Critical review of the Trochoidomeandridae family (Scleractinia; Cretaceous) and the genera *Felixigyra*, *Rhipidomeandra*, *Trochoidomeandra*, and *Wellsimeandra*

HANNES LÖSER

**Abstract**

The Early to early Late Cretaceous coral family Trochoidomeandridae is critically reviewed. Its systematic position is changed from the suborder Rhipidogyrina to the suborder Heterocoenina. A third species – *Axosmilia cylindrica* Prever, 1909 – is assigned to the type genus *Trochoidomeandra*. The positions of the other genera formerly assigned to the family are modified. *Rhipidomeandra* and its junior synonym *Wellsimeandra* are – together with *Felixigyra* – gathered in the informal *Felixigyra* group. The group is assigned to the suborder Meandrinina and considered a very early member of this suborder. Their members differ by smaller trabeculae and a different septal ornamentation from the Trochoidomeandridae family. The genus *Rhipidomeandra* is revisited and new, hitherto unknown material is presented: two species originally assigned to *Phyllastrea*, one species originally assigned to the genus *Columellogyrus*, and two species in open nomenclature. Together these additions significantly expand the stratigraphical and palaeobiogeographical distribution of this genus.

**Key words:** Corals, Cretaceous, taxonomy, Scleractinia.

**1. Introduction**

The family Trochoidomeandridae was established by **Turnšek & Mihajlović** (1981) on the basis of *Trochoidomeandra Morycowa*, 1971. The family is poorly known because the type species of *Trochoidomeandra*, *T. problematica* Morycowa, 1971, is extremely rare and fine skeletal structures are almost unknown. Moreover, most material subsequently assigned to *Trochoidomeandra* does not belong to this genus. After the creation of the family Trochoidomeandridae, three more genera (*Bogdanoviccoenia Kumicheva*, 2002, *Rhipidomeandra Morycowa & Masse*, 1998, *Wellsimeandra Iakieva & Chesmedzheva*, 2003) were assigned to it, probably because they simply did not fit in any other family. The critical revision of the type genus *Trochoidomeandra* both modifies the systematic position of the family and indicates that all previously assigned genera need to be separated from the Trochoidomeandridae.

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BSPG</td>
<td>Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany</td>
</tr>
<tr>
<td>IGM</td>
<td>Instituto de Geología, Mexico City, Mexico</td>
</tr>
<tr>
<td>MB</td>
<td>Museum für Naturkunde der Humboldt-Universität, Berlin, Germany</td>
</tr>
<tr>
<td>PU</td>
<td>Università degli Studi di Torino, Dipartimento di Scienze della Terra, Italy</td>
</tr>
<tr>
<td>TUM</td>
<td>The Tohoku University Museum, Sendai, Japan</td>
</tr>
<tr>
<td>crd</td>
<td>distance of calicular rows (mm)</td>
</tr>
<tr>
<td>crw</td>
<td>width of calicular rows (mm)</td>
</tr>
<tr>
<td>s</td>
<td>number of septa</td>
</tr>
<tr>
<td>sd</td>
<td>density of septa</td>
</tr>
<tr>
<td>si</td>
<td>number of septa in isolated calices</td>
</tr>
<tr>
<td>n</td>
<td>number of measurements</td>
</tr>
<tr>
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<td>range (mm)</td>
</tr>
<tr>
<td>µ</td>
<td>arithmetic mean (mm)</td>
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<tr>
<td>σ</td>
<td>standard deviation (mm)</td>
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<tr>
<td>cv</td>
<td>coefficient of variation according to K. Pearson (%)</td>
</tr>
<tr>
<td>µ ± σ</td>
<td>first interval (mm)</td>
</tr>
</tbody>
</table>

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

- * earliest valid publication of the specific name
- p only part of the specimen belongs to the species
- v specimen was observed by the author

**Acknowledgements**

I am grateful to **Dieter Korn** (Berlin), **Elzbieta Morycowa** (Kraków), **Daniele Ormezzano** (Torino), and **Winfried Werner** (München) who allowed me to examine material from their museum and university collections. Field work in Italy was covered by project FL 42/73 of the Deutsche Forschungsgemeinschaft, field work in Spain and the examination of type material was supported by a UNAM/DGAPA PASPA (Mexico) programme. Comments by an anonymous reviewer helped to improve the manuscript. Linguistic correction by **Brian Hallmark** (Tucson, Arizona, USA).

**2. Material and methods**

The material discussed here comes from localities that are commented on and provided with additional references in **Löser et al.** (2005).
Germany, Bavaria, Allgäuer Helvetikum, Kurental (D.2296); Schrattenkalk, Late Barremian to Early Aptian, Sartouisi – Weissi zones. Specimen BSPG 1994 XI.14.

Greece, Kozani, Nea Nikopolis (GR.2090); Early Cenomanian (BSPG 2003 XX 5818, 7443).

Greece, Viotia, Arachova (GR.976); Evangelistria Schichten, Early Aptian. Specimens BSPG 2003 XX 5578, MB K524, K 542, K544.

Italy, Abruzzi, Monti d’Ocre (without exact locality; I.171); Early Aptian. Specimen PU 18291/11.

Italy, Abruzzi, Monti d’Ocre, Fossa Mezza Spada (I.1732); Early Aptian. Specimens PU 17955, 18101, 18102.

Italy, Abruzzi, Monti d’Ocre, Fossa Agnese (I.1735); Early Aptian. Specimens BSPG 2003 XX 5297, 5301, 5401.

Italy, Abruzzi, Monti d’Ocre, Fonte Cerasetti; Early Aptian. Specimen BSPG 2003 XX 5323.

Japan, Iwate-ken, Shimohi-gun, Tanohata-mura, Koikorobe (J.3326); Miyako Gr, Tanohata Fm, Moshi sandstone, Late Aptian. Specimen TUM 56501.

Mexico, Michoacán, Turitzio, Loma de San Juan; Cumburindo Fm, Early Aptian. Specimen IGM 7008.

Spain, Cantabria, Santander, Cobreces, Luña playa (E.2213); Altamira Fm, Early Cenomanian, Dixoni Zone. Specimen BSPG 2007 V.48.

Coral slabs and thin sections were examined using a Zeiss STEMI 2000-C stereo microscope. Microphotographs for illustration purposes were obtained using an Epson Perfection V750-M Pro transparency scanner with an optical resolution of 6400 dots per inch. Scanned images were then transferred to grey scale bit maps. Their quality was amended by histogram contrast manipulation (contrast stretching) where possible.

To gain more insight into the intraspecific variation of the corals, thin sections were systematically measured. To achieve statistical significance, the largest possible number of measurements were taken (n). For each type of measurement in one thin section the lowest and highest measured values (min-max) were obtained. Based on the values, the arithmetic mean (μ), the standard deviation (σ), the coefficient of variation according to K. Pearson (cv), and the first interval (μ±σ) were calculated. Thin sections were measured and values were calculated using the Palaeontological Database System PaleoTax, module PaleoTax/Measure (http://www.paleotax.de/measure).

### 3. Systematic palaeontology

Order Scleractinia Bourne, 1900
Suborder Heterocoeiniina Beauvais, 1974
Family Trochoidomeandridae Turnšek & Mihajlović, 1981

**Genera.** – Only the type genus.

**Diagnosis.** – Only solitary corals known. Septa compact, thick. Symmetry of septa irregularly radial. Septa not connected to each other. Septal lateral face with long and thick ornamentation similar to apophysal septa that are connected to each other forming a loose meshwork. No pali or paliform lobes, synapticulae, or columnella. Endotheca unknown.

**Remarks.** – The family was originally and is currently assigned to the suborder Rhipidogyrina Roniewicz, 1976, mainly because of the assumed existence of a septo-thecal wall. Considering the type genus a solitary coral, it contradicts the concept of this suborder in various aspects. The type of strong septal ornamentation, as the type genus show, is unknown from the Rhipidogyrina. The first septal cycle is not disproportionally stronger as in the Rhipidogyrina (based on studies on type material of Lobophyllia flabellum Michelin, 1843, type species of Rhipidogyrus). The family is therefore placed in the suborder Heteroeciniina, closely related to the family Paronastraeidae Beauvais, 1974 with Budaia Wells, 1933, Hexasmilia Fromentel, 1870, Hexasmiliopsis Löser, 2008, Paronastraea Beauvais, 1977, and Tiarasmitia Wells, 1932 (see Löser 2006, 2008a, b, 2010b).

Kuzmicheva (2002) created for the family a new suborder and included the genera Bogdanovicocenia Kuzmicheva, 2002, Tiarasmitia, and Trochoidomeandra. Bogdanovicocenia is here considered a junior synonym of Preverastraea, a presumably rhipidroyrid coral (Family Aulastreaoporidae). Tiarasmitia belongs to the family Paronastraeidae. Indeed both – Preverastraea and Tiarasmitia – show strongly ornamented lateral septal faces (see Löser 2007, 2010b). But in Preverastraea spines dominate, and in Tiarasmitia long apophysal septa. In Trochoidomeandra, the septal ornamentation shows a third mode as discussed below. The three genera are then just examples of genera with strongly ornamented septal lateral faces, and there are more genera showing such patterns. This characteristic alone is insufficient to gather genera into one group because the type of ornamentation differs from genus to genus.

**Genus Trochoidomeandra Morycowa, 1971**

**Type species:** Trochoidomeandra problematica Morycowa, 1971, by original designation.

**Diagnosis.** – Solitary turbinate coral. Calicular outline elliptical. Septa compact. Microstructure of septa of medium sized trabeculae. Septa in cross section externally slightly thicker, becoming slightly thinner towards the centre. Septa thick (maximum thickness 700µm in the type of the type species). Symmetry of septa irregularly radial. Cycles of septa subregular. Number of septa low (ca. 24 in the type of the type species). Septal cycles differ in length and thickness. Half of all septa extended to the calicular cen-
tre. Septa not connected to each other. Septal distal margin unknown, lateral face with long and thick apophyseal septa, inner margin swollen. Pali or paliform lobes absent. Costae absent (probably due to preservation). Synapticulae absent. Columella absent. Endotheca unknown. Wall absent.

**Remarks.** – The genus was originally and also later (Morycowa & Masse 1998) understood as a meandrinoid coral where calicular rows are growing centrally from one point, with poorly marked calices, very irregular developed septa and a septothecal wall. Later (Turnšek & Mihajlović, 1981) considered the genus a solitary coral with extremely ornamented septal lateral faces where the ornamentation itself is similar to septa. Comparable patterns are known from Tiarasmilia Wells, 1932 or Paronastrea Beauvais, 1977, but in these genera the ornamentation (also called apophyseal or secondary septa) shows a growth direction towards the calicular centre, and moreover, they are not connected to each other, whereas in *Trochoidomeandra* the septal ornamentation is not oriented in any direction, and the apophyseal septa are connected to each other and form a more or less rigid meshwork.

If *Trochoidomeandra* would be a colony, the so-called septothecal walls should be fused in the centre of the calice, because the centre would be the origin of the “colony” but they aren’t. What Morycowa (1971) is considering septa, is too irregular developed and moreover in places so densely connected that calices cannot be distinguished. Also the quite regular arrangement of septal cycles when considering the genus a solitary coral is a strong argument for a solitary form.

**Species included:** The type species, *Trochoidomeandra problematica* Morycowa, 1971, and another two species: *Trochoidomeandra ovalis* Turnšek & Mihajlović, 1981 and *Trochoidomeandra cylindrica* (Prever, 1909). Critical synonymy lists are given below to show that all *Trochoidomeandra* material – except for the type material – belongs to other genera.

_Trochoidomeandra cylindrica* (Prever, 1909)

Pl. 1, Figs. 1–2

* v 1909 Axosmilia cylindrica Prever, p. 112, text-fig. 18, pl. 10, fig. 1.

**Types:** Holotype PU 17955, by monotypy.

**Dimensions:**

| 8.5 x 9.5mm |
| 48 |

**Occurrences:** Early Aptian of Italy (Abruzzi, L’Aquila) Monti d’Ocre, Fossa Mezza Spada (PU 17955).

_Trochoidomeandra problematica* Morycowa, 1971

* v 1971 Trochoidomeandra problematica Morycowa, p. 131, text-figs. 38–39, pl. 37, figs. 1–2, pl. 38, fig. 1. non 1988 Trochoidomeandra problematica Morycowa, 1971. – Kuzmicheva & Aliiev, p. 180, pl. 8, fig. 3 [= Rhipidomeandra sp.]. non 1997 *Trochoidomeandra cf. problematica* Morycowa 1971. – Baron-Szabo & Fernandez Mendiola, p. 48, fig. 5e [= Tiarasmilia sp.]. non 2002 Trochoidomeandra problematica Morycowa, 1971. – Kuzmicheva, pl. 11, fig. 1 [= Paronastrea sp.]. 2004 Trochoidomeandra problematica Morycowa, 1971. – Stolarski et al., fig. 7c [refiguration of the type material].

_Trochoidomeandra ovalis* Turnšek & Mihajlović, 1981

* 1981 Trochoidomeandra ovalis Turnšek & Mihajlović, p. 26, pl. 25, figs. 1–5, pl. 26, figs. 1–2.

non 1993 Trochoidomeandra ? ovalis Turnšek 1981. – Baron-Szabo, p. 161, pl. 4, fig. 5 [= Tiarasmilia sp.].

_Trochoidomeandra sp.

non 1977 Trochoidomeandra sp. – Sikharulidze, p. 97, pl. 18, fig. 2 [= Rhipidomeandra sp.]. non 1998 Trochoidomeandra sp. – Yamagiwa et al., p. 62, pl. 4, fig. 3 [= Tiarasmilia casteri]. non 1985 Trochoidomeandra sp. – Sikharulidze, pl. 29, fig. 1 [= Rhipidomeandra sp.].

Suborder Meandrinina Alloiteau, 1952

Felixigyra group

**Genera included:** Felixigyra Prever, 1909, Rhipidomeandra Morycowa & Masse, 1998, Wellsimeandra Idaikheva & Cheshmedzhieva, 2003. The genera Rhipidomeandra and Wellsimeandra were originally assigned to the family Trochoidomeandridae, but they differ by their almost smooth septal faces.

**Diagnosis.** – Hydnophoroid and meandrinoid colonies known. Septa compact, thick. No septal symmetry, but distinct septal generations that differ in length and thickness. Septa generally not connected to each other, in places by the means of dissepiments. Septal lateral face rarely with medium size thorns, inner margin swollen or T-shaped. Lonsdaleoid septa present in places. No pali or paliform lobes, synapticulae, columella. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, septothecal. Budding intracalicinal, polystomodeal.

**Remarks on systematic position.** – It is here assumed that the *Felixigyra* group are early so-called meandrinid corals. The genus Meandrina sensu stricto is very probably a faviid coral and the name cannot be applied to Cretaceous corals. The Cretaceous corals currently assigned to the suborder Meandrinina (sensu Alloiteau 1952) are characterised by having very small trabeculae (often only marked as a dark line), and therefore smooth or only finely ornamented septal distal margins, and finely dentated septal lateral faces. The most prominent group is the Phyllosmiliidae family that counts with almost 50 genera, most of them having their first occurrence during the Late Turonian or Coniacian (see Löser 2013b for more de-
The genera of the *Felixigya* group are comparable to the Phyllosmiidae but differ by almost smooth lateral septal faces, the occasional existence of londsdaleoid septa, and the absence of a columella. One specimen depicted here (BSPG 2003 XX 5578) shows remains of microstructure comparable to those of the Phyllosmiidae. Only the wall formation (see PU 18291#11) differs remarkably from all members of the Meandrinina suborder and appears more like that found in Amphistreid corals.

There was no explanation for the original systematic position for *Rhipidomeandra* by **Morycowa & Masse** (1998). The new genus was considered closely related to *Trochoidomeandra* that was still understood a colonial coral ignoring the revision carried out by Türnsek & Mihailovic (1981).

*Felixigya* was until recently (Löser 2010a) misinterpreted as a genus synonymous with *Eohydaphora* and therefore assigned to other families such as Eugyridae, Faiviidae or Stylinidae. The systematic position proposed in the synonymy of *Sonora* (Mexico) and the Early Cenomanian of Kozani (Greece). (including all species established by Prever 1998). The new genus was considered closely related to *Eohydnophora* and was found, together with topotypical material from the type locality, to belong to *Rhipidomeandra*. *Columellogrya maeandra* Sikharulidze, 1985 is considered *Rhipidomeandra* as well.

**Diagnosis.** – Cerioid to meandroid colony. Calicular rows – if present – short or medium-long and curved. Calices in rows partly distinct. No neighbouring calices in one row. Valley septa absent. Septa compact. Septa in cross section externally slightly thicker, getting slightly thinner towards the centre. No septal symmetry, but size orders can be distinguished. Septal generations differ in length and thickness. Half of all septa reach close to the centre of the calicular rows, all others are shorter. Septa occasionally connected to each other, only by the means of disseptions. Septal distal margin unknown, lateral face with occasional thorns, inner margin T-shaped and swollen. Londsdaleoid septa present in places. Endotheca consists of numerous tabulae and disseptions. Wall compact, formation unknown. Inner face of the wall with thorns. Collins tectiform in the type species. Pali or paliform lobes, costae, synapticulae, columella, coenosteum absent. Budding intracalical, polystomodeal, or septal.

**Remarks.** – Closely related to *Rhipidomeandra* is *Wellsimeandra* Ikakieva & Cheshmedzhieva, 2003, that differs according to its authors by tectiform collines and shorter calicular rows. The type material of *Rhipidomeandra* shows, indeed, very long and regular calicular rows, whereas, in the type material of *Wellsimeandra* the calicular rows are very short, giving the colony a more hydno-phoroid appearance. Other material shows in the same colony a cerioid calicular arrangement and calicular rows as in *Rhipidomeandra*. *Wellsimeandra* is therefore included in the synonymy of *Rhipidomeandra*.

The type species of *Rhipidomeandra* shows no coenosteum, the calicular rows share one wall, and the calicular rows are long. There exists additional material that has an extended coenosteum, double walls and very short calicular rows giving a cerioid appearance. All this material is for the moment included into *Rhipidomeandra*.

**Species distinction.** – Species are distinguished on the basis of their calicular width. The septal density shows a high variation within one colony. The length of calicular rows is not taken into account, because it is either not possible to measure this value (e.g. in the specimens with long calicular rows) or it varies too much in one colony.

**Range:** Barremian to Early Cenomanian.

**Genus Felixigya** Prever, 1909

**Type species:** *Felixigya deangelisi* Prever (1909), by subsequent designation in Wells (1936).

**Species included:** *Felixigya deangelisi* Prever, 1909 (including all species established by Prever 1909) and some questionable material in open nomenclature from the Albian of Sonora (Mexico) and the Early Cenomanian of Kozani (Greece).

**Remarks.** – The genus was revised by Löser (2010a) in greater detail. All *Felixigya* species from the Early Aptian of the Monti d’Ocre were found synonymous. Unfortunately the type material of the type species is poorly preserved and thin sections are not available. The type material of other, subjectively synonymous species, is better preserved and includes thin sections. The genus was assigned to the family Eugyridae in Löser (2010a), but it differs by the very thick septa and their inner swollen margins. Lacking microstructural details of the septa do not allow one to define the size of the trabeculae that would be decisive for the systematic position.

**Range:** Aptian to Early Cenomanian.

**Genus Rhipidomeandra** Morycowa & Masse, 1998

**Type species:** *Rhipidomeandra bugrovae* Morycowa & Masse (1998), by original designation.

**Species included:** The genus counts up to the present with only the type species of *Rhipidomeandra* and *Wellsimeandra*. Prever (1909) established two species in the extant coral genus *Phyllasraea Dana*, 1846 (non *Phyllasraea* Fromentel, 1879): *P. schnarrenbergeri* and *P. stoliczkaei*. Neither species have ever been cited in the literature, with the exception of catalogues of Cretaceous coral species (Felix 1914; Löser et al. 2002). The material described by Prever (1909) is completely different from *Phyllasraea* and was found, together with topotypical material from the type locality, to belong to *Rhipidomeandra*. *Columellogrya maeandra* Sikharulidze, 1985 is considered *Rhipidomeandra* as well.

**Diagnosis.** – Cerioid to meandroid colony. Calicular rows – if present – short or medium-long and curved. Calices in rows partly distinct. No neighbouring calices in one row. Valley septa absent. Septa compact. Septa in cross section externally slightly thicker, getting slightly thinner towards the centre. No septal symmetry, but size orders can be distinguished. Septal generations differ in length and thickness. Half of all septa reach close to the centre of the calicular rows, all others are shorter. Septa occasionally connected to each other, only by the means of disseptions. Septal distal margin unknown, lateral face with occasional thorns, inner margin T-shaped and swollen. Londsdaleoid septa present in places. Endotheca consists of numerous tabulae and disseptions. Wall compact, formation unknown. Inner face of the wall with thorns. Collins tectiform in the type species. Pali or paliform lobes, costae, synapticulae, columella, coenosteum absent. Budding intracalical, polystomodeal, or septal.

**Remarks.** – Closely related to *Rhipidomeandra* is *Wellsimeandra* Idakieva & Cheshmedzhieva, 2003, that differs according to its authors by tectiform collines and shorter calicular rows. The type material of *Rhipidomeandra* shows, indeed, very long and regular calicular rows, whereas, in the type material of *Wellsimeandra* the calicular rows are very short, giving the colony a more hydno-phoroid appearance. Other material shows in the same colony a cerioid calicular arrangement and calicular rows as in *Rhipidomeandra*. *Wellsimeandra* is therefore included in the synonymy of *Rhipidomeandra*.

The type species of *Rhipidomeandra* shows no coenosteum, the calicular rows share one wall, and the calicular rows are long. There exists additional material that has an extended coenosteum, double walls and very short calicular rows giving a cerioid appearance. All this material is for the moment included into *Rhipidomeandra*.

**Species distinction.** – Species are distinguished on the basis of their calicular width. The septal density shows a high variation within one colony. The length of calicular rows is not taken into account, because it is either not possible to measure this value (e.g. in the specimens with long calicular rows) or it varies too much in one colony.

**Range:** Barremian to Early Cenomanian.

*1985 Columellogrya maeandra* Sikharulidze, p. 64, text-fig. 10, pl. 29, fig. 3.
Löser, review of Trochoidomeandridae

Dimensions: (TUM 56501)

<table>
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<th>crw</th>
<th>0.94–1.59</th>
<th>2.13–2.66</th>
<th>10</th>
<th>4/2mm</th>
</tr>
</thead>
</table>

Remarks. – The type material of the species and the present specimen is the only known material. It shows very small dimensions.

Occurrences: Early Aptian of Georgia (Kartli) Ali. Late Aptian of Japan (Iwate-ken, Shimohi-gun) Tanohata-mura, Koikorobe (TUM 56501).

Rhipidomeandra morycowae (Idakieva & Cheshmedzhieva, 2003)

Dimensions: (BSPG 2003 XX 5578)

<table>
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<th>5.53</th>
<th>6.11</th>
<th>5.75</th>
<th>11/5mm</th>
</tr>
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</table>

Remarks. – It was not possible to observe the type material because the staff of Sofia University did not reply to various inquiries. The sample presented here differs from the type material by longer calicular rows and thinner septa. It presents remains of microstructure that are comparable to that of Phyllosmilia. The wall formation is the same as that observed in other Rhipidomeandra species.


Rhipidomeandra schnarrenbergeri (Prever, 1909)

Dimensions: (PU 18101)

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<th>10/5mm</th>
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</table>

Remarks. – The holotype is a small colony without any polished surface. The type as well as the toptotypical specimen show numerous isolated calices and short calicular rows.

Occurrences: Late Barremian of France (Bouches-de-Rhône) Orgon, (Vaucluse) Les Gardettes. Early Aptian of Italy (Abruzzi, L’Aquila) Monti d’Ocre, Fossa Mezza Spada (PU 18101).

Rhipidomeandra stoliczkai (Prever, 1909)

Dimensions: (BSPG 2003 XX 5323)

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<th>3.76–9.26</th>
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<th>9/2.5mm</th>
</tr>
</thead>
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Remarks. – The holotype is the only available specimen. It has a polished surface. It mainly has isolated calices. It differs from most other species by its large calicular dimensions.

Occurrences: Early Aptian of Italy (Abruzzi, L’Aquila) Monti d’Ocre, Fossa Mezza Spada (PU 18102).

Rhipidomeandra sp. 1

Dimensions: (BSPG 1994 XI 14)

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<th>1.22–2.12</th>
<th>3.71–4.47</th>
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<th>4/2mm</th>
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Remarks. – The holotype is a large colony with a polished surface. The type as well as the toptotypical specimen show numerous isolated calices and short calicular rows.

Occurrences: Late Aptian of France (Bouches-de-Rhône) Orge, (Vaucluse) Les Gardettes. Early Aptian of Italy (Abruzzi, L’Aquila) Monti d’Ocre, Fossa Mezza Spada (PU 18102).
Remarks. – The material of this species has isolated calices and calicular rows, as well as both forms with and without a coenosteum. Within the material from Italy, it shows the longest and most pronounced calicular rows and has the most affinities to the type material of *Rhipidomeandra bugrovae*, the type species of the genus.

**Occurrences**: Late Barremian of Germany (Bavaria) Künrental (BSPG 1994 XI 14). Early Aptian of Greece (Viotía) Arachova (MB K544); Italy (Abruzzi, L'Aquila) Monti d'Ocre (PU 18291#11); Fossa Agnese (ERNO L-5401); Mexico (Michoacán) Turitzio, Loma de San Juan.

*Rhipidomeandra* sp. 2

Fig. 1

**Dimensions:**

(BSPG 2003 XX 5818)

<table>
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<th></th>
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<td>0.19</td>
<td>12.4</td>
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</tr>
<tr>
<td>sd</td>
<td>7/2</td>
<td>4/1</td>
<td>mm</td>
<td></td>
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</table>

**Remarks.** – The three specimens have the smallest dimensions of all known specimens and an extensive coenosteum. The Greek material has smaller dimensions than the material from Spain, but preliminarily all specimens are kept together in one species.

**Occurrences**: Early Cenomanian of Spain (Cantabria, Santander) Cobreces, Luña playa (BSPG 2007 V 48); Greece (Kozani) Nea Nikopolis (BSPG 2003 XX 5818, 7443).

4. Discussion

The family Trochoidomeandridae with its only genus *Trochoidomeandra* is quite an isolated family. Its ancestors or closely related families are unknown. Its systematic position is preliminary. The new position of the family in the suborder Heterocoeniina is mainly supposed by the strongly ornamented lateral septal faces. The ornamentation of the septal lateral faces with apophysal septa is considered a convergent characteristic that occurs in some families more commonly than in others. Generally, this type of ornamentation is restricted to Heterocoenini.

The present study has increased the number of known *Rhipidomeandra* species as well as data about their distribution in time and space. With the exception of one species that occurred in the Early Cenomanian, the genus had its principal stratigraphical distribution in the Barremian and Aptian, with most species in the Early Aptian (Fig. 2). This distribution pattern corresponds with the general diversity patterns of Cretaceous corals that have a notable diversity peak during the Early Aptian (*Löser* et al. accepted, fig. 1).

The distribution of *Rhipidomeandra* is comparable to that of the similar *Felixigyra*, which has its highest abundance during the Early Aptian and few records during the Albian and Cenomanian. *Rhipidomeandra* shows a particular distribution pattern (Fig. 3) with four different distribution areas that can be distinguished; the Late Barremian to Early Aptian of the Central Tethys, the Cenomanian of the Tethys, the Barremian and Aptian of the Eastern Tethys and the Western Pacific, and an unspecific area combining the Guerrero Terrane with one locality in the Central Tethys.

The here applied informal group with the genera *Felixigyra* and *Rhipidomeandra* combines characteristics of several suborders. The wall structure and lonsdaleoid septa is reminiscent of Amphiastreids, the thickened inner margins of the septa and microstructural features are closer to *Meadrininids* (sensu lato), and the poorly ornamented septa place the genera closer to the Eugyridae in the suborder Fa-
viina. The preliminary position within the Meandrinina is
guided by the microstructural details and the striking fea-
ture of the swollen inner septal margins. This character is
shared by two suborders, the Rhipidogyrina (family Rhipi-
dogyridae) and the Meandrinina (family Phyllosmiliidae).
The latest Rhipidogyridae are known from the Late Aptian
(Ogilvinella sp. in Tomás et al. 2008), whereas the earliest
Phyllosmiliidae are known from the Aptian on (Pachyphylla;
Löser 2013a). Both families share the characteristic
that the first septal cycle or generation is disproportionally
thicker than younger cycles (generations). This feature is
not shared by the members of the Felixigyra group. Rhipi-
dogyrids later than Aptian do not belong to this family:
Barysmilia Milne-Edwards & Haine, 1848 (for instance
Eliašová 1991) belongs to the Phyllosmiliidae; the type
of the type species of Placohelia Počta, 1887 (see Eliašová
1991) lacks microstructure and the genus probably belongs
to the Hemiporitidae; Rhipidastrea Eliášová, 1991 is –
based on the observation of thin sections from the type
of the type specimen – a penular coral that belongs to
the family Leptophylliidae. The genus Paracanthogyra Mor-
ycow & Marcopoulou-Diacantoni, 2002, originally as-
signed to the Rhipidogyridae, was later assigned the family
Aulastraecoporid (Löser 2011).

5. References

Alloiteau, J. (1952): Embranchement des coelentérés. – In: Piv-
eteau, J. (Ed.): Traité de Paléontologie (1): 376–684; Paris
(Masson).

(„Urgon“) von Nordspanien (Playa de Laga, Prov. Guernica). – Berliner geowissenschaftliche Abhandlungen, (E), 9:
147–181.


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Plate 1


Fig. 3. *Rhipidomeandra stoliczkai* (Prever, 1909), holotype of *Phyllastraea stoliczkai*, PU 18102, transversal slab.

Figs. 4–6. *Rhipidomeandra morycowae* (Idakieva & Cheshmedzhieva, 2003), BSPG 2003 XX 5578, transversal thin section. Fig. 6 with remnants of microstructure.


Fig. 9. Holotype of *Phyllastraea schnarrenbergeri*, PU 18101, coral surface.

Scale bars 1 mm.
Plate 2

Fig. 1. *Rhipidomeandra* sp. 1, PU 18291#11, transversal thin section.

Figs. 2–3. *Rhipidomeandra* sp. 1, BSPG 1994 XI 14, transversal slab.

Figs. 4–6. *Rhipidomeandra* sp. 1, ERNO L-5401, transversal and longitudinal thin section.

Figs. 7–9. *Rhipidomeandra maeandra* (Sikharulidze, 1985), TUM 56501, transversal and longitudinal thin section.

Scale bars 1 mm.