.

Gen. indet. sp. indet.

Pl. 12, fig. 3a, b

Material: 1 sample; 2 thin sections, XR128T; XR128L. It belongs to the collection Ricci C.-Rusciadelli G., preserved in University "G. D'Annunzio" Chieti-Pescara, Laboratory of Stratigraphy.

Locus typicus: Monte Rotondo, Scanno (Aq), Italy. Kimmeridgian-Tithonian interval. Corals and Chaetetids Unit (Rusciadelli et al. 2011).

Localities: Internal zone of CCU (wp 932).

Description. Massive colony. Plocoid to astreoid arrangement of calices. Calicular margins not deciphered. Calices randomly distributed, calicular diameter and distance vary across the colony.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR128B	4.6	3.3	4.1	6.9	3.7	5.1
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR128B	tot: >18?	~2(S1)	~1(S2)	0.2	variable	

Large and well-developed vesicular peritheca. Radial elements irregularly distributed, locally in vortex, their density changes considerably in part due to the oblique section. Radial elements long, thin, bicuneiform and frequently curved. Symmetry not clearly manifested, two size orders. The number of the costo-septa belonging to S1 or S2, and the total number of radial elements, varies among corallites. Typical rhipidogyrid microstructure. Columella absent. Endotheca not observed. Wall-region indistinct.

Remarks. The present specimen differs from other plocoid rhipidogyrid genera by the absence of columella (*Ogilvinella, Astreoidogyra*), by the absence of tabular endotheca (*Bodeurina*), by the irregularity of the septal apparatus and by the wall (*Bracthelia*). Because of the bad state of preservation of the unique sample, characters are not sufficiently established to be recognised easily. For this, before getting a better specimen, the idea to create a new name is abandoned.

Suborder **Stylinina** Alloiteau, 1952
Family Stylinidae d'Orbigny, 1851
Genus "*Pseudocoenia*" d'Orbigny, 1850

Type species: *Pseudocoenia bernardina* d'Orbigny, 1850

Here, the taxonomic concept of the genus *Pseudocoenia* is used, in its accepted meaning since Roniewicz (1966) up to Zaman (2012). This conception was reinforced by the nomenclatural proposition of Löser (1994; 1998). Unfortunately, the proposition has been rejected recently by the ICZN (Opinion 2321; Case 3386; September 2013). Solving this question requires the observation and preparation of specimens from the MNHN Paris, examination of a potential senior synonym and designation of type specimen that is out of aim of this work. For this reason, the term "*Pseudocoenia*" with quotation marks is temporarily used, awaiting a satisfying stable solution to solve this long lasting nomenclatural issue.

All "*Pseudocoenia*" colonies presented in this collection are octameral. Among them, the distinction of species is far from stabilised and population studies are required to reach a stable taxonomy. The first two massive species are distinguished by the diameter of calices, the third one is ramose with a poor expression of S2 septa.

"Pseudocoenia" limbata (Goldfuss, 1826)

Pl. 13, figs 1a, b, c, 3

1826 *Madrepora limbata* Goldfuss p. 22, pl. 8 fig. 7
1829 *Astrea limbata* Goldfuss, p. 110, pl. 38, fig. 7.
1875 *Stylina limbata* - Becker, p. 144.
1881 *Cryptocoenia limbata* - Koby, p. 94, pl. 21, fig. 1-5, pl. 22, fig. 1-2.
1966 *Pseudocoenia limbata* - Roniewicz, p. 183, pl. 3, fig. 1a-d.
1976 *Pseudocoenia limbata* - Roniewicz, 51, pl. 6, figs 1a-c, 2.
1990 *Pseudocoenia limbata* - Errenst, p. 170-171, pl. 3, fig. 6.
1993 *Pseudocoenia limbata* - Dozet & Turnšek, p. 69, pl. 1, fig. 3.
1997 *Pseudocoenia limbata* - Turnšek, pl. 169a-e.
1987 *Cryptocoenia* cf. *limbata* - Khusanov, p. 55, pl. 2, fig. 3, pl. 2a, fig. 2.

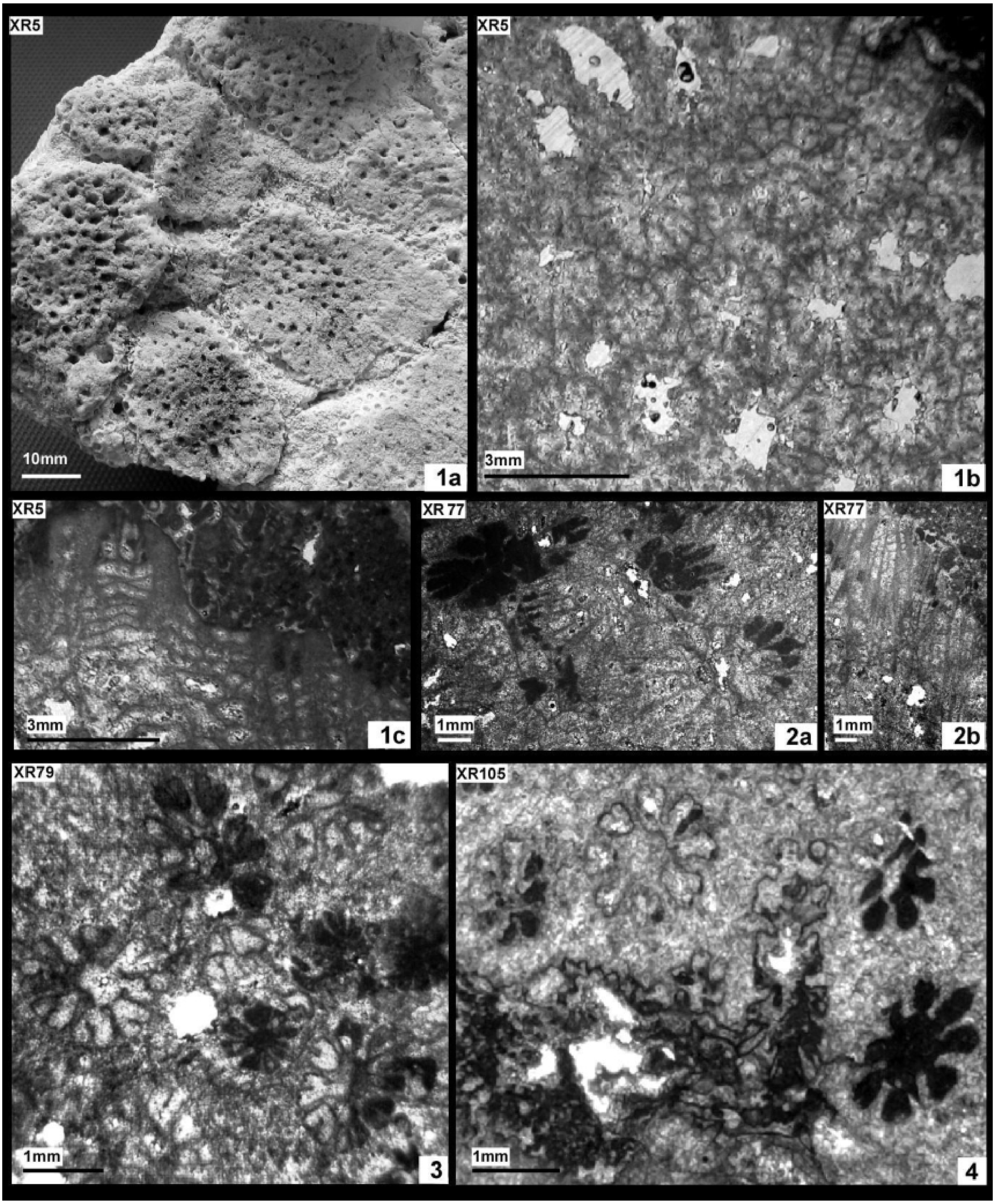


PLATE 13

Fig. 1 - XR5, "*Pseudocoenia" limbata* (Goldfuss, 1829). 1a: natural transverse section of thick and densely packed branches of a ramose colony; 1b: transverse section of corallites; 1c: longitudinal section of corallites.

Fig. 2 - XR77, "*Pseudocoenia" decipiens* (Étallon, 1864). 2b: transverse section; 2a: longitudinal section.

Fig 3 - XR79, "*Pseudocoenia" limbata* (Goldfuss, 1829), transverse section.

Fig. 4 - XR105, "*Pseudocoenia"* sp., in transverse section.

2003 *Pseudocoenia limbata* - Helm et al., p. 82, fig. 7B.
2003 *Pseudocoenia limbata* - Pandey & Fürsich, p. 25, text-fig. 4.
2012 *Pseudocoenia limbata* - Zaman, p. 150, pl. 30-31, tab 31-33.

Material: 3 samples (XR 5; XR45 (no thin section); XR79), 6 thin sections.

Localities: XR 5; XR45: External zone of CCU (debris; RT5C); XR 79: inner zone of CCU (wp760).

Description. Branching ramose colony; plocoid arrangement of corallites. Extracalicular budding. Longitudinal section showing a planar calicular platform. Calices randomly distributed, well distinct, circular to sub-circular, quite constant in diameter.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR 5	1.8	1.3	1.4	3	1.5	2.2
XR 45	2	1.4	1.6	2.7	2.1	2.4
XR 79	2.0	1.6	1.7	2.1	1.0	1.8
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 5	16 (S1:8+ S2:8)	1.3	0.4/0.3	0.1	3 (1S1+2S2)/ mm	
XR 45	8(S1)+ ?8(S2)	1.2	0.3	0.1	4/mm	
XR 79	16 (S1:8+ S2:8)	0.7	0.4	~0.2	3 (S1)/ mm	

The external surface characterised by a thick peritheca, consisting of vesicular dissepiments. Thin costo-septa. Radial symmetry expressed by two size orders, arranged in multiple of 8. S1 costo-septa longer than S2 costo-septa, thickness comparable. Radial elements straight, rarely curved with a slight enlargement of peripheral edge. Septa vertically continuous in longitudinal section. The endotheca made of densely-packed, thick and planar to convex upward tabuloid dissepiments. A well-developed parathecal wall present.

Remarks. Since Goldfuss (1826; 1829) two species with the same species name were created *Madrepora limbata* (1826) and *Astrea limbata* (1829) based on a badly preserved silicified material issued from the Nattheimer Schichten. Numerous following authors adopted very different and sometimes confusing views about these initial creations, in part because the presence or absence of columella was hard to establish in such a badly preserved material and because the existence of different taxa characterised by their absence or presence of columella was not recognised by the authoritative works of Milne Edwards & Haime (see for instance Milne Edwards & Haime, 1851, p. 58). Becker (1875) mentioned he had seen abundant material from the same area, remarked the troubling constant absence of columella and grouped the two species in a single one considering that the species may vary from hummocky massive forms to ramose ones. It is speculated that such a grouping in 1875 was probably clear enough to avoid the way of the distinction, a path so often imprinted in a very typological period. But Koby (1881) mentioned he has seen more than hundred samples of *"Cryptocoenia" limbata* and declare that it would be temerary to make several species on the basis of the shape of the colony. The type material was observed and it is rather suggested that both octameral specimens of Goldfuss belong to the genus "*Pseudocoenia*". This position was already defended by Roniewicz (1966). So, the nomenclatural situation is particular in the sense that both nominal taxa may be considered simultaneously secondary homonyms and synonyms.

"Pseudocoenia" decipiens (Étallon, 1864)

Pl. 13, fig. 2a, b

1864 *Stylina octosepta* Étallon, p. 369, pl. 51, fig. 12.
pars 1864 *Stylina decipiens* Étallon, p. 367, pl. 51, fig. 9.
1864 *Stylina octosepta* - Étallon, p. 369, pl. 51, fig. 12.
pars 1881 *Cryptocoenia decipiens* - Koby, p. 90, pl. 20, fig. 2-3, non fig. 1.
non 1904 *Cryptocoenia decipiens* - Koby, p. 38, pl. 8, fig. 3.
1973 *Cryptocoenia decipiens* - Babaev, p. 76, pl. 3, fig. 3.
1973 *Cryptocoenia octosepta* - Babaev, p. 77, pl. 3 fig. 4.
non 1976 *Pseudocoenia decipiens* - Roniewicz, p. 52, pl. 6, fig. 3.
1982 *Cryptocoenia decipiens* - Bendukidze, p. 9, pl. 2, fig. 1a, b.
1985 *Cryptocoenia octosepta* - Liao & Xia, p. 138, pl. 5, fig. 4, 5, pl. 6, fig. 2.
? 1985 *Pseudocoenia decipiens* - Liao & Xia, p. 137, pl. 5, fig. 3.
1990 *Pseudocoenia decipiens* - Errenst, p. 171, pl. 4, fig. 1a-c.
non 1994 *Cryptocoenia octosepta* - Liao & Xia, p. 144 pl. 36 fig. 3; pl. 37 fig. 2-4.
? 1994 *Pseudocoenia decipiens* - Liao & Xia, p. 137, pl. 32, fig. 8.
1997 *Stylina decipiens* - Turnšek, p. 191.

Material: 1 sample (XR77), 1 thin section.
Locality: Internal zone of CCU (wp 757).

Description. Massive plocoid colony. Extracalicular budding. Calices circular to sub-circular, corallites densely-packed, randomly distributed in transverse section.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR 77	2.8	2.1	2.5	3.6	3.0	3.3
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 77	16 (8S1+8S2)	~1.6(S1)	~0.8(S2)	0.3	~2/mm	

External surface with perithecal vesicular dissepiments. Dissepiments well-spaced and prevalently convex upward. Costo-septa showing radial symmetry, arranged in two size orders S1 and S2, containing each 8 radial elements. S3 incomplete, appearing only in a single calyx. S1. Radial elements straight and usually claviform. Irregular granules appear on lateral facies of some radial elements. Endotheca consisting of dissepiments and tabulae. Dissepiments usually convex upward and densely packed (3/4 per mm); tabulae planar or undulated with lower density (~2 per mm).

Remarks. Étallon (in Thurmann & Étallon, 1864) created among others two species of "*Stylina*" based on the Thurmann's material: *Stylina decipiens* and *Stylina octosepta*. The type material was observed in Porrentruy. It appears that two syntypes of *Pseudocoenia decipiens* exist, but they do not belong to the same species. The specimen S 2199 is here chosen as lectotype that has 16 septa and not only 8 per corallite (as specimen S2219). It is believed that the traditional view of the species is often wrong since Koby (1881) who included in the species very similar forms that have two times more costae than septa. *S. octosepta* is considered as synonym.

The present species differs from "*P*". *limbata* by the higher mean and maximum sizes of the corallites.

"Pseudocoenia" sp.

Pl. 13, fig. 4

Material: 1 sample (XR105), 2 thin sections.
Locality: Internal zone of CCU (wp 884).

Description. Branching ramose colony with plocoid arrangement of corallites. Extracalicular budding. Calices circular, rarely elliptical. Corallites size quite constant both within a branch and among corallites of different branches. Corallites densely-packed and uniformly distributed.

Branch	**d Max**	**d Min**	**d Mean**			
XR105	12.1	8.8	10.3			
Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR105	1.8	1.5	1.6	2.0	1.7	1.8
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR105	8(S1)+?(S2)	0.7(S1)	0.2(S2)	0.3(S1)	3(S1)/mm	

Corallum poorly preserved, highly re-crystallised. External surface not observed. However, remains of vesicular peritheca appear in longitudinal section. Costo-septa showing radial symmetry, characterised by one main size order (S1) composed of 8 radial elements. The second size order (S2) not totally developed: few rudimental costo-septa shorter and thinner respect to the S1 present in some corallites. S1 morphology clavate to rhopaloid. Endotheca consisting of sub-planar tabulae with density about 3-4 per mm and vesicular dissepiments.

Remarks. The old descriptions of *P. ramosa* d'Orbigny 1850 and *P. digitata* d'Orbigny 1850 suggest some proximity but these species need a new review of the type material. For this reason, the open nomenclature is preferred. The fact is that few octameral "*Pseudocoenia*" have such a weak development of S2 septa and this is the ground for keeping this species apart from previous ones.

Genus *Stylosmilia* Milne-Edwards & Haime, 1848

Type species: *Stylosmilia michelini* Milne-Edwards & Haime, 1848

The difference between *Stylosmilia* and *Goniocora* is usually based on the form of the corallum, phaceloid for *Stylosmilia* and dendroid for *Goniocora*. The character should normally be quantified by mean of the angle between branches. Presently, it is not established here whether these genera are separated, or they are just two end members of a single variation. Due to phaceloid morphology of samples the attribution to the genus *Stylosmilia* is preferred which has also the priority in terms of nomenclature.

Stylosmilia pumila (Quenstedt, 1852)

Pl. 14, fig. 1a, b

1852 *Caryophyllia pumila* Quenstedt, p. 652, pl. 58, fig. 16.
1875 *Goniocora pumila* - Becker, p. 165.
1880 *Caryophyllia pumila* - Quenstedt, p. 712, pl. 171, fig. 1-2.
1966 *Goniocora pumila* - Roniewicz, p. 193-194, pl. 7, fig. 3.
1972 *Goniocora pumila* - Turnšek, p. 171, 231, pl. 11, fig. 1-2.
1976 *Stylosmilia pumila* - Roniewicz, p. 57, pl. 8, fig. 1.
1990 *Stylosmilia* cf. *pumila* - Errenst, p. 176, pl. 5, fig. 5a, b.
1991 *Goniocora pumila* - Lauxmann, p. 127, pl. 2, fig. 4.
1997 *Goniocora pumila* - Turnšek, p. 98.
2003 *Goniocora pumila* - Helm et al., p. 82.

Material: 1 sample (XR93), 2 thin sections.
Locality: Internal zone of CCU (wp 779).

Description. Phaceloid colony. Corallites thin, small, moderately packed and clearly costate. Extracalicular increase, single or multiple. Shape of calices circular, regular.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR93	2.8	1.7	2.4	3.5	2.2	3.3
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR93	tot:20 5(S1)+ 5(S2)+ +20(S3)	0.8-1.0 (S1-S2)	0.3(S3)	~0.2(S1)	4-5/m (S1+S2+S3)	

Radial symmetry, occurring in multiple of five: S1 and S2 contain 5 radial elements respectively, while S3 contains 20. Nevertheless, the difference in terms of length and thickness between S1 and S2 is not everywhere appreciated. In light of this, just two orders containing 10 and 20 radial elements respectively could be, alternatively evoked. Radial elements straight, S1 and S2 frequently clavate, with a slight enlargement of the inner edge, but clear auriculae are not seen in the unique longitudinal section, which is probably too far from the central axis. Granules observed along the lateral faces of the radial elements. Styliform columella present, but not systematically in every section. Tabular endotheca, tabulae are thin, planar, not-inclined, and loosely packed. Wall probably para-septothecal.

Stylosmilia michelini Milne-Edwards & Haime, 1848

Pl. 14, figs 2a, b, 3a, b, c

1848 *Stylosmilia michelini* Milne-Edwards & Haime, p. 275 pl. 6 fig. 2.
1881 *Stylosmilia michelini* - Koby, p. 61 pl. 13 fig. 3-6.
1904-05 *Stylosmilia michelini* - Koby, p. 12 pl. 3 fig. 1
1909 *Stylosmilia michelini* - Prever, p. 999.
1943 *Stylosmilia michelini* - Vaughan & Wells, p. 111 pl. 9 fig. 4.
1956 *Stylosmilia michelini* - Wells, p. 376 fig. 266-7 b-d.
1957 *Stylosmilia michelini* - Alloiteau, p. 360.
1964 *Stylosmilia michelini* - Beauvais, p. 116.
1973 *Stylosmilia michelini* - Babaev, p. 69 pl. 1 fig. 3.
1976 *Stylosmilia michelini* - Roniewicz, p. 55 pl. 8 fig. 2.
1977 *Stylosmilia michelini* - Gill, p. 284 pl. 4 fig. 1-4.
1982 *Stylosmilia michelini* - Bendukidze, p. 15 pl. 3 fig. 5, 6, 7; pl. 4 fig. 1, 6
1985 *Stylosmilia michelini* - Rosendahl, p. 42 pl. 4 fig. 2.
1985 *Stylosmilia michelini* - Liao & Xia, p. 132 pl. 1 fig. 5, 10 pl. 2 fig. 2, 7.
1986 *Stylosmilia michelini* - Beauvais, p. 223 pl. 35 fig. 3.
1990 *Stylosmilia michelini* - Errenst, p. 175 pl. 5 fig. 3a-b.
1991 *Stylosmilia michelini* - Lebanidze, p. 11 pl. 4 fig. 1 pl. 5 fig. 1 text fig 2.
1994 *Stylosmilia michelini* - Liao & Xia, p. 131 pl. 25 fig. 1, 2; pl. 29 fig. -4, 6, not fig.5.

Material: 2 samples (XR92; XR101), 4 thin sections.

Localities: Internal zone of CCU (XR92: wp 878; XR101: wp 776).

Description. Phaceloid colony. Corallites long and thin, wide angle between branches (XR92: 26 to 46). Extracalicular increase, frequently multiple. Calices circular to sub-circular. Occasionally costae make some sharp relief in the circular outline. Calicular diameter and distance between corallites varies considerably across the colony. Thin and continuous epitheca in sample XR101.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR92	2.7	1.7	2.3	4.1	2.5	3.1
XR101	3.8	2.3	3.1	8	5	6.2
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR92	tot:24 6(S1)+6 (S2)+12(S3)	1.0 (S1) 0.9/0.8 (S2)	0.3(S3)	~0.2/0.1 (S1)	4-5/mm (S1+S2+S3)	
XR101	tot:24 6(S1)+6(S2) +12(S3)	1.3(S1) 1(S2)	0.3(S3)	~0.2/0.1 (S1)	4-5/mm (S1+S2+S3)	

Radial elements consisting of compact costo-septa. Radial elements long, thin and straight. Longer septa frequently joining the columella. Radial symmetry. Three size orders (S1, S2, S3), arranged in multiple of six and differing in length, less in thickness. Granules present along the lateral faces, the presence of auriculae not demonstrated. Microstructure detected into septa as midseptal zigzag line. Elongated substyliform columella. Remains of planar endothecal dissepiments (or tabulae?). Wall parathecal.

Remarks. The sample here described is characterised by an external morphology similar to *Stylosmilia corallina*, consisting of more than a cluster of branches with more than two individuals (i.e. corallites). On the contrary *Stylosmilia corallina* presents almost a double number of septa compared to the sample described here. The number of radial elements and the size of corallites are considered as the strongest characters to classify species of this genus and for this reason the sample is attributed to *Stylosmilia michelini.*

Stylosmilia octonaria Roniewicz, 1976

Pl. 14, fig. 4a, b, c

1976 *Stylosmilia octonaria* Roniewicz, p. 56 pl. 8 fig. 5.
1985 *Stylosmilia* cf. *octonaria* - Rosendahl, p. 42.
1988 *Stylosmilia octonaria* - Fezer, p. 87.
1991 *Goniocora octonaria* - Lauxmann, p. 127 pl. 2 fig. 6.

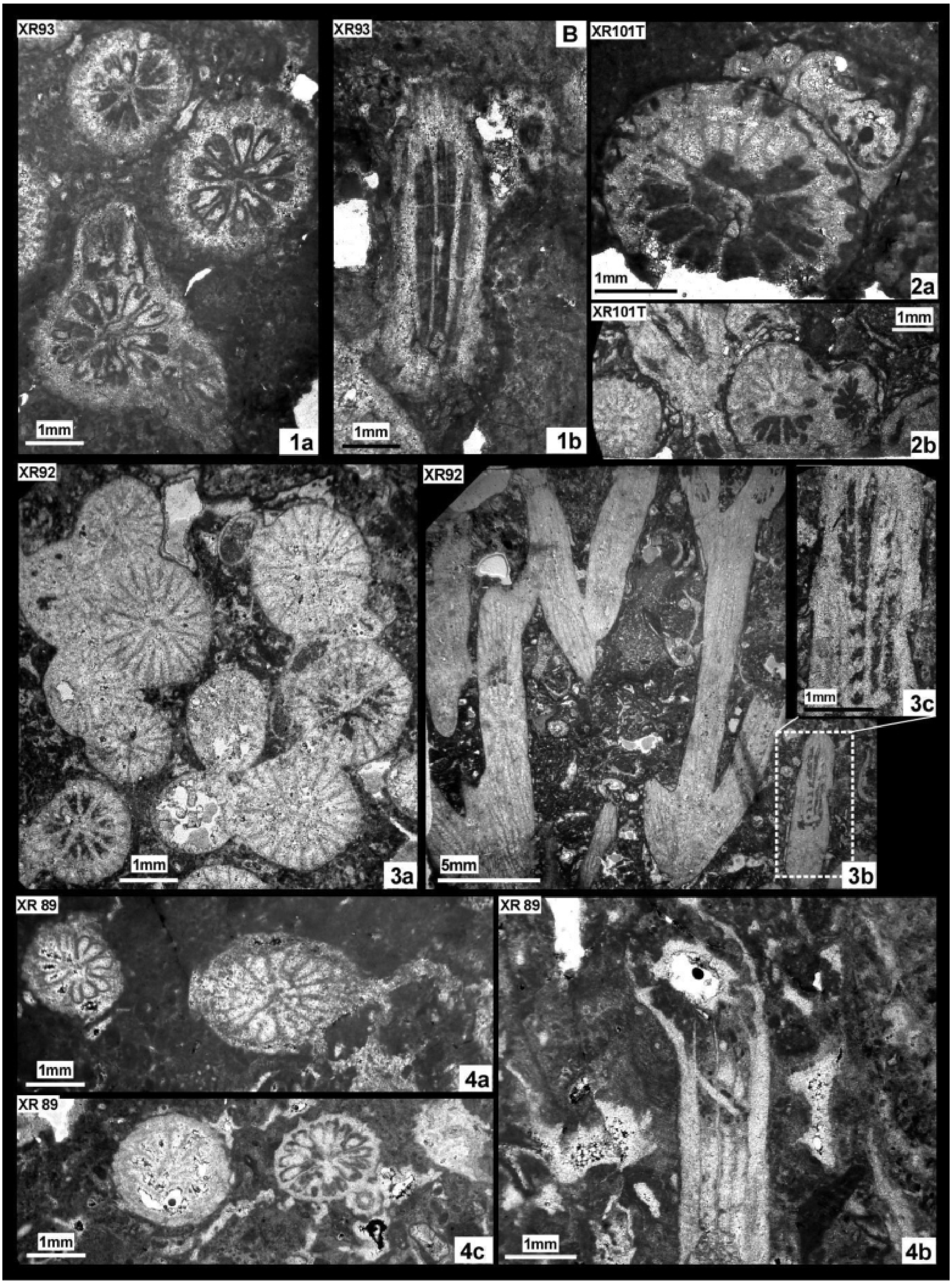


PLATE 14

Fig. 1- XR93, *Stylosmilia pumila* (Quenstedt, 1852). 1a: transverse section showing a corallite with a multiple extracalicular increase; 1b: oblique, nearly longitudinal section.

Fig. 2 - XR101T, *Stylosmilia michelini* Milne-Edwards and Haime, 1848. 2a, b: in transverse sections.

Fig. 3 - XR92, *Stylosmilia michelini* Milne-Edwards and Haime, 1848. 3a: transverse section, 3b: longitudinal section; c: zoom of 3b on radial elements in longitudinal section.

Fig. 4 - XR89, *Stylosmilia octonaria* Roniewicz, 1976. 4a, b: transverse sections; 4c: oblique to longitudinal section.

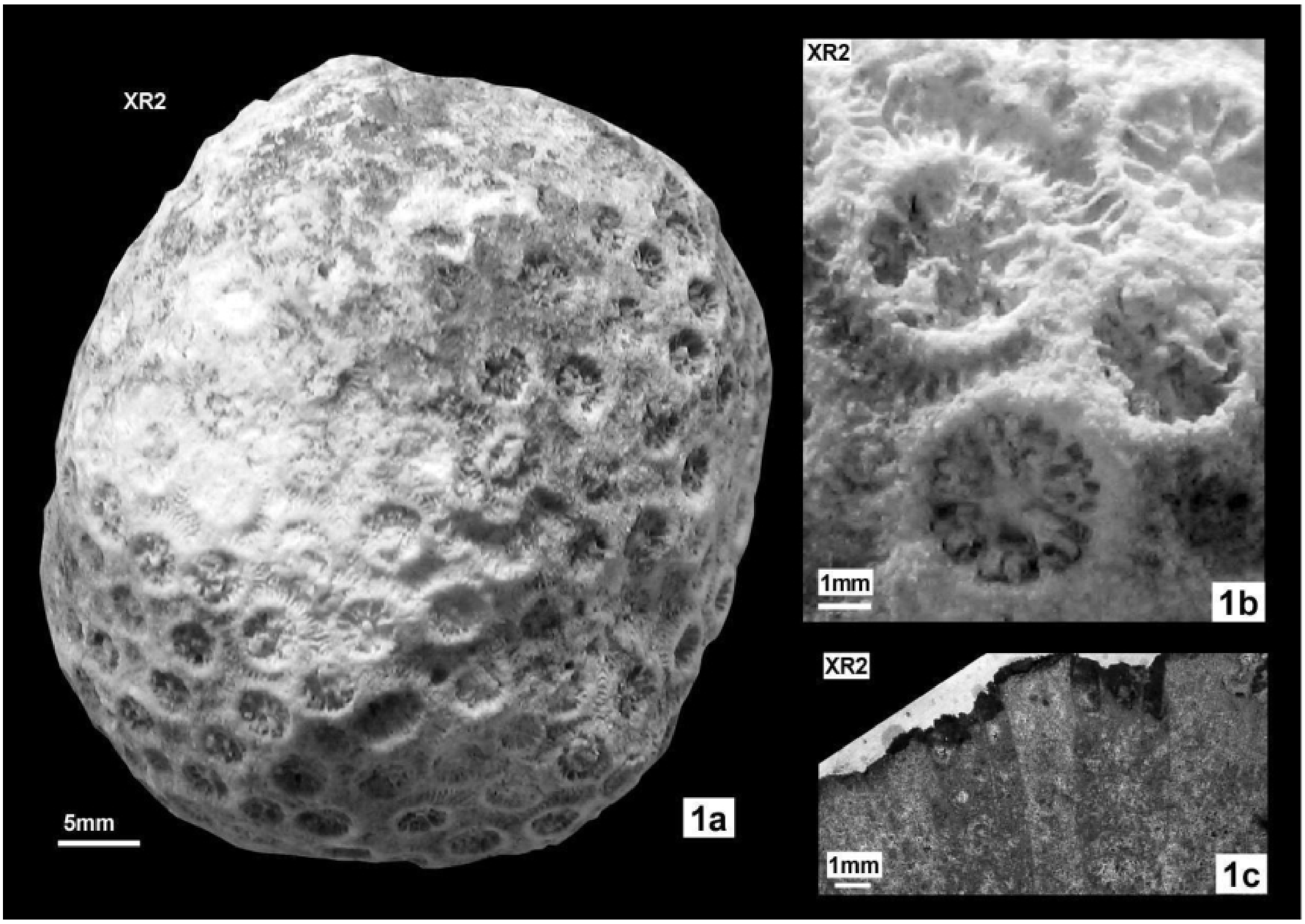


PLATE 15

Fig. 1 - XR2, *Stylina tubulosa* (Goldfuss, 1829). 1a, b: external distal view of the colony; 1c: longitudinal thin section.

Material: 1 sample (XR89), 2 thin sections.
Locality: Internal zone of CCU (wp 773, M771).

Description. Phaceloid colony. Branches long and thin. Budding extracalicular simple. Shape of calices circular to sub-circular. Calicular distance high, compared to calicular diameter, rarely corallites touching each other.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR89	2.6	1.5	2.2	6.3	2.8	4.5
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR89	tot:>16 ~8(S1)+ ~8(S2)+ ?(S3)	1.0(S1) 0.6/0.8 (S2)	0.2(S3)	~0.2/ 0.1(S1)	5-6/mm (S1+S2)	

Costo-septa irregularly distributed within the calices. Two or three size orders. The number of costo-septa belonging to S1, S2 variable, sporadically they contain a sum of 16 elements, and an octomeral symmetry could be evoked. S3 few and rudimental. Radial elements straight, thin, frequently with a slight enlargement of the inner edge (auriculae). Longer costo-septa frequently joining the columella. Granules present along the lateral faces. Styliform columella present, but not systematically in every section. Wall present, of unknown nature.

Remarks. Gregory (1930) introduces the species *Stylosmilia octoradiata* characterised by an octameral symmetry and very small diameters of the corallites (1-1.5 mm). However, Roniewicz (1976) introduces the species *Stylosmilia octonaria*, differing from *Stylosmilia pumila* only in terms of symmetry (8 for *octonaria* and 5 for *pumila*). Due to their difference in diameter, it is not sure that *S. octonaria* and *S. octoradiata* could be synonymous.

Genus *Stylina* Lamarck, 1816

Type species: *Stylina echinulata* Lamarck, 1816.

The genus *Stylina* is a problem for taxonomy and for nomenclature that need a decision of the international commission for zoological nomenclature (Zaman 2012). *Stylina* is here used in the sense proposed by Étallon (1859) and not by Alloiteau (1948). This is also the modern use of the term found in Baron-Szabo (2002) or Zaman (2012).

Stylina tubulosa (Goldfuss, 1829)

Pl. 15, fig. 1a, b, c

1829 *Astrea tubulosa* Goldfuss, p. 112 pl. 38 fig. 15.
1880 *Astrea tubulosa* - Quenstedt, p. 766 pl. 173 fig. 9 non 10-11.
1913 *Stylina tubulosa* - Speyer, p. 207 pl. 21 fig. 6.
1964 *Stylina tubulosa* - Beauvais, p. 135 pl. 10 fig. 4.
1980 *Stylina tubulosa* - Lyuljeva & Permyakov, p. 131 pl. 57 fig4, 5.
1991 *Stylina tubulosa* - Lauxmann, p. 120.

Material: 1 sample (XR2), 2 thin sections.
Locality: Debris of Nerineids and Diceratids horizon.

Description. Small, massive plocoid colony. Extracalicular budding. Spherical external morphology of the colony, with diameter less than 5 cm. Calices circular, corallites well-spaced, rarely touching each other.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR2	3.5	1.8	3.0	6	3.5	4.7
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR2	tot:24 6(S1)+6 (S2)+12(S3)	~2.3 (S1)	~0.3/0.5 (S3)	~0.1	4-5/mm	

Peritheca large and well-distinct composed of vesicular dissepiments. From confluent to non confluent, but mostly sub-confluent costae. Radial elements arranged in radial symmetry, three size orders deciphered (S1, S2, S3). S1 and S2 contain 6 elements respectively and S3 contains 12 elements. S3 shorter and thinner than S1 and S2; frequently rudimental. Costo-septa thin and attenuated. Rare granules on the lateral faces. Styliform and well distinct columella, its diameter reaches about 0.5-0.7 mm inside larger corallites. Endotheca characterise d by thin, well-spaced, planar or inclined dissepiments. Wall region large, well-distinct and prominent.

Genus *Heliocoenia* Étallon, 1859

Type species: *Heliocoenia variabilis* Étallon, 1859

The genus is used in the original sense of Étallon (1859) and recently precised by Zaman (2012).

Heliocoenia variabilis Étallon, 1859

Pl. 16, figs 1, 2b, 3a, b, 4a, b

1859 *Heliocoenia variabilis* Étallon, p. 475.
1881 *Heliocoenia variabilis* - Koby, p. 66 pl. 28 fig. 1-2 pl. 30 fig. 5.
1904 *Heliocoenia variabilis* - Koby, p. 10 pl. 4 fig. 7.
1948 *Heliocoenia tumularis* - Alloiteau, p. 703 text-fig. 3.
1964 *Alloiteaucoenia tumularis* - Beauvais, p. 144 text fig 30.
1966 *Heliocoenia (Decaheliocoenia) variabilis* - Roniewicz, p. 207 pl. 10 fig. 1 text-fig. 9D-E).
1972 *Heliocoenia variabilis* - Turnšek, p. 168, 230 pl. 8 fig. 3 pl. 9 fig. 1-6.
1976 *Heliocoenia variabilis* - Roniewicz, p. 60 pl. 9 fig. 4.
1980 *Heliocoenia variabilis* - Lyuljeva & Permyakov, p. 137 pl. 65 fig. 5-6.
1990 *Heliocoenia variabilis* - Errenst, p. 182 pl. 7 fig. 2a-g.
1994 *Heliocoenia variabilis* - Beauvais, p. 880 pl. 1 and 2.
1997 *Heliocoenia variabilis* - Turnšek, p. 101.
2003 *Heliocoenia variabilis* - Pandey & Fürsich, p. 22 pl. 5 fig. 1-4.
2015 *Heliocoenia variabilis* - Lathuilière et al. in corallosphere.org.

Material: 5 samples (XR70; XR85; XR129; XR 94; XR99t), 11 thin sections.
Localities: XR70, XR85; XR129; XR94: internal zone of CCU (wp 750; wp 772- M771 wp 932; wp789); XR99pp: Nerineids and Diceratids Horizon.

Description. Massive colony, plocoid arrangement of corallites. Extracalicular increase. Corallites densely packed. Calices circular in outline, rarely sub-circular. In the sample XR70 two groups of corallites (Cor1, Cor2) distinct relatively to their diameter: Cor1 corallites from 1.5 to 1.8 mm; Cor2 corallites less than 1.1 mm. Cor1 are more abundant, Cor2 do not exceed 10% of the corallites.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR 70	1.88 (Cor1)	1.2 (Cor1)	1.5 (Cor1) 1(Cor2)	2.7	1.3	2.1
XR85	1.2	0.7	0.9	1.0	1.5	1.3
XR 129	1.8	1.2	1.6	2.58	1.29	1.9
XR 94	2.4	1.4	1.8	2.7	1.4	1.9
XR 99t	1.7	1.1	1.4	2.5	1.5	2
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 70	tot: 20-22	~1.4(S1)	~0.2(S3)	~0.2 (S1)	7-8/mm (S1+S2+S3)	
XR85	tot: max 20	~0.7(S1)	~0.2(S3)	~0.2(S1)	5/mm (S1+S2)	
XR 129	tot: max 23	~1.3(S1)	~0.6(S3)	~0.2 (S1)	7-8/mm (S1+S2+S3)	
XR 94	tot: 22	~1.1(S1)	~0.3(S3)	~0.2 (S1)	7-8/mm (S1+S2+S3)	
XR 99t	tot:?	~1.2(S1)	~0.3(S3)	~0.2 (S1)	4/mm	

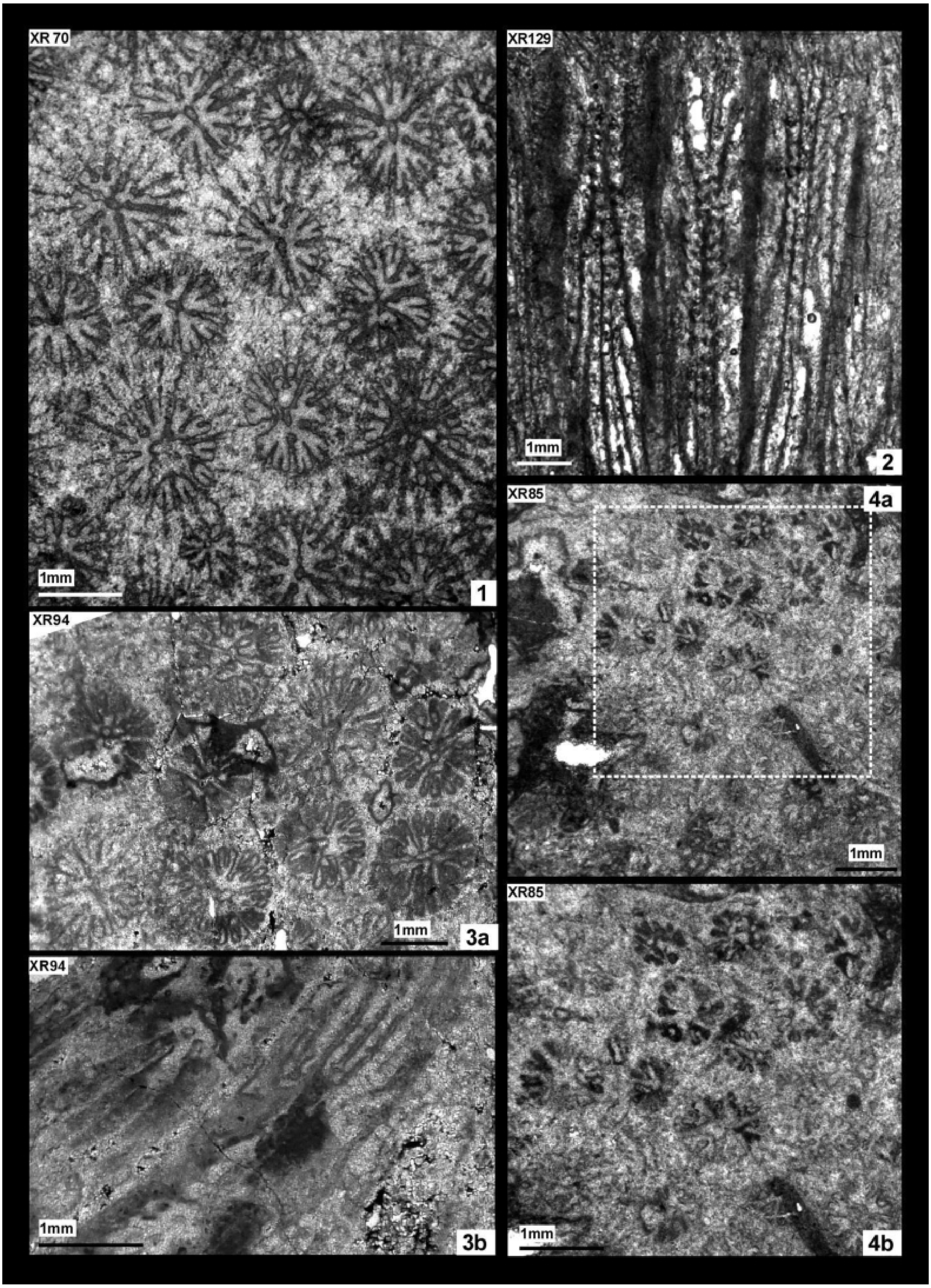


PLATE 16

Fig. 1 - XR70, *Heliocoenia variabilis* Étallon, 1859, ransverse section.
Fig. 2 - XR129, *Heliocoenia variabilis* Étallon, 1859, longitudinal section.
Fig. 3 - XR94; *Heliocoenia variabilis* Étallon, 1859. 3a: transverse section; 3b: longitudinal section.
Fig. 4 - XR85, *Heliocoenia variabilis* Étallon, 1859. 4a: transverse section; 4b: zoom of 4a.

Costo-septa arranged in radial and bilateral symmetry. Three size-orders clearly detected, not perfectly regularly arranged. In the samples (XR99t; XR85), S3 are rudimental and the cycle not complete. Costo-septa thin, long and spinose. Major septa frequently join the columella. Auriculae common on the inner edge of the septa, granules present on the lateral faces. Thin and well-spaced endothecal dissepiments detected in the samples XR 94, XR 85 and XR129. Styliform to sublamellar columella. Wall region large and well distinct, polygonal in the sample XR129.

Remarks. The variability of species of *Heliocoenia* is a question that still requires a morphometric approach with numerous samples (Zaman 2012) in order to establish reproducible identifications.

? ***Heliocoenia*** sp.

Pl. 17, fig. 1a, b

Material: 1 sample (XR68), 2 thin sections.
Locality: internal zone of CCU (wp 750).

Description. Massive colony, with packed corallites arranged in plocoid to plocoid/cerioid structure. Budding seems, at least locally, strangely intracalicinal. Form of calices mainly circular, elliptical morphologies rare. Corallites very densely packed, usually in touch each other. Calicular diameter varies considerably and several corallites can be grouped relating to different size.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR68	1.8	1.0	1.5	2.3	1.2	1.6
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR68	18-20	0.6-0.7	0.2-0.3	~0.1	7-8/mm	

Peritheca very narrow and perithecal structure not easy to detect in longitudinal section. However, remains of vesicular dissepiments are observed in transverse section. Irregularly arranged costo-septa constitute the radial elements. In transverse section, radial elements appear straight and very thin (probably due to the bad peculiar preservation). Longer costo-septa show a slight enlargement of the peripheral edge. Auriculae recognised along the inner edge of the septa. Styliform elongated columella present inside most of corallites, its diameter is about 0.1-0.2 mm. Wall narrow, often fusing with adjacent corallites.

Remarks. The cerioid state in the colonial structure is reached in some part of the colony and such a variability was not known till now in the genus *Heliocoenia*. This is the reason of the question mark.

Heliocoenia sp.

Pl. 17, fig. 2

Material: 1 sample (XR 1), No thin section.
Locality: External zone of CCU (RT5C).

Description. Branching ramose colony; plocoid arrangement of corallites. Branches cylindrical, robust and straight, circular to elliptical in transverse section. Diameter about 1.7-2 cm, length of the preserved branch portion is at least 13 cm. Corallites densely packed and prominent. Extracalicular budding suspected. Peritheca non costate. Calices circular, quite regular and diameter constant.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR1	2.3	1.4	2	3.4	1.7	2.4
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR1	Tot: >12 6 (S1)+6(S2)+?(S3)	0.7	0.2	0.1	3-4/mm	

Costo-septa arranged in radial symmetry in multiple of 6. Two size orders (S1, S2) clearly observed contain 6 radial elements respectively. Few shorter and thinner septa belonging to a rudimental and non-complete third order (S3) occur into some corallites. Costo-septa straight and compact. Longer septa usually clavate. Endotheca presents dissepiments. Punctiform columella. Wall region thick and well developed.

Remarks. Based on number of radial elements and diameter of calices XR1 is close to *H. variabilis*, however the species of XR1 is kept separated because it is clearly branched.

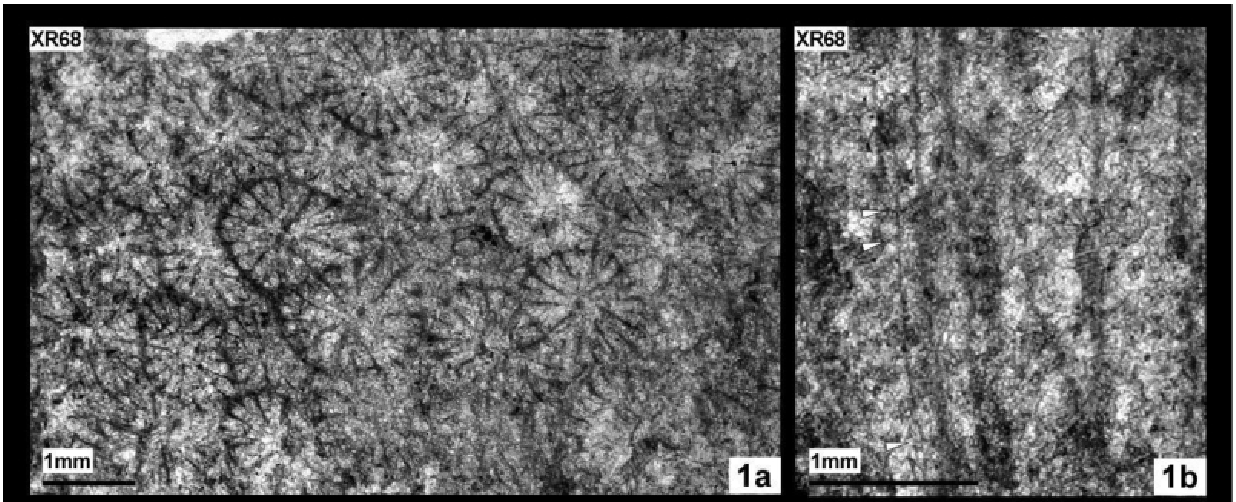
Family Cladophylliidae Morycowa & Roniewicz, 1990
Genus *Cladophyllia* Milne Edwards & Haime, 1851

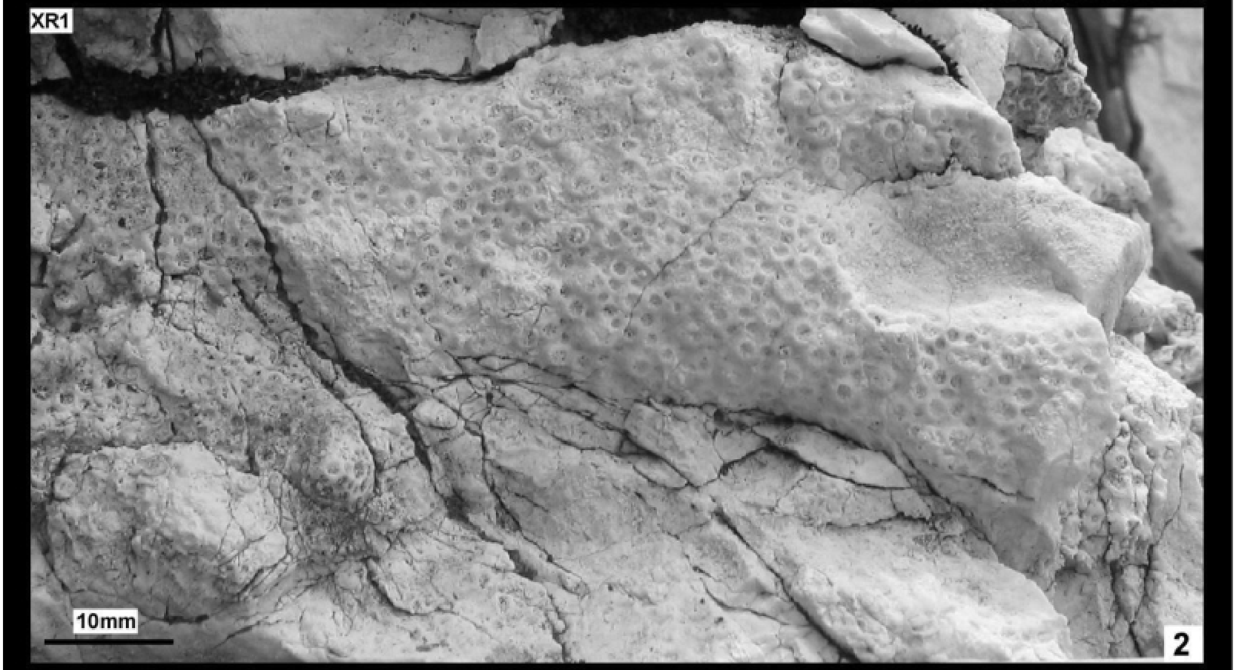
Type species: *Lithodendron dichotomum* Goldfuss, 1826

? ***Cladophyllia*** sp.

Pl. 17, fig. 3

Material: 1 sample (XS9.1), 1 thin section.
Locality: Unit CSU (XS 9).





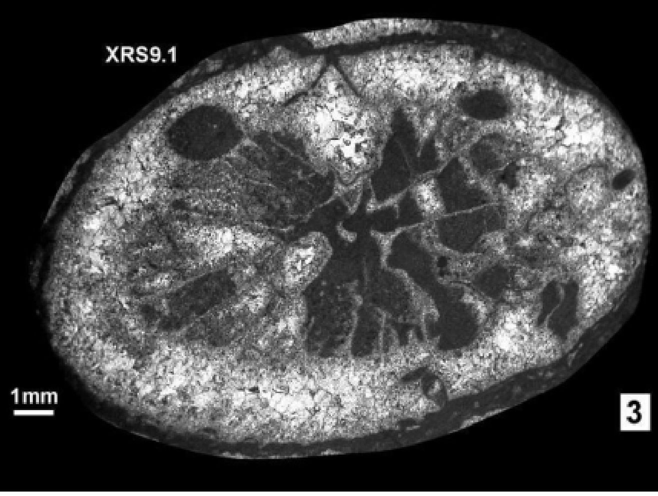


PLATE 17

Fig. 1- XR 68, ?*Heliocoenia* sp. 1. 1a: transverse section; 1b: longitudinal section in a very bad state of preservation.
Fig. 2 - XR1, *Heliocoenia* sp. 2, natural calicular surface in distal view (part of a broken branch).
Fig. 3 - XS9.1, ?*Cladophyllia* sp., single corallite in transverse section.

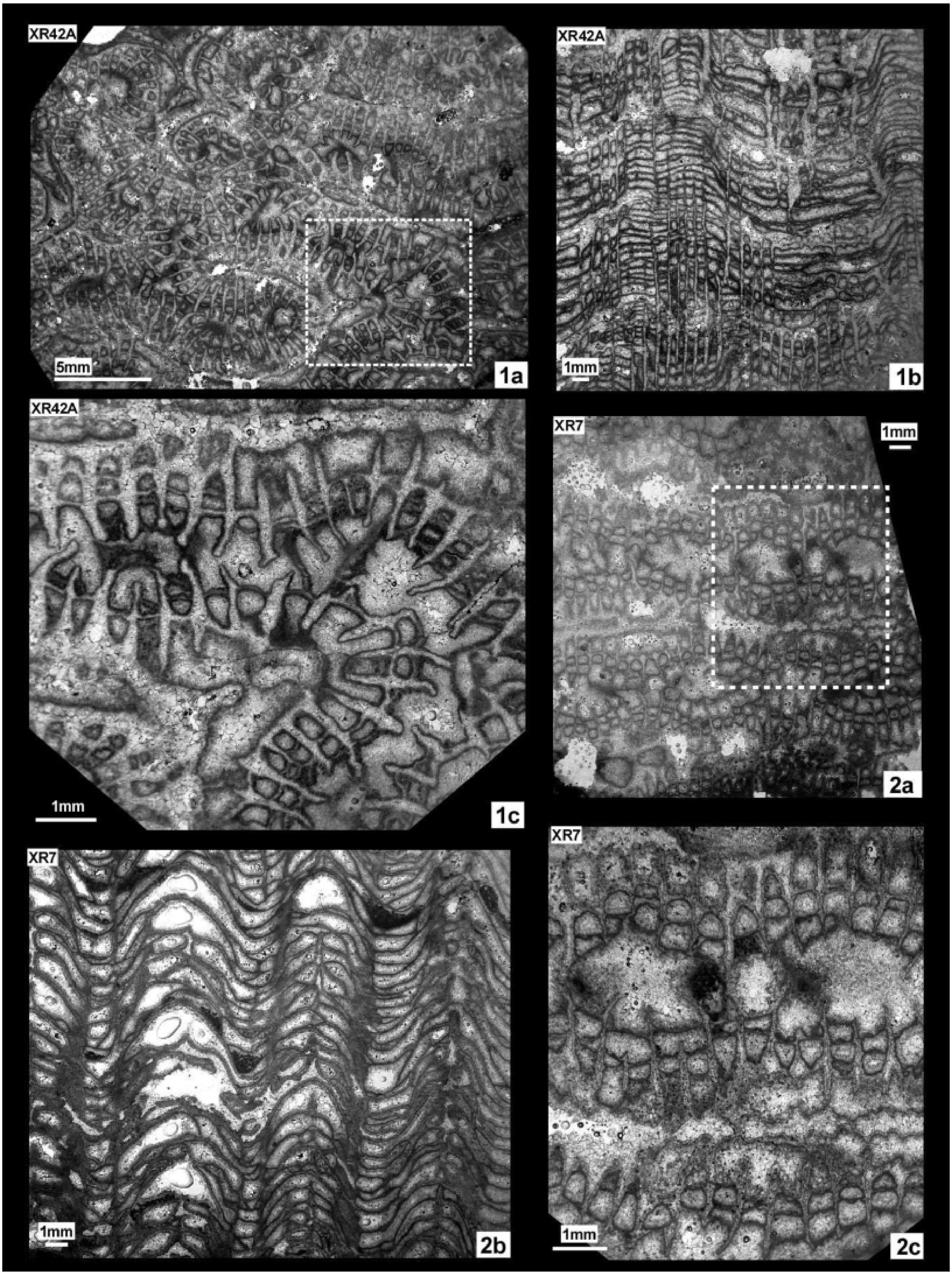


PLATE 18

Fig. 1- XR42A, *Eugyriopsis sinuosa* (Ogilvie, 1897). 1a: transverse section; 1c: zoom of 1a; b: longitudinal section.
Fig. 2 - XR7, *Eugyriopsis sinuosa* (Ogilvie, 1897). 2a: transverse section; 2c: zoom of 2a, b: longitudinal section.

Description. Solitary or broken branch of phaceloid/dendroid colony. Calices possibly circular or elliptical (only one, section possibly oblique). Septa thin, rhopaloid or attenuated straight to sinuous and possibly ornamented on lateral faces by very few spines. Three complete size-orders observed few rudimental septa of lower order present. The axial zone is difficult to interpret with a single section. A columella is possible but not well established, the axial organ seems to be connected to a septum. Endotheca not abundant, thin tabular dissepiments. Wall thick, peripheral of unknown nature.

Calices	d long axes	d short axes			
XS9.1	12.9 (oblique)	8			
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XS9.1	~30	5.2	0.9	0.12	3/mm

The bad preservation of the sample does not allow a firm identification.

Family Incertae sedis

Genus *Eugyriopsis* Beauvais, 1976

Type species: *Dendrogyra sinuosa* Ogilvie, 1897

Eugyriopsis sinuosa (Ogilvie, 1897)

Pl. 18, figs 1a, b, c, 2a, b, c

1897 *Dendrogyra sinuosa* Ogilvie, p. 126 pl. 16 fig. 3-4.
1906 *Dendrogyra sinuosa* - Szadeczky, p. 153.
1909 *Dendrogyra sinuosa* - Prever, p. 993 fig. 7.
1963 *Latomeandra*? *eguchii* Mori, p. 61 pl. 23 fig. 4-5.
non 1966 *Myriophyllia sinuosa* - Gofshtejn & Krasnov, p. 121.
1976 *Eugyriopsis sinuosa* - Beauvais, p. 24 pl. 6 fig. 1.
1988 *Amphimeandra eguchii* - Beauvais and Mori, p. 104 fig. 1 pl. 1
2002 *Eugyriopsis* cf. *sinuosa* - Löser & Mori, p. 86 fig. 3.1-5.
2002 *Amphimeandra eguchii* - Löser and Mori, p. 93, fig. 6.1-3.

Material: 2 samples (XR7, 4 thin sections and XR 42A, 2 thin sections).

Locality: External zone of CCU (M5e and M5d).

Description. Giant massive meandroid colony (about 2 x 1.5 m). Corallites arranged in long, straight and parallel to tortuous series. Intracalicular increase, producing series in which only one corallite is observed in the width of a valley. Ambulacrum and valley septa absent. Calices distinct due to the curvature of some septa and due to the deepening of tabulae toward the centres of calices. In transverse section this deepening results in an apparent enlargement of calices. Within the valley, calices separated by septa that cross the valley, without touching each other. Septa compact, unequal, poorly ornamented, straight, curved or bent, occasionally enlarged at the inner edge. They are potentially lonsdaleoid on the collines but vertically continuous in the valleys. Remains of microstructures appear as small dots aligned along the mid-septal plan, the distance between two trabecular axes about 60 μm. Endotheca made by densely packed, wide tabuloid dissepiments that deepen in the valleys. Similarly, to lonsdaleoid septa, the wall grows upon tabuloid dissepiments.

Calices	coll-coll	c-c		
XR 7	6.5	4.5-5.5		
XR 42 A	5.5-7.1	/		
Re	**Ml**	**ml**	**tk**	**dsy**
XR 7	1.5	0.5	~0.3-0.4	2/mm
XR 42 A	2.7(S1)	1.7(S3)	~0.3/0.4(S1)	3-4/mm

Remarks. *Amphimeandra* is in synonymy with *Eugyriopsis*, the only observed difference between type species consists in the shape of the series, straight in the type material of *Amphimeandra* and sinuous in the type material of *Eugyriopsis*. This character seems too weak to distinguish two genera. Moreover, the two collected samples, one with straight valleys and the other with sinuous ones probably derived from a single, partially reworked, huge colony.

Beauvais & Mori (1988) assigned *Amphimeandra* to the family of Amphiastreidae. This assignation is based on a misinterpretation of the 3D structure of the skeleton. Beauvais and Mori's marginarium is interpreted here as the section crossing a tabuloid dissepiment and the underlying vesicle in the collines region. Consequently, the "Taschenknospung" (pocket budding) is absent and then the assignation to Amphiastreidae is not valid. The assignation to the Stylinidae (Beauvais 1976) is not more convincing (absence of auriculae, intracalicular increase, etc.). The assignation of *Amphimeandra* to the Trochoidomeandridae (with a question mark) by Roniewicz (2012, in corallosphere.org) is also difficult to support. The diagnosis of this family by Turnšek (1981) as: "Rhipidogyrina with extremely thick septa of the first cycle and strong lateral septal dentations or outgrowth", does not correspond to our observations.

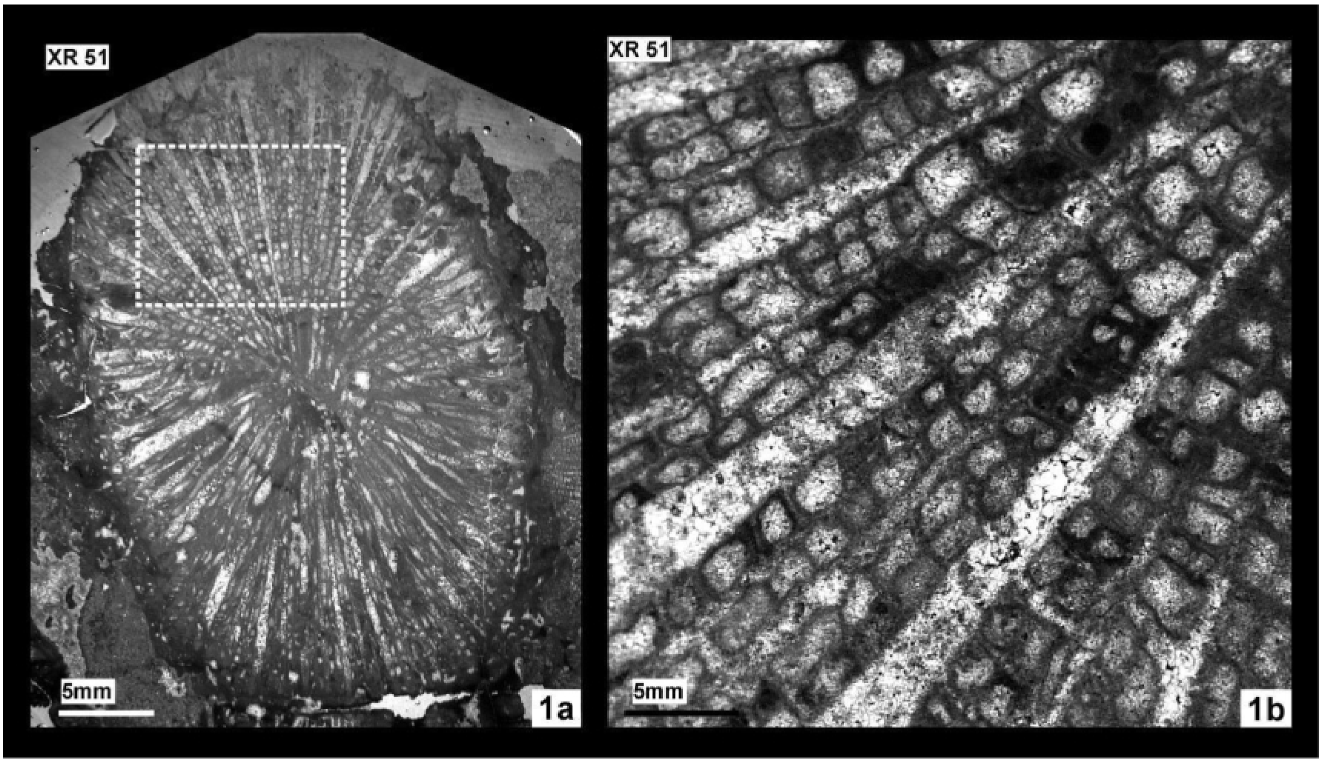


PLATE 19

Fig. 1 - XR51, *Kobyphyllia* cf. *recta* (Koby, 1884). 1a: transverse section of a single corallite; 1b: zoom of 1a.

Suborder **Faviina** Gregory, 1900
Family Montlivaltiidae Dietrich, 1926
Genus *Kobyphyllia* Baron-Szabo, 1997

Type species: *Plesiophyllia recta* Koby, 1884

Plesiophyllia recta could not stay in its original genus because of homonymy with *Plesiophyllia* Michelotti in Sismonda (1871). For this reason, Baron-Szabo (in Baron-Szabo & Fernandez-Mendiola 1997) created a new genus in honour to Koby. Unfortunately, based on the type material figured in the Corallosphere (under the item *Plesiophyllia* Koby), her view on this genus it is not here agreed while it is accepted the classification of Koby (1884) within the Montlivaltiidae. *Kobyphyllia* should be seen as a *Montlivaltia* having a lamellar columella.

Kobyphyllia cf. ***recta*** (Koby, 1884)

Pl. 19, fig. 1a, b

1884 *Plesiophyllia recta* Koby, p. 158 pl. 59 fig. 12.
2013 *Plesiophyllia recta* - Budd & Lathuilière in corallosphere.org.

Material: 1 sample (XR51), 1 thin section.
Locality: Unit CCU (M5).

Description. Solitary or a disarticulated branch of a phaceloid/dendroid colony. Very large calices, subcircular to oval (oblique section). Costo-septa radial elements, slightly carinate on lateral faces and enlarged in peripheral edge. Three size-orders clearly differentiated, others less evident. Endotheca abundant, tabular dissepiments regularly distributed. Microarchitecture compatible with Montlivaltiidae. Columella lamellar. Parathecal wall (?).

Calices	**d long axe**	**d short axes**			
XR51	35	23			
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XR51	Tot: 108	15.2	5.9	0.3 (S1)	3/mm

Kobyphyllia recta (Koby) was known from Koby by a single Middle Oxfordian specimen of a smaller size with a costal density a little lower. For these reasons of shape and size, "cf." is preferred.

Genus *Clausastrea* d'Orbigny, 1849

Type species: *Clausastrea tesselata* d'Orbigny, 1849

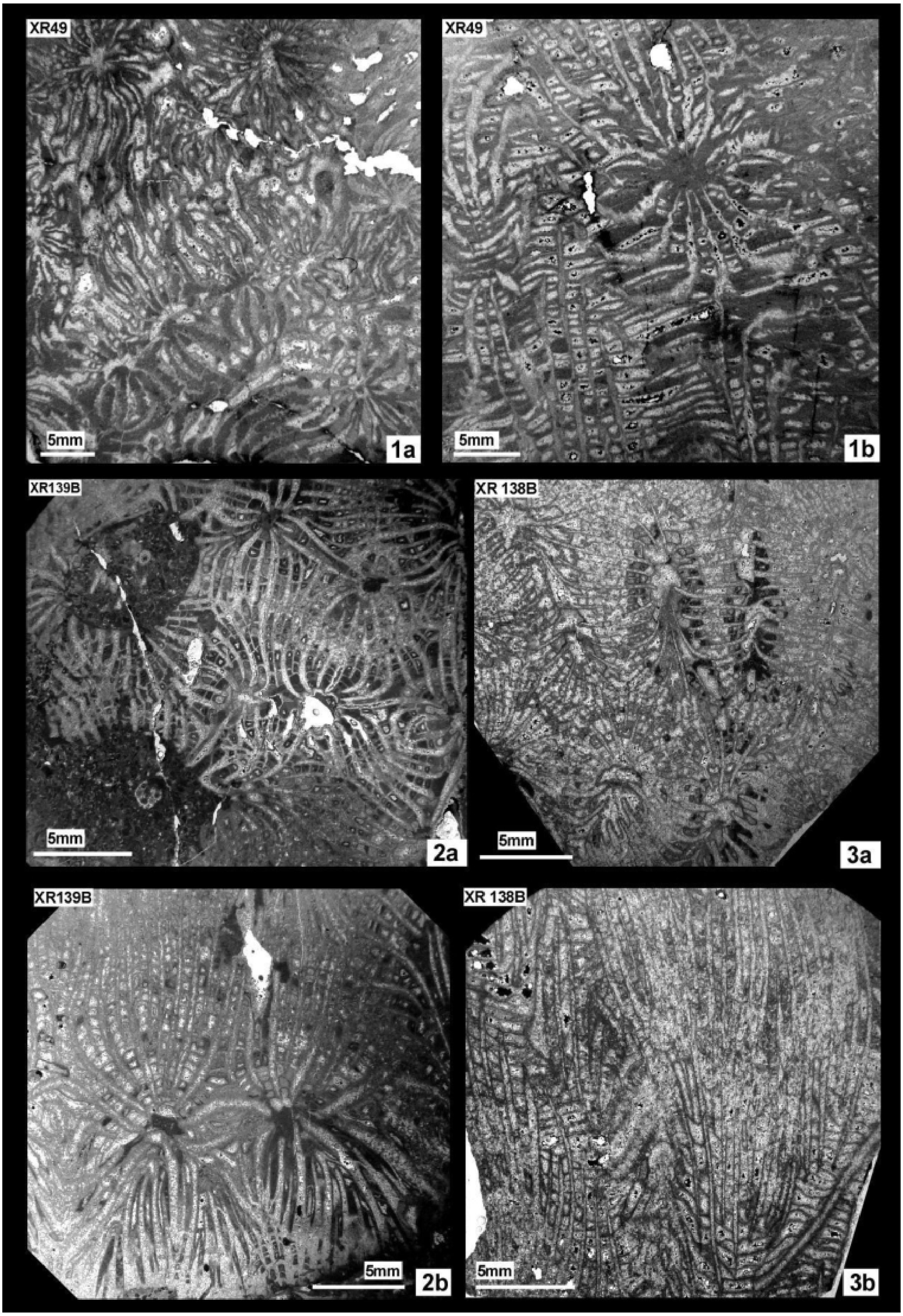


PLATE 20

Fig. 1- XR49, *Clausastrea topalensis* Roniewicz, 1976. 1a: transverse section, 1b: oblique section.
Fig. 2 - XR139B, *Clausastrea eliasovae* no sp. 2a, 2b: transverse sections.
Fig. 3 - XR138B, *Clausastrea eliasovae* no sp. 3a: transverse sections; 3b: oblique to longitudinal section.

Clausastrea topalensis Roniewicz, 1976

Pl. 20, fig. 2a, b

1955 *Synastrea cristata* (Goldfuss), Geyer, p. 207 pl. 24 fig. 1.
1976 *Clausastrea topalensis* Roniewicz, p. 66 pl. 12 fig. 2.
1976a *Clausastrea topalensis* - Eliášová, p. 180 pl. 10 fig. 2; text fig. 7.

Material: 1 sample (XR49), 2 thin sections.
Locality: Unit USS (RT 52, Mvb).

Description. Massive colony, thamnasterioid arrangement of corallites. Calices randomly distributed, or forming short series, composed of few (four) calices. Calicular margin convex upward and usually well-distinct. Intracalicular budding. Calices elliptical or irregular. Calicular diameter about 7- 8 mm, considering the boundary of the calices corresponding to the enlargement of the radial elements. The diameter of the fossa about 1.5-2 mm. The distance between two calicular centres about 15-16 mm, but 5-6 mm within a series.

	d	fd	c-c*	c-c**
XR49	7-8	2	15-16	5-6
Re	**s**	**1**	**tk**	**dsy**
XR49	(16) 19-21	4-12	0.6	5-6/5mm

*c-c: calicular distance outside series; ** c-c: calicular distance inside series

No wall divides calices. Septa confluent and sub-confluent. The sum of radial elements ranges from 16 (within the series) to 21. Septa irregularly distributed; some septa thinner and shorter than others but their number and size change among corallites. In transverse section septa curved to slightly tortuous, the maximum septa thickness (where enlargement occurs) is about 0.6 mm. Montlivaltid microarchitecture. The lateral faces of the radial elements ornamented by strong regularly distributed carinae. In transverse section carinae are 0.2- 0.3 mm in size, with density about 6 per 5 mm. Endotheca characterised by tabuloid dissepiments. Dissepiments planar, undulated or slightly inclined, density high, about 2-3 per mm (7-8 per 5 mm).

Remarks. The absence of wall, the mostly confluent septa, the size of corallites and trabeculae, the nature of the endotheca are characters that clearly distinguish this species from *Complexastrea.*

Clausastrea eliasovae nov. sp.

Pl. 20, figs 2a, b, 3a, b

? 1852 *Astraea confluens* Quenstedt, p. 649 pl. 58 fig. 1.
1897 *Thamnastraea confluens* - Ogilvie, p. 220 pl. 9 fig. 1a-c.
1954 *Thamnasteria confluens* - Geyer, p. 157 pl. 12 fig. 2.
1976a *Clausastrea confluens* - Eliášová, p.176, pl; 9 fig. 1, text fig.4.

Material: The holotype corresponds to the sample n XR138B (1 sample; 2 slabs, XR138L, XR138T; 2 thin sections). It belongs to the collection Ricci C.-Rusciadelli G., housed in University "G. D'Annunzio" Chieti-Pescara, Laboratory of Stratigraphy.

Locus typicus: Monte Rotondo, Scanno (Aq), Italy. Kimmeridgian-Tithonian interval. debris MVs3/M16: Nerineids and Diceratids horizon/ USS (Rusciadelli et al. 2011).

Derivatio nominis: The species is dedicated to Helena Eliášová for her great work on the corals of Štramberk. She has also described the characters of the present species.

Material: 2 samples (XR139B, XR138B), 4 thin sections.

Description. Massive thamnasterioid colony. Calices distributed randomly or in short series, and densely packed. Corallites concave upward, calicular margin defined by a marked enlargement of the septa. Intracalicular budding. Calices elliptical to irregular, 8-9 mm in diameter. Well-distinct fossa, 1.2 mm in diameter. The distance between two calicular centres vary considerably across the colony, ranging from 7.1 to 13.6 mm, where the budding occurs it is lower (4 mm). Radial elements straight or abruptly curved and not precisely confluent. Three size orders of septa deciphered, differing in terms of thickness and length, irregularly distributed. Occasionally one or two straight septa appear longer and thicker than the others. Number of the radial elements ranges from 26 to 39. Their density is about 9-19 per 5 mm.

No wall divides calices (despite the transverse section can give this illusion). Endotheca characterised by densely packed tabuloid dissepiments that climb between series but without forming a compact paratheca (see longitudinal section).

	Calices					**Re**		**Endoth.**
	c–c	**d**	**fd**	**s**	**1**	**tk**	**dsy**	**end. dsy***
XR139B	7.1–13.6	8–9	1.2	26–39	7.8(max) 3.1(min)	0.8 (S1) 0.4 (S2)	9–10/5mm (S1+S2+S3)	9/5mm
XR138B	6.5–7	~6.5	~1	30–39	4.1(max) 1.7 (min)	0.5 (S1) 0.2 (S2)	7–8/5mm	8–9/5mm

* end. dsy: density of endotheca.

Remarks. The samples are similar to "*Clausastrea confluens* (Quenstedt 1852)" described by Eliášová (1976a). However, a complex nomenclatural problem arises with the use of this binomen.

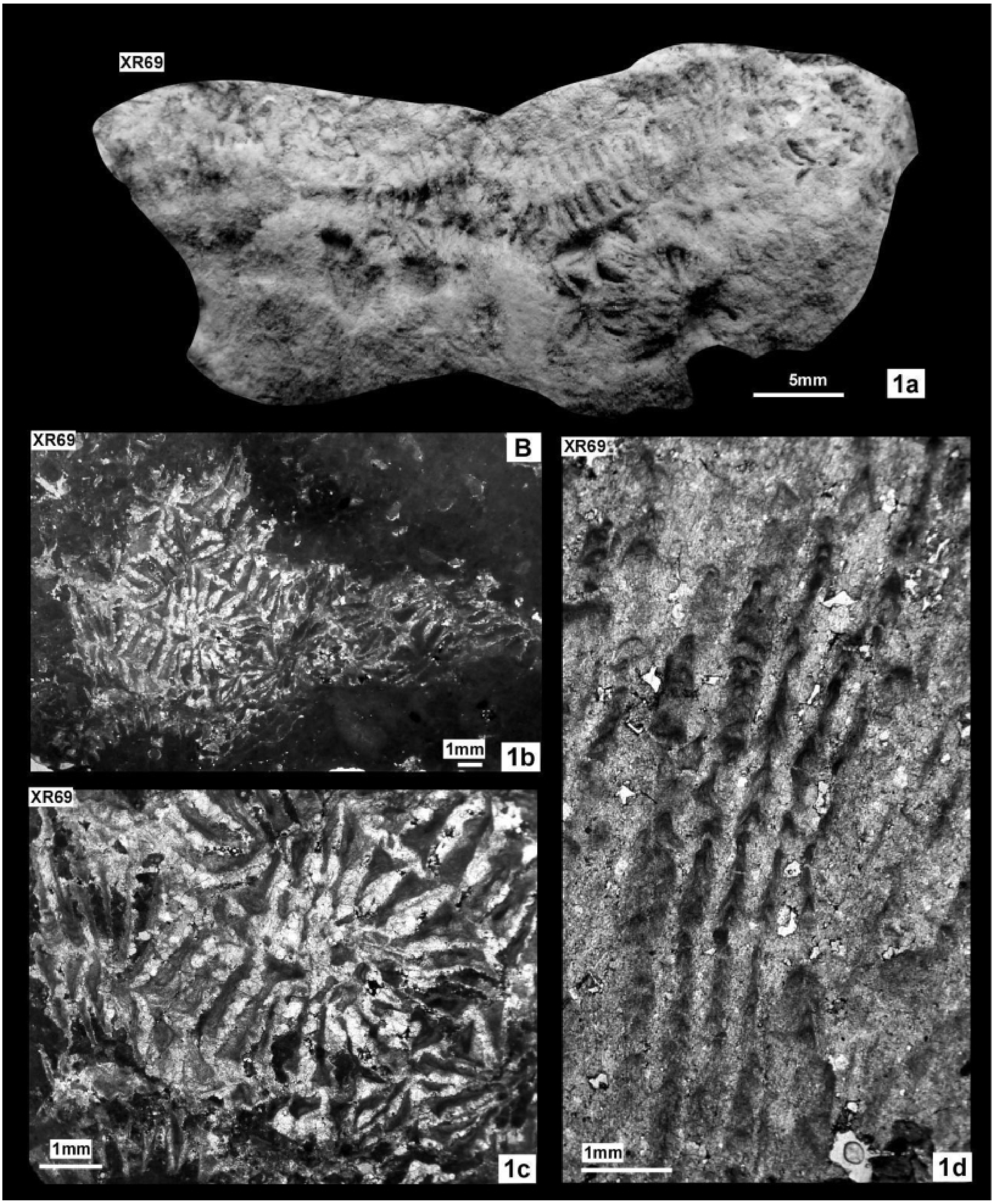


PLATE 21

Fig. 1 - XR69, *Thecomeandra remesi* Eliášová, 1973. 1a: natural surface of the specimen; 1b: transverse section; 1d: zoom of 1b; 1c: longitudinal section of radial elements with their growth lines.

Historically the term *Astrea confluens* was used for three different taxa (see Table 4). Goldfuss (1826) created the first *Astrea confluens,* a coral now considered as the type species of the genus *Margarastreopsis* Beauvais 1964 (Beauvais 1964). In 1843, Quenstedt created another *Astrea confluens* (primary junior hom-

Tab. 4 - Nomenclature historical review of taxa related to *Clausastrea confluens* (Quenstedt, 1852).

Initial citation	Intermediate citation	Intermediate citation	Present citation
Astrea confluens Goldfuss		*Margarastreopsis confluens* (Goldfuss) in Beauvais, 1964	*Margarastreopsis confluens* (Goldfuss)
Astrea confluens Quenstedt, 1843 (primary junior homonym)	*Astrea confluens* Quenstedt, 1852 pl. 57 fig. 27	*Latiphyllia confluens* (Quenstedt) in Beauvais, 1964	
	Astrea confluens Quenstedt, 1852 pl. 58 fig. 1	*Clausastrea confluens* (Quenstedt) in Eliasova, 1976	*Clausastrea eliasovae* nov. sp.
		Thamnastraea confluens (Quenstedt) in Ogilvie, 1897	*Clausastrea pseudoconfluens* Eliasova, 1976
		Clausastrea confluens (Quenstedt) in Morycowa, 1964	

onym) without figures and without reference to the Goldfuss species (Quenstedt 1843). In 1852 he illustrated his nominal species with two figures subsequently interpreted as two different species (Quenstedt 1852). The first one illustrated Pl. 57 fig. 27 is preserved in the Quenstedt's collection in Tübingen and is now traditionally interpreted as a *Latiphyllia*. Following Becker (1875) it is here believed that this sample corresponds to the initial sample of the publication of 1843. The other sample figured Pl. 58 fig. 1 is considered as lost and was unfortunately used by subsequent authors to designate *Thamnastraea confluens* "Quenstedt" in Ogilvie 1897 or *Clausastrea confluens* "Quenstedt" in Morycowa (1964). For this reason, Eliášová (1976a), created *Clausastrea pseudoconfluens* based on a new type material and put in her synonymy the citations of Morycowa (1964) and some other following authors. Considering that *Astrea confluens* is a junior homonym referring to a *Latiphyllia*, a new available name is needed to designate the concept described by the binomen "*Clausastrea confluens* (Quenstedt 1852)" *sensu* Eliášová (1976). *Clausastrea eliasovae* is here chosen to name this species and the new material proposed as a type bearing name. Presently, these two species of *Clausastrea* are taxonomically justified by their different dimensions. It cannot be completely excluded that more samples could fill the morphometric gap between both species but the description of *C. confluens (=eliasovae)* and *C. pseudoconfluens* Eliášová by Eliášová herself include respectively 15 and 10 samples and then seem to be stable enough. Here, all the dimensions fit with *C. eliasovae* but the endothecal density is closer to *C. pseudoconfluens*.

The present species cannot be confused with *Paraclausastrea, Meandrastrea, Latiphyllia* and *Complexastrea* species that have a vesiculous endotheca.

Genus *Thecomeandra* Eliášová 1973

Type species: *Thecomeandra remesi* Eliášová 1973

Thecomeandra remesi Eliášová, 1973

Pl. 21, fig. 1a, b, c, d

1973 *Thecomeandra remesi* Eliášová, p. 71 pl. 1 pl. 2 fig. 1, 2 pl. 3 fig. 1, 2 pl. 4 fig. 1, 2.
1976a *Thecomeandra remesi* - Eliášová, p. 171.
2015 *Thecomeandra* aff. *remesi* - Kołodziej p. 195 fig. 1G.

Material: 1 sample (XR69), 4 thin sections.
Locality: Unit CCU (Mp 750).

Description. Massive meandroid colony. Variable length of series, the longest preserved segment of series about 4 cm; shorter series contain one or few calices. Collines prominent and tectiform. Intracalicular budding. The distance between two adjacent series (calicular diameter) about 5-6mm. Single calices poorly distinct within the series. Septa subconfluent or non-confluent. Longer septa reaching the centre of the valley, where they tend to be rhopaloid. All septa present an enlargement of the outer edge, slight for the minor order, pronounced for major septa. Septal density about 2/mm and the thickness of major septa in the peripheral zone 0.5-0.6 mm.

	d	**c-c***		
XR69	/	5-6		
Re	**s**	**l**	**tk**	**dsy**
XR69	/	2.4	0.5	2/mm

* c-c: distance between two adjacent series.

Montlivaltid microarchitecture very probable, large granules. In the longitudinal section granules recur every 0.6-0.8 mm. On the distal edge teeth recur every 0.2-0.3 mm. In longitudinal section, the microstructure is partly preserved under the appearance of emphasised periodic growth increments, which confirms the acute character of the distal teeth.

Remarks. In the Plate 21, an ambulacrum can be seen between valleys in the best-preserved part of the picture. This is a character that was not known in the species described by Eliášová. Nevertheless, in other parts of the same picture, radial elements can be confluent. This suggests that this character is not stable enough to distinguish XR69 from the type species of the genus *Thecomeandra remesi* Eliášová 1973.

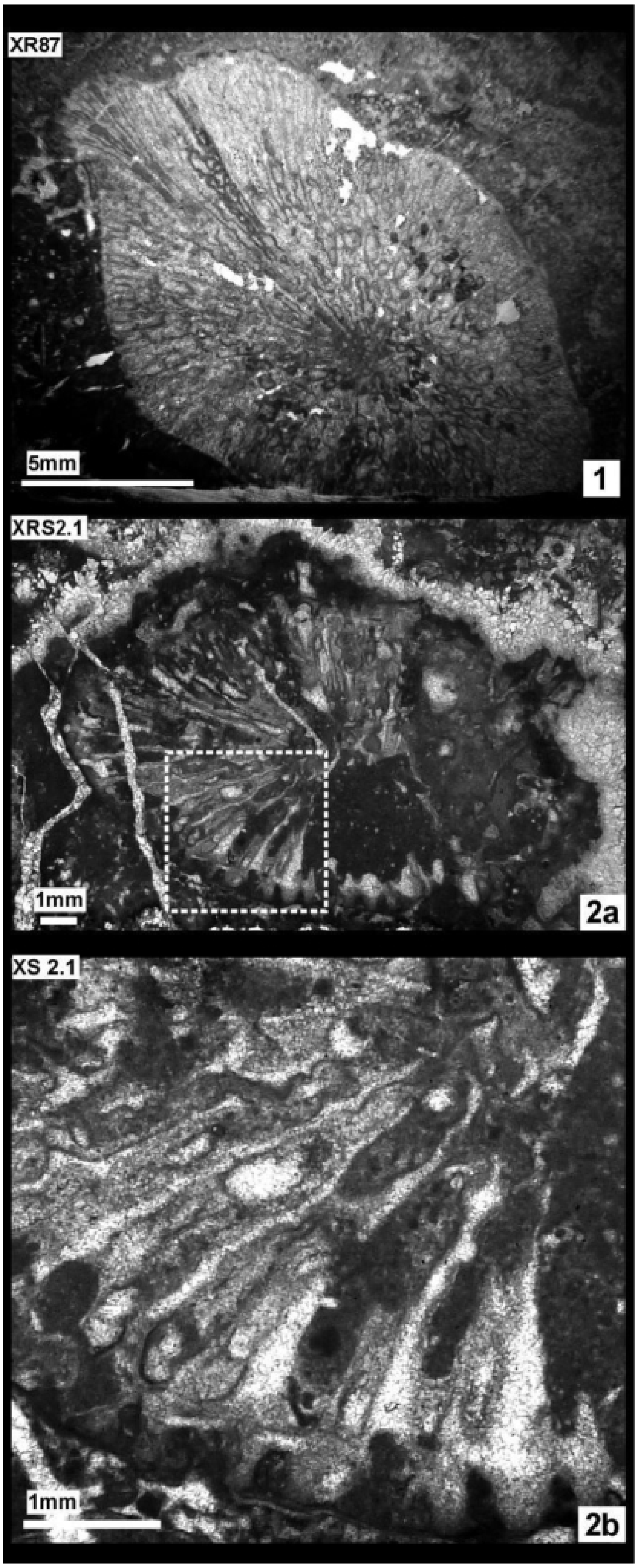


PLATE 22

Fig. 1 - XR87, *Dermosmilia laxata* (Étallon, 1864), transverse section of a single corallite.

Fig. 2 - XS2.1, *Dermosmilia* sp; 2a: transverse section of a single corallite; 2b: zoom of 2a on costo-septa and their typical ornamentation.

Family Dermosmiliidae Koby, 1887

Genus *Dermosmilia* Koby, 1884

Type species: *Dermosmilia divergens* Koby 1884

Dermosmilia laxata (Étallon, 1864)

Pl. 22, fig. 1

1864 *Thecosmilia laxata* Étallon, p. 384 pl. 54 fig. 10.
1884 *Dermosmilia laxata* (Étallon); Koby, p. 195 pl. 51 fig. 1-5.
1884 *Dermosmilia etalloni* Koby; Koby, p. 200 pl. 52 fig. 3.
1889 *Dermosmilia laxata* (Étallon); Koby, p. pl. 129 fig. 11 p. 474 pl. 124 fig. 6.
1889 *Dermosmilia subcrassa* Koby; Koby, p. 475 pl. 124 fig. 5.
1954 *Dermosmilia laxata (*Étallon); Geyer, p. 144 pl. 10 fig. 6.
1958 *Dermosmilia laxata* (Étallon); Frajová, p. 66 pl. 5 fig. 1.
1966 *Dermosmilia laxata* (Étallon); Roniewicz, p. 239 pl. 23 fig. 2.
1972 *Dermosmilia laxata* (Étallon); Turnšek, p. 199, 252 pl. 32 fig. 1-2.
1981 *Dermosmilia laxata* (Étallon); Turnšek *et al.* fig. 6 a, b.
1986 *Dermosmilia laxata* (Étallon); Beauvais, p. 215 pl. 29 fig. 2.
1990 *Dermosmilia laxata* (Étallon); Errenst, p. 200 pl. 12 fig. 4.
1996 *Dermosmilia laxata* (Étallon); Baron-Szabo & Steuber, p. 17-18 pl. 8 fig. 4.
1997 *Dermosmilia laxata* (Étallon); Turnšek, p. 72.

Material: 1 sample (XR87), 4 thin sections.
Locality: Unit CCU (Mp 773).

Description. Dendroid, but not sympodial, colony. Lobate outline suggests an intracalicular budding. External surface characterised by short and sharp costae. No epitheca.

Calices	**d**	**c-c**			
XR87	11.5 (short axis)	16			
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XR87	tot: ~80	9.3	1	~0.1/0.2	~7-8/3mm (costae)

Costo-septa subcompact, long, thin, straight

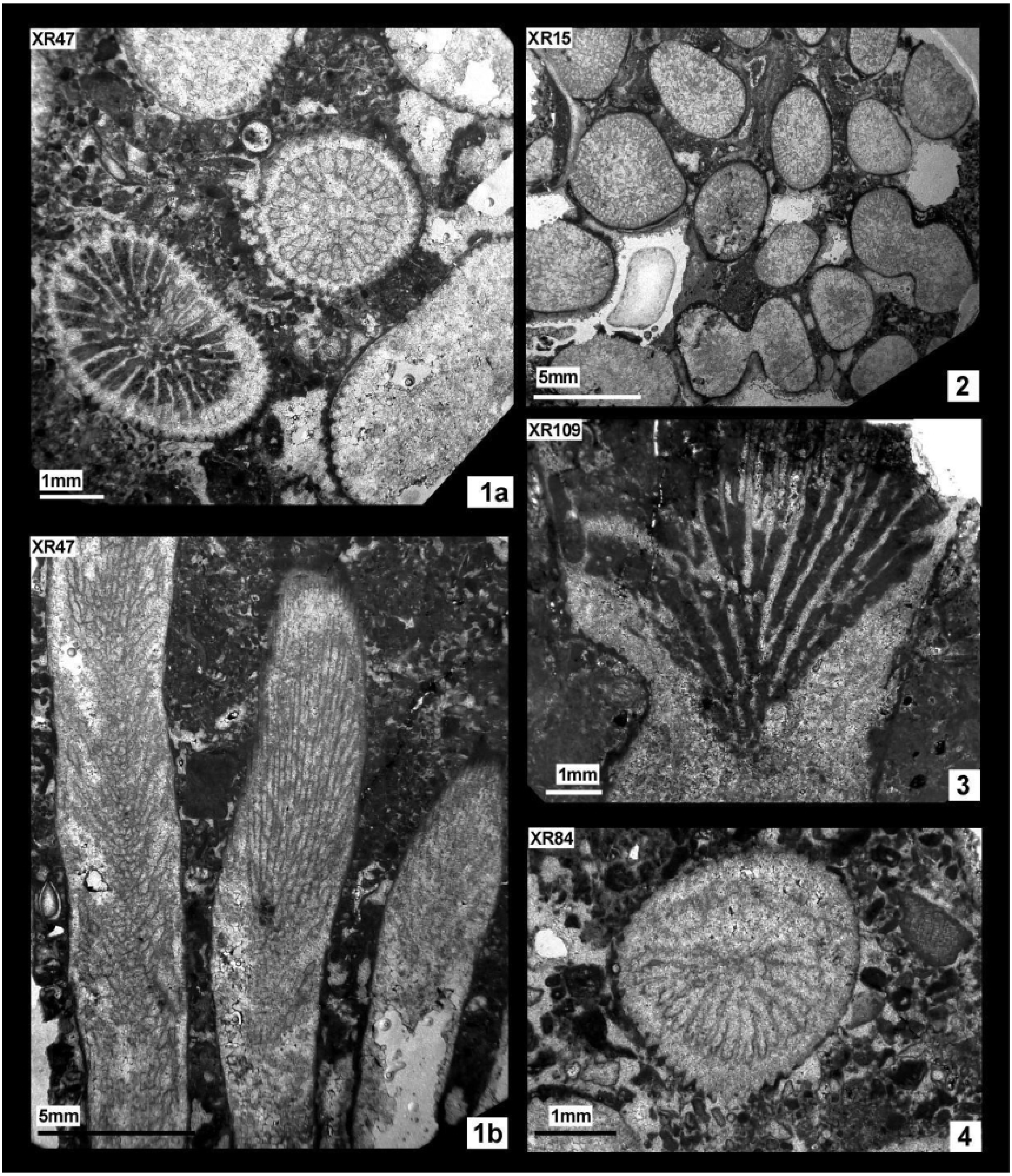


PLATE 23

Fig. 1 - XR47, *Calamophylliopsis flabellum* (Blainville, 1830). 1a: transverse section; 1b: longitudinal section of three parallel branches.
Fig. 2 - XR15, *Calamophylliopsis flabellum* (Blainville, 1830), transverse section.
Fig. 3 - XR109, *Calamophylliopsis flabellum* (Blainville, 1830), oblique section showing morphology and ornamentation of costo-septa.
Fig. 4 - XR84, *Calamophylliopsis flabellum* (Blainville, 1830), transverse section of a single corallite.

or curved. About 80 costo-septa counted, arranged in bilateral symmetry, marked by the curvature of septa and the elongation of the corallite. Longer costo-septa anastomosing at the inner edge. Promi-

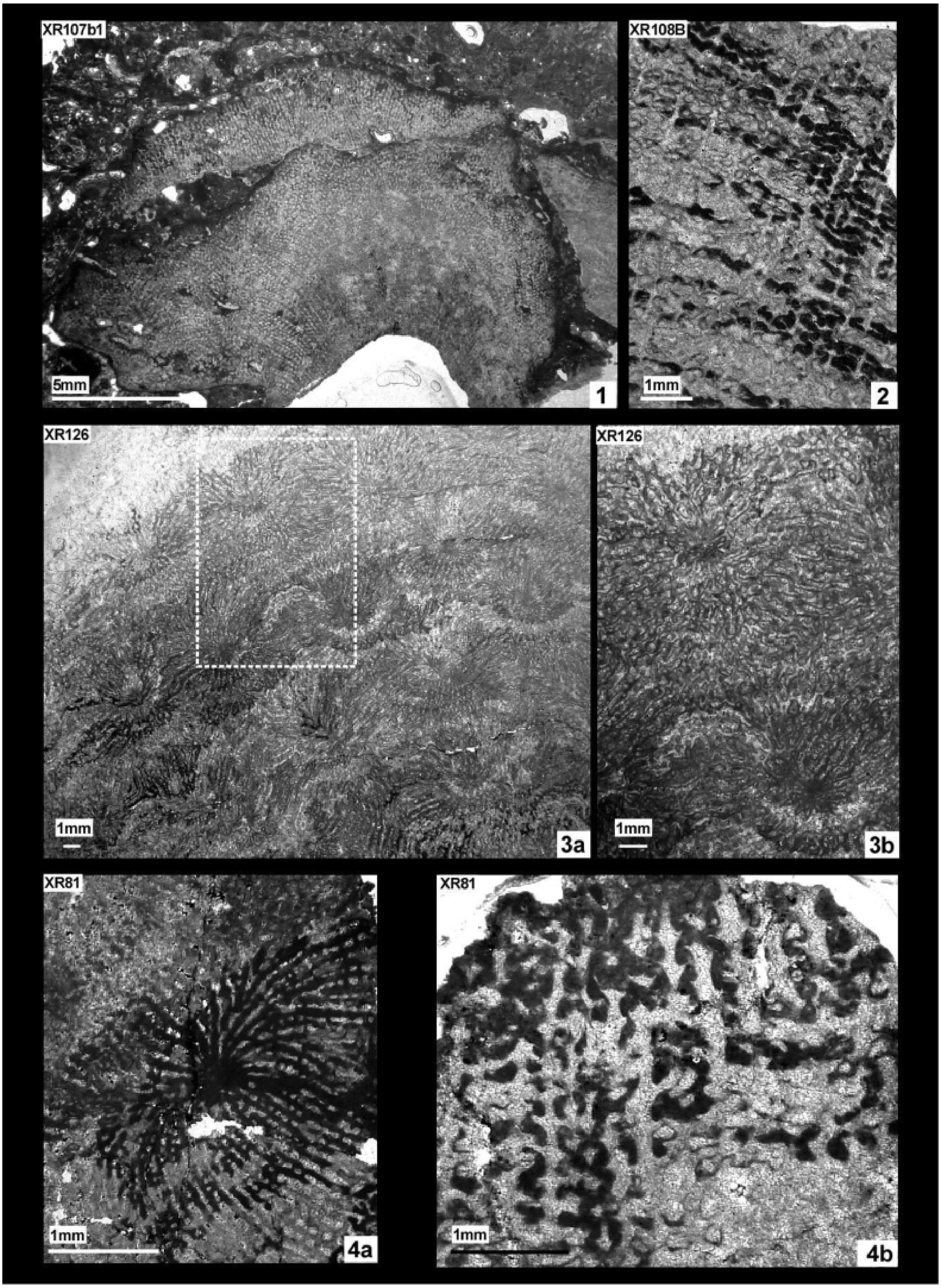


PLATE 24

Fig. 1 - XR107b1, *Microsolena* sp. A, oblique section across one or two massive-encrusting colonies.
Fig. 2 - XR108B, *Microsolena* sp. longitudinal section.
Fig. 3 - XR126, *Microsolena* sp. 3a: transverse section; 3b: zoom of 3a.
Fig. 4 - XR81, *Microsolena* sp. 4a: transverse section of a single corallite; 4b: longitudinal section of radial elements.

nent granules, occasionally flattened on lateral faces of the septa. They are asymmetrically distributed respect to the septal plan and occasionally in touch (synapticulae). Some thin septa show a zigzag morphology in transverse section. Columella spongy.

Remarks. A revision of species of *Dermosmilia* introduced by Koby (1884) appears to be necessary, since most of the species show comparable dimensions and they were distinguished mainly based on branching morphology. *D. laxata* is here preferred because it fits in dimensions of our specimen and it has the nomenclatural priority (*D. glomerata* is older but probably belonging to another genus).

cf. ***Dermosmilia*** sp.

Pl. 25, fig. 2a, b

Material: 1 sample (XS2.1), 1 thin section.
Locality: Unit SSU (XS 2.1).

Description Poorly preserved solitary or more probably, due to the size, broken branch of phaceloid/dendroid colony. Calices subcircular. Costo-septa markedly enlarged in peripheral edge and rhopaloid. Two size-orders poorly distinguished. Dermosmilid microarchitecture. Wall parathecal or synapticulothecal (?). The axial zone not very clear, due to a bioerosion cavity, which damaged the preservation. As consequence, *Dermosmilia* cannot be firmly confirmed.

Calices	d long axe	d short axe			
XS2.1	13.2	8.7			
Re	**s**	**Ml**	**ml**	**tk**	**dsy**
XS2.1	?	4.2	3.5	0.3 (S1)	3/mm

Genus *Calamophylliopsis* Alloiteau, 1952

Type species: *Calamophyllia flabellata* Fromentel, 1861

Calamophylliopsis and *Rhabdophyllia* seem to be very close, they differ in terms of phaceloid and dendroid external morphology and presence/absence of ruffles. *Rhabdophyllia* has the nomenclatural priority, however the conservative position is preferred, as it is not known how transitional these characters could be. The genus *Misistella* seems also very close.

Calamophylliopsis flabellum (Blainville, 1830)

Pl. 23, figs 1a, b, 2, 3, 4

1830 *Calamophyllia flabellum* Blainville, p. 312 and p. 318 pl. 52 fig. 4.
1843 *Lithodendron flabellum* Michelin, p. 94 pl. 21 fig. 4.
1884 *Calamophyllia flabellum* Koby, p. 182 pl. 53 fig. 1-5, pl.54 fig.1.
1964 *Calamophylliopsis flabellum* var. *compacta* - Beauvais, p. 242 pl. 32 fig. 6 pl. 33 fig. 2.
1964 *Calamophylliopsis flabellum* var. *nodosa* - Beauvais, p. 243 pl. 33 fig. 6.
1964 *Calamophylliopsis flabellum* var. granulosa - Beauvais, p. 243 pl. 33 fig. 7.
1976 *Calamophylliopsis compacta* (Koby); Roniewicz, p. 76 pl. 18 fig. 1-2 pl. 19 fig. 3.
1990 *Calamophylliopsis flabellum* - Errenst, p. 201 pl. 12 fig. 6a-c.
1997 *Calamophylliopsis flabellum* -Turnšek, species no. 27.

Material: 5 samples (XR47; XR5Nph; XR 15; XR 127; XR109; XR84), 14 thin sections.

Localities: Outer and inner zone of CCU and Nerineids and Diceratids horizon. XR47: M5d; XR5Nph: M5n; XR15: ch debris; XR127: wp918; XR109: wp898; XR84: wp 771.

Description. Phaceloid colony. Corallites cylindrical or flattened, parallel or having a small angle each other. In transverse section, calices circular, quite regular, elliptical, or lobate. Intracalicular increase, distomodaeal or polystomodeal producing short series or clusters. Calices moderately to closely packed.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR 47	5.3	2.9	4.2	6	4.2	4.9
XR 5Nph (no in fig.26)	4	3.1	3.5	5	3.5	4.4
XR 15	6.4	3.2	4.9	5.9	4.7	5.2
XR 127 (no in fig.26)	4.4	3.2	3.4	5	3.6	4.2
XR 109	5.6	2.7	4.9	7.5	4.4	5.8
XR 84	4.5	3.2	3.5	6.4	4.2	5.1
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR 47	tot: ~48 12(S1)+ 12(S2)+ ~24(S3)	1.6* (S1)	0.6* (S3)	~0.1/0.2 (S1,S2)	7-8/mm	
XR 5Nph	>45	1.6	0.6	~0.1/0.2	6-7/mm	
XR 15	>50	1.3	0.5	~0.1	9/mm	
XR 127	/	~1.6	~0.6-0.8	~0.2	5-6/mm**	
XR 109	~52	1.2	0.8	~0.1	3-4/mm	
XR 84	?52	1.7	1	0.2	8/mm	

* calculated on circular forms. ;** calculated on costae

Costae and epitheca constitute the external surface. Costae well distinct, their peripheral edge is distally sharp and proximally more rounded. Epitheca thin, not present everywhere. Radial symmetry deciphered in corallites showing circular forms, while bilateral symmetry appears in corallites showing elliptical to elongated forms. In circular forms three size orders have been detected: S1 and S2 contain 12 elements respectively, differing slightly in length, not in thickness; S3 contains roughly 24 costo-septa, usually rudimental and incomplete. Radial elements straight, rarely slightly curved, with a thickness enlargement of the peripheral edge. Radial elements compact and occasionally subcompact, free or joining. Strong granules on lateral faces. Spongy columella present. Endotheca made of densely packed vesicular dissepiments. Septothecal wall, usually well distinct, made by enlargement of radial elements. In distal parts radial elements thinner, united by a distinct paratheca.

Remarks. As already noticed by Koby (1884), this very common species displays a very wide range of variability in terms of dimension but also with regards to the presence of epithecal ruffles. In this respect an assignation to *Rhabdophyllia* is not discarded. The proliferation of nominal species is probably an overstatement. The proposed specific assignation is grounded on Koby's specimens as they were measured by Beauvais (1964). The original sample of the initial Blainville's quotation (an indication to a Guettard's specimen) is probably lost.

Suborder **Microsolenina** Morycowa & Roniewicz, 1995
Family Microsolenidae Koby, 1889
Genus *Microsolena* Lamouroux, 1821

Type species*: Microsolena porosa* Lamouroux, 1821

Microsolena sp.

Pl. 24, figs 1, 2, 3a, b, 4a, b

Material: 8 samples (XR81; XR83; XR107b1; XR103; XR126; XR107B2; XR108B; XR127A), 19 thin sections.

Localities: Inner zone of CCU. XR81: wp766; XR83: wp769; XR107b1: wp893; XR103: wp884; XR126: wp918; XR107B2: wp893; XR108B: wp896; XR127A: wp926.

Description. Massive (XR81; XR83) to pseudocolumnar (XR107b1), thamnasterioid colonies. Calices slightly elliptical. Fossa sub-circular to elliptical. Biseptal confluent sheet. Septa thin, curved, regularly perforated. In sample XR 81 about 32-33 septa counted. Typical pennulae and meniana with outer rims growing distalward. In longitudinal section the density of pennulae along a septum is high (3-4/mm in XR81, XR 83; 5/mm in XR107b1). Meniana are short vertically (0,3 mm) and large horizontally (0,9-1 mm) (ref. XR126). Pennular rims oriented upward. Synapticulae abundant. Densely packed vesicular dissepiments clearly detected only in XR103.

	Calices		**Re**			
	df	**f–f**	**tk**	**dsy**	**trab. dsy**	**pen dsy**
XR 81	~1	12.3	~0.2	3–4/mm	4/mm	3–4/mm
XR83 (no in fig.27)	0.7	4.3	~0.3	3/mm	3–4/mm	3–4/mm
XR107b1	/	6–8	<0.2	5/mm	4–5 /mm	5/mm
XR103 (no in fig.27)	1.5 *; 1.5x2.3**	3.3	0.1–0.2	4–5/mm	3/mm	2–3/mm
XR126	0.6–0.8***	6–11	0.3	2–3/mm	3–4/mm	3/mm
XR107b2 (no in fig.27)	/	/	/	4–5/mm	/	3/mm
XR108B	0.5x0.7**	7.2	0.2–0.3	3/mm	3	3–4/mm
XR127A (no in fig.27)	/	/	0.3	3/mm	3	2–3/mm

* measured on circular form ;** measured on elliptical form;

*** measured on sub-circular form

Remarks. The attribution of the specimens to one of the very numerous nominal species of *Microsolena* and also of *Dimorpharaea,* with which the borders are not well established, is abandoned. *Microsolena* is obviously a highly variable genus and the present state of taxonomic pulverisation cannot meet a satisfying solution without a population approach.

Genus *Comoseris* d'Orbigny, 1849

Type species: *Pavona meandrinoides* Michelin, 1843

Comoseris sp.

Pl. 25, figs 1a, b, 2a, b

Material: 3 samples (XR117; XR119; XR121), 10 thin sections.

Localities: XR117: Inner zone of CCU (wp911); XR119: Inner zone of CCU (wp912); XR121: Inner zone of CCU (wp913).

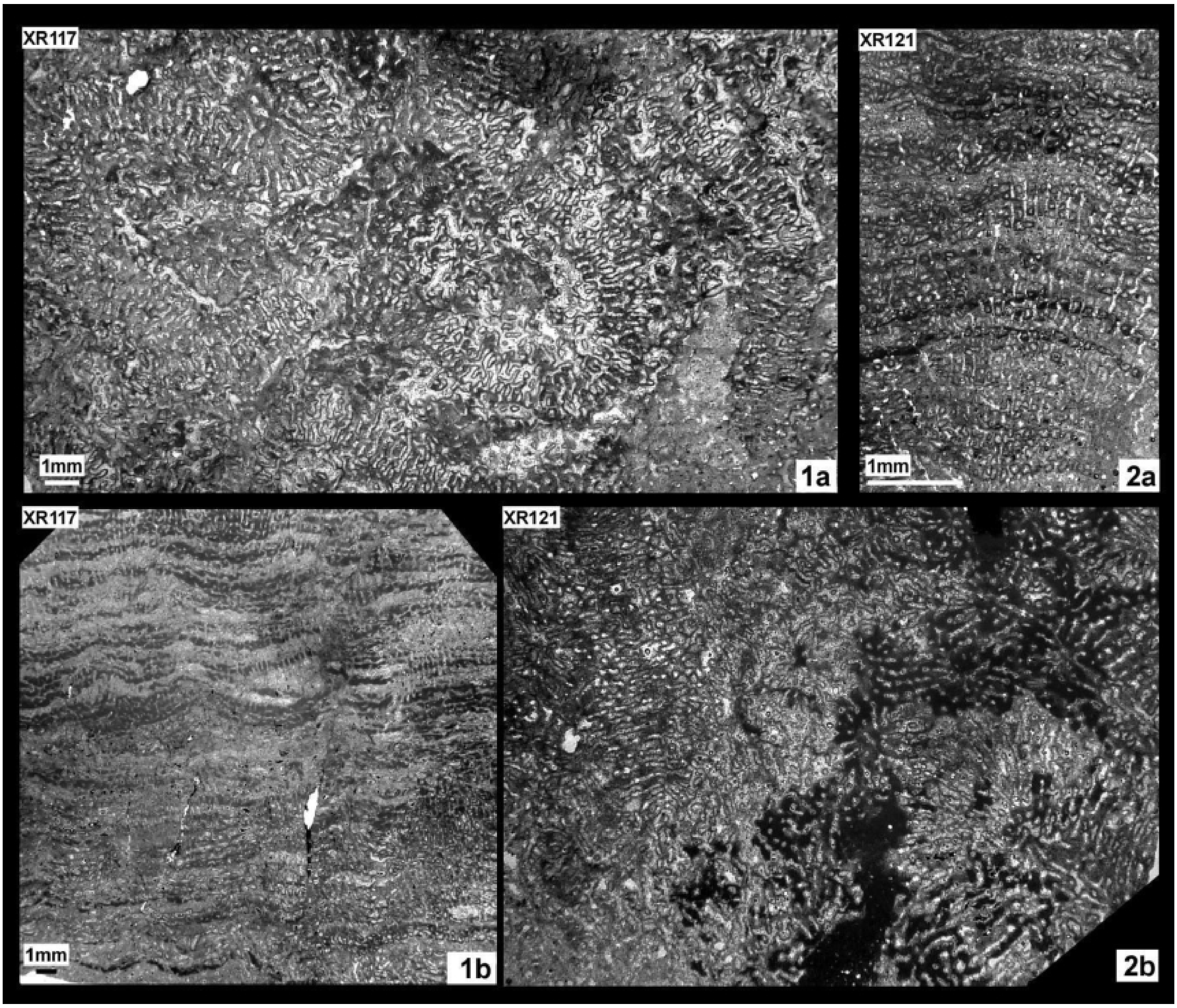


PLATE 25

Fig. 1 - XR117, *Comoseris* sp. 1a: transverse sections; 1b: oblique to longitudinal sections.
Fig. 2 - XR121, *Comoseris* sp. 2a: oblique to longitudinal sections; 2b: transverse sections.

Description. Massive meandroid colony, series large, long, tortuous. The distance between two collines about 3-5 mm. Septa short, clavate morphology is frequent. Septa regularly perforated. Large trabeculae present. Pennulae and menianes marked. Synapticulae frequent. Columella trabecular and spongy. Endotheca dissepimental.

	Calices		Re			
	coll–coll	c–c*	tk	dsy	trab. dsy	pen dsy
XR117	3 –5	/	0.2	4/mm	>4/mm	3
XR119	/	/	0.2	3/mm	3–4/mm	/
XR121	3.1	2.3	0.2	3	3–4/mm	2

* within valley

Family Latomeandridae Alloiteau, 1952 emend. Roniewicz, 1976

Genus *Ovalastrea* d'Orbigny, 1849

Type species: *Astrea caryophylloides* Goldfuss, 1826

?***Ovalastrea*** sp.

Pl. 26, fig. 1a, b, c

Material. 1 sample (XR115), 2 thin sections.
Locality. Internal zone of CCU (wp 909, M909).

Description. Massive colony, with plocoid arrangement of corallites. Increase unclear. Calices well-distinct, randomly distributed, circular, subpolygonal or elliptical in transverse section. Circular calices (c.f.) diameter about 4 mm; in elliptical form (ell.f.) major diameter (D) about 6 mm and the minor diameter (d) about 3 mm. Calicular distance varies across the colony.

Calices	**d Max**	**d Min**	**d Mean**	**c-c Max**	**c-c Min**	**c-c Mean**
XR 115	4.8* D :7.0** d:4.1**	3.1* D:4.7** d:2.0**	3.7* D:5.7** d:3.1**	6.2	4.2	5.1
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR115	tot:48 24 (S1/S2)+ 24 (S3)	1.9 (S1/S2)	0.5 (S3)	0.2-0.3 (S1/S2)	5-6/mm	

* measured in circular form;
** measured in elliptical form: D: major diameter; d: minor diameter

Peritheca present, wide (about 3 mm in transverse section) and vesicular. Mean size of vesicular chambers roughly 0.8 mm. Peritheca continuously vesicular, not interrupted by costae. Radial elements consist of costo-septa. Radial elements free but occasionally joined and frequently perforated. Radial symmetry in circular corallites; bilateral symmetry in elongated corallites marked by the elongation but also by a weak torsion of septa. Two or three size orders. The difference between S1 and S2 in terms of costo-septa length is subtle and consequently the number of costo-septa belonging to S1 or S2 is not really significant. In circular calices the sum of costo-septa belonging to S1 and S2 is 24, and 24 others are in the S3 size order. In elongated calices the number of costo-septa is higher (about 30 for S1 and S2). Radial elements long, thin and straight, rarely longer radial elements slightly curved. In transverse section they present a slight enlargement of the peripheral edge and frequent ornamentations on lateral faces. Short and thin granules on the lateral facies and teeth are present along the inner edge of the radial elements. Papillose columella. The endotheca composed of dense dissepiments. They are subplanar in the center but highly convex at the periphery, and their density changes a lot across the colony, from less than 2 per mm, to more than 5 per mm. Wall-region large, well-distinct and prominent. Wall probably paraseptothecal.

Remarks. Compared to the type specimen of the type species of *Ovalastrea*, the present specimen shows some peculiarities. It is more clearly perforate at the inner edge and the peritheca is continuously vesicular whereas the costae cross the peritheca in the type material. The pennular nature is plausible but not well demonstrated in the type material, which is highly silicified. On this point our diagnostic is less clearly cut than in Tomás et al (2008). The present material (XR115) does not appear really pennular. For these reasons a question mark is used before the generic determination and we still keep the genus in its traditional family. The specimen possibly belongs to a different genus, but more material is needed to create a new taxon.

Genus *Fungiastraea* Alloiteau, 1952

Type species: *Fungiastraea laganum* Alloiteau, 1952

?Fungiastraea arachnoides (Parkinson, 1808)

Pl. 26, figs 2, 3

1808 *Madrepora arachnoides* Parkinson, p. 54 pl. 6 fig. 4-6, pl. 7fig. 11
1851 *Thamnastrea arachnoides* - Milne-Edwards & Haime, p. 97 pl. 17 fig. 1-4
1889 *Thamnastrea arachnoides* -Koby, p. 358 pl. 130 fig. 3
1943 *Synastrea arachnoides* - Vaughan & Wells, p. 16 fig. 4
1956 *Synastrea arachnoides* - Wells, p. 386 fig. 279-4b
? 1964 *Morphastraea arachnoides* -Beauvais, p. 219 pl. 26 fig. 3
1966 *Fungiastraea arachnoides* - Roniewicz, p. 237 pl. 20 fig. 4
1972 *Fungiastraea arachnoides* - Turnšek, p. 62/112 pl. 35 fig. 5-6
1973 *Thamnastrea arachnoides* - Babaev, p. 122 pl. 14 fig. 4
1976 *Fungiastraea arachnoides* - Roniewicz, p. 98 pl. 29 fig. 2a-c
1980 *Synastraea arachnoides* - Lyulyeva & Permyakov, p. 81 pl. 4 fig. 3
1984 *Fungiastrea arachnoides* - Ali, p. 538 text fig. 1-A
1986 *Fungiastraea arachnoides* - Beauvais, p. 217 pl. 30 fig. 2
1987 *Thamnasteria arachnoides* - Khusanov, p. 69 pl. 12 fig. 2
1991 *Fungiastraea arachnoides* - Errenst, p. 24 pl. 18 fig. 8a, b
1993 *Fungiastraea arachnoides* -Pandey & Fürsich, p. 36 pl. 11 fig. 11-12 text fig.
2003 *Fungiastrea arachnoides* - Helm et al., p. 81, fig. 7D
non 2007 *Fungiastrea* aff. *Arachnoides* Pandey et al., p. 45, pl. 13, fig. 1a-b

Material: 2 samples (XR111; XR128A), 5 thin sections.

Localities: Inner zone of CCU, XR111: wp 904, XR 128A: wp 932.

Description. Massive, most probably thamnasterioid colony. Corallites densely packed. Calices circular to sub-circular, elongated where intracalicular budding occurs. Calicular distance varies markedly across the colony. Septa join occasionally at the inner edge. Radial elements densely packed, thin, curved or tortuous, often parallel each other. Rhopaloid morphology of the inner edge frequent. Septa poorly differentiated in length and thickness, no size orders of septa clearly detected. Synapticulae frequent, well or poorly developed, however they are randomly distributed and their size and frequency change markedly across the corallites. Endotheca characterised by a dense structure, consisting of thin and regularly distributed tabuloid dissepiments and vesicular dissepiments of different sizes.

	Calices			Re				Endoth.
	c–c	d	fd	s	l	tk	dsy	end. dsy
XR111	5.5	~5.6–6	??	?34–37	/	0.1–0.2	14/5mm	?34–37
XR128A	~10	7.5–8.5	1	/	/	0.2	5–6/ 2mm	?

Columella spongy (not papillose) and wide, interconnected to longer septa, or well distinct.

Remarks. The section obtained is not very favourable and this is the reason of the question mark before the genus name. The type species of the genus *Fungiastraea laganum* Alloiteau, 1952 is from the Late Cretaceous, not well preserved and probably synonymous with *Synastrea*. The binoma *F. arachnoides* is widely used in Jurassic but our material is not sufficient to improve the knowledge on taxonomic relationships between both genera. The confluent character of radial elements seems clear enough to discard the genus *Mixastrea* but the quality of the material does not allow neither a firm identification nor new elements in the necessary comparison of similar genera such as *Protoseris*, *Synastrea* and *Kobya*.

Suborder **Fungiina** Duncan, 1884
Family Thamnasteriidae Vaughan and Wells, 1943
Genus *Thamnasteria* Lesauvage, 1823

Type species: *Astrea dendroidea* Lamouroux, 1821

Thamnasteria cf. ***concinna*** (Goldfuss, 1826)

Pl. 26, fig. 4

1826 *Astrea concinna* Goldfuss, p. 64, pl. 22, 1a non 1b.
1888 *Thamnastraea concinna* - Solomko, p. 182, pl. 6, fig. 2.
1962 *Thamnasteria concinna* - Kuzmicheva & Makridin, p. 126, pl. 2, fig. 3.
1973 *Thamnasteria concinna* - Babaev, p. 120, pl. 14, fig. 1.
1976 *Thamnasteria concinna* - Roniewicz, p. 92, pl. 25, fig. 1ad, 2ab.
1982 *Thamnasteria concinna* - Roniewicz, p. 158, fig. 1-5, pl. 52-58, pl. 68, fig. 1.
1984 *Thamnasteria concinna* - Roniewicz, p. 66, pl. 2 ,fig. 1-3, pl. 3, fig. 1-2, pl. 4, fig. 1.
1987 *Thamnasteria concinna* - Khusanov, p. 68, pl. 12, fig. 1.
1993 *Thamnasteria concinna* - Bertling, p. 96, pl. 4, fig. 1-4.
2001 *Thamnasteria concinna* - Reuter et al. p. 37, fig. 7.
2012 *Thamnasteria concinna* (Goldfuss); Morycowa, p. 23, fig. 15 A-D.

Material: 1 sample (XR87), 1 thin section.
Locality: Inner zone of CCU, wp773.

Description. Massive thamnasterioid colony known only from a small section. Biseptal sheets thin, curved to tortuous, frequently joining at the inner edge. Rhopaloid morphology in some septa. Septa poorly differentiated in terms of length and thickness. Synapticulae (or adtrabecular bars?) frequent and large. Spines present. Endotheca not observed. The axial zone seems to be occupied by a columella attached to longer septa.

	Calices			Re				En-doth.
	c–c	d	fd	s	l	tk	dsy	end. dsy*
XR87	2–2.5	/	0.25	>21	1.3–1.5	0.1	6–7/ mm	/

The absence of petaloid septa leads to prefer an identification as *Thamnasteria* rather than *Mesomorpha*.

Remarks. The specimen fits with the dimensions of the classical species *T. concinna* Goldfuss. Nevertheless, are not clearly depicted within this genus: 1) the general colony shape (useful to distinguish from *T. dendroidea*) and 2) the distribution of adtrabecular bars with regards to the synapticulae. For these reasons, “cf.” is preferred.

Family Haplaraeidae Vaughan & Wells, 1943
Genus *Diplaraea* Milaschewitsch, 1876

Type species: *Diplaraea arbuscula* Milaschewitsch, 1876

Diplaraea sp.

Pl. 26, fig. 5a, b

Material: 1 sample (XS5.1), 1 thin section.
Locality: Unit CSU (XS 5).

Description. Thin phaceloid coral. Open bushy structure of colony. Intracalicular increase. Costo-septa abundant, thick, irregularly porous and enlarged at peripheral edge or near peripheral edge. Costae constitute the external surface. More than three size orders of septa, poorly differentiated. Granules on lateral faces. Spongy columella present. Synapticulae abundant, they participate in a perforated wall.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XS 5.1	9.8	6.2	7.9	17	14	15.3
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XS 5.1	~52	3.3	1.1	0.1-0.2	3/mm	

Remarks. Dimensions are close to *Diplaraea northeyi* (Gregory) but this species probably does not

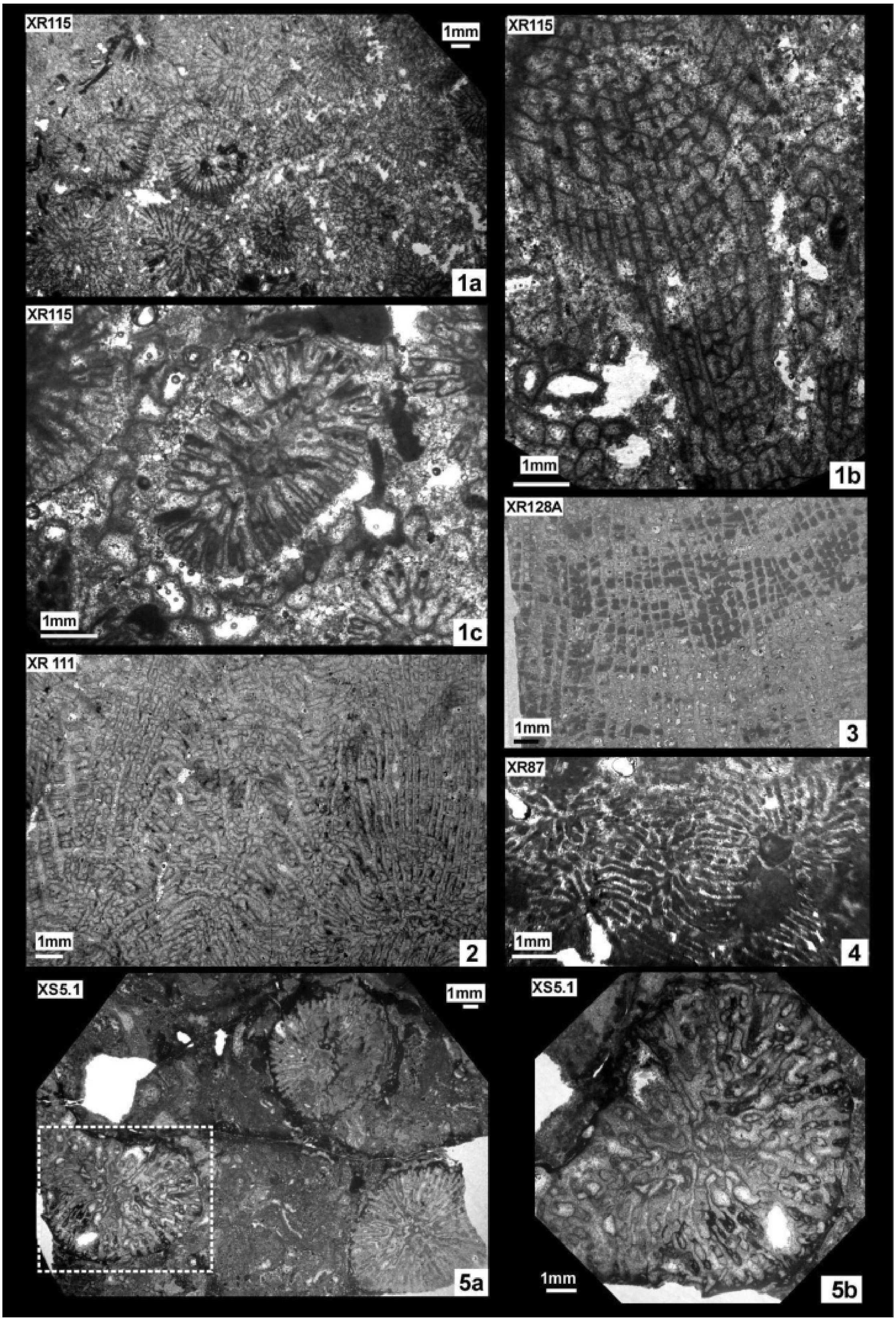


PLATE 26

Fig. 1 - XR115, ?*Ovalastrea* sp. 1a, 1c: transverse sections; 1b: longitudinal section.
Fig. 2 - XR111, ?*Fungiastraea arachnoides* (Parkinson, 1808), oblique section.
Fig. 3 - XR128A, ?*Fungiastraea arachnoides* (Parkinson, 1808), longitudinal section.
Fig. 4 - XR87, *Thamnasteria* cf. *concinna* (Goldfuss, 1826), transverse section.
Fig. 5 - XS 5.1, *Diplaraea* sp. 5a: transverse section; 5b: zoom of 5a on a single corallite.

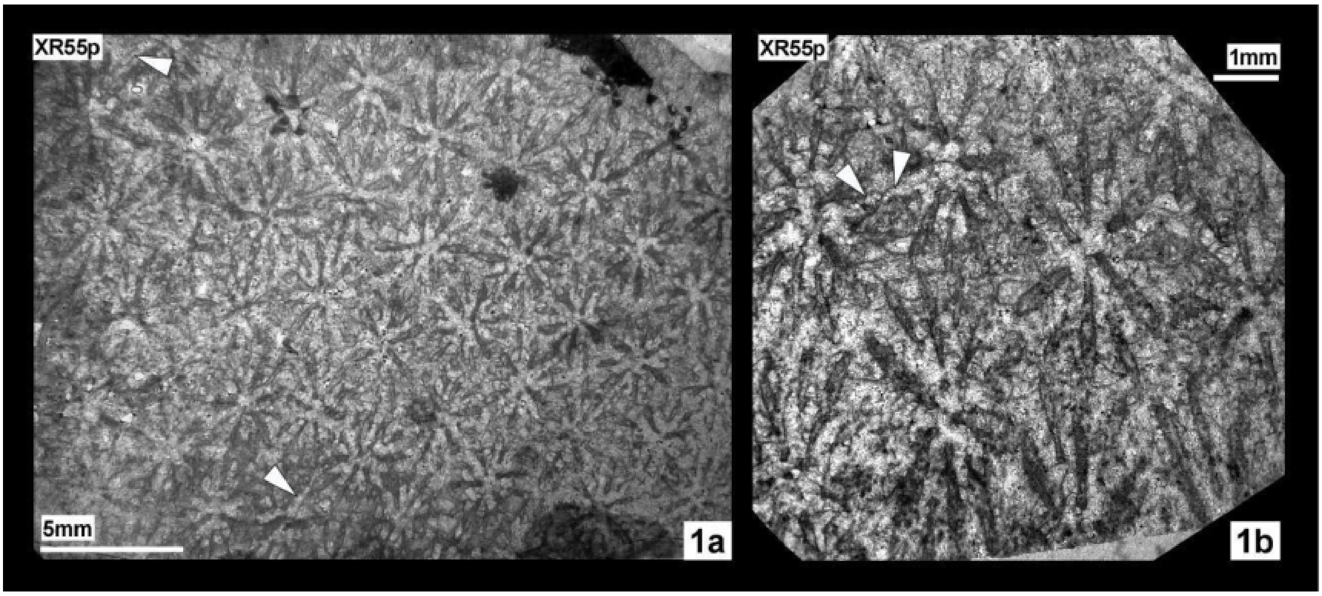


PLATE 27

Fig. 1 - XR55p, *Solenocoenia sexradiata* (Goldfuss, 1826), transverse sections.

belong to *Diplaraea* as already noticed by Thomas (1963). The situation is not so different for *Diplaraea isseli* Prever. In both cases nothing indicates a perforated wall in these taxa. As only one sample and a single thin section are available, the open nomenclature is preferred.

Suborder Uncertain
Family Solenocoeniidae Roniewicz, 2008

Remarks. The family has been erected by Roniewicz (2008) to include the only genus *Solenocoenia* Roniewicz & Gill 1976, initially placed within an uncertain family, characterized by corallites connected by perithecal horizontal channels and a special organisation of the endotheca. Lauxmann (1991, p.116) did not agree with this interpretation considering that canals are not distributed homogeneously. This interesting remark implicitly suggests that these canals could be produced by a non-coral organism that interacted with the living coral. In this case the phyletic independence of the family Solenocoeniidae would become disputable. Anyway, we cannot follow completely Lauxmann in her nomenclatural choice. We cannot use the name *Convexastrea* d'Orbigny, 1849 considered as a *nomen vanum*, based on a type species by monotypy *Astrea regularis* Klipstein from the Triassic never sufficiently diagnosed or illustrated, the type specimen from an unknown locality in the Dolomites being lost.

Genus *Solenocoenia* Roniewicz and Gill, 1976

Type species: *Convexastrea semiradiata* Étallon, 1864

Solenocoenia sexradiata (Goldfuss, 1826)

Pl. 27, fig. 1a, b

1829 *Astrea sexradiata* Goldfuss, p. 71 pl. 24 fig. 5.
1881 *Cryptocoenia thiessingi* Koby, p. 86, p. 29, fig. 2.
1881 *Convexastrea bernensis* - Koby, p. 105, pl. 24, fig. 1-3.
1881 *Convexastrea sexradiata* - Koby, p. 103, pl. 25, fig. 1-3.
1881 *Convexastrea bachmanni* Koby, p. 103, pl. 23, fig. 5.
1881 *Convexastrea meriani* Koby, p. 102, pl. 23, fig. 1-4.
1881 *Convexastrea semiradiata* Koby, p. 106, pl. 24, fig. 4-5.
1904 *Convexastrea sexradiata* - Koby, p. 41, pl. 8, fig. 8.
1976 *Solenocoenia sexradiata* - Roniewicz, p. 113, pl. 14, fig. 5, pl.15, fig. 3a,b.
1979 *Solenocoenia sexradiata* - Sikharulidze, p. 40, pl. 26, fig. 1.
1991 *Convexastrea sexradiata* - Lauxmann, p. 116, pl. 1, fig. 7.
1991 *Solenocoenia sexradiata* - El-Asaad, p. 285, pl. 6, fig. 1a-d.
1993 *Convexastrea sexradiata* - Bertling, p. 84 pl. 1 fig. 4.
2008 *Solenocoenia sexradiata* - Roniewicz, p. 131, fig. 16J-M.

Material: 1 sample (XR55p), 2 thin sections.
Locality: Internal zone of CCU (wp 748).

Description. Massive sub-spherical colony, about 10 cm in size with plocoid arrangement of corallites and extracalicular budding. Calices circular to sub-circular, calicular diameter quite constant and calices densely packed. Calices occasionally connected through a narrow canal that cross right the peritheca and connects neighbouring fossae.

Calices	d Max	d Min	d Mean	c-c Max	c-c Min	c-c Mean
XR55p	2.3	1.7	2	4.6	2.6	3.5
Re	**s**	**Ml**	**ml**	**tk**	**dsy**	
XR55p	tot:12 6(S1)+ 6(S2)	1.9 (S1)	~1 (S2)	0.2 (S1)	3-4/ mm	

Peritheca vesicular, their chambers are about 0.6-08 mm in size. Radial elements are costo-septa. The total number of the costo-septa is 12, arranged in radial symmetry, expressed by two size orders (S1, S2), which contain 6 elements respectively. S1 and S2 differ each other in length and thickness. Radial elements loosely packed, straight, non-confluent, and bicuneiform. Rarely longer costo-septa present claviform morphology also. Irregularly distributed granules occur on lateral faces of the septa. Trabeculae remains appear on some radial elements of the S1 cycle. Columella absent. Endotheca composed of thick dissepiments.

Results

Distribution of coral communities and zonation

With the aim of highlighting the major ecological characteristics of the corals, their distribution is shown considering: 1) framebuilding density; 2) colony-size; 3) external morphology and corallites arrangement; 4) calice-size and 5) systematic classification, i.e. based on significant skeletal features used in modern taxonomy. Figures 4 and 5 show the distribution pattern of coral characters (Fig. 4) and taxa (Fig. 5).

Frame building density, coral assemblages and isolated coral colonies. Corals are observed either part of assemblages or as isolated specimens. Coral assemblages are characterised by the presence of mainly *in situ*, whole, or with a low degree of reworking, coral colonies forming metric scale bioconstructed structures, showing different packing. Two main types of coral assemblages are recognized, because of the packing density, the continuity (*sensu* Insalaco 1998) and the coral colony size: 1) dense coral assemblages and 2) sparse coral assemblages. Dense coral assemblages (1) are represented by structures a couple of metres high and a few metres wide, constituted by closely packed, *in situ*, whole coral colonies that form a true rigid framework. Sparse coral assemblages (2) are represented by sparsely packed, *in situ* or toppled, whole corals or large fragments. They form open structures that extend over areas from few up to several tens of square metres, generally a few tens of centimetres high. Adjacent corals are not bound to each other by secondary frame-builders. Isolated coral colonies are found in life position, toppled or as large coral fragments, dispersed within sediment. They usually show little evidence of abrasion, suggesting a deposition not so far from the growing area.

Dense coral assemblages are located in the more internal sector of the reef flat, adjacent to the back-reef. In this sector a series of adjacent dense coral assemblages form a discontinuous framework, distributed along a belt some metres wide, parallel to the platform margin (Fig. 4). Here, coral colonies are enclosed by well-washed, fairly well-sorted and reworked sediments, mainly constituted by coral and stromatoporoid rubble, other bioclasts and peloids. Out of this narrow belt, dense coral assemblages are not observed, except for an isolated assemblage constituted by large phaceloid corals present within the central zone of the reef flat. Sparse coral assemblages are mainly located in the inner zone of the reef complex, corresponding to the back-reef, the most protected and deeper area, characterised by a rather irregular topography. Here, corals are spaced apart or form relatively spaced clusters, poorly developed in height, scattered in poorly-sorted bio-lithoclastic grains. Out of the back-reef, some sparse coral assemblages occur, associated with dense coral assemblages, within the narrow belt of the inner sector of the reef flat. Isolated coral colonies are mainly located in the inner zone of the reef complex, however their distribution persists in reef flat and in the reef crest, where they are found as toppled or reworked large fragments. Their abundance progressively decreases towards the most external sector of the reef complex, where corals are replaced by stromatoporoids (mainly type 2) and stromatoporoid-mounds (Rusciadelli et al. 2011).

Coral colony-size. Nevertheless, three main coral colony-size classes can be identified: 1) large-size corals, (30 cm up to 3 m in size); 2) medium- to small-size corals (from 5 cm up to 30 cm in size); 3) very small-size corals (cm- to subcm-size corals).

Large-size corals dominate the most inner reef flat, representing the main components of dense coral assemblages developed within the narrow belt, adjacent to the back-reef. Medium- to small-size corals dominate in the back-reef and correspond to coral colonies forming sparse coral assemblages, and isolated corals. From here, their abundance progressively decreases toward the reef crests. Very small-size corals are represented by solitary corals and the cateniform colony (*?Heterocoenia cf. minutisima*). They are mainly present on the reef flat and reef crest, although their abundance is an order of magnitude lower than medium- to small-size corals.

External morphology of skeletons and arrangement of corallites. Massive morphologies are subdivided into hemispherical (dome-shaped), columnar and massive-encrusting forms. A further informal massive-undefined morphology type is here introduced grouping colonies for which the external outline is not completely preserved, being compatible both with massive dome-shaped, globose, massive-encrusting and massive/columnar. Massive colonies show plocoid, cerioid, astreoid, thamnasterioid and meandroid corallite arrangements. Branching corals show ramose and phaceloid organisations. Ramose corals usually show a large-size and are characterised by a plocoid arrangement of corallites. Phaceloid forms are informally subdivided based on their branch thickness and size (i.e. robustness) into robust and thin phaceloid colonies. Robust phaceloid colonies are characterised by medium to large size (3-10 mm) of corallite diameters, densely packed branches and a large external size (up to 2 metres high). Thin phaceloid colonies are characterised by smaller branches forming a more open bush, with a small size (up to few decimetres). Solitary corals are usually discoid or flabellate, although most of them are found in transverse section and their three-dimensional form (e.g. discoid, cylindrical, cupolate) remains unknown. A few isolated, solitary corallites are found dispersed within skeletal debris. However, the shape of their section and their skeleton structures are compatible both with solitary form and fragments of broken branches of phaceloid colonies.

Massive-undefined morphologies are observed along the whole portion of observed depositional profile, although their frequency is irregular, and are the most common skeletons both in the back-reef and in the inner sector of the reef flat. They are part of dense and sparse coral assemblages as well as isolated corals. Conversely, they are sporadically observed as isolated colonies in the central sector of the reef flat and on the reef crest. Massive dome-shaped colonies (e.g. *Amphiastrea*, *Amphiaulastrea*, *Thecidiosmilia*, *Microsolena*, *Comoseris*, *Fungiastraea*) dominate in the back reef, and some of them are part of dense coral assemblages located in the narrow belt of the inner reef flat. Massive to columnar and massive-encrusting colonies (*Microsolena*) are reduced to few individuals, observed in the back-reef. Branching ramose coral colonies occur rather exclusively in the inner reef flat. Thin phaceloid colonies are common, reaching their maximum abundance in the centre of the back-reef (e.g. *Stylosmilia, Intersmilia*), within a belt a few meters-width . The abundance of thin phaceloid colonies drastically decreases towards both the reef crest and the reef flat. Robust phaceloid forms (e.g. *Calamophylliopsis*) dominate in the inner sector of the reef flat, where they constitute a common component of dense coral assemblages and they appear two times as large isolated colonies. Solitary, flabelloid corals and presumed branches of phaceloid corals span from the inner sector part of the reef flat to the reef crest, while they are rare in the back reef.

The plocoid colonial forms (e.g. *Bracthelia, Heliocoenia, "Pseudocoenia"* and *Ogilvinella*) are the most recurrent, observed both in the back reef and the reef flat, though absent in the reef crest. In terms of abundance, plocoid corals are followed by thamnasterioid, meandroid, cerioid, astreoid and cateniform colonies. Thamnasterioid corals (e.g. *Microsolena*, *Fungiastraea, Thamnasteria*) occur in the centre and in the most inner sector of the back-reef, being part of sparse coral assemblages or as isolated individuals. Meandroid colonies (*Psammogyra, Pruvostastraea, Eugyriopsis*) dominate in the inner sector of the reef flat and count for many of the large colonies in the dense coral assemblages.

Calice-size (and valley width in meandroid corals). About 90% of collected corals show corallite diameter ranging between 2 and 7 mm (considering the mean values). According to corallite-size classification proposed by Sanders and Baron-Szabo (2005), such diameter corresponds to small (up to 3 mm) and medium (3-8 mm) classes. The rest of collected corals (less than 10%) show larger calices, such as flabelloid corals (e.g. *Fromentelligyra*), some Faviina colonies (e.g. *Clausastrea* and *Dermosmilia*) with diameter up to 11 mm and large meandroid colonies (e.g. *Psammogyra* and *Pruvostastraea*), with valleys up to 17 mm wide.

Corals with small and medium calices are spread along the entire reef complex, although their greatest abundance is in back reef. Conversely, corals with large calices and valleys range from the most inner reef flat to the reef crest. The only coral with large calices (*Dermosmilia*) is observed in the back reef.

Coral distribution according to suborders, families, genera and species. The suborder Amphiastreina is represented by *Amphiastrea basaltiformis*, *Amphiaulastrea* sp., *Thecidiosmilia morycowae* (massive cerioid), *Pleurophyllia cara*, *Intersmilia* aff. *diaboli* (thin phaceloids forms) and *Heterocoenia* cf. *minutisima* (cateniform-encrusting) (Tab. 1). Although not very abundant, their distribution appears concentrated in back-reef.

The suborder Stylinina and Stylophyllina are represented by 7 genera and 15 species (Tab. 1). They are present both in back-reef and in the inner reef flat. It is noteworthy that *Cyathophora*, "*Pseudocoenia*" and *Heliocoenia* show morphological changes and a subsequent differentiation of species from the back-reef to the reef flat. *Cyathophora* aff. *parva*, "*Pseudocoenia*" *decipiens*, "*Pseudocoenia*" sp., and *Heliocoenia* sp. XR68 occur in the back reef, while large-size *Cyathophora bourgueti,* ?*Heliocoenia* sp. XR1 and "*Pseudocoenia*" *limbata* are present in the inner reef flat. *Stylosmilia* (3 species) are exclusive of the back reef, usually forming small sparse coral aggregates, or as isolated colonies.

The suborder Faviina (13 coralla) is represented by 2 families, 5 genera and 7 species (Tab. 1). The coral distribution pattern does not show an evident zonation, occurring from the back reef to the reef flat. However, the family Montlivaltiidae is exclusive of outermost reef flat. *Calamophylliopsis flabellum* (n 5 specimens) occurs in the back reef as thin phaceloid and in the inner reef flat as robust phaceloid colonies.

The suborder Microsolenina is represented by several corals (Tab. 1) with a high concentration in the back reef (Tab. 1). They form very small assemblages constituted by few colonies or are found as isolated colonies. Microsolenina corals are absent in the reef flat and on the reef crest.

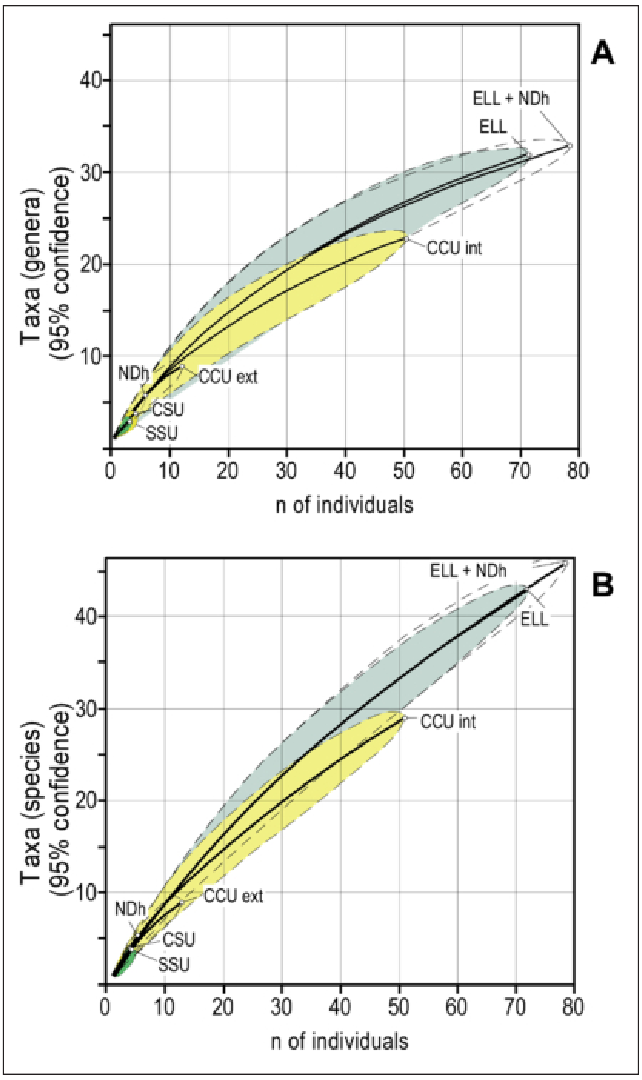


Fig. 3 - Rarefaction curve for genera (A) and species (B) in: Corals and Chaetetids Unit (internal (CCU int) and external (CCU ext) sector); Corals and Stromatoporoids Unit (CSU); Stromatoporoids Unit (SSU); Nerineids and Diceratids horizon (NDh); Ellipsactinia Limestones (ELL) and for the whole coral collection (ELL + NDh).

Discussion

The following discussion emphasizes the paleoecological significance of coral assemblages. The focus is to show and explain how the coral assemblages have been affected by environmental changes recorded along the depositional profile. The uncommon opportunity to observe a well constrained ancient depositional profile offers several paleoecological insights relevant for other Late Jurassic coral communities, despite the relative low sample-size of the collection.

Coral diversity

The individual rarefaction curve (Fig. 3) related to genera of the whole collection (ELL and NDh) and the whole Ellipsactinia Limestones (ELL) outline a trend approaching the flat portion of the rarefaction curve. Otherwise, curves related to genera and species parcelled out into single units describe a steep trend. It means that at the scale of the whole reef the number of samples can be considered statistically significant to assess the coral genus diversity, while at the scale of reef units, a part of the diversity remains to be theoretically discovered. The steeper trends are related to species and genera of external units, in which diversity appears far from fixed. Nevertheless, the complementary facies and sedimentary analyses have indicated that the external units (CSU and SSU) of the studied reef portion do not represent suitable areas for the development and fossil preservation of mature corals communities. Consequently, a pronounced increase in the number of coral genera, dependent on sample-size is not really expected there. Therefore, the few corals found and collected in CSU and SSU are here considered not casual, rather being virtually representative of a poor coral community.

With respect to the work of Prever (1909), which contains the only known coral collection related to the Upper Jurassic reef unit in the central Apennines, the number of identified corals at genus- and species-level is nearly doubled. Moreover, 43 species and 32 genera grouped in 16 families and 9 suborders identified within a stratigraphic unit outcropping in an area of 6 km^2 and some tens of meters exposed thickness, appears to be still significant also with respect to the other similar Upper Jurassic larger reef complex units of the Intra Tethys domain. Examples of the richest coral units are the Štramberk Limestones in Outer Western Carpathians (120 species, Eliášová 2008), the Upper Kimmeridgian-Valanginian unit of Bulgaria (72 species, Roniewicz 2008), Štramberk-type limestones from the Polish Outer Carpathians (80 species from exotic pebbles in the flysch, Kołodziej 2015 and literature therein), Upper Jurassic barrier reef complex of Slovenia (77 species, Turnšek 1997) and the upper Berriasian part of the Oehrli Formation from western Austria and Switzerland (61 species, Baron-Szabo 2018). Although the number of coral taxa observed in central Apennines is much lower, the gap is considered to be result of differences in the sizes of the geographic areas sampled. Coral diversity indices (Tab. 2) point to high coral diversity and evenness (Equitability very close to one), in addition to a very low dominance (Dominance and Berger Parker indices low than 0.2) and Hill index close to zero, indicating a high diversity. The values even more relevant considering that the reef front and outer slope of the reef could not be sampled. In comparison with recent diversities of coral genera, for similar latitudes (estimation around 20°N latitude for Central Italy in Late Jurassic; Fig. 1), despite the enormous difference in the sampling area, the diversity calculated for Ellipsactinia Limestones in Apennines is higher than the recent Carribean province (20 genera according to Veron 1995) but, lower than the Indonesian) coral triangle (70 genera according to Veron 1995). With respect to other Jurassic reefs, the observed diversity is higher than the high latitude reefs of the northern margin of Tethys but also higher than low latitude reefs, in the climax phase during Oxfordian (Martin-Garin et al. 2012).

These results and comparisons point to paleoecological conditions close to the optimum for coral growth and diversification. Thus, it is likely that during the Late Jurassic in central Italy a mix of favourable conditions for coral development existed. In addition to paleolatitudinal position, climate and water temperature, it is argued that the depositional setting played a key role for coral spreading, offering a wide and diversified area for colonization.

Coral vs stromatoporoid cover

Late Jurassic coral and stromatoporoid co-occurrence within the same reef seems to be related to the paleolatitude and biogeographic position (e.g. Leinfelder et al. 2005). However, their countertrend density pattern along the depositional profile reflects their different ecological requirements within the reef complex (Rusciadelli et al. 2011). The distribution pattern of corals and stromatoporoids suggest that very shallow water condition, high water energy and elevated abrasive conditions in the reef crest promoted the stromatoporoids and discouraged the development of dense coral bioconstructions (Rusciadelli et al. 2011).

Further information can be inferred observing the distribution pattern of the coral cover. The highest percentage of coral cover is confined to a

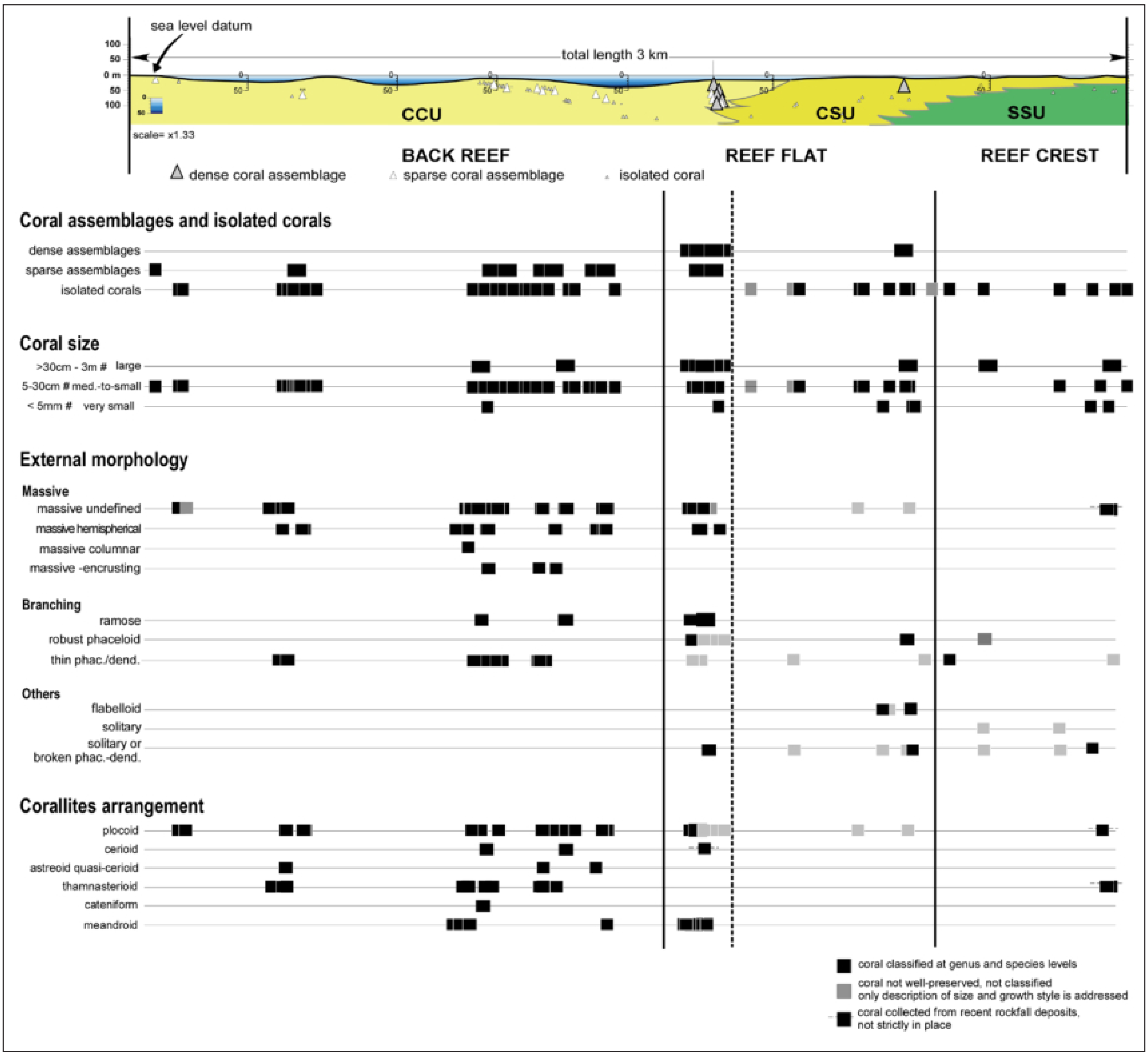


Fig. 4 - Distribution pattern of corals, on the basis of different types of assemblages, and main skeletal features. The vertical exaggeration used here is 1.33.

narrow belt, corresponding to the inner reef flat, where dense coral assemblages developed. From this belt, the coral cover decreases both towards the back reef and towards the central reef flat and reef crest, where corals are found as scattered colonies (sparse coral assemblages) or as individuals (Figs 4 and 5). This type of coral cover, known in many other fossil and modern reefs (e.g. Chappell 1980; Faure & Laboute 1984; Hubbard et al. 1990; Perrin et al. 1995) is explained considering the positive interaction between bathymetry and geomorphology of the depositional profile that determine various other abiotic and biotic local factors (such as hydrodynamism, sedimentation, oxygenation, substrate, colonization, etc.). It is likely that the more regular profile, slightly inclined and an intermediate bathymetry between crest and back reef, promotes the coral proliferation and recruitment, much more than in rugged back reef and shallower reef crest zones (Figs 4, 5 and 6).

Coral size as expression of coral health, strength and longevity

Coral-size changes in modern as well as in fossil coral reefs are common and frequently observed. However, the interpretation of causes ruling these changes is not straightforward. In general, the tropical latitude (Moyer et al. 2003; Foster &

Foster 2013) and light saturation, depending on the photosynthetic activity of zooxanthellae (e.g. Chappell 1980; Loya 1972), promote larger coral average-colony size.

Nevertheless, in shallow water areas with a saturating light intensity, unstable, severe and unpredictable conditions strongly interfere with the general laws (e.g. Loya 1972: 114-115). Thus, coral-size variations appear to be related to other factors, such as resilience after disturbances, mortality and coral reproductive activity (Connell 1983; Babcock 1984; Hughes 1984; Jackson 1979; Hughes & Jackson 1980, 1985; Soong 1993). In fossil reefs, in addition to the paleolatitudinal gradient, the presence of large colonies is likewise related to the mortality, the facility to survive after disturbance (e.g. Leinfelder 2001; Riegl 1995, 2001), or their ability to cope with high sedimentation rate (Bertling & Insalaco 1998: p. 153). Accordingly, a coral ability to achieve large size, especially in high energy and debris-rich reefs, is quite infrequent, as corals are exposed to destructive disturbance before they could grow to a large size (Bertling & Insalaco 1998). Thus, the presence of large size coral assemblages within a fossil reef, could suggest that external ecological gradients (e.g. paleolatitude, light, water motion, sediment accumulation rate) and coral abilities (e.g. rapid growth, resilience, sediment tolerance) were positively combined.

In the studied case, large coral-size assemblages are concentrated within a narrow belt in the inner reef flat, where the highest coral cover is also recorded (Figs 4, 5 and 6). A coherent inference is that, within this narrow reef belt, many of local factors combined. A proof of this is given by sedimentological analyses of facies associated to large coral assemblages (Rusciadelli et al. 2011) that reveal a hydraulic competence able to rework and export grain sizes up to medium-sand, leaving corals free from fine-grained sediments and mud accumulation. Thus, it is likely that the combination of a bathymetry of a few meters, a regular profile, a quite steady stand of moderate to high hydraulic energy and a moderate abrasion, encouraged settlement, growth, health and longevity of coral specimens well-adapted to these conditions, generating colonies up to 2m and more in diameter.

Shape of coral skeletons as multifunctional adaptive responses to external factors

Changes in coral skeleton shapes along the reef profile are one of the most discussed aspects of reef zonation (e.g. James 1983, 1984). This is because coral shape changes are considered as adaptive responses of growing corals to light, hydrodynamic stress, sediment flux and subaerial exposure (e.g. Loya 1972; Chappell 1980). For modern reefs, there are several general schemes addressing the distribution of coral shapes across the reef profile (James 1983, 1984; James & Ginsburg 1979; Chappell 1980; Perrin et al. 1995; Done 1982, 1992; James & Bourque 1992; Wells 1954; Geister 1977). These schemes, not strictly dependent from taxonomic distribution, are one of several crucial aspects of the morphological uniformitarian criteria applied to fossil coral reefs (Bosence & Allison 1995; Lathuilière 2000; Leinfelder 2001). However, many limitations related to the use of uniformitarian approach arise when the abilities of ancient corals are considered (Lathuilière 2000).

The different coral shapes of the Central Apennine reef complex show an evident zonation, expressed more clearly by some morphologies than others (Fig. 4). Despite the lack of the reef front in our setting, which makes the comparison incomplete, the coral distribution pattern along the reef complex indicates low similarities with the coral growth types distribution reported from Holocene reef flat and back reef.

The abundance of massive undefined and dome-shaped forms, opposed to the total lack of platy corals as expression of light deficiency, is consistent with the bathymetric reconstruction of the profile that never reached zones deep enough to trigger a photic limitation.

Large and robust branching corals are usually considered to possess a high mechanical strength, able to resist to wave action and storms. This facility is clearly inspired from the role of branching ramose *Acropora,* acting as frame-builder and baffler in modern coral reef front (e.g. Barnes 1973; Chappell 1980). However, the role in reef building and the distribution of *Acropora* cannot be directly extended to all branching corals (both ramose and phaceloid) in Jurassic reefs. Many recent branching (ramose) forms, as *Acropora*, are very fast growing colonies (up to 23 cm/yr) capable of ensuring a keep-up strategy of the reef growth, show high regeneration potential (e.g. Wood 1999), oriented growth-style (as *Acropora palmata*, Grauss et al. 1977) and prefer well-

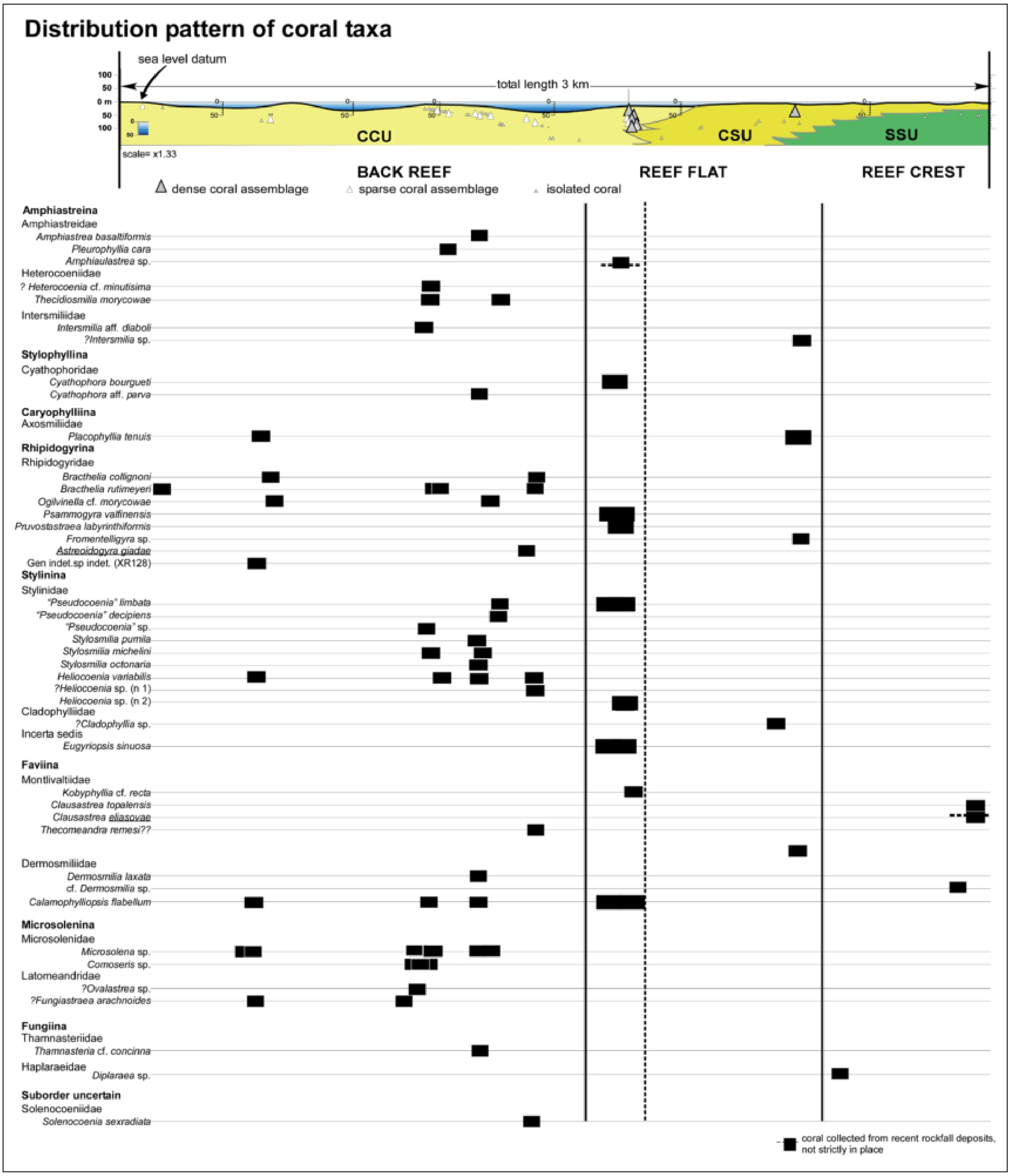


Fig. 5 - Distribution pattern of coral taxa. The vertical exaggeration used here is 1.33.

lit, oligotrophic environments (Morgan et al. 2016). Conversely, Jurassic phaceloid corals grew only with an annual growth rate around 1 cm (Lathuilière, 2000; Lathuilière et al. 2005; Geister, 1995) and they seem to get advantage not only in the reef front, but also in inner and proximal slope settings due to 1) their tolerance to sediment by-passing that can affects the other forms and 2) their probably ability to feed dominantly heterotrophically (Sanders & Baron-Szabo 2005; Kołodziej et al. 2012).

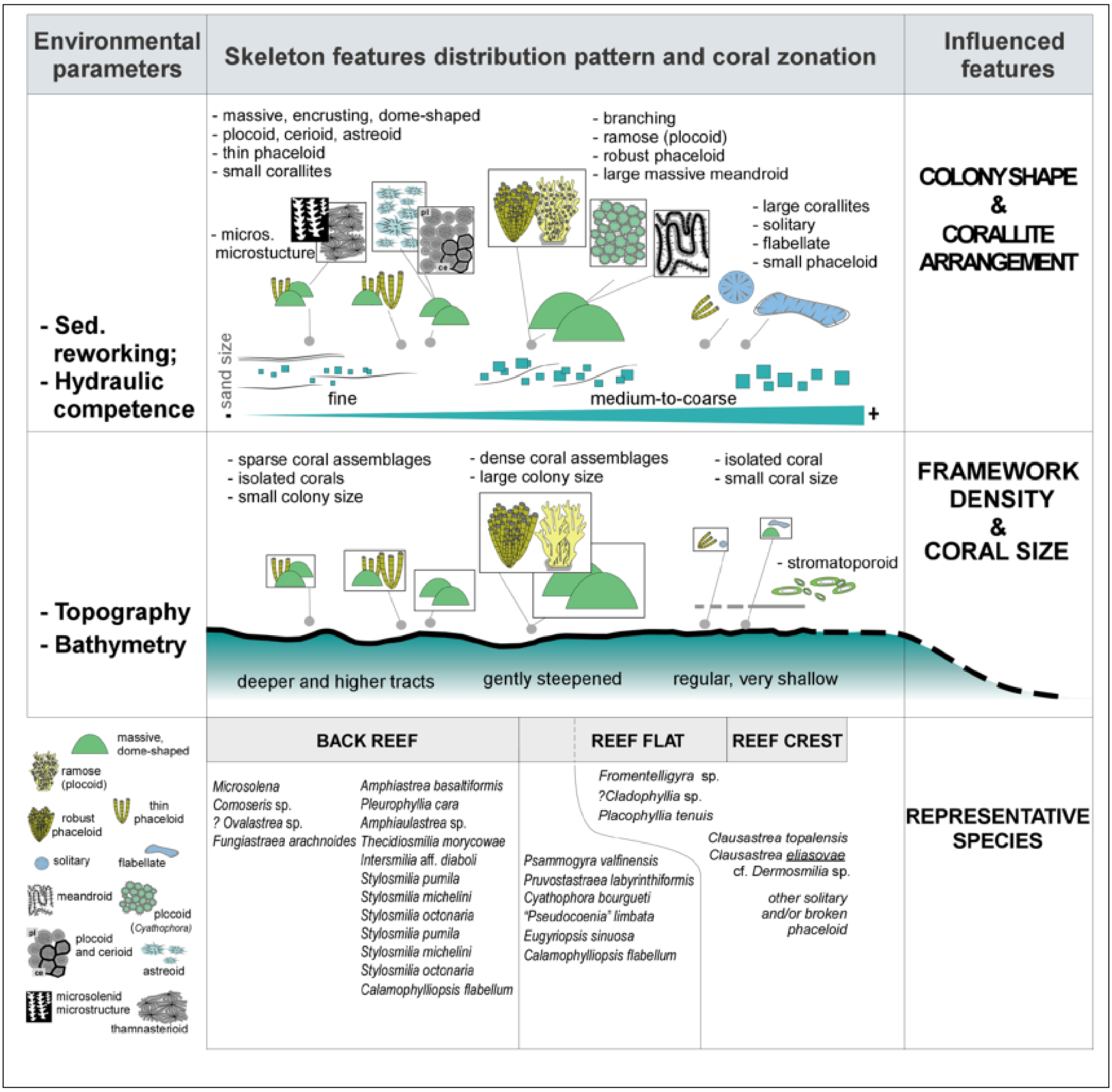


Fig. 6 - Distribution of framework density, coral size, colony shapes, corallite arrangement and main representative species along the depositional profile as function of the main controlling factors. The vertical exaggeration used here is 1.33.

The reconstructed environmental conditions of the inner reef flat of the studied reef complex are certainly different from those characterising the modern narrower reef front developed on the top of steep slopes. However, it is likely that the branching (ramose) corals developed in the narrow belt of the inner reef flat (Fig. 4), took advantage of their ability to resist to moderate-to-high hydraulic regime and to cope with moderate sedimentation rate (Rusciadelli et al. 2011). Accordingly, it is likely that large and robust phaceloid species (*Calamophylliopsis flabellum*) acted similarly to branching ramose ones. Their increased corallite size and the packing of their branches that form compact bushes, designed their shape to achieve skeleton strength and resistance, where it was required.

Thin phaceloid coral distribution suggests different ecological requirements with respect to their thicker and larger counterparts. Although widespread, they dominate in the centre of the back reef, where they are found as decimetre-size colonies in growth position and as a part of sparse coral assemblages. Their thin and brittle branches and their open structure are congruent with a very low energy environment. Furthermore, the high abundance of phaceloid corals in the inner zones is consistent with the recent restored model proposed by Hoffmann et al. (2018) for Štramberk reef complex.

Corallite structure, arrangements and sediment clearance and rejection efficiency

The modern corallite arrangement is related to the ability of the colony for sediment clearance, i.e. to all mechanisms or features both active and passive that favour removing sediment from coral (Hubbard & Pocock 1972; Stafford-Smith 1993; Sanders & Baron-Szabo 2005). Hubbard (1973) reported an increased rejection efficiency passing from cerioid to plocoid and meandroid. Similarly, Hubbard & Pocock (1972) conclude that corallite shapes characterised by large calices, high number of septa, high relief, heavy ornamentation and fenestrate structure are provided with active polyps, resulting in efficiency for sediment rejection. These characteristics, hypothetically, could have major impacts on fossil corals paleoecological reconstructions. However, the uniformitarian approach to morphologic function analysis of coral skeletons requires a more nuanced application. Ancient well-constrained paleoenvironments and depositional profiles, along which the coral distribution pattern can be observed, represent rare places where models could be indirectly tested (e.g. Perrin et al. 1995). Thus, the present case study, despite the difficulty to reach high sample-sizes, represents an opportunity to assess the disputable relationship between skeleton structure and sediment clearance efficiency.

The most consistent facts to document this relationship are: 1) the dominance of the plocoid arrangement, within the whole reef complex portion; 2) the presence of meandroid colonies in debris rich zones; 3) the change in the corallite diameter from inner to outer reef. The dominance of plocoid corals (case 1) represents, in fact, a quite expected outcome within a moderate to high debris-rich paleoenvironment. This is because plocoid forms, especially if they have a high relief, can circulate the sediment between polyps above the perithecal zone whereas cerioid corals cannot do other than rejecting the sediment on neighbouring polyps. It is inferred that the mechanical ability to circulate sediments among polyps constituted a successful strategy to cope with changeable sedimentation rates within the reef complex, low to moderate and discontinuous in the back reef, moderate to high and steadier in the inner reef flat (Fig. 6). Likewise, the occurrence of large meandroid colonies (2) in the inner reef flat is consistent with the presumed efficiency in mechanisms producing effective sediment rejection (e.g. Hubmann et al. 2002; Sanders and Baron-Szabo 2005; Leinfelder 1993, 2001). It is likely that the colony shape and the configuration of series (valleys) indicated a critical morphological character, favouring internal flows and vortices, leading to a passive shedding of sediment (Hubmann et al. 2002) even before offering a structural help to soft tissues mobility. Regarding the corallite diameter (3), data suggests a positive correlation between corallite-size and sediment grain-size. In fact, colonies and solitary specimens showing large corallites occur almost exclusively in the reef flat and reef crest, where medium- to coarse sand-sized sediments are present. Conversely, corals showing small and medium sized corallites abound in the back reef, where fine sand-size sediment dominate (Rusciadelli et al. 2011). Accordingly, it is argued that, in addition to the harmful effect of mud, the corals were affected by the destructive mechanical action of coarse sediment, and this effect is proportional with sediment size as is observed for modern corals (Hubbard 1973; Hubbard & Pocock 1972; Bak & Elgershuizen 1976) (Fig. 6).

The lower sample-size of the other coral forms does not allow any generalized conclusions with any confidence. However, it does not seem random that all cerioid and quasi-cerioid are confined within the middle of the back reef, while the few flabellate and indeterminate solitary corals are observed in outer reef flat and reef crest.

The thamnasterioid arrangement type shows a significant distribution pattern, being observed exclusively in the most inner sector of reef complex and absent in central and external sectors (Fig. 4). This occurrence is in contradiction with their presumed mobility of polyps and sediment tolerance and high diffusion in sediment rich environment (Leinfelder 1993, 2001; Sanders & Baron-Szabo 2005). However, it cannot be ignored that most of thamnasterioid genera found in the back reef have been assigned to Microsolenina, i.e. all of them show a characteristic septal microarchitecture of radial elements, equipped with pennulae (Figs 5 and 6). Because pennulae are considered as apparatus of strategic importance for coral trophism and ecology (e.g. Insalaco 1999; Gill et al. 2004), it is expected that their presence has regulated the distribution of colonies more than the ability of the corallite arrangement did. This is especially true if one considers that the best functional morphologic equivalent of Jurassic *Microsolena* is the agariciid *Leptoseris*, a coral devoid of tentacles.

Suborders, families, coral internal structures and paleocecology

The distribution pattern along the depositional profile of coral taxa, integrated with the analyses of eventual functionality of microstructural/ microarchitectural features permits to document a direct (or indirect) relationship between skeletal heritable structures and depositional environments. The coral collection does not allow a test for all recognised taxa, however for well attended suborders and families paleoecological considerations are approached.

The systematic classification of Amphiastreina (Pachythecaliina) corals drew attention of many authors (e.g. Eliášová 1975; Kołodziej 1995, 2003; Stolarski & Roniewicz 2001; Stolarski & Russo 2001; Roniewicz & Stolarski 2001; Kołodziej et al. 2012). However, studies related to their ecological behaviour have not received a comparable attention, also because it is a dead branch in the phyletic tree of corals. For paleoecological interpretation, the particular features of Amphiastreina are: 1) a well developed, usually thick and structured wall; 2) few, deep and compact septa; 3) the presence in families Amphiastreidae and Donacosmiliidae of the marginarium (see Stolarski & Russo 2001). However, the specific abilities of their soft body and how tentacles - if applicable - were placed with regards to the marginarium and its probable impact on their sediment clearance capability are speculative. In the Central Apennines reef complex, Amphiastreina occur in the back reef, exhibit a moderate variety of skeleton characters (Fig. 5). This distribution seems to be in general agreement with the weak ability to cope with high sedimentation rate for zooids characterised by deep calices, strong walls, compact and non-ornamented septa (Fig. 5), although further investigations are needed.

Stylinidae and Rhipidogyridae are among the most abundant corals in many shallow reefs of central and western Tethys (e.g. Roniewicz 1976, 2008; Turnšek 1997; Morycowa 2012). These two taxa show common skeletal internal structures and microstructures such as auriculae. It has been suggested that these auriculae could provide a support bracket for mesenterial filaments (Zaman & Lathuilière 2011). Hypothetically, this would suggests a common ability in their nutrition and possibly also a favorable place in the aggression hierarchy. In contrast, Stylinidae specimens have few compact septa and are poorly ornamented, while Rhipidogyridae specimens are distinguished by the characteristic neorhipidacanth microstructure of their radial elements, a high number of septa and usually a stout ornamentation. In the case studied, they are well represented and show a similar distribution pattern, ranging from the back reef to the reef flat (Figs 4, 5 and 6). However, examining all the skeleton characters, it is speculated that their distribution pattern was mainly governed by their colonial shape and structure, rather than by their internal structure. Stylinidae specimens occur in the inner zones as small plocoid and phaceloid colonies, while they occur in the reef flat as large-sized colonies, branching ramose or massive and robust dome-shaped coralla (Figs 4 and 5). Similarly, Rhipidogyridae specimens occur in the back reef as small plocoid or quasi-cerioid colonies, while they are widespread in the reef flat as large-sized meandroid colonies (in the inner reef flat) or flabelloid coralla (*Fromentelligyra* in the reef flat) (Figs 4 and 5). Therefore it suggests that apomorphic microarchitectures of these two taxa are independent from external factors affecting the different zones of the reef complex. The occurrence and diversity of Stylinidae and Rhipidogyridae corals in the whole reef complex indicate that the general ecological conditions were suitable for their recruitment, while changes in colonial shapes and corallite arrangements fit for different conditions at the scale of reef zones (Fig. 6).

Among microskeletal features, the characters of the suborder Microsolenina (Morycowa & Roniewicz 1995) are probably the most used to constrain paleoecological reconstruction. This suborder was created to group pennular corals that have “a uniform trabecular pattern” (Morycowa & Roniewicz 1995). Pennulae are balconies that project from the lateral faces of the septa at more or less regular intervals (see illustration in Gill et al. 2004). Initially, Gill (1967) considered pennulae as a synapomorphic character of the Pennulaceae within the suborder of Fungiida. Later and informally Gill (1977; reproduced in Gill & Russo 1980) recognised pennulae not only in Scleractinia but also in rugose corals such as *Metriophyllum*. In 1975, Cuif devoted a study to the Triassic pennular corals and stated that pennular microarchitectures have very different microstructures and are consequently convergent. Their relations to trabecular axes are various among groups (e.g. Cuif 1975; Roniewicz 1989; Pandey & Lathuilière 1997). Pennular structures were found in the Fungiidae *Cycloseris chinensis* whereas other species of the genus lack pennulae and the genus reveals to be well defined by means of molecular phylogeny (Gitterberger et al. 2011). Pennulae are also known in a species of Caryophyllidae, a quite distinct and well-defined group (Zibrowius, written communication). All these facts demonstrate that pennulae constitute a homoplasic character and their use for taxonomy requires consequently a more precise description than previously thought. Since the work done by German physiologists (Schlichter & Fricke 1990, 1991; Schlichter 1991, 1992; Schlichter et al. 1994) that reveal the ability of *Leptoseris fragilis* for filter feeding and light enhancement, an analogy, rather than a homology, was done with Jurassic pennular corals (Lathuilière & Gill 1995; Morycowa & Roniewicz 1995) based on the earlier description and definition of the pennulae in the paleontological literature by Gill (1967). Subsequently, numerous studies have used this microarchitectural character for paleoecological interpretations (e.g. Insalaco 1996; Dupraz & Strasser 1999; Gill et al. 2004). The function of pennulae is imputed to hold very peculiar gastrovascular tubes, which confer to the zooxanthellate coral a status of suspension-feeder. However, the most interesting argument for paleoecological interpretation using the comparison of Mesozoic pennular corals with *Leptoseris* is the ecological niche covered by living pennular corals. In fact, the bathymetric occurrences of *Leptoseris* often correspond to poorly illuminated environments, even going across the lower boundary of euphotic zone (-95 and -145 m in Red Sea, see Gill et al. 2004 and references therein). Particularly interesting is also the finding of *Leptoseris* within Holocene cryptic reefal environments of the Great Barrier Reef in Australia, where other zooxanthellate corals are absent (Reitner 1993, cited by Insalaco 1996 pag. 186). The exclusive development of pennular corals within these two severe and poles-apart niches indicates that reduced light availability represents a major controlling factor for living pennular corals. The photo-adaptation demonstrated by physiological studies (e.g. Schlichter & Fricke 1990) is a satisfactory explanation for this distribution. The mixotrophic feeding behaviour represents a complementary strategy to flourish within these poorly illuminated environments. However, the recent finding of an azooxanthellate *Leptoseris* (*L. troglodyta*) in a cryptic habitat (Hoeksoema 2012) suggests that a rapid and univocal interpretation of pennular structure as deep zooxanthellate filter-feeding and photoadapted organisms is too simple.

The interpretation of pennular corals in the fossil record mainly focused on peculiar communities, often outcropping in biostromes and highly dominated by platy microsolenids (Insalaco 1996; Leinfelder et al. 1996; Nose & Leinfelder 1997; Dupraz & Strasser 1999; Lathuilière et al. 2005; Martin-Garin et al. 2007). Such coral communities dominated by pennular species were interpreted as deep zooxanthellate coral assemblages. The associated benthic biota (such as echinoids, bivalves, encrusting and boring organisms, microbialites), the embedding sediment and stratigraphic architecture of the sections induced the authors to relate the microsolenid-bearing biostromes to slow-sedimentation, low-energy regimes and nutrient-rich environments. Alternatively, or in addition, the nutrient excess has been raised as a major controlling factor by other authors (Leinfelder et al. 1996; Nose & Leinfelder 1997; Dupraz 1999; Dupraz & Strasser 1999; Leinfelder 2001). Dupraz & Strasser (1999) related the occurrence of “microsolenid biostromes” to periods of high trophic levels and low sediment rate, experienced by lagoonal muddy environments. Leinfelder (2001) pointed out to the occurrence of microsolenid associations in Switzerland and France within clay intervals, indicative of deep and calm waters, as well as within pure carbonate intervals, indicative of shallower and more elevated water energy. Corals with pennulae from the Central Apennines reef complex developed bioconstructions radically different from microsolenid biostromes, as observed in northern Tethyan reefs (Insalaco 1996; Insalaco et al. 1997; Dupraz & Strasser 2002; Olivier et al. 2004, 2006, 2011; Lathuilière et al. 2005;

Martin Garin et al. 2007). In Central Apennines, they were part of very small and open coral assemblages or occured as isolated colonies, scattered within fine-sand size carbonate sediments, conversely to microsolenid biostromes, where colonies are packed, extensively encrusted or often embedded in marly sediments. However, their occurrence within this context represents a further opportunity to understand how the controlling factors affected the distribution pattern and recruitment of this taxon. Identified genera *Fungiastraea*, *Dimorpharaea*, *Microsolena*, *Comoseris* and *Ovalastrea*. Among them, *Dimorpharaea* and *Microsolena* are the best candidates for a fruitful comparison with *Leptoseris fragilis* for reasons of functional morphology and for their distribution in the fossil record. For *Fungiastraea* as well for *Comoseris*, the regularity and alternation of the pennulae are less obvious and the correspondence between pennulae and gastrovascular canals are less well established. For the genus identified as *Ovalastrea* even the existence of pennulae is doubtful. All of them are concentrated within the centre and the inner part of the back reef (Fig. 5). Along these reef belts, pennular corals shared the space with other non pennular ones. Their general relative abundance in the inner reef contrasts with their absence in the zone of maximum coral density and diversity recorded in the inner reef flat (Fig. 5). This distribution pattern indicates that the ecological conditions where pennular corals flourished were not very severe and restrictive for other corals. The microfacies observed within the area where pennular corals occur is characterised by packstone with very fine sand-size bioclasts and peloids and few amount of carbonate mud. Corals are usually enveloped by thin cortex of microencrusters and most of them are bioeroded (*Gastrochaenolites* and *Entobia* borings) (Rusciadelli et al. 2011). The reconstruction of the depositional environment suggests low energy conditions, reduced background-sediment reworking and accumulation rate. (Rusciadelli et al. 2011). The reef complex portion where pennular corals flourished is characterised by a very irregular topography, morphological high grounds alternating to deeper zones, with a maximum vertical drop of more than 30 m (Rusciadelli et al. 2011). Attempting to constrain the ecological factors ruling this distribution pattern, it is argued that in addition to a normal reduction light gradient in the deepest zones, other controlling factors should have combined (Fig. 6). It is interpreted that the low hydraulic energy and topography irregularities produced a very low water circulation, while the low hydraulic competence caused a strong decrease in re-washing and export of fine grained sediments, even the mud, which was locally accumulated. Water turbidity and very fine sand size sediment were consequently increased, discouraging most of corals not equipped with skeletal features able to cope with these conditions (Fig. 6). In this scenario the presence of Microsolenidae could be explained by their mixotrophic behavior and by their ability to tolerate moderate accumulation rate of fine sand-size sediment and mud. The alternative hypothesis to explain the Microsolenidae occurrence, i.e. ruled by a high concentration of nutrients, as it is argued in many Oxfordian reef complexes of the northern-Tethys domain (e.g. Dupraz & Strasser 1999, 2002), remains possible but speculative and not corroborated in our case study. In fact, sedimentological studies at local and regional scale do not reveal the presence of any large or either localised nutrient-source areas, which could be only theorised, not related to sediment input. However, it is possible that, the same factors which led to a reduced water circulation, also induced stagnation of organic matter and nutrients, changing the trophic and ecological conditions at a very local scale.

Conclusions

A new coral collection of 79 samples and nearly 120 thin sections was studied from the Upper Jurassic reef complex of the Central Apennines, a paleontologically unexplored region for Prever (1909).

Ellipsactinia Limestones includes 73 individuals. 43 species were described, grouped in 32 genera and 16 families and 9 suborders. Among them 2 taxa are new. They are *Astreoidogyra giadae* nov. gen. nov. sp. and *Clausastrea eliasovae* nov. sp..

Corals were collected from a well constrained depositional and sedimentological setting within the Intra-Tethys domain, which allowed the recognition of a clear coral zonation, and a geometrical reconstruction of paleobathymetry. Limitations derive from an incomplete depositional profile, preventing the study of the reef front and the fore reef and from the difficulty to obtain a high sample-size in each zone.

Within the reef crest and the external reef flat, the coral cover is low, reduced to few individuals, while the number of stromatoporoid-bearing mounds is the highest observed. This distribution pattern is interpreted as mainly ruled by hydrodynamic disturbances and abrasive currents increasing toward the external and highest area of the reef complex.

The inner reef flat, adjacent to the gently steepened inner slope, records the highest coral cover. Large robust branching (*"Pseudocoenia", Heliocoenia, Calamophylliopsis*) and dome-shaped meandroid (*Psammogyra, Pruvostastraea, Eugyriopsis*) colonies dominate. Their skeletons reveal their ability to resist by different strategies against waves and sedimentation.

The back reef records a high number of medium to small coral colonies and a very scattered coral cover as result of morphological irregularities of the depositional profile. However, several colonial external forms and corallite arrangement types occur here, suggesting a poorly selective pressure for colonial forms and structures of corals. Phaceloid colonies (*Stylosmilia*, *Calamophylliopsis*, *Intersmilia* and *Pleurophyllia*) are still present here, showing smaller size, open bush shapes and thin branches. Plocoid corals (*Bracthelia, Heliocoenia* and *Ogilvinella*) have usually a densely packed arrangement of small-sized corallites. Cerioid and quasi-cerioid colonies are few but exclusive of the back reef. Among them, Amphiastreina genera occur, showing thick walls, few deep compact smooth septa. All these skeletal features converge toward a low weak ability for sediment clearance and rejection, which is consistent with a depositional environment characterised by low sediment reworking rate and low mechanical disturbances. The most attended specimens belong to Stylinidae and Rhipidogyridae families. Their occurrence in different zones indicates for both a successful adaptation to the general condition of the reef complex, at least from the reef crest to the back reef.

The occurrence of Microsolenina specimens (*Microsolena, Dimorpharaea, Comoseris, Ovalastrea, Fungiastraea*) as part of small assemblages or as isolated specimens in the centre and in the inner back reef and their absence in the most external reef zones is here interpreted as controlled by local scale factors. The combined effect of very low water energy and low-to-absent hydraulic competence have increased water turbidity and fine-to-very fine sand-size sediment accumulation rate, providing suitable conditions for the mixotrophic species, which do not required well-lit and well-washed waters.

It is inferred that the diverse conditions developed within the reef complex favoured formation of varied ecological niches that, in turn, should have stimulated the proliferation of a great number of taxa in a relatively small area.

The present study provides a significant attempt to fit a Jurassic coral zonation with a bathymetric reconstruction based on geometrical data. This zonation is depicted from an Intra-Tethyan platform, a domain generally much less studied for reefs than the north Tethyan margin. The results represent a solid base for a predictive model of coral distribution in coeval Intra-Tethyan reefs and a stimulating base for comparison with reefs of other paleogeographical settings.

Acknowledgements: This work was funded by Fondi Ricerca Scientifica ex 60% 2008 (G.R.) and by Progetti di Ricerca di Interesse Nazionale (PRIN, 2008) (G.R. project coordinator). We thank Roberto Rinaldi, Angelo Pesce, Alexander Saturni and Zappacosta Marco for the initial fieldwork in the Marsica region. Hannes Löser and Rosemarie Christine Baron-Szabo are thanked for constructive discussions that improved the manuscript. We are also indebted to Bogusław Kolodziej and Martin Nose for their accurate and constructive review and to Larry Mayer for the revision of English language. The Editor Francesca Bosellini is also kindly acknowledged for her valuable suggestions.

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