Rivista Italiana di Paleontologia e Stratigrafia	volume 116	no. 2	1 pl.	pp. 189-200	July 2010

REVISION OF THE EARLY CRETACEOUS CORAL GENUS *FELIXIGYRA*

HANNES LÖSER

Received: February 22, 2010; accepted: May 12, 2010

Key words: Scleractinian corals, Systematics, *Felixigyra*, Cretaceous, Italy.

Abstract. The Early Cretaceous coral genus *Felixigyra* Prever, 1909 is revised on the basis of type material from Italy. *Felixigyra* has a hydnophoroid-meandroid colony organisation with conical monticules attached to each other. The very thick monticules are arranged in a way that calicular centres become apparent. The septa are compact and rhopaloid. The genus can be related to other genera of the Eugyridae family, but differs from them by its particularly developed monticules. It also shows certain resemblance to meandroid genera of the Trochoidomeandridae family. Of the six species originally assigned to *Felixigyra* only five are recognized, since the type of *Felixigyra crassa* is too poorly preserved to give a diagnosis. The remaining five species have almost no significant difference in calicular dimensions. In addition to the Italian material, one sample from the Early Cenomanian of Greece and one sample from the Early Albian of Mexico are also assigned to the genus. Material assigned to *Felixigyra* after Prever (1909) needs to be entirely reclassified to the genus *Eohydnophora*.

Riassunto. Sulla base di esemplari provenienti da località tipo italiane, viene revisionato il genere *Felixigyra* Prever, 1909, corallo del Cretacico inferiore. *Felixigyra* presenta una colonia di tipo idnoforoide-meandroide, con monticule coniche unite le une alle altre. Le spesse monticule sono disposte in modo da evidenziare i centri calicinali. I setti sono compatti e ropaloidi. Il genere può essere assimilato ad altri della famiglia Eugyridae, ma si discosta da questi fondamentalmente per lo sviluppo di particolari monticule. Mostra inoltre una certa somiglianza con generi meandroidi della famiglia Trochoidomeandridae. Delle sei specie originariamente assegnate a *Felixigyra*, solo cinque sono state effettivamente riconosciute, in quanto l'esemplare tipo di *Felixigyra crassa* è risultato talmente mal conservato da non permettere una diagnosi. Le rimanenti cinque specie non presentano significative differenze nelle dimensioni calicinali. Oltre al materiale italiano, sono stati assegnati a questo genere anche un esemplare del Cenomaniano inferiore della Grecia ed un esemplare dell'Albiano inferiore del Messico. Il materiale assegnato successivamente a *Felixigyra* Prever (1909), necessita di essere interamente riclassificato come appartenente al genere *Eohydnophora*.

Introduction

Felixigyra, named after the German geologist and palaeontologist Johannes Felix, was introduced by P. L. Prever (1909) in a monograph on the Cretaceous fossils of the Abruzzi near Aquila (Parona 1909). Together with the new genus, Prever established six species (*F. crassa, F. deangelisi, F. dollfusi, F. duncani, F. taramellii, F. vaughani*). Thin sections were only used to document part of this material and in other cases Prever only illustrated complete unsectionned specimens. While the images of the complete samples do not provide much information, the drawings based on thin sections are very precise and characterise the material well. A type species was not designated by Prever. When Wells (1936) selected a type species he was probably guided by page precedence rather than the quality of the material because he selected the first species described by Prever. Unfortunately, his selection of *F. deangelisi* was not the best choice as no thin section was obtained and therefore no good drawing made. Moreover, the small sample is not well preserved.

For a long time the genus went almost unused and its species rarely mentioned. Morycowa (1964) was the first author who assigned specimens outside of the type area to *Felixigyra*. Morycowa (1971) established a new species and subspecies within the genus. With the detailed descriptions and illustrations provided by the Polish specialist, *Felixigyra* became better known among coral taxonomists and was recorded more often from other regions. Other species, formerly assigned to other genera (such as *Holocystis* and *Hydnophora*) turned out to belong to this genus. Today, the literature lists 11 species currently assigned to this genus (Löser et

Universidad Nacional Autónoma de México, Instituto de Geología, Estación Regional del Noroeste, L.D.Colosio y Madrid, Col. Los Arcos, Hermosillo, Sonora, Mexico. E-mail: loeser@paleotax.de

al. 2002). *Felixigyra* is an occasionally occurring genus and was indicated in 27 different regions (Löser 2009; a region in this sense groups age-equivalent localities together that have the same age and that are located in the same basin, in the same continental margin, or on the same interoceanic platform, see Löser & Minor 2007 for details).

Abbreviations

The following abbreviations are used:

BSPG, Bayerische Staatssammlung für Geologie und Paläontologie, München, Germany;

ERNO, Instituto de Geología, Estación Regional de Noroeste, Universidad Nacional Autónoma de México, Hermosillo, Mexico;

PU, Universita' degli studi di Torino, Dipartimento di Scienze della Terra, Torino, Italy;

TUM, Tohoku University Museum Sendai, Japan.

The following abbreviations for the measurements are used:

crw, width of the valleys between the monticules (Fig. 1; monticules in the sense of Wells 1956: F351);

crd, distance of the valleys between the monticules (Fig. 1);

mt, thickness of the monticules (Fig. 1);

sd, density of septa;

V min, lowest measured value (of all measured values as crw, crd and mt);

V max, highest measured value (of all measured values as crw, crd and mt);

A, average (of all measured values as crw, crd and mt);

S, standard deviation (of all measured values as crw, crd and mt).

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

*, earliest valid publication of the species name;

?, the assignation of this description to the species is doubtful;

non, the described material does not belong to the species concerned;

p, the described material belongs only in part to the species concerned;

v, the specimen was observed by the author.

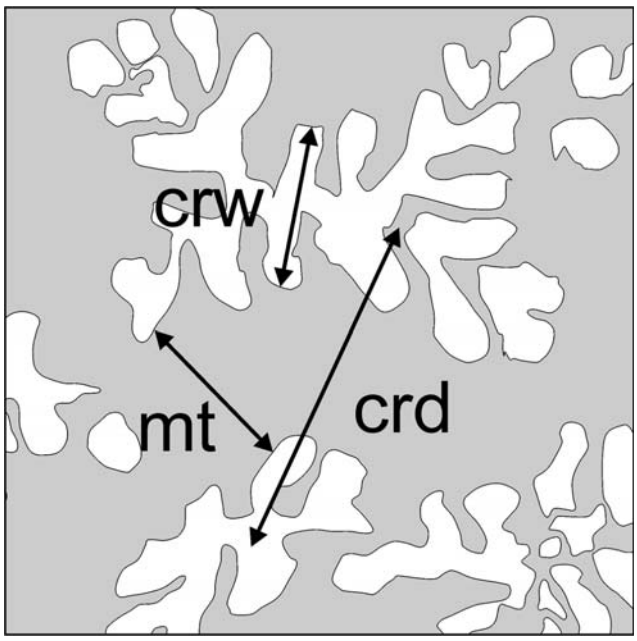


Fig. 1 - Measurements taken in *Felixigyra* colonies. Skeletal substance in grey.

Material

The material from all below listed localities is not very well preserved. The original aragonite skeletal substance was altered to calcite. This process did not allow the preservation of original microstructure. For the geographic positions of the sample areas see Fig. 2.

Greece. Kozani, Nea Nikopolis; Early Cenomanian. The locality was first mentioned by Brunn (1956). It was dated by the the presence of *Orbitolina* (*Conicorbitolina*) *corbarica* and *Ichthyosarcolites* sp. (Steuber & Löser 1997). Sample: BSPG 2003 XX 5818.

Italy. The locality "Monti d'Ocre" (south of the village Bagno close to Aquila) encompasses several sample locations which (as far as they could be found) are believed to belong to only one lithostratigraphical unit. The unit was dated in Parona (1909) as Cenomanian. Cherchi et al. (1978) assumed an Aptian age, based on orbitolinide

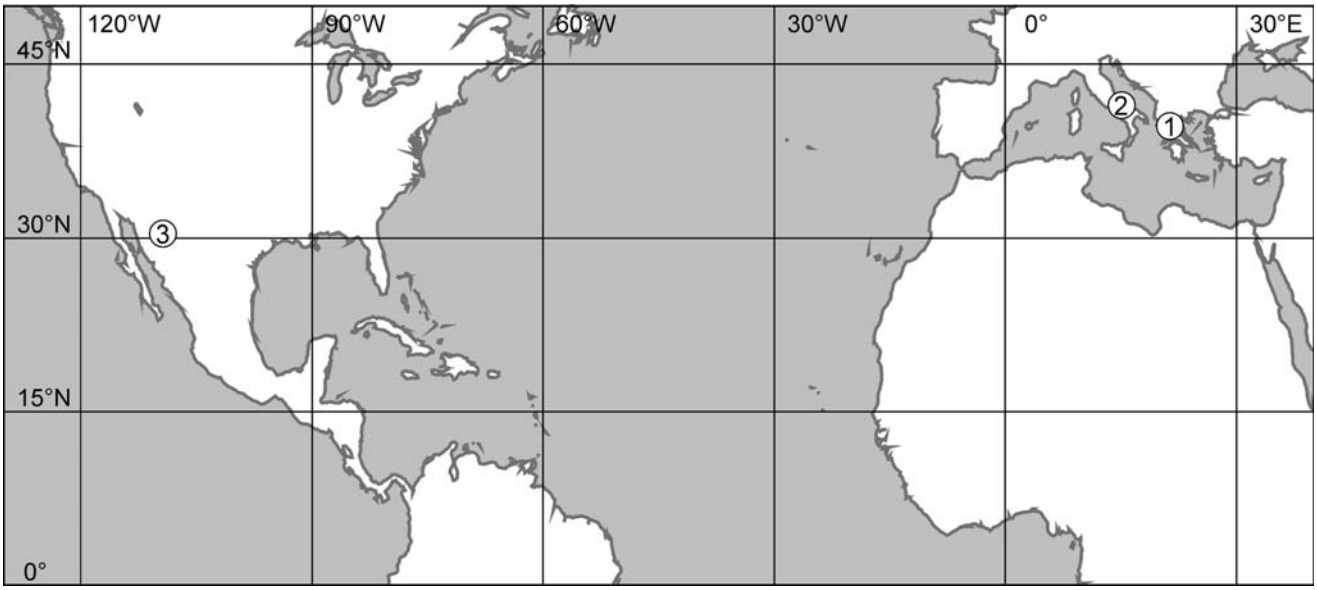


Fig. 2 - Map of sample areas. 1, Greece; 2, Italy; 3, Mexico.

foraminifera. On the basis of rudists Masse & Morycowa (1994) placed the localities in the upper part of the Lower Cretaceous (Upper Aptian to [Upper] Albian). According to Chiocchini et al. (1989), a hiatus exists in the whole Monti d'Ocre complex in the Upper Albian (? Inflatum/Dispar zone) up to the Lower part of the Middle Cenomanian. More recent examinations and comparisons with other faunas (Löser 1998), mainly based on the occurrence of the rudist genus *Himeraelites*, proposed preliminarily a Lower Aptian age (Camoin 1983; Baron-Szabo & Steuber 1996; Alsharhan 1997; Steuber pers. comm. 1997). Masse et al. (1998) dated material from the Colle Pagliare (Monti d'Ocre) on the basis of *Himeraelites* as Albian. It is not clearly expressed whether this locality correlates with the other sampling localities in the Monti d'Ocre complex, but in any case, the idea that *Himeraelites* represents an Albian age is not followed herein. Masse (2002 pers. comm.) believes that the occurrence of certain radiolitid rudists which first occurred in the Upper Aptian and the absence of typical Early Aptian species (such as *Offneria*) is important for the dating. Recently, *Himeraelites* was also found in Upper Aptian sediments of the Arabian peninsula (Skelton, pers. comm. 2002). Steuber (Abu Dhabi, pers. comm. Feb. 2010) reported just lately that he found at the locality 7 (Fossa Mezza Spada) a rudist specimen of the genus *Offneria*, which, together with *Himeraelites*, indicates clearly an Early Aptian age.

The material described here comes from only one point (Fossa Cerasetti). The material is rather poor preserved. It was not possible to cut or polish samples, or to obtain thin sections from sample without such. Therefore it was unavoidable to illustrate complete samples or peels of species where no thin sections are available. Samples: PU 18027-18036.

Mexico. Sonora, Municipio Ures, Cerro de Oro; Bisbee Group, Mural Limestone, Cerro la Espina Member, Early Albian. Material from the locality was described by Baron-Szabo & González-León (2003), but the sample presented here was not mentioned. Sample: ERNO 3142.

Systematic description

Order **Scleractinia** Bourne, 1900

Suborder **Faviina** Vaughan & Wells, 1943

Family Eugyridae Eguchi, 1951

Felixigyra Prever, 1909

Type species: *Felixigyra deangelisi* Prever, 1909; subsequently designated by Wells (1936)

Diagnosis: meandroid-hydnophoroid colony. The monticules are conical (Bosellini 1999: fig. 4) or elongated and attached to each other by the means of apophyses forming a loose meandroid network. The lines formed by monticules can be branching or form zig-zag lines. The monticules are thick. The polygonal monticules and/or the connected conical monticules are arranged in a way that calicular centres become apparent. Apart from this, some isolated calices are present. Calicular centres can clearly be distinguished. The septa are compact, thick and often connected in the centre of the calices, directly or by dissepiments. Two generations of septa can be distinguished that alternate in thickness and length. Their tips are often swollen. Their lateral faces are dentated. A columella does not exist. The wall is probably septothecal. The endotheca consists of thin tabulae and dissepiments.

Comparison. The type material of the type species morphologically does not correspond to material assigned to the genus after the publication of Prever (1909). From this material (see for instance Schöllhorn 1998; Tomás et al. 2008) which belongs to *Eohydnophora*, *Felixigyra* sensu stricto differs by its connected monticules, the formation of calicular centres and isolated calices, the very thick monticules, and the swollen septal tips. Isolated calices can be found in *Felixigyra* sensu lato (e.g. Masse & Morycowa 1994), but they are very rare. From other Cretaceous genera of the Eugyridae family (*Eohydnophora*, *Eugyra*, *Myriophyllia*, *Pseudomyriophyllia*, *Hydnophoraraea*) it differs by the absence of the columella (*Myriophyllia*, *Pseudomyriophyllia*), the short monticules (*Eugyra*), the connections between the monticules (*Eohydnophora*, *Hydnophoraraea*), and the thick monticules (*Eohydnophora*, *Euygra*, *Myriophyllia*, *Pseudomyriophyllia*). Within the family Eugyridae, only in the genus *Pseudomyriophyllia* calices can be clearly distinguished.

Apart from its affinities to members of the Eugyridae family, the genus shows affinities to the genera *Rhipidomeandra* Morycowa & Masse, 1998, and *Wellsimeandra* Idakieva & Cheshmedzhieva, 2003. Both genera differ from *Felixigyra* by having more than two septal generations and lonsdaleoid septa. Lonsdaleoid septa are absent not only in the type species of *Felixigyra* s.s., but in all examined samples.

Systematic position. The systematic position is preliminary. Fine structures are not visible in the type of the type species because no thin sections are available from it. The genus seems to be closely related to the genera *Eohydnophora*, *Eugyra* and *Pseudomyriophyllia* (? *Myriophyllia*). These genera have been removed from the Stylinidae and moved into the Faviidae family by Morycowa (1997), based on the revision of a topotypical sample of *Meandrina cotteaui* d'Orbigny, 1850, type species of *Eugyra*. Because of the poorer ornamentation of the lateral faces of the septa and the meandroid and hydnophoroid arrangement of calices, these genera are separated here and assigned to the Eugyridae family. The relationship of the above mentioned Cretaceous genera to the Tertiary and extant genus *Hydnophora* is unknown. This genus has been previously placed in the Faviidae family (Bosellini 1999), by other authors in the Merulinidae family (Veron et al. 1977, Veron 2000).

Distribution. *Felixigyra* was found only in the type locality in Italy, in Greece and in Mexico. Its range is from Aptian to Early Cenomanian. All material assigned after Prever (1909) does not belong to this genus.

Species. Prever (1909) established six species (*F. crassa, F. deangelisi, F. dollfusi, F. duncani, F. taramellii, F. vaughani*). From some type specimens thin sections are available, others are provided with a polished surface, other are complete specimens. PU collection rules did not allow the preparation of additional polished sections or thin sections. Therefore, it cannot be decided for all species, whether they belong to *Felixygyra* s.s. or not.

The species are distinguished by the width of the valley, the thickness of the collines, the distance of the

valles and the septal density. To obtain reliable values, the distances where systematically measured on the base of a thin section or peel. The scanned peel or thin section was imported into the computer program PaleoTax/Measure (www.paleotax.de/measure). Depending on the size of the sample, between 10 and 20 values were obtained for each character. For each character, the minimum and maximum value, as well as the average and the standard deviation was determined. These values are given for the holotype, lectotype or the only available sample in the case of *Felixigyra* sp.

Herein, with exception for *F. crassa*, all *Felixigyra* species established by Prever will be presented with dimensions and description. The taxonomic significance of the obtained values and the consequences for the taxonomy of the genus is discussed below. The synonymy lists include the positively indicated quotations, and (illustrated) material that has been assigned to *Felixigyra* species but belongs to another genus. The revision of these quotations are beyond of the scope of this study.

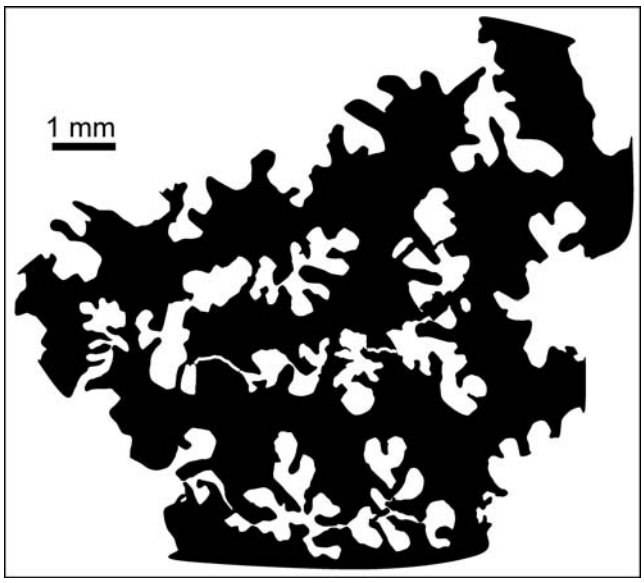


Fig. 3 - *Felixigyra deangelisi* Prever, 1909. Drawing after a peel of a transverse section. PU 18028, lectotype of *Felixigyra deangelisi.*

Felixigyra crassa Prever, 1909

*v 1909 *Felixigyra crassa* Prever, p. 122, pl. 12: 5.

Type: Holotype by monotypy is PU 18026.

Remarks. The holotype consists of a colony that is not sectioned and not polished, but eroded (which gives the appearance to be sectionned in the illustration). It is not certain that the species belongs to *Felixigyra* s.s. and is here mentioned only for the reason of completeness.

Felixigyra deangelisi Prever, 1909

Fig. 3, 4, Pl. 1, figs 1-3

*v 1909 *Felixigyra Deangelisi* Prever, p. 118, pl. 12: 7, 8.

?v 1971 *Felixigyra patruliusi patruliusi* Morycowa, p. 62, text-fig.18, pl. 10: 1-4, pl. 11: 1

Types: There exist two syntypes - PU 18027 (pl. 12: 7, 8) and PU 18028. PU 18028 is, even if not illustrated, designated here as the lectotype because it is larger than PU 18027 and has two polished surfaces. PU 18027 becomes the paralectotype.

Dimensions: (from the lectotype; all values in mm)

	V min	V max	A	S
crw	0.54	0.925	0.72	0.1
crd	1.05	1.6	1.41	0.155
mt	0.425	1.285	0.83	0.27
sd	5 / 2 mm			

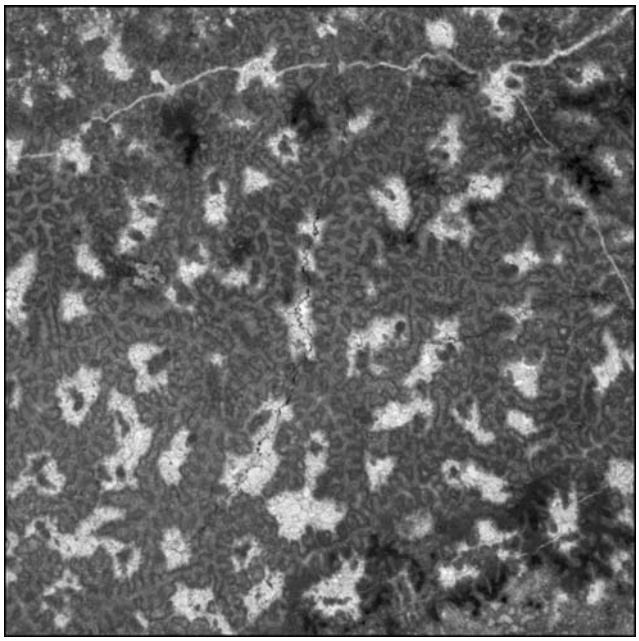


Fig. 4 - *Felixigyra deangelisi* Prever, 1909. Transversal thin section. Early Cenomanian of Nea Nikopolis, Kozani, Greece. BSP 2003 XX 5818. x 5.

Description. Meandroid -hydnophoroid colony. The monticules are conical and attached to each other forming a loose network. The series formed by monticules are branching and forming zig-zag lines. The monticules have a massive and thick centre. Calicular centres are not easily observable, but calices can be distinguished. The septa are compact and thick. The septa appear clearly in two generations, those of the second generation are much shorter and slightly thinner. Swol-

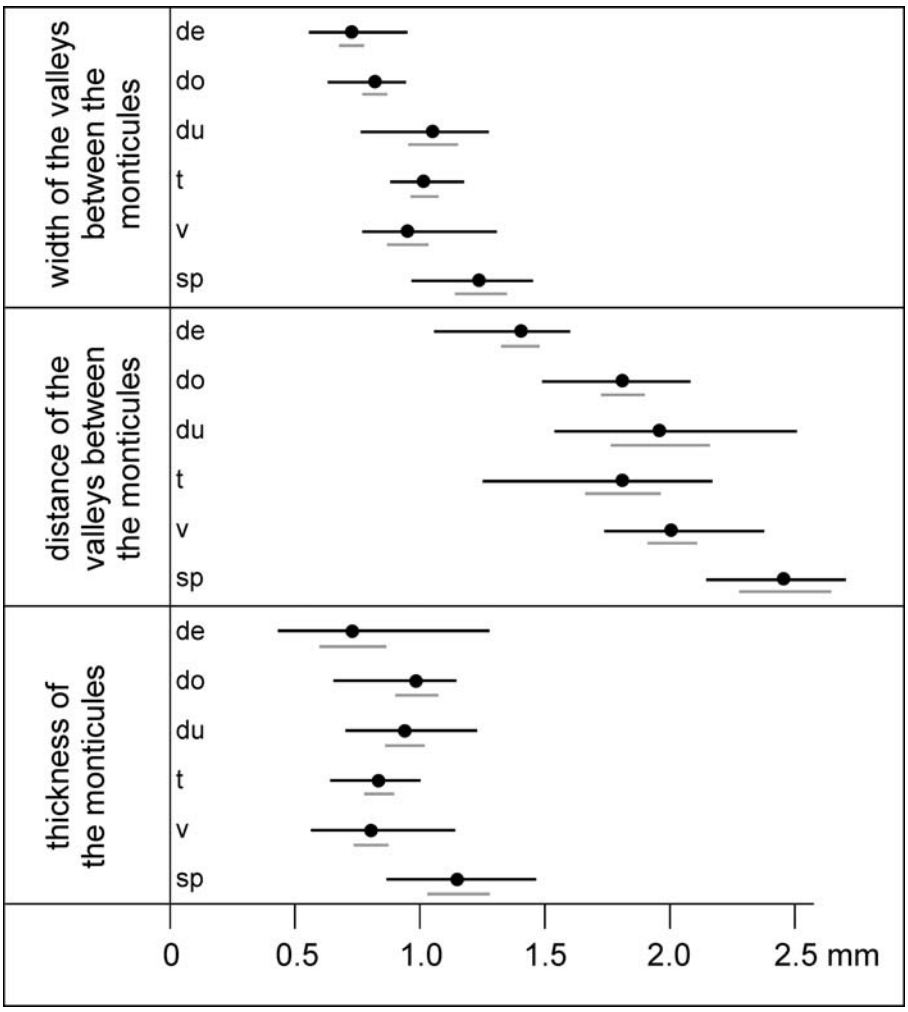


Fig. 5 - Comparison of calicular dimensions of the five species that are assigned here to the genus *Felixigyra*. Abbreviations of the species: de, *F. deangelisi*; do, *F. dollfusi*; du, *F. duncani*; t, *F. taramellii*; v, *F. vaughani*; sp, *Felixigyra* sp. from Mexico. Dark line length marks the range; full circles mark the average. Grey line length marks the standard deviation.

len tips are restricted to septa of the first cycle. The lateral faces of the septa show thorns. The endotheca consists of dense thin tabulae (3-4 / 2 mm) and dissepiments.

Remarks. The type is not well preserved and because of the low contrast in skeleton and sediment material, neither good photographs of the polished colony surface, nor well preserved peels were obtained. The species has the smallest dimensions of all species (Fig. 5). A third sample from Greece assigned to this species differs only by the slightly higher density of septa (7 / 2 mm). The material described by Morycowa (1971) shows certain affinities to this species. Most figures in Morycowa (1971) illustrate oblique thin sections, what makes the comparison somehow difficult. The thin sections where recently (October 2009) searched at the collection of the Kraków Jagiellonian University but only the thin section figured on plate 10, figure 1d could be found.

Occurrence. Early Aptian of Monti d'Ocre, Fosso Cerasetti (Italy, Abruzzi, L'Aquila). Early Cenomanian of Nea Nikopolis (Greece, Kozani).

Felixigyra dollfusi Prever, 1909

Pl. 1, fig. 4

*v 1909 *Felixigyra Dollfusi* Prever, p. 121, pl. 12: 6, 6a

non v 2006 *Felixigyra dollfusi* Prever, 1909 - Löser & Ferry, p. 481, fig. 4.4, 4.5

Type: Holotype by monotypy is PU 18029.
Dimensions: (from the holotype; in mm)

	V min	V max	A	S
crw	0.62	0.92	0.814	0.1
crd	1.48	2.09	1.8	0.176
mt	0.65	1.14	0.975	0.173
sd	5 / 2 mm			

Description. A large colony with meandroid and meandroid-hydnophoroid calicular arrangement. The monticules form a loose meandroid network and long

parallel zig-zag lines giving the colony a meandroid appearance. Calicular centres are more visible where monticules are not arranged in lines. Calicular centres can be distinguished. The septa are compact, thick and probably in two size orders. The endotheca is unknown.

Remarks. The large colony is not sectioned, nor does there exist a polished surface. It is therefore not possible to give a more detailed description.

Occurrence. Early Aptian of Monti d'Ocre, Fosso Cerasetti (Italy, Abruzzi, L'Aquila).

Felixigyra duncani Prever, 1909

Pl. 1, figs 5, 6

*v 1909 *Felixigyra Duncani* Prever, p. 119, text-fig. 22, 23, pl. 11: 11, 11a, pl. 12: 4

non v 1964 *Felixigyra duncani* Prever, 1909 - Morycowa, p. 52, text-fig. 7, pl. 9: 5, pl. 10: 5

non 1973 *Felixgyra duncani* Prever - Turnšek & Mihajlovic, p. 97, pl. 2: 1-3, pl. 3: 1-2

non 1980 *Felixigyra duncani* Prever 1909 - Kuzmicheva, p. 95, pl. 35: 2

non 1987 *Felixigyra duncani* Prev. - Sokolov & Ivanovskij, pl. M-6: 5

non 1988 *Fellixigyra duncani* Prever, 1909 - Kuzmicheva & Aliev, p. 158, pl. 2: 2, pl. 9: 2

non v 1989 *Felixigyra duncani* Prever, 1909 - Morycowa, p. 63, pl. 29: 2, 3

non 2002 *Felixigyra duncani* Prever, 1909 - Kuzmicheva, p. 169, pl. 25:1

non 2003 *Felixigyra duncani* Prever, 1909 - Baron-Szabo et al., p. 208, pl. 37: 5

Type: Holotype by monotypy is PU 18030.
Dimensions: (from the holotype; in mm)

	V min	V max	A	S
crw	0.76	1.277	1.04	0.2
crd	1.526	2.5	1.96	0.4
mt	0.7	1.22	0.923	0.16
sd	4 / 2 mm			

Description. The small but well preserved colony mainly shows connected conical monticules forming a loose meandroid network without forming lines. Calicular centres are clearly visible. The monticules are very thick, their apophyses can be thick or thin. Calicular centres can be easily distinguished. The septa are compact, thick and often connected in the centre of the calices, mainly by dissepiments. Two generations of septa can be distinguished that alternate in thickness and length. Septa of the second generation can be very short and only marked by a thorn. The septa of the first cycle are occasionally rhopaloid. The lateral faces of the septa are sparsely dentated. The endotheca consists of thin tabulae and dissepiments. Dissepiments are slightly thinner and vesicular.

Occurrence. Early Aptian of Monti d'Ocre, Fosso Cerasetti (Italy, Abruzzi, L'Aquila).

Felixigyra taramellii Prever, 1909

Pl. 1, figs 7, 8

*v 1909 *Felixigyra Taramellii* Prever, p. 120, text-fig. 26, 27, pl. 11: 12, pl. 12: 1-3.

non v 1964 *Felixigyra taramelli* Prever, 1909 - Morycowa, p. 51, pl. 10: 4

Types: There exist four syntypes (PU 18031, pl. 12: 1; PU 18032; PU 18033, text-fig. 26, 27; 18034) of which 18033 is designated here as the lectotype because it has two well preserved thin sections. The remaining syntypes become paralectotypes.

Dimensions: (from the lectotype; in mm)

	V min	V max	A	S
crw	0.88	1.17	1.02	0.112
crd	1.26	2.17	1.8	0.3
mt	0.63	1	0.82	0.12
sd	5-6 / 2 mm			

Description. A large colony with meandroid and meandroid-hydnophoroid calicular arrangement. The monticules form a loose meandroid network and long parallel lines giving the colony a meandroid appearance. Calicular centres are more visible where monticules are not arranged in lines. Calicular centres can be easily distinguished. The septa are compact, relatively long, thick and often connected in the centre of the calices, directly or by dissepiments. Two generations of septa can be distinguished that alternate in thickness and length. The septa of the first generation are often rhopaloid. Their lateral faces are sparsely dentated. The endotheca consists of numerous thin tabulae and dissepiments.

Remarks.The septa are longer and thinner than in the type species, which can be also due to a better preservation of the lectotype of *F. taramellii*. The second septal generation is more visible in this material than in other samples of the genus.

Occurrence. Early Aptian of Monti d'Ocre, Fosso Cerasetti (Italy, Abruzzi, L'Aquila).

Felixigyra vaughani Prever, 1909

Fig. 6, Pl. 1, figs. 9-12

*v 1909 *Felixigyra Vaughani* Prever, text-fig. 24, 25, pl. 11: 10.
non v 2008 *Felixigyra* cf. *vaughani* Prever, 1909 - Löser, p. 49, pl. 2: 12

Types: Two syntypes (PU 18035, text-fig. 24, 25; 18036, pl. 11: 10) of which PU 18035 was designated as the lectotype (Löser 2008) because there exist two well preserved thin sections. PU 18036 became the paralectotype.

Dimensions: (from the lectotype; in mm)

	V min	V max	A	S
crw	0.67	1.29	0.95	0.167
crd	1.73	2.38	2.02	0.2
mt	0.57	1.14	0.8	0.14
sd	4 / 2 mm			

Description. The well preserved colony mainly shows connected conical and polygonal monticules forming a loose meandroid network where the monticules are slightly aligned and form very clear calicular centres. The monticules are very thick, their apophyses are mainly thick. Calicular centres can be distinguished very well. The septa are compact, thick and often connected in the centre of the calices, mainly by dissepiments. Two to rarely three (clearly due to good preservation) generations ("size orders") of septa can be distinguished, which alternate in thickness and length. Septa of the last generation are very short and only marked by a thorn. The septa of the first cycle are often rhopaloid. The lateral faces of the septa are sparsely dentated. There exist many rudimentary septa remaining in the monticule. They reach with the non-rudimentary septa between five to six septa per millimeter. The endotheca consists of thin tabulae and dissepiments. Dissepiments are slightly thinner and vesicular.

Remarks. From the lectotype two well preserved thin sections are available showing many details not observable in other thin sections. Here, the formation of calicular centres is more clearly visible than in all other samples. The lectotype of this species exposes the closest relationship to the genera *Rhipidomeandra* and *Wellsimeandra*.

Felixigyra sp.

Fig. 7

Dimensions: (in mm)

	V min	V max	A	S
crw	0.97	1.43	1.22	0.2
crd	2.17	2.7	2.44	0.38
mt	0.816	1.459	1.126	0.244
sd	6-7 / 2mm			

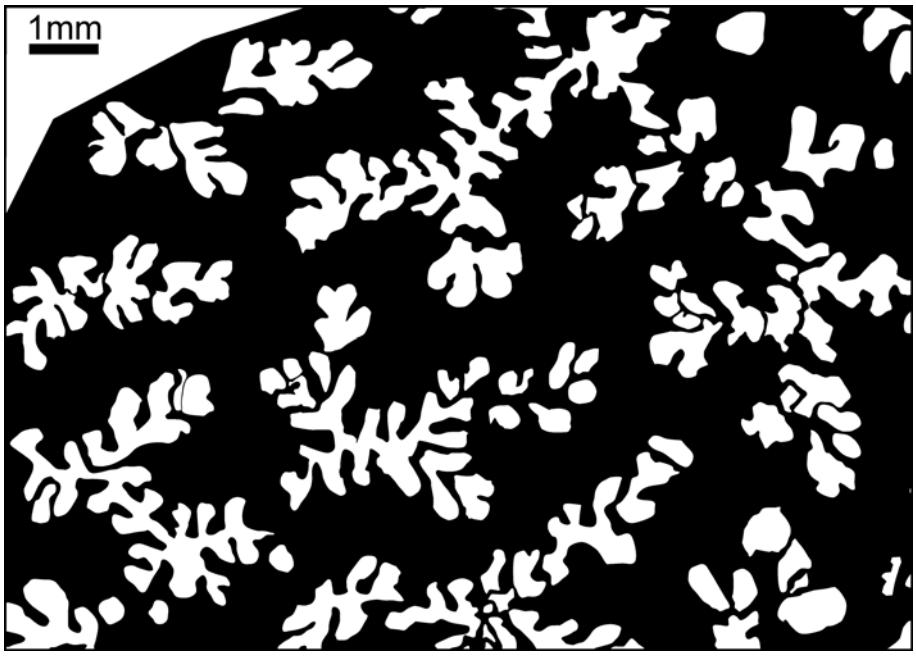


Fig. 6 - *Felixigyra vaughani* Prever, 1909. Drawing after a transverse thin section. PU 18035, lectotype of *Felixigyra vaughani*.

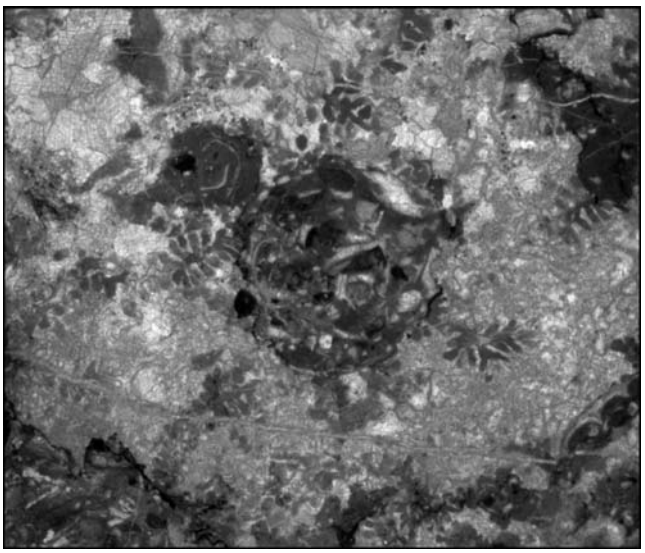


Fig. 7 - *Felixigyra* sp. Transversal thin section. Early Albian of Cerro de Oro, Mun. Ures, Sonora, Mexico. ERNO 3142. x 5.

Remarks. This species is represented by only one poorly preserved specimen. The calicular dimensions are larger than in all other samples, but it cannot be decided whether it qualifies the sample to represent a new species or not. More material is needed to decide this question.

Occurrence. Early Albian of Cerro de Oro (Municipio Ures, Sonora, Mexico).

Discussion

Species separation

The comparison of the calicular dimensions (Fig. 5) of the various (type) specimens gives no clear indication for the separation of species. The width of the calicular rows shows the lowest standard deviation making it the best characteristic to separate the species, but the differences between the samples are not significant. Moreover, for samples from which no thin sections were available, correct measurements could not be obtained. Except for *Felixigyra deangelisi,* which shows very small dimensions compared to all other species, and *Felixigyra* sp. which shows very large dimensions, the dimensions for all remaining samples fall in a range that would normally be considered one species.

Reclassification of *Felixigyra* s.l.

Very probably most published material assigned to *Felixigyra* after Prever (1909) does not correspond to *Felixigyra* s.s. and has to be assigned to *Eohydnophora* Yabe & Eguchi, 1936, which is a hydnophoroid coral that forms conical or polygonal monticules, but rarely elongated, straight or bent monticules. A revision of this genus would go beyond the scope of the present paper. Cretaceous species with conical monticules are traditionally assigned to *Hydnophora* or *Hydnophoraraea*. The difference between these two genera is not very clear because the type of *Monticularia styriaca* Michelin, 1847, type species of *Hydnophoraraea* is an unjustified neotype and has never been illustrated with the details of its fine structure. The relationship between the Cretaceous and extant hydnophoroid genera (respectively

PLATE 1

Fig. 1 - *Felixigyra deangelisi* Prever, 1909. Peel of a transverse section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18028, lectotype of *Felixigyra deangelisi*. x 6.5.

Fig. 2 - *Felixigyra deangelisi* Prever, 1909. Peel of a longitudinal section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18028, lectotype of *Felixigyra deangelisi*. x 6.5.

Fig. 3 - *Felixigyra deangelisi* Prever, 1909. Colony surface. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18028, lectotype of *Felixigyra deangelisi*. x 2.6.

Fig. 4 - *Felixigyra dollfusi* Prever, 1909. Colony surface. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18029, lectotype of *Felixigyra dollfusi*. x 2.

Fig. 5 - *Felixigyra duncani* Prever, 1909. Transverse thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18030, holotype of *Felixigyra dollfusi*. x 3.2.

Fig. 6 - *Felixigyra duncani* Prever, 1909. Longitudinal thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18030, holotype of *Felixigyra dollfusi*. x 3.2.

Fig. 7 - *Felixigyra taramellii* Prever, 1909. Transverse thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18033, lectotype of *Felixigyra taramellii*. x 4.5.

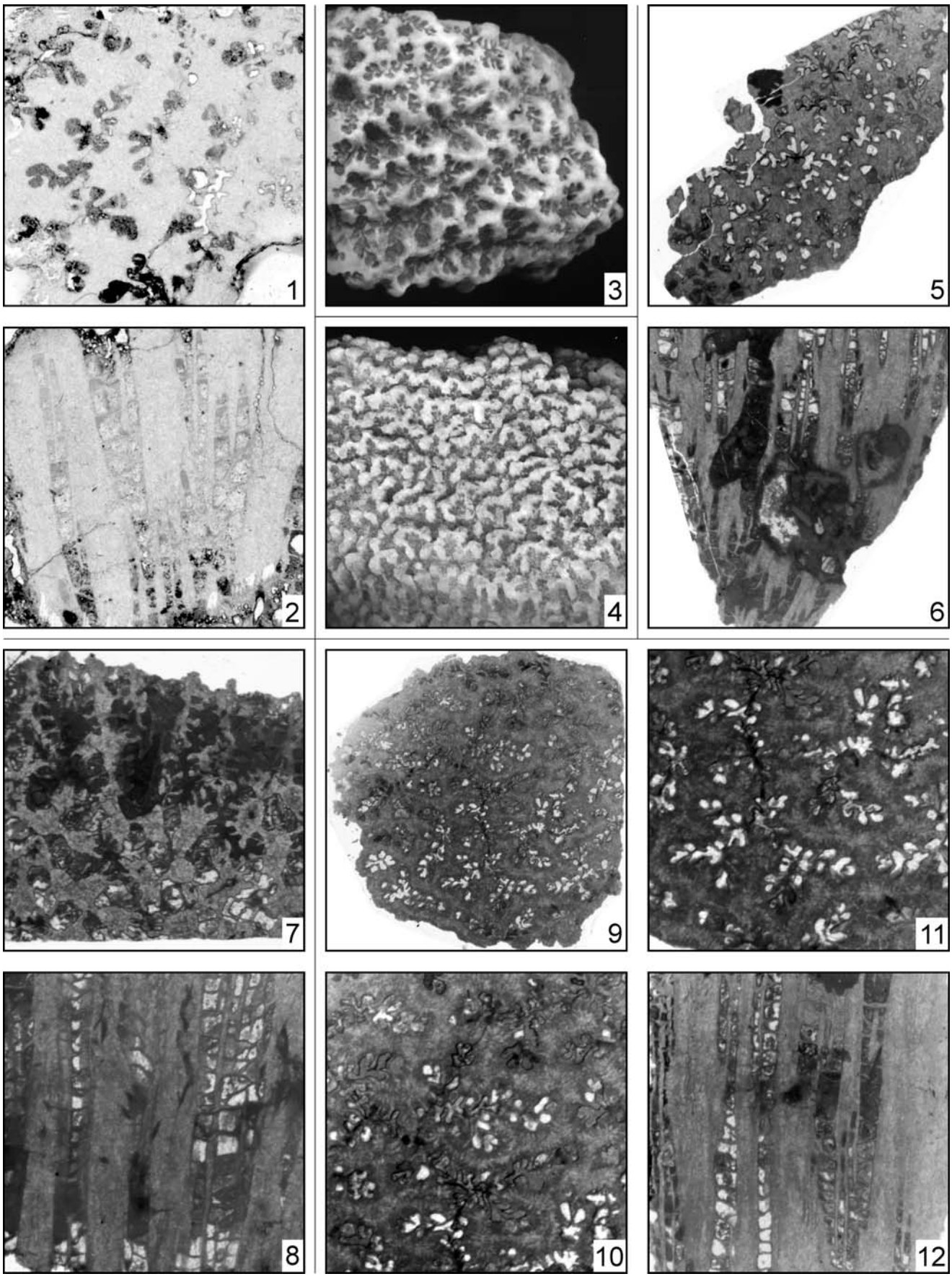
Fig. 8 - *Felixigyra taramellii* Prever, 1909. Longitudinal thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18033, lectotype of *Felixigyra taramellii*. x 4.5.

Fig. 9 - *Felixigyra vaughani* Prever, 1909. Transverse thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18035, lectotype of *Felixigyra vaughani*. x 2.7.

Fig. 10 - *Felixigyra vaughani* Prever, 1909. Transverse thin section, detail. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18035, lectotype of *Felixigyra vaughani*. x 5.2.

Fig. 11 - *Felixigyra vaughani* Prever, 1909. Transverse thin section, detail. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18035, lectotype of *Felixigyra vaughani*. x 5.2.

Fig. 12 - *Felixigyra vaughani* Prever, 1909. Longitudinal thin section. Early Aptian of Fosso Cerasetti, Monti d'Ocre, L'Aquila, Italy. PU 18035, lectotype of *Felixigyra vaughani*. x 4.5.


1
3
5
2
4
6
7
9
11
8
10
12

Endotheca Columella	Monticules	Barremian-Early Cenomanian	Late Turonian-Maastrichtian	Cenozoic-Extant
tabular, without columella	conical	?		
	polygonal elongated	*Eohydnophora*		
vesicular, with or without columella	conical, rarely polygonal		*Hydnophororaraea*	*Hydnophora*
	polygonal elongated			

Fig. 8 - Comparison of hydnophoroid coral genera of the suborder *Faviina*.

Hydnophororaraea and *Hydnophora*) has often been discussed (Felix 1903; Oppenheim 1930; Turnšek & Buser 1976) without coming to a satisfactory solution. Early Cretaceous (Barremian to Early Cenomanian) hydnophoroid corals of the Eugyridae family show an endotheca made of laterally extended tabulae, whereas Late Cretaceous (Late Turonian to Maastrichtian) and Cenozoic members of the family show a vesicular endotheca made up by dissepiments. Late Cretaceous and Cenozoic hydophoroid forms share the same type of endotheca, but they differ by the columella: Late Cretaceous hydnophoroid corals never expose a lamelar columella as Cenozoic members do (see Bosellini 1999). Whereas Cenozoic hydnophoroid corals of the family are all unified in one genus (*Hydnophora*) independent of whether they have conical, polygonal or elongated monticules, Early Cretaceous forms with conical monticules are traditionally separated from those with polygonal or elongated monticules: the forms with conical monticules are assigned to *Hydnophora*, *Hydnophororaraea* or *Eohydnophora*, whereas the forms with larger monticules were assigned to *Eohydnophora* (as *Felixigyra*). From the Turonian on, such a differentiation is not necessary because all forms show conical monticules and (in one and the same colony) only occassionally polygonal ones. Late Cretaceous hydnophoroid forms with elongated monticules do not exist. Fig. 8 illustrates the problem. For the Early Cretaceous forms with conical monticules a name is not available, except *Felixigyra* which shows monticules connected by apophyses, a character that is not found in other Early Cretaceous hydnophoroid corals with conical monticules. The question is whether a name is needed for hydnophoroid forms with conical monticules. Probably all hydnophoroid *Eugyridae* with a tabular endotheca should be unified under the name *Eohydnophora*, as was originally proposed by Yabe & Euchi (1936) when they erected the genus. This also implies the question of whether a (poorly defined) genus *Hydnophororaraea* is really needed – the Late Cretaceous hydnophoroid forms differs from the Cenozoic ones only by the absence of a lamelar columella.

Conclusions

The re-examination of the type of the type species and all other *Felixigyra* species shows that all *Felixigyra* material assigned after Prever (1909) to this genus, differ significantly from *Felixigyra* s.s.; *Felixigyra* s.s. is in reality a very rare genus and was only found at three localities world-wide. Species subsequently placed in this genus, and material assigned to species established by Prever need to be reclassified to the genus *Eohydnophora* Yabe & Eguchi, 1936.

Acknowledgements. I am grateful to Daniele Ormezzano, who allowed me to examine the material of the collection P.L. Prever kept at the Universita' degli Studi di Torino, Dipartimento di Scienze della Terra, Italy. Thanks go to Francesca Bosellini (Modena) for translating the abstract and comments on the manuscript. Insightful reviews by Boguslaw Kołodziej (Kraków) and Jacob Leloux (Leiden) have improved the paper. Thanks are also going to Maurizio Gaetani (Milano) for his patience with this difficult paper. For grammatical correction I would like to thank Brian Hallmark (Tucson) very much.

REFERENCES

Alsharhan A.S. (1997) - Mesozoic carbonate platform-basin systems, United Aarab Emirates. Guidebook. V. of 75 pp. Al Ain University, Al Ain.

Baron-Szabo R.C. & González León C. M. (2003) - Late Aptian-Early Albian corals from the Mural Limestone of the Bisbee Group (Tuape and Cerro de Oro areas), Sonora, Mexico. In: Scott R.W. (Ed.) - Bob F. Perkins Memorial Volume. *Spec. Publ. Geology*: 187-225.

Baron-Szabo R.C., Hamedani A. & Senowbari-Daryan B. (2003) - Scleractinian corals from Lower Cretaceous deposits north of Esfahan (Central Iran). *Facies*, 48: 199-216.

Baron-Szabo R.C. & Steuber T. (1996) - Korallen und Rudisten aus dem Apt im tertiären Flysch des Parnass-Gebirges bei Delphi-Arachowa. *Berliner geowiss. Abh.* (E), 18: 3-75.

Bosellini F.R. (1999) - The scleractinian genus *Hydnophora* (revision of Tertiary species). *Paläont. Z.*, 73: 217-240.

Brunn J.H. (1956) - Contribution à l'étude géologique du Pinde septentrional et d'une partie de la Macédoine occidentale. *Ann. géol. pays helléniques*, 7: 1-358.

Camoin G. (1983) - Plate-formes carbonatées et récifs à Rudistes du Crétacé de Sicile. *Trav. Lab. Géol. Hist. Paléont.*: 1-244.

Cherchi A., Castro P. de & Schroeder R. (1978) - Sulla età di livelli a Orbitolinidi della Campania e delle Murge Baresi (Italia meridionale). *Boll. Soc. Nat. Napoli*, 87: 1-24.

Chiocchini M., Mancinelli A. & Romano A. (1989) - The gaps in the middle-upper Cretaceous carbonate series of the southern Apennines (Abruzzi and Campania regions). *Geobios Mém. Spéc.*, 11: 133-149.

Felix J. (1903) - Studien über die korallenführenden Schichten der oberen Kreideformation in den Alpen und den Mediterrangebieten (1) Die Anthozoën der Gosauschichten in den Ostalpen. *Palaeontographica*, 49: 163-360.

Kuzmicheva E.I. (1980) - [Corals]. In: Chernov V.G., Yanin B.T., Golovinova M.A. & et al. (Eds) - [Urgonian sediments of the Soviet Carpathes]: 90-108, Moskva.

Kuzmicheva E.I. & Aliev O.B. (1988) - [Corals]. In: Ali-Zade A.A., Aliev G.A. & Aliev M.M. (Eds) - [Cretaceous fauna of Azerbaijan]: 153-184, Baku.

Kuzmicheva E.I. (2002) - [Skeletal morphology, systematics and evolution of the Scleractinia]. *Tr. Paleont. Inst.*, 286: 1-211.

Löser H. (1998) - Remarks on the Aulastraeoporidae and the genus *Aulastraeopora* (Scleractinia; Cretaceous) with the description of a new species. *Abh. Ber. Naturk. Vorgeschichte*, 20: 59-75.

Löser H. (2008) - Early Cretaceous coral faunas from East Africa (Tanzania, Kenya; Late Valanginian-Aptian) and revision of the Dietrich collection (Berlin, Germany). *Palaeontographica*, 285, 1/3: 23-75.

Löser H. (2009) - Fossile Korallen aus Jura und Kreide. Aufbau, Klassifikation, Bestimmung und Fundmöglichkeiten. V. of 216 pp. CPress, Dresden.

Löser H., Barattolo F., Calzada Badia S., Chikhi-Aouimeur F., Dhondt A., Erlich R.N., Főzy I., Geister J., Hiss M., Kołodziej B., Leloux J., Lewy Z., Minor K.P., Mitchell S., Moosleitner G., Peza L., Remane J., Romana R., Sikharulidze G.Y., Sinnyovski D., Steuber T., Tröger K.-A., Turnšek D., Vecchio E., Vilella i Puig J. & Žítt J. (2002). - List of Citations. *Cat. Cretaceous Corals*, 2: 1-784.

Löser H. & Ferry S. (2006) - Coraux du Barrémien du Sud de la France (Ardèche et Drôme). *Geobios*, 39: 469-489.

Löser H. & Minor K. (2007) - Palaeobiogeographic aspects of Late Barremian to Late Albian coral faunas from Northern Mexico (Sonora) and the southern USA (Arizona, Texas). *N. Jb. Geol. Paläont., Abh.*, 245: 193-218.

Masse J.P., Gallo Maresca M. & Luperto Sinni E. (1998) - Albian rudist faunas from southern Italy: taxonomic, biostratigraphic and palaeobiologic aspects. *Geobios*, 31: 47-59.

Masse J.P. & Morycowa E. (1994) - Les Scléractiniaires hydnophoroïdes du Crétacé inférieur (Barrémien-Aptien inférieur) de Provence (S.E. de la France). Systématique, stratigraphie et paléobiogéographie. *Geobios*, 27: 433-448.

Matthews S.C. (1973) - Notes on open nomenclature and on synonymy lists. *Palaeontology*, 16, 4: 713-719.

Morycowa E. (1964) - Hexacoralla des couches de Grodziszcze (Néocomien Carpathes). *Acta Palaeont. Polon.*, 9: 1-114.

Morycowa E. (1971) - Hexacorallia et Octocorallia du Crétacé inférieur de Rarau (Carpathes orientales roumaines). *Acta Palaeont. Polon.*, 16: 1-149.

Morycowa E. (1989) - Class Anthozoa Ehrenberg, 1834. In: Malinowski L. (Ed.) - Geology of Poland (3:) Atlas of guide and characteristic fossils (2c:) Mesozoic, Cretaceous: 58-67, Warszawa.

Morycowa E. (1997) - Some remarks on *Eugyra* de Fromentel, 1857 (Scleractinia, Cretaceous). *Bol. Real Soc. Esp. Hist. Nat.*, 91: 287-295.

Oppenheim L.P. (1930) - Die Anthozoen der Gosauschichten in den Ostalpen. V. of 604 pp. Privately published, Berlin.

Parona C.F. (1909) - La fauna coralligena del Cretaceo dei Monti d'Ocre nell'Abruzzo Aquilano. *Mem. descr. Ct. geol. Ital.*, 5, 1: 1-233.

Prever P.L. (1909) - Anthozoa. In: Parona C.F. (Ed.) - La fauna coralligena del Cretaceo dei Monti d'Ocre nell'Abruzzo Aquilano. *Mem. descr. Ct. geol. Ital.*, 5, 1: 51-147.

Schöllhorn E. (1998) - Geologie und Paläontologie des Oberapt im Becken von Organyà (Nordspanien). *Coral Res. Bull.*, 6: 1-139.

Sokolov B.S. & Ivanovskij A.B. (1987) - [Reefs and reef-building organisms]. V. of 293 pp. Nauka, Moskva.

Steuber T. & Löser H. (1997) - Cenomanian coral-rudist associations near Kozani (Northern Greece). *GeoArabia*, 2: 494.

Tomás S., Löser H. & Salas Roig R. (2008) - Low-light and nutrient-rich coral assemblages in an Upper Aptian carbonate platform of the southern Maestrat Basin (Iberian Chain, eastern Spain). *Cretaceous Res.*, 29: 509-534.

Turnšek D. & Buser S. (1976) - Knidarijska favna iz senonijske brece na Banjski Planoti. *Razpr. Slovenska akad. znanosti umetnosti*, (4), 19: 37-88.

Turnšek D. & Mihajlovic M. (1973) - Prikaz koralske faune titonskih krecnjaka Srbije. 28: 93-129, Beograd.

Veron J.E.N. (2000) - Corals of the World. V. of 3 tomes. AIMS, Townsville.

Veron J.E.N., Pichon M. & Wijsman-Best M. (1977) - Scleractinia of Eastern Australia (2) Families Faviidae,

Trachyphylliidae. *Australian Inst. Mar. Sci. Monogr. Ser.*, 3: 1-233.

Wells J.W. (1936) - The nomenclature and type species of some genera of recent and fossil corals. *Am. J. Sci.*, (5), 31, 182: 97-134.

Wells J.W. (1956) - Scleractinia. In: Moore R.C. (Ed.) -Treatise on Invertebrate Paleontology: F328-444, Lawrence, Kan.

Yabe H. & Eguchi M. (1936) - *Eohydnophora*, a new genus of Cretaceous corals. *Proc. Imp. Acad. Japan*, 12: 141-143.