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Reassignment to the Middle Devonian of some rugose corals investigated by LE MAÎTRE (1934) in the Chalonnes Formation from the Southeastern Armorican Massif (France)

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Abstract

Nine taxa of rugose corals collected by LE MAÎTRE (1934) and coming from the Chalonnes Formation of the Southeastern Armorican Massif in France have been revised. They belong to the genera *Stringophyllum* WEDEKIND, 1922, *Sociophyllum* BIRENHEIDE, 1962, *Acanthophyllum* DYBOWSKI, 1873, *Beugniesastraea* COEN-AUBERT, 1989 and *Fasciphyllum* SCHLÜTER, 1885. Among this material, *Stringophyllum acanthicum* (FRECH, 1885), *Sociophyllum elongatum* (SCHLÜTER, 1881), *Acanthophyllum vermiculare* (GOLDFUSS, 1826) and *A. tortum* (TSIEN, 1969) occur close to the Eifelian-Givetian boundary, on the south side of the Dinant Synclinorium in Belgium. Moreover, the first three species have been defined in the Middle Devonian of the Eifel Hills in Germany and they are observed in the Late Eifelian and the Early Givetian of this area. For comparison, *A. heterophyllum* (MILNE-EDWARDS & HAIME, 1851) and *Sociophyllum* cf. *elongatum* sampled by LE MAÎTRE (1934) in the Late Emsian Valet Formation from the Southeastern Armorican Massif have also been investigated. The Belgian material of *Stringophyllum acanthicum* is included in the systematic description of this taxon.

Keywords: Rugose corals, Chalonnes Formation, Devonian, France.

Résumé

Neuf taxons de Rugueux récoltés par LE MAÎTRE (1934) et provenant de la Formation de Chalonnes, dans le Sud-Est du Massif Armoricain ont été révisés. Ils appartiennent aux genres *Stringophyllum* WEDEKIND, 1922, *Sociophyllum* BIRENHEIDE, 1962, *Acanthophyllum* DYBOWSKI, 1873, *Beugniesastraea* COEN-AUBERT, 1989 et *Fasciphyllum* SCHLÜTER, 1885. Au sein de ce matériel, *Stringophyllum acanthicum* (FRECH, 1885), *Sociophyllum elongatum* (SCHLÜTER, 1881), *Acanthophyllum vermiculare* (GOLDFUSS, 1826) et *A. tortum* (TSIEN, 1969) sont présents près de la limite Eifelien-Givetien, au bord sud du Synclinorium de Dinant en Belgique. De plus, les trois premières espèces ont été définies dans le Dévonien moyen de l'Eifel en Allemagne et sont observées dans l'Eifelien supérieur et le Givetien inférieur de cette région. A titre de comparaison, *A. heterophyllum* (MILNE-EDWARDS & HAIME, 1851) et *Sociophyllum* cf. *elongatum* échantillonnés par LE MAÎTRE (1934) dans la Formation de Valet du Sud-Est du Massif Armoricain, qui est datée de l'Emsien supérieur, ont également été étudiés. Le matériel belge de *Stringophyllum acanthicum* est inclus dans la description de ce taxon.

Mots-clefs: Rugueux, Formation de Chalonnes, Dévonien, France.

Introduction

This paper is devoted to the partial revision of the rugose corals collected by LE MAÎTRE (1934) in the Chalonnes Formation from the Southeastern Armorican Massif. From a systematic point of view, it concerns the genera *Stringophyllum* WEDEKIND, 1922, *Sociophyllum* BIRENHEIDE, 1962, *Acanthophyllum* DYBOWSKI, 1873, *Beugniesastraea* COEN-AUBERT, 1989 and *Fasciphyllum* SCHLÜTER, 1885.

The Chalonnes area is situated 32 km to the east of Ancenis, at the eastern end of the Ancenis Basin as this geological structure was called by LE MAÎTRE (1934). Detailed locality and geological maps of the Chalonnes-Chaudefonds area have been published by LE MAÎTRE (1934, fig. 1), DUBREUIL & VACHARD (1979, p. 242), DUCASSOU *et al.* (2009, figs 1-2) and BALLEVRE *et al.* (2010, figs 1-2). As it appears from the two latter papers and also from LARDEUX (2009) and STRULLU-DERRIEN *et al.* (2010), the tectonic structure of the investigated area is highly complicated and characterized by two main units. The southern unit named Châteaupanne Unit consists of Ordovician marine sediments, unconformably overlain by the reefal limestones of the Chalonnes Formation, followed by the Sainte-Anne

Formation. The Chalonnes Formation is represented by several large lenses of massif limestone irregularly distributed between Liré to the south of Ancenis and La Fresnaye to the east of Chaudefonds as it is shown on the map of DUBREUIL & VACHARD (1979). Most lenses occur between Montjean and Chaudefonds (Fig. 1) and it is in this area that are located the three outcrops described herein, namely the Châteaupanne quarry at Montjean, the Station quarry at Chalonnes and the Saint-Charles quarry at Chaudefonds. The Chalonnes Formation is abruptly capped by shales and sandstones

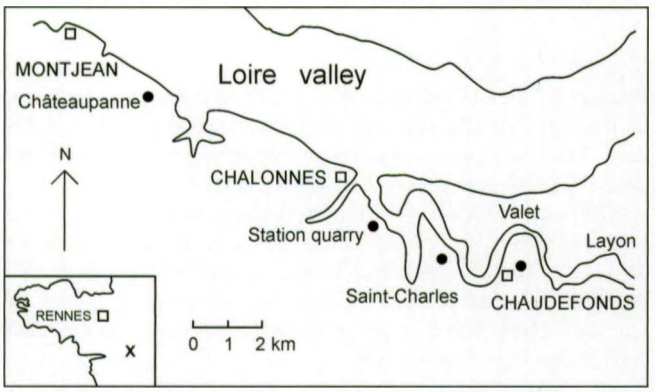

Fig. 1 – Location map of the quarries concerned by this paper at Montjean, Chalonnes and Chaudefonds in the southeastern Armorican Massif.

with plant remains characteristic of the Sainte-Anne Formation, reaching a thickness of several tens of metres.

The northern structural unit named Tombeau Leclerc Unit is separated from the Châteaupanne Unit by a southward thrust and it is represented by an Upper Ordovician to Lower Devonian condensed sequence with an inverted polarity. Contrary to the Chalonnes Formation, there are only isolated Devonian lenses in this unit such as the La Grange Limestone or the Valet Limestone. The La Grange Limestone has been dated as Emsian by BULTYNCK (1989), on the basis of conodonts. The Valet Limestone named Chaudefonds Limestone by LE MAÎTRE (1934) is only known in the disused Valet quarry at Chaudefonds and is younger than the La Grange Limestone; indeed, Late Emsian conodonts have been found in this outcrop by LARDEUX & WEYANT (1993). For comparison, two species of *Acanthophyllum* and *Sociophyllum* collected by LE MAÎTRE (1934) in the Valet quarry have also been studied.

According to BLAISE *et al.* (1986, p. 22) and BALLEVRE *et al.* (2010, p. 245), conodonts are lacking in the Chalonnes Formation and its age is still controversial. This lithostratigraphic unit was considered as Emsian to Early Eifelian by LE MAÎTRE (1934) after a detailed study of the rugose and tabulate corals, stromatoporoids, brachiopods and bivalves. However DUBREUIL & VACHARD (1979) identified Givetian amphiporids, foraminifers and algae in the Chalonnes Formation. In the recent papers of DUCASSOU *et al.* (2009), BALLEVRE *et al.* (2010) and STRULLU-DERRIEN *et al.* (2010), an Emsian to Early Eifelian age is proposed for the overlying Sainte-Anne Formation.

As it results from this study, the association of rugose corals investigated herein in the Chalonnes Formation is very similar to that from the south side of the Dinant Synclinorium in Belgium, close to the Eifelian-Givetian boundary. One important taxon of this fauna is the species *Stringophyllum acanthicum* (FRECH, 1885), already identified by LE MAÎTRE (1934, p. 159), but never revised by the author of this paper. Therefore, the Belgian material of *S. acanthicum* is included in the systematic description of this taxon.

All the types, figured specimens and coralla belonging to the collection of LE MAÎTRE (1934) are housed in the Faculté Libre des Sciences et Technologies at Lille in France (abbreviation GFCL). The Belgian illustrated specimens of *S. acanthicum* are stored in the Institut royal des Sciences naturelles de Belgique at Brussels (abbreviation IRScNB), whereas old thin sections of this species are referred herein to the "Old collection from the Institut royal des Sciences naturelles de Belgique".

Description of the outcrops from the Ancenis Syncline

The collection of LE MAÎTRE (1934) consists mainly of fossil corals collected by herself *in situ* and among the blocks excavated in the active quarries; moreover, she received samples from the directors of these outcrops. The material includes also some specimens from older collections such as that of L. Bureau. In the Chalonnes Formation, most coralla are fragmentary and it is not possible to know from which precise levels of the active quarries they are coming. The distribution of the rugose coral taxa in the different outcrops described herein is given in Figure 2.

Saint-Charles Quarry at Chaudefonds

This quarry active until 1967 is lying 2 km to the west of the village of Chaudefonds and has provided a diversified fauna of rugose corals to LE MAÎTRE (1934).

	Saint-Charles quarry at Chaudefonds	Châteaupanne quarry at Montjean	Station quarry at Chalonnes	Valet quarry at Chaudefonds
Stringophyllum acanthicum	1			
Sociophyllum elongatum		**2**		
Sociophyllum cf. *elongatum*				**1**
Sociophyllum sp.	1			
Acanthophyllum heterophyllum				**1**
Acanthophyllum vermiculare	7			
Acanthophyllum tortum	2			
Acanthophyllum sp.	1			
Beugniesastraea ligeriensis			1	
Fasciphyllum cf. *conglomeratum*		**1**	1	
Fasciphyllum cf. *katranicum*		1		

Fig. 2 – Distribution of the rugose coral taxa identified in the different quarries from the Southeastern Armorican Massif, with the number of specimens indicated for each outcrop.

It has been described in detail by this author and by LARDEUX (2009). Below the Saint-Charles quarry were exposed in the past Ordovician shales. The Chalonnes Formation is 130 m thick according to LE MAÎTRE (1934) and 150 m thick according to LARDEUX (2009). It comprises several levels rich in stromatoporoids and corals including heliolitids, favositids, solitary and fasciculate rugose corals; the latter are represented among others by *Stringophyllum acanthicum*, *Acanthophyllum vermiculare* (GOLDFUSS, 1826), *A. tortum* (TSIEN, 1969), *A.* sp. and *Sociophyllum* sp. The reefal limestone is typically massive in the middle part of the Chalonnes Formation whereas brachiopods are locally abundant in its upper part. The Chalonnes Formation is overlain by shales and sandstones from the Sainte-Anne Formation.

Châteaupanne Quarry at Montjean

The great and still active quarry of Châteaupanne at Montjean is located 5 km to the west of Chalonnes. It has been investigated by LE MAÎTRE (1934) and CAVET *et al.* (1970, p. 14) who noted respectively a thickness of 120 m to 130 m and about 100 m for the Chalonnes Formation. Once more, the Chalonnes Limestone shows several levels with various corals and stromatoporoids including amphiporids. There are rather few specimens of rugose corals in the collection of LE MAÎTRE (1934). Among them, I have identified small corallites of *Sociophyllum elongatum* (SCHLÜTER, 1881), *Fasciphyllum* cf. *conglomeratum* (SCHLÜTER, 1881) and *F.* cf. *katranicum* (GORIANOV, 1968 *in* BULVANKER *et al.*, 1968), which were not figured by LE MAÎTRE (1934).

As mentioned already by CAVET *et al.* (1970), there are shales below the Chalonnes Limestone in the Châteaupanne quarry. These layers have been studied recently by STRULLU-DERRIEN *et al.* (2010) who consider them as the basal member of the Chalonnes Formation. They consist in fact of bluish shales and sandstones with plant remains. They have also yielded acritarchs, which are partially reworked from the Late Ordovician and spores whose assemblages indicate a Pragian to Early Emsian age. According to the geological map from the southern working face of the Châteaupanne quarry provided by STRULLU-DERRIEN *et al.* (2010, fig. 3), several small, normal and strike-slip faults affect the Ordovician basement and the basal member of the Chalonnes Formation.

In the Châteaupanne quarry, the Chalonnes Formation is capped by the sandstones of the Sainte-Anne Formation, which contain abundant plant debris and only rare brachiopods and crinoids. Several poorly preserved specimens of crinoids and *Plectodonta minor*, collected by PENEAU (1928) in the old Châteaupanne quarry, have been illustrated recently by BALLEVRE *et al.* (2010, figs 4A-G). After discussing the geographical and stratigraphical distribution of the brachiopod *P. minor* throughout France, Germany, the Czech Republic, Spain and Morocco, these authors propose an Emsian to Early Eifelian age for the Sainte-Anne Formation. It must be added however that PENEAU (1928, pp. 98-100 and figs 2-4) described and figured a disrupted contact between the Chalonnes and Sainte-Anne Formations; according to this author, the shales and sandstones with plants of the latter lithostratigraphic unit are folded in a small overturned

anticline whose inverted limb is crushed against the Chalonnes Limestone. These observations seem to be confirmed by SHELLEY & BOSSIERE (2001, p. 1601) who mentioned also various tectonic disruptions in the limestones of the Châteaupanne quarry.

An Emsian age is also suggested by DUCASSOU *et al.* (2009), for the Sainte-Anne Formation from the Châteaupanne quarry, on the basis of the floristic content. But the plant debris of this outcrop are badly preserved and difficult to identify, whereas the acritarchs are mainly ubiquitous and not stratigraphically discriminant. As for the spore assemblage found in the Sainte-Anne Formation, it is similar to those from Lower Devonian localities after DUCASSOU *et al.* (2009).

Station Quarry at Chalonnes

This quarry lying 500 m to the south of the station of Chalonnes is now disused and flooded. It was still active at the time of LE MAÎTRE (1934) who described it and mentioned a thickness of about 150 m for the Chalonnes Formation. Once more, the reefal limestone may be massive in the lower part of the lithostratigraphic unit where it contains stromatoporoids, heliolitids, favositids and branching tabulate corals with a few amphiporids. Brachiopods are locally abundant in the upper part of the Chalonnes Formation, whereas a thin level with amphiporids occurs at the top of the quarry. Some massive, fasciculate and solitary rugose corals coming from this outcrop are present in the collection of LE MAÎTRE (1934), with more especially her new species *Beugniesastraea ligeriensis* (LE MAÎTRE, 1934) and one corallite of *Fasciphyllum* cf. *conglomeratum*.

Valet Quarry at Chaudefonds

For comparison, *Acanthophyllum heterophyllum* (MILNE-EDWARDS & HAIME, 1851) and *Sociophyllum* cf. *elongatum* coming from the Valet quarry at Chaudefonds and figured by LE MAÎTRE (1934) have also been investigated. This excavation, located less than 1 km to the northeast of Chaudefonds, was already disused and flooded at the time of LE MAÎTRE (1934). It shows the Valet Limestone, formerly named Chaudefonds Limestone, and has been described by LE MAÎTRE (1934), BLAISE *et al.* (1986, p. 25) and LARDEUX & WEYANT (1993). According to the two latter papers, the layers are in normal position and dipping to the southwest, whereas LE MAÎTRE (1934) considered that they are dipping to the northeast. Many fossils such as solitary and fasciculate rugose corals, heliolitids, brachiopods and trilobites are present in a bed of crinoidal limestone exposed in the northeast corner of the Valet quarry. This place was named Valet A by LE MAÎTRE (1934) who collected also some material in a temporary trench named Valet B, situated to the south of the quarry. *Acanthophyllum heterophyllum* is recorded in this outcrop, probably positioned rather high in the Valet Limestone. LE MAÎTRE (1934) also mentioned the occurrence of three specimens of *Calceola sandalina* in level Valet A, but did not illustrate them. At the end of her study, she proposed a Late Emsian to Early Eifelian age for the fauna of the Valet quarry. Conodonts were found in several samples of this outcrop by LARDEUX & WEYANT (1993) who assigned them to the *Polygnathus serotinus* Zone, characteristic of the Late Emsian.

Geological setting of the Belgian material

The Belgian material referred in this paper to *Stringophyllum acanthicum* comes from the south side of the Dinant Synclinorium, close to the Eifelian-Givetian boundary. In this area (Fig. 4), the Eifelian is represented in ascending order by the top of the Eau Noire Formation, the Couvin and Jemelle Formations and the lower part of the Hanonet Formation. The Givetian starts within the Hanonet Formation, which is succeeded by the Trois-Fontaines and Terres d'Haurs Formations.

Some specimens of *S. acanthicum* have been collected by the author in the Hanonet Formation from the railway section of Pondrôme (outcrop Houyet MC-1981-5) and the Resteigne quarry (outcrop Wellin MC-1974-95). One corallum is coming from the base of the Trois-Fontaines Formation in the small quarry located to the southwest of the Fondry des Chiens at Nismes (outcrop Olloy-sur-Viroin MC-1983-5). In these three outcrops described in detail by COEN-AUBERT (1996, 1997 and 1998), *S. acanthicum* is associated with *A. vermiculare*, *A. tortum* and *Sociophyllum torosum* (SCHLÜTER, 1881). Several samples of *Stringophyllum acanthicum* have been found among old collections at Brussels, in the Hanonet Formation from the La Couvinoise quarry at Couvin (outcrop Couvin 8708), which has been investigated by BULTYNCK & HOLLEVOET (1999). Finally, *S. acanthicum* has also been observed by the author in a bioherm occurring in the upper part of the Jemelle Formation, at the place named Devant les Tiennes, lying 1100 m to the northeast of Wellin (outcrop Wellin MC-27; Lambert coordinates: x= 203,925 and y= 87).

To be complete, it is interesting to mention that the Trois-Fontaines Formation revised among others by COEN-AUBERT (2008) starts with coarsely

Identifications of LE MAÎTRE (1934)	This paper
Endophyllum (Schizophyllum) acanthicum FRECH	*Stringophyllum acanthicum* (FRECH, 1885)
Spongophyllum oehlerti NICHOLSON	*Sociophyllum elongatum* (SCHLÜTER, 1881)
	Sociophyllum cf. *elongatum* (SCHLÜTER, 1881)
Endophyllum cf. *buchelense* SCHLÜTER	*Sociophyllum* sp.
Cyathophyllum (Rhopalophyllum) heterophyllum MILNE-EDWARDS & HAIME	*Acanthophyllum heterophyllum* (MILNE-EDWARDS & HAIME, 1851)
Cyathophyllum (Leptoinophyllum) vermiculare praecursor FRECH	*Acanthophyllum vermiculare* (GOLDFUSS, 1826)
Cyathophyllum (Astrophyllum) gerolsteinense WEDEKIND	*Acanthophyllum vermiculare* (GOLDFUSS, 1826)
Cyathophyllum torquatum SCHLÜTER	*Acanthophyllum vermiculare* (GOLDFUSS, 1826)
Cyathophyllum dianthus GOLDFUSS	*Acanthophyllum* sp.
Spongophyllum ligeriense sp. nov.	*Beugniesastraea ligeriensis* (LE MAÎTRE, 1934)

Fig. 3 – Correlation between the taxonomic names of rugose corals used by LE MAÎTRE (1934) and the taxonomic names revised herein.

crinoidal limestones which often contain colonial rugose corals, including *Sociophyllum elongatum*, *S. torosum*, *Beugniesastraea kunthi* (SCHLÜTER, 1880), *B. parvistella* (SCHLÜTER, 1882), *Fasciphyllum katranicum* and *F. conglomeratum*. Then, a biostrome with massive stromatoporoids is capped by a stringocephalid coquina, whereas the upper part of the lithostratigraphic unit is mainly composed of lagoonal limestones. *F. conglomeratum* occurs also at the base of the X Formation at Wellin; the latter unit consists of bedded or massive crinoidal limestones often rich in corals and stromatoporoids and it is correlated laterally at Wellin with the top of the Jemelle Formation and the lower part of the Hanonet Formation.

Systematic Palaeontology

The relationship between the taxonomic names of rugose corals used herein and the identifications of LE MAÎTRE (1934) is shown in Figure 3.

Family Stringophyllidae WEDEKIND, 1922
Genus *Stringophyllum* WEDEKIND, 1922

Type species: By subsequent designation of WEDEKIND (1925, p. 64), *Stringophyllum normale* WEDEKIND, 1922.

Diagnosis
Solitary rugose corals. Septa of two orders, rather thick and consisting of coarse monacanthine trabeculae. Septa sometimes continuous from the wall to the axis of the corallum, but more often discontinuous or even disrupted at the periphery by presepiments. Major septa bilaterally arranged and reaching usually the centre of the tabularium where they are occasionally breaking up into isolated trabeculae. Minor septa discontinuous, represented by short segments and spines which may be lacking totally. Dissepimentarium composed of several rows of elongate dissepiments. Tabulae complete or incomplete, normally concave.

Stringophyllum acanthicum (FRECH, 1885)
Pl. 1, Figs 1-6; Pl. 2, Figs 8-9; Pl. 3, Fig. 4

* 1885 — *Endophyllum acanthicum* nov. sp. - FRECH, p. 929, pl. 41, fig. 5.
p. 1886 — *Endophyllum acanthicum* Frech - FRECH, p. 87, pl. 6, fig. 4 (*non* pl. 6, figs 1-3)
non 1894 — *Endophyllum acanthicum* Frech - FRECH, p. 443, fig. 6.
non 1908 — *Endophyllum acanthicum*, Frech? - REED, p. 8, pl. 2, fig. 5.
non 1911 — *Endophyllum acanthicum* Frech - FRECH, p. 53, pl. 8, fig. 4.
v 1922 — *Stringophyllum difficile* n. sp. - WEDEKIND, p. 10, fig. 8.
1925 — *Schizophyllum acanthicum* Frech - WEDEKIND, p. 60, pl. 13, fig. 78.
v 1925 — *Schizophyllum duplex* Wedekind - WEDEKIND, p. 63, pl. 12, fig. 73.
1932 — *Schizophyllum acanthicum* (Frech) - KETTNEROVA,

p. 50, figs 35-36.
v 1934 — *Endophyllum (Schizophyllum* Wedekind) *acanthicum* Frech - LE MAÎTRE, p. 159, pl. 6, fig. 13.
v 1947 — *"Schizophyllum" acanthicum* Frech – LE MAÎTRE, p. 50, pl. 5, figs 1-3, 10.
1950 — *Stringophyllum acanthicum* Frech - TERMIER & TERMIER , p. 97, pl. 46, fig. 19.
non 1952 — *Stringophyllum duplex* Wdkd - SOSHKINA, p. 94, pl. 33, fig. 111.
non 1952 — *Stringophyllum difficile* Wdkd - SOSHKINA, p. 95, pl. 33, fig. 115.
v p. 1969 — *Stringophyllum acanthicum* (Frech), 1885 - TSIEN, p. 30, pl. 32, figs 1-2, 4-7 (*non* fig. 3).
v 1969 — *Stringophyllum duplex* (Wedekind), 1927- TSIEN, p. 35, pl. 4, fig. 4.
v p. 1969 — *Stringophyllum büchelense* (Schlüter), 1889 - TSIEN, p. 33, pl. 32, fig 9 (*non* pl. 4, figs 1-3, pl. 32, figs 8, 10).
? 1972 — *Stringophyllum duplex* (Wedekind), 1925 - SHURIGINA, p. 101, pl. 35, fig. 4 (*non* figs 3, 5).
v *non* 1974 — *Stringophyllum acanthicum* (Frech, F., 1885) - TSIEN, p. 259, fig. 2.
v 1974 — *Stringophyllum duplex* (Wedekind, R., 1925) - TSIEN, p. 265, fig. 8.
v *non* 1975 — *Stringophyllum acanthicum* - TSIEN, fig. 15a.
v p. 1978 — *Stringophyllum acanthicum* (Frech 1885) - BIRENHEIDE, p. 152, pl. 19, fig. 1a (*non* figs 1b-c)
non 1978 — *Stringophyllum duplex* Wedekind - HE, p. 152, pl. 75, fig. 3.
non 1980 — *Stringophyllum difficile* Wedekind, 1921- IVANIA, p. 37, pl. 9, figs 44-45, pl. 16, fig. 77.
1984 — *Stringophyllum acanthicum* (Frech, 1885) - LÜTTE, p. 201, fig. 8, pl. 6, figs 1-4.
non 1987 — *Stringophyllum acanthicum* (Frech) - CAO & OUYANG, p. 162, pl. 30, fig. 8.
non 1988 — *Stringophyllum acanthicum* (Frech 1885) - LÜTTE & OEKENTORP, p. 235, figs 4b-c.
non 1988 — *Stringophyllum duplex* (Wedekind) - HE & FAN, pl. 29, fig. 1.
non 1989 — *Stringophyllum duplex* Wedekind, 1925 - WANG *et al.*, p. 98, pl. 5, fig. 3., pl. 34, figs. 1-6.
non 1995a — *Stringophyllum* cf. *acanthicum* (Frech 1885) - SCHRÖDER, p. 398, pl.4, figs 24-27.
non 1995b — *Stringophyllum acanthicum* (Frech 1885) - SCHRÖDER, p. 48, pl. 5, fig. 26, pl. 6, fig. 27.
p. 1995b — *Stringophyllum* cf. *acanthicum* (Frech 1885) - SCHRÖDER, p. 49, pl. 5, fig. 25, (*non* pl. 6, figs 28-29).
non 1997a — *Stringophyllum* cf. *acanthicum* (Frech 1885) - SCHRÖDER, p. 213, pl.1, fig. 2.
non 1998 — *Stringophyllum acanthicum* (Frech 1885) - SCHRÖDER, p. 59, pl. 13, fig. 84.
non 2004 — *Stringophyllum acanthicum* Frech, 1885 - SCHRÖDER, p. 610, pl. 4, fig. 5.
2005 — *Stringophyllum* cf. *acanthicum* (Frech, 1885) - SCHRÖDER, pl.10, fig. 1.

Holotype

Pl. 41, fig. 5 *in* FRECH (1885) and pl. 13, fig. 78 *in* WEDEKIND (1925). Specimen from the Middle Devonian of Blankenheim in the Eifel Hills, Germany which was probably stored in the Museum für Naturkunde from the Humboldt University of Berlin in Germany, according to SCHRÖDER (1995a, p. 398).

Material and localities

Thirty-three specimens with 45 thin sections. Personal sampling: Houyet MC-1981-5-Z174, Z297, Z448, Z451 and Z590; Wellin MC-27-B211; Wellin MC-1974-95-B303: Olloy-sur-Viroin MC-1983-5-A396. Old collection from the Institut royal des Sciences naturelles de Belgique: Couvin 8708-Co2d-10863, 10910, 10930, 10952, 22881, 27838, 27839, 27842, 27844, 27848, 27857, 27893, 27900, 27902, 27971, 27983, 27994, 28021, 28025 and 28026; Rochefort 213-Co2c-10328, 10331 and 10339; Rochefort 7272c-Co2d-10822. Collection of LE MAÎTRE (1934): Saint-Charles quarry at Chaudefonds GFCL 844.

Diagnosis

A species of *Stringophyllum* with 84 to 106 septa at a diameter of 18 mm to 33 mm. Septa rather discontinuous at the periphery. Minor septa more or less developed in the inner part of the dissepimentarium.

Description of the Belgian material

My own sampling consists of conical, cylindrical or ceratoid coralla, which are complete or fragmentary with frequent growth lines. Their height varies between 2 cm and 7 cm. The outer wall is often not well preserved. Some specimens are locally encrusted by thin laminar stromatoporoids and rarely by alveolitids.

The septa are non-carinate and dilated throughout their length. In rare cases, they are attenuated at their axial ends. The septa are more or less discontinuous at the periphery where are observed some alignments of coarse trabeculae and very few presepiments.

The major septa reach usually the axis of the corallum; their axial ends are occasionally rhopaloid, curved or arranged about a plane of bilateral symmetry. Some coarse trabeculae or even fragments of septa are often present in the centre of the tabularium where there may be also a small open space. The minor septa are discontinuous and highly variable. They are mostly developed in the inner part of the dissepimentarium, where they are represented by spines and by long or short segments. Normally, they are rather steady between the major septa, but in some specimens, they are only present locally.

The dissepimentarium consists of 4 to 10 or even 3 to 11 rows of inclined dissepiments, which are frequently horizontal at the periphery. The tabulae are closely spaced and are more or less irregular or incomplete with a general concave pattern; they are often disrupted by

coarse trabeculae and by fragments of thickened septa.

There are 74 to 110 septa per corallum. The diameter of the corallum ranges from 15 mm to 40 mm. The width of the tabularium varies commonly between 7.5 mm and 12 mm and more generally between 6 mm and 15 mm.

Description of the specimen figured by LE MAÎTRE (1934)

The material of LE MAÎTRE (1934) is restricted to one rather fragmentary, though well preserved, transverse section. The outer wall is present and is encrusted by a thin laminar stromatoporoid. The septa are non-carinate, dilated throughout their length and discontinuous at the periphery. The major septa reach nearly the axis of the corallum where some coarse trabeculae occur; their axial ends are sometimes rhopaloid. The minor septa are regularly represented by segments and spines in the inner part of the dissepimentarium.

The number of septa is 92 for a diameter of 18.5 mm whereas the width of the tabularium measures 8 mm.

Discussion

Stringophyllum acanthicum has been introduced by FRECH (1885) and its holotype has been figured in thin section by WEDEKIND (1925). From the beginning, there was some confusion about this taxon because FRECH (1886, 1894 and 1911) illustrated specimens very different from it and placed it in synonymy with *S. buechelense* (SCHLÜTER, 1889). However, this species from the Givetian Büchel Formation of the Bergisches Land in Germany, whose lectotype has been refigured by ENGEL & VON SCHOUPPÉ (1958, pl. 8, fig. 9) and SCHRÖDER (2005, pl. 10, fig. 9a), is easily separated from *S. acanthicum* by the poorly developed minor septa, by septa, which are more discontinuous at the periphery and interrupted by presepiments, as also by slightly smaller septal number and diameter of the corallum. Therefore, the references characterized by the occurrence of presepiments and rare minor septa are excluded from the list of synonymy. Among the material of TSIEN (1969), one specimen is identified herein as *Sociophyllum torosum,* whereas some colonies assigned by TSIEN (1969) to *Stringophyllum buechelense* were also referred by COEN-AUBERT (1989, p. 10) to the same species of *Sociophyllum*. On the contrary, one corallum considered by TSIEN (1969, pl. 32, fig. 9) as *Stringophyllum buechelense* is clearly a representative of *S. acanthicum*. As for the two samples determined by TSIEN (1974 and 1975) as *S. acanthicum*, they were ascribed by COEN-AUBERT (1999, p. 35) to *Sociophyllum wedekindi* COEN-AUBERT, 1999. The material investigated by SCHRÖDER (1995a and b, 1997a, 1998, 2004 and 2005) as *S. acanthicum* and *S.* cf. *acanthicum* is highly heterogeneous and even includes coralla having thick septa with some stereoplasmic thickenings. However, two specimens assigned by SCHRÖDER (1995b, pl. 5, fig. 25 and 2005, pl. 10, fig. 1) to *S.* cf. *acanthicum* show all the features of *S. acanthicum*.

According to BIRENHEIDE (1962b, p. 119), the holotype of *S. duplex* (WEDEKIND, 1925) from the Givetian of the Eifel Hills belongs to *S. acanthicum*. This is also the case for the corallum described by TSIEN (1969 and 1974) as *S. duplex* and maybe for one sample studied by SHURIGINA (1972, pl. 35, fig. 4). In addition to *S. duplex*, BIRENHEIDE (1978) synonymized with *S. acanthicum* the species *S. normale* WEDEKIND, 1922 from the Givetian of the Sauerland in Germany and *S. difficile* WEDEKIND, 1922 from the Givetian of the Bergisches Land, what is quite probable for the latter. As for *S. normale*, which is the type species of *Stringophyllum*, it is characterized by septa much more continuous at the periphery than *S. acanthicum*; its holotype has been reillustrated among others by BIRENHEIDE (1978, pl. 19, figs 1-c).

As mentioned by LE MAÎTRE (1934 and 1947), *S. roemeri* (KETTNEROVA, 1932) and *S. perneri* (KETTNEROVA, 1932) from the Givetian of Moravia in the Czech Republic are very similar to *S. acanthicum*. *S. smithi* (TAYLOR, 1951) from the Givetian of South Devon in England is also close to *S. acanthicum*. *S. dartingtonense* (MIDDLETON, 1959) from the Givetian of the same area differs in having more septa and a small open space in the centre of the tabularium. These two English taxa have been described respectively by TAYLOR (1951, p. 181) and MIDDLETON (1959, p. 149). *S. radugini* IVANIA, 1965 from the Givetian of the Kuznetsk Basin in Russia is distinguished from *S. acanthicum* by slightly smaller septal number and diameter of the corallum and by minor septa rather discontinuous. Finally, *S. liuheense* HE, 1978 from the Middle Devonian of the Sichuan Province in China resembles qualitatively *S. acanthicum*, but is characterized by a smaller size and fewer septa.

Geographical and stratigraphical occurrence

Stringophyllum acanthicum represented by one specimen from the Chalonnes Formation of the Southeastern Armorican Massif has been introduced in Germany where it is certainly known in the Late Eifelian Freilingen Formation and in the Early Givetian Rodert Formation from the Eifel Hills, in the Givetian Schwelm Formation from the Sauerland and in the

Givetian from the Bergisches Land. On the south side of the Dinant Synclinorium in Belgium, the species has been mostly collected in the Hanonet Formation from Couvin, Pondrôme and Resteigne; but it is also present in the upper part of the Jemelle Formation at Wellin and close to the base of the Trois-Fontaines Formation at Nismes. This Belgian material comes mainly from the base of the Givetian and occasionally from the Late Eifelian. Outside Germany and Belgium, *S. acanthicum* has been found in the Givetian from Moravia in the Czech Republic and in the Upper Eifelian from the Ma'der and the Moroccan Meseta in Morocco. It may also occur in the Givetian of the Urals in Russia.

Genus *Sociophyllum* BIRENHEIDE, 1962

Type species: By original designation, *Spongophyllum elongatum* SCHLÜTER, 1881.

Diagnosis
Fasciculate rugose corals. Septa of two orders, rather thick and consisting of coarse monacanthine trabeculae. Septa sometimes continuous from the wall to the axis of the corallites, but more often disrupted at the periphery by presepiments. Major septa bilaterally arranged and reaching or not the centre of the tabularium where they are occasionally breaking up into isolated trabeculae. Minor septa lacking or poorly developed. Dissepimentarium composed of a few rows of elongate dissepiments. Tabulae complete or incomplete, normally concave.

Sociophyllum elongatum (SCHLÜTER, 1881)
Pl. 1, Figs 8-10

* 1881 — *Spongophyllum elongatum* Schlüt. - SCHLÜTER, p. 94, pl. 11, figs 1-3.
v 1934 — *Spongophyllum oehlerti* Nicholson – LE MAÎTRE, p. 157.
1962a — *Stringophyllum (Sociophyllum) elongatum* (SCHLÜTER 1881) - BIRENHEIDE, p. 54, pl. 7, fig. 1.
non 1974 — *Spongophyllum elongatum* Schlüter - SONG, p. 160, pl. 82, fig. 2.
v 1989 — *Sociophyllum elongatum* (Schlüter, 1881) - COEN-AUBERT, p. 9, pl. 1, figs 2-7, pl. 3, figs 12-14.
non 1997a — *Sociophyllum elongatum* (Schlüter 1881) - SCHRÖDER, p. 214, pl. 1, figs 3-8, pl. 2, figs 9-10.
1998 — *Sociophyllum elongatum* (Schlüter 1881) - SCHRÖDER, p. 63, pl. 16, fig. 101.
v 2004 — *Sociophyllum elongatum* (Schlüter, 1881) - BARCHY *et al.* pl. 1, figs 1-2.

Remark
A complete list of synonymy about the references before 1989 has been provided by COEN-AUBERT (1989).

Lectotype
Pl. 7, fig. 1 *in* BIRENHEIDE (1962a) chosen by BIRENHEIDE (1962a, p. 54). Specimen B1 from the Schlüter collection stored in the Paläontologisches Institut from the University of Bonn in Germany. To the east-northeast of Berndorf in the Hillesheim Syncline, Eifel Hills, Germany. Loogh Formation, Early Givetian.

Material and localities
Two specimens with 5 thin sections. Collection of LE MAÎTRE (1934): Châteaupanne quarry at Montjean GFCL 646 (780LM) and 853LM.

Diagnosis
A species of *Sociophyllum* with 30 to 35 major septa at a diameter of 8 mm to 13 mm. Septa often separated from the outer wall by a ring of presepiments. Major septa extending more or less into the tabularium. Minor septa mostly absent.

Description
The material is restricted to small corallites whose outer wall is rarely preserved. The septa are non-carinate and more or less dilated throughout their length. They are often discontinuous at the periphery or separated from the outer wall by a few rows of presepiments. The major septa extend nearly to the axis of the corallites; in the centre of the tabularium occur some coarse trabeculae and even fragments of septa. The minor septa are lacking or represented by rare spines, trabeculae and short segments.

The dissepimentarium consists of 5 to 7 rows of large inclined dissepiments. The tabulae complete or incomplete are typically concave.

There are 29 to 36 major septa per corallite. The diameter of the corallites ranges from 12.5 mm to 15 mm whereas the width of the tabularium varies between 4.5 mm and 6 mm.

Discussion
The specimen of *Sociophyllum elongatum* illustrated herein (Pl. 1, Figs 8-10) has been identified and briefly described by LE MAÎTRE (1934) as *S. oehlerti* (NICHOLSON, 1881). The latter species has been introduced by NICHOLSON (1881) on the basis of a few corallites coming from the locality of Montjean. It is very different from *S. elongatum* in having a diameter

of 20 mm to 25 mm, several rows of presepiments, thin and continuous septa inside this wide crown and minor septa lacking or more or less long. In the two corallites of *S. elongatum* investigated herein, it is rather difficult to observe the presepiments as the outer wall is often abraded. The German colony assigned to *S. elongatum* by SCHRÖDER (1998) is similar to the lectotype selected by BIRENHEIDE (1962a) and to the Belgian material figured by COEN-AUBERT (1989) and BARCHY *et al.* (2004). On the contrary, the sampling of SCHRÖDER (1997a) is excluded from the synonymy list of *S. elongatum* as it is characterized by a wider tabularium and one row of large presepiments lying horizontally at the periphery. The Chinese specimen illustrated by SONG (1974) shows thin and poorly developed septa inside the ring of presepiments.

The material of *S. elongatum* from the Southeastern Armorican Massif resembles also *S. longiseptatum* (BULVANKER, 1958) from the Givetian of the Kuznetsk Basin in Russia and *S. guanziyaoense* KONG, 1978 from the Eifelian of the Guizhou Province in China. However, the two latter taxa are separated from the former by a few segments of minor septa present in the inner dissepimentarium.

Geographical and stratigraphical occurrence

Besides the two specimens from the Chalonnes Formation in the Southeastern Armorican Massif, *Sociophyllum elongatum* is known in the Early Givetian of Germany and Belgium. In the first country, it occurs in the Eifel Hills from the Loogh Formation to the base of the Dreimühlen Formation. In Belgium, it is locally abundant at the base of the Trois-Fontaines Formation, on the south side of the Dinant Synclinorium.

Sociophyllum* cf. *elongatum (SCHLÜTER, 1881)
Pl. 3, Figs 7-8

v 1934 — *Spongophyllum oehlerti* Nicholson - LE MAÎTRE, p. 32, pl. 6, figs 1-2.

Material and localities

One specimen with two thin sections. Collection of LE MAÎTRE (1934): Valet quarry A at Chaudefonds GFCL 837.

Description

Only one corallite is available. The outer wall is preserved locally. At the periphery, there are several rows of large presepiments with a few spines and short segments of septa. The non-carinate and slightly dilated septa are restricted to the inner dissepimentarium and the outer tabularium; they are sometimes discontinuous. The minor septa are mostly lacking.

The dissepimentarium consists of 3 to 4 rows of large inclined dissepiments. The incomplete and concave tabulae are disrupted by fragments of thickened septa.

There are more or less 25 major septa for a diameter of 15.5 mm to 16 mm, whereas the width of the tabularium measures 5.7 mm to 6.3 mm.

Discussion

This form assigned by LE MAÎTRE (1934) to *Sociophyllum oehlerti* resembles the corallites of *S. elongatum* with septa poorly developed which have been figured by COEN-AUBERT (1989, pl. 1, figs 4-5 and pl. 3, fig. 14); but it has a slightly larger diameter. *S. oehlerti* differs from *S.* cf. *elongatum* by greater size and septal number and by longer septa of both orders. *S.* cf. *elongatum* is also related to *S. glomerulatum* (CRICKMAY, 1962) from the Late Eifelian of the Northwest Territories in Canada which has been well illustrated by PEDDER (1964, pls 69 and 70) and whose major septa reach more often the centre of the tabularium.

Geographical and stratigraphical occurrence

The form has only been found in the Valet Formation from the Southeastern Armorican Massif.

Sociophyllum sp.
Pl. 2, Fig. 7

v 1934 — *Endophyllum* cf. *buchelense* Schlüter - LE MAÎTRE, p. 160, pl. 6, fig. 7.

Material and localities

One specimen with two thin sections. Collection of LE MAÎTRE (1934): Saint-Charles quarry at Chaudefonds GFCL 840.

Description

Only one corallite with a partial longitudinal section is available. The outer wall is often preserved. The septa are non-carinate and dilated throughout their length. They are continuous at the periphery or they are occasionally separated from the outer wall by one or two rows of presepiments. The major septa leave a small open space in the centre of the tabularium. The minor septa are lacking or represented by rare short segments in the inner part of the dissepimentarium.

The dissepimentarium consists of 1 to 3 rows of large inclined dissepiments. The concave tabulae

are disrupted by coarse trabeculae and fragments of thickened septa.

There are 35 major septa for a diameter of 10 mm to 13.5 mm whereas the width of the tabularium measures 5.9 mm to 6.5 mm.

Discussion
This form has been ascribed by LE MAÎTRE (1934) to *Stringophyllum* cf. *buechelense*. However, *S. buechelense* is separated from it by several features: greater septal number and diameter of the corallum, septa more discontinuous at the periphery and major septa reaching the centre of the tabularium. There are some similarities between *Sociophyllum* sp. and *S. redactum* MCLAREN & NORRIS, 1964 from the Givetian of the Northwest Territories in Canada which is distinguished by a wider open space in the centre of the corallites as well as by septa slightly less numerous and more continuous at the periphery.

Geographical and stratigraphical occurrence
The form has only been found in the Chalonnes Formation from the Southeastern Armorican Massif.

Family Ptenophyllidae WEDEKIND, 1923
Genus *Acanthophyllum* DYBOWSKI, 1873

Type species: By subsequent designation of SCHLÜTER (1889, p. 296), *Cyathophyllum heterophyllum* MILNE-EDWARDS & HAIME, 1851.

Diagnosis
Large solitary rugose corals. Septa of two orders, rarely discontinuous at the periphery, thin to more or less dilated throughout their length. Major septa, sometimes thicker in the outer or in the inner part of the dissepimentarium, carinate in the tabularium and reaching usually the axis of the corallum. Minor septa traversing the entire dissepimentarium. Wide dissepimentarium composed of numerous rows of inclined dissepiments which are occasionally subhorizontal at the periphery. Tabulae incomplete and closely spaced, forming concave floors.

Acanthophyllum heterophyllum
(MILNE-EDWARDS & HAIME, 1851)
Pl. 2, Fig. 6

v * 1851 — *Cyathophyllum heterophyllum* - MILNE-EDWARDS & HAIME, p. 367, pl. 10, figs 1, 1a-b.
v 1934 — *Cyathophyllum (Rhopalophyllum) heterophyllum* Milne-Edwards et Haime - LE MAÎTRE, p. 30, pl. 5, fig. 15.
v 1997 — *Acanthophyllum heterophyllum* (Milne-Edwards & Haime, 1851) - COEN-AUBERT, p. 11, pl. 1, figs 1-4, pl. 2, figs 5-7.
non 1997a — *Acanthophyllum heterophyllum* (Milne-Edwards & Haime 1851) - SCHRÖDER, p. 213, pl. 1, fig. 1.
1997b — *Acanthophyllum heterophyllum* (Milne-Edwards & Haime 1851) - SCHRÖDER, p. 16, pl. 3, figs 30-31.
1998 — *Acanthophyllum heterophyllum* (Milne-Edwards & Haime 1851) - SCHRÖDER, p. 58, pl. 13, fig. 82.
1999 — *Acanthophyllum heterophyllum* (Milne-Edwards & Haime, 1851) - PEDDER, p. 403, pl. 9, figs 1-4, 6, 9.

Remark
A complete list of synonymy about the references before 1997 has been provided by COEN-AUBERT (1997).

Holotype
Pl. 10, figs 1, 1a and 1b *in* MILNE-EDWARDS & HAIME (1851) and pl. 1, figs 1-2 *in* COEN-AUBERT (1997). Specimen Z47a or MNHN LP S 11670 from the collection Milne-Edwards stored in the Laboratory of Palaeontology, Museum National d'Histoire naturelle in Paris, France. Devonian from the Eifel Hills in Germany. The precise details mentioned by BIRENHEIDE (1961, p. 90) are unsatisfactory as this author thought that the type of the species was probably lost.

Material and localities
One specimen with one thin section. Collection of LE MAÎTRE (1934): Valet quarry B at Chaudefonds GFCL 834.

Diagnosis
A species of *Acanthophyllum* with 70 to 90 septa at a diameter of 20 mm to 42 mm. Major septa strongly dilated in the inner part of the dissepimentarium. Dissepiments often arranged in horizontal layers at the periphery.

Description
The material is restricted to one transverse section. The outer wall is nearly completely abraded. The septa are non-carinate and slightly dilated throughout their length; however, the major septa are much thicker in the dissepimentarium than the minor ones. The major septa reach more or less the centre of the tabularium where there are some pseudofossulae and fragments of septa; their axial ends may be also irregular or weakly rhopaloid. The minor septa traverse all, nearly all or half the dissepimentarium; sometimes, they are shorter or discontinuous at their inner ends.

The number of septa is 56 for a diameter of 13.5 mm to 16 mm whereas the width of the tabularium measures 7 mm.

Discussion

The transverse section investigated herein has only 56 septa and is characterized by minor septa of variable length. So it seems to correspond to a juvenile stage of a rather small specimen of *Acanthophyllum heterophyllum* revised by COEN-AUBERT (1997). Such juvenile stages have been figured by MA (1956, pl. 22, figs 1a-d) and by PEDDER (1999, pl. 9, fig. 3), where the minor septa are also poorly developed. Concerning the list of synonymy, typical representatives of *A. heterophyllum* have been illustrated by SCHRÖDER (1997b and 1998), whereas the material of SCHRÖDER (1997a) differs by inclined dissepiments, a rather wide tabularium and by major septa weakly dilated in the dissepimentarium.

Geographical and stratigraphical occurrence

In addition to the material from the Valet Formation in the Southeastern Armorican Massif, *Acanthophyllum heterophyllum* is well known in Germany, Belgium and the North of France. In the first country, it is common in the Eifel Hills, from the Early Eifelian Nohn Formation to the Early Givetian Loogh Formation and maybe in the overlying Cürten Formation. In Belgium and France, *A. heterophyllum* occurs on the south side of the Dinant Synclinorium, at the top of the Jemelle Formation, in the Hanonet and X Formations and at the base of the Trois-Fontaines Formation; these lithostratigraphic units belong to the Late Eifelian and to the Early Givetian. The species has also been observed in the Early Eifelian from the Holy Cross Mountains in Poland and in the Late Eifelian and Early Givetian from the Ma'der in Morocco.

Acanthophyllum vermiculare (GOLDFUSS, 1826)
Pl. 2, Figs 1-5; Pl. 3, Fig. 9

v * 1826 — *Cyathophyllum vermiculare* nobis - GOLDFUSS, p. 58, pl. 17, fig. 4.
v 1934 — *Cyathophyllum (Leptoinophyllum) vermiculare* Goldfuss mut. *praecursor* Frech - LE MAÎTRE, p. 149, pl. 5, fig. 8.
v 1934 — *Cyathophyllum (Astrophyllum) gerolsteinense* Wedekind - LE MAÎTRE, p. 151, pl. 5, fig. 9.
v 1934 — *Cyathophyllum torquatum* Schlüter - LE MAÎTRE, p. 154, pl. 5, figs 16-17.
v 1958 — *Leptoinophyllum vermiculare* (Goldfuss 1826) - GRÄF, p. 79, pl. 3, figs 3-4.
v 1997 — *Acanthophyllum vermiculare* (Goldfuss, 1826) - COEN-AUBERT, p. 13, pl. 3, figs 1-8.
v 1998 — *Acanthophyllum vermiculare* (Goldfuss, 1826) - COEN-AUBERT, pl. 2, fig. 1.
? 1998 — *Acanthophyllum vermiculare* (Goldfuss 1826) - SCHRÖDER, p. 58, pl. 13, fig. 83.
1999 — *Acanthophyllum vermiculare* (Goldfuss, 1826) - SCHRÖDER & KAZMIERCZAK, p. 102, pl. 3, figs 15-16.
non 2002 — *Acanthophyllum* sp. ex gr. *vermiculare/concavum/simplex* - SCHRÖDER, p. 183, pl. 3, fig. 18.
non 2005 — *Acanthophyllum* aff. *vermiculare* (Goldfuss, 1826) - SCHRÖDER, p. 100, pl. 9, figs 5-8.

Remark

A complete list of synonymy about the references before 1997 has been provided by COEN-AUBERT (1997).

Holotype

Pl. 17, fig. 14 *in* GOLDFUSS (1826), pl. 3, figs. 3-4 *in* GRÄF (1958) and pl. 2, fig. 1 *in* COEN-AUBERT (1998). Specimen GMBo 198 from the Goldfuss collection stored in the Paläontologisches Institut from the University of Bonn in Germany. Probably fields lying to the west of the church of Nohn in the Hillesheim Syncline, Eifel Hills, Germany. Probably Müllert Member of the Ahbach Formation at the base of the Givetian.

Material and localities

Seven specimens with 11 thin sections. Collection of LE MAÎTRE (1934): Saint-Charles quarry at Chaudefonds GFCL 830, GFCL 831, GFCL 835, GFCL 647 (810LM), 800LM, 809LM, and 833LM.

Diagnosis

A species of *Acanthophyllum* with 68 to 80 septa at a diameter of 20 mm to 35 mm. Septa thin to slightly dilated throughout their length. Dissepiments often inclined.

Description

The material consists mainly of rather complete transverse sections. The outer wall is more or less well preserved and is locally encrusted in some coralla by a thin laminar stromatoporoid.

The septa are slightly dilated or occasionally slender throughout their length; at the periphery, they are often thinner and rarely discontinuous. Some spinose carinae occur locally in that place and in the tabularium where the septa may be thicker or less dilated in a few specimens. The major septa reach the axis of the corallum; their axial ends are sometimes rhopaloid, twisting in a whorl, forming pseudofossulae or breaking into fragments and isolated trabeculae. The minor septa traverse the entire

dissepimentarium or hardly enter into the tabularium; they are rarely shorter or contratingent.

The dissepimentarium consists of 10 to 25 rows of small inclined dissepiments, which may be in horizontal rows at the periphery. The tabulae are closely spaced, incomplete and intersecting laterally with a general concave pattern; they are frequently disrupted by the axial ends of the major septa.

There are 72 to 94 septa per corallum. The diameter of the corallum ranges from 17 mm to 38.5 mm and even reaches 49 mm in one specimen. The width of the tabularium varies between 3.3 mm and 8.7 mm.

Discussion

The specimens assigned by LE MAÎTRE (1934) to *Acanthophyllum vermiculare minor* (FRECH, 1886), *A. gerolsteinense* (WEDEKIND, 1924) and *A. torquatum* (SCHLÜTER, 1884) belong to the same species and display the same variability as the Belgian material identified by COEN-AUBERT (1997) as *A. vermiculare*. The lectotype of *A. torquatum* from the Eifelian of the Eifel Hills has been selected by BIRENHEIDE (1961, p. 99) and corresponds to the corallum figured by SCHLÜTER (1889, pl. 4, figs 1-4), which shows thin septa in the adult stage. According to BIRENHEIDE (1961 and 1978, p. 147), *A. torquatum* is characterized by stereoplasmic thickenings affecting the septa and the dissepiments in the juvenile stages. These stereoplasmic thickenings have never been observed by the author among her great Belgian population of *A. vermiculare*. For SCHRÖDER & KAZMIERCZAK (1999, p. 103), the transverse section of the lectotype of *A. torquatum* with slender septa illustrated by SCHLÜTER (1889, pl. 4, fig. 4) is conspecific with *A. vermiculare*. As mentioned by COEN-AUBERT (1997), *A. torquatum orientale* (REED, 1922) from the Frasnian of Chitral in Pakistan is also very close to *A. vermiculare*.

A. gerolsteinense from the Eifelian of the Eifel Hills whose lectotype has been designated by BIRENHEIDE (1962b, p. 106), is distinguished from *A. vermiculare* by septa dilated in the inner part of the dissepimentarium; however, it was regarded as a synonym of *A. torquatum* by BIRENHEIDE (1961 and 1962b). *A. vermiculare praecursor* from the Middle Devonian of the Eifel Hills is a doubtful and badly known subspecies. The different specimens figured by FRECH (1886, pl. 2, figs 4, 6-10) have thin septa like *A. vermiculare*, but have only 58 to 64 septa for a diameter ranging from 19 mm to 27 mm. The neotype selected by GRÄF (1958, p. 85) for *A. vermiculare praecursor* differs from the material of FRECH (1886) by rather short minor septa and is still smaller than *A. vermiculare* with a diameter between 7 mm and 17 mm and only 46 septa. This neotype has been considered as not valid by BIRENHEIDE (1972, pp. 414-416) and has been placed in synonymy by this author with *Grypophyllum primum* (WEDEKIND, 1923) from the Eifelian of the Eifel Hills. Moreover, BIRENHEIDE (1972, p. 418) referred to *G. convolutum* (WEDEKIND, 1925) from the Givetian of the Sauerland in Germany one of the coralla illustrated by FRECH (1886, pl. 2, fig. 9) and proposed for *Acanthophyllum vermiculare praecursor* a lectotype which has never been figured in thin sections.

The references of the synonymy list given by SCHRÖDER (1995a and b) and SCHRÖDER & KAZMIERCZAK (1999) concern typical representatives of *A. vermiculare* with slender septa. However, the more recent references of SCHRÖDER (2002 and 2005) are different by their quantitative data and by septa rather dilated in the dissepimentarium; therefore, they seem to be related to *A. simplex* (WALTHER, 1929) from the Givetian of the Bergisches Land in Germany which has been revised by COEN-AUBERT (2000).

Geographical and stratigraphical occurrence

In addition to the material from the Chalonnes Formation in the Southeastern Armorican Massif, *Acanthophyllum vermiculare* is well known in Germany, Belgium and other areas of France. In the first country, it is common in the Eifel Hills, from the Late Eifelian Junkerberg Formation to the Early Givetian Kerpen Formation. In Belgium and France, *A. vermiculare* is abundant close to the Eifelian-Givetian boundary, in the Hanonet Formation and at the base of the Trois-Fontaines Formation, on the south side of the Dinant synclinorium. It has also been observed in the Early Givetian from the Ma'der in Morocco. According to COEN-AUBERT (1997), *A. vermiculare* may be present in the Middle Devonian from the Pyrenees in France and at the base of the Lochkovian from the Saaremaa Island in Estonia.

Acanthophyllum tortum (TSIEN, 1969)

Pl. 3, Figs 5-6

v * 1969 — *Grypophyllum tortum* Tsien nov. sp. - TSIEN, p. 123, pl. 48, figs 11-13.

v 1998 — *Acanthophyllum tortum* (Tsien, 1969) - COEN-AUBERT, p. 11, pl. 1, figs 8-12, pl.2, figs 2-6.

Holotype

Pl. 48, fig. 13 *in* TSIEN (1969) and pl. 1, fig. 10 *in* COEN-AUBERT (1998). Specimen Couvin 8708a (82)-Co2d-27905 stored in the Department of Palaeontology from

the Institut royal des Sciences naturelles de Belgique at Brussels, Belgium. Haine quarry named nowadays La Couvinoise quarry and located to the north of Couvin, on the south side of the Dinant Synclinorium, Belgium. Hanonet Formation, base of the Givetian.

Material and localities
Two specimens with 3 thin sections. Collection of LE MAÎTRE (1934): Saint-Charles quarry at Chaudefonds GFCL 648 (808LM) and GFCL 649 (811LM).

Diagnosis
A species of *Acanthophyllum* with 50 to 60 septa at a diameter of 19 mm to 30 mm. Septa slightly to moderately dilated throughout their length. Dissepiments often inclined.

Description
The material is mostly restricted to transverse sections. The outer wall is well preserved and encrusted by laminar stromatoporoids or even locally by a tabulate coral.

The septa are non-carinate or bear a few small vepreculae. They are slightly dilated or rarely slender throughout their length. In one specimen, the septa are locally discontinuous at the periphery. The major septa reach the axis of the corallum; their axial ends are occasionally curved, forked or divided into fragments. The minor septa traverse all or sometimes nearly all the dissepimentarium; they may be also somewhat shorter, contratingent, discontinuous at their inner ends or hardly entering into the tabularium. The dissepiments are inclined.

There are 56 to 60 septa per corallum for a diameter ranging from 18 mm to 21 mm whereas the width of the tabularium measures 6 mm to 7 mm.

Discussion
The two specimens available in the collection of LE MAÎTRE (1934) have not been figured by this author and have been identified by her as *Acanthophyllum torquatum*. They are separated from *A. vermiculare* by a smaller number of septa for similar dimensions of the coralla, by septa somewhat more dilated throughout their length and by their looser texture in transverse section. The same remarks concern the differences with *A. torquatum*. Despite the rather slight thickening of the septa and the minor septa, which do not traverse systematically the entire dissepimentarium, the two samples of the Southeastern Armorican Massif fall within the variation of the Belgian material referred to *A. tortum*.

Geographical and stratigraphical occurrence
Besides the two specimens from the Chalonnes Formation in the Southeastern Armorican Massif, *Acanthophyllum tortum* is only known close to the Eifelian-Givetian boundary, on the south side of the Dinant Synclinorium in Belgium. It is very abundant in the Hanonet Formation, but it is also locally present in the upper part of the X Formation at Wellin and at the base of the Trois-Fontaines Formation.

Acanthophyllum sp.
Pl. 1, Fig. 7

v 1934 — *Cyathophyllum dianthus* Goldfuss - LE MAÎTRE, p. 153, pl. 5, figs 13-14.

Material and localities
One specimen with two thin sections. Collection of LE MAÎTRE (1934): Saint-Charles quarry at Chaudefonds GFCL 833.

Description
From this specimen are available one transverse section and one poor longitudinal section which has been figured upside down by LE MAÎTRE (1934, pl. 5, fig. 14). The outer wall is preserved locally. The septa are strongly dilated throughout their length and bear a few vepreculae in the tabularium where some of them are very thick. The minor septa traverse the entire dissepimentarium or even enter into the tabularium where they are sometimes contratingent.

The dissepimentarium consists of 5 to 6 rows of inclined dissepiments. The tabulae are incomplete and disrupted by thick septa with some spinose carinae.

The number of septa is 58 for a diameter of 14.5 mm to 15.5 mm whereas the width of the tabularium measures 8 mm.

Discussion
This specimen belongs typically to a young stage of the genus *Acanthophyllum*; but it is not clear whether it is a juvenile form from a large corallum of *A. heterophyllum* or from another species of the taxon. This specimen has been assigned by LE MAÎTRE (1934) to *Cyathophyllum dianthus* GOLDFUSS, 1826 mostly from the Early Givetian Loogh Formation of the Eifel Hills in Germany, which is the type species of the genus *Cyathophyllum* GOLDFUSS, 1826 and whose neotype has been chosen by BIRENHEIDE (1963, p. 377). *C. dianthus* is a fasciculate rugose coral characterized by very thin septa with zigzag carinae and by numerous

rows of small dissepiments arranged in horizontal layers at the periphery; moreover, its corallites have a greater diameter than *Acanthophyllum* sp.

Geographical and stratigraphical occurrence
The form has only been found in the Chalonnes Formation from the Southeastern Armorican Massif.

Family Spongophyllidae DYBOWSKI,1873
Genus *Beugniesastraea* COEN-AUBERT, 1989

Type species: By original designation, *Spongophyllum kunthi* SCHLÜTER, 1880.

Diagnosis
Massive cerioid to subfasciculate rugose corals with corallites usually slender and separated by a well delimited wall. Septa of two orders, rather thin and disrupted at the periphery by presepiments. Major septa reaching the centre of the tabularium. Minor septa long to irregularly developed. Dissepimentarium composed of a few rows of large elongate dissepiments. Tabulae closely spaced, often flat or concave.

Beugniesastraea ligeriensis (LE MAÎTRE, 1934)
Pl. 3, Figs 1-3

v * 1934 — *Spongophyllum ligeriense* sp. nov. - LE MAÎTRE, p. 158, pl. 6, fig. 14.

Holotype
Pl. 6, fig. 14 *in* LE MAÎTRE (1934) and Pl. 3, Figs 1-3 figured herein. Specimen GFCL 845 stored in the Department of Geology from the Faculté Libre des Sciences at Lille, France. Chalonnes Formation from the Station quarry at Chalonnes, Southeastern Armorican Massif, France. Lower or Middle Devonian.

Material and localities
One colony with 4 thin sections. Collection of LE MAÎTRE (1934): Station quarry at Chalonnes GFCL 845.

Diagnosis
A species of *Beugniesastraea* with 30 to 34 septa at a diameter of 3.1 mm to 5.2 mm. Septa slightly dilated throughout their length. Minor septa long.

Description
The holotype and only colony available is mainly represented by its transverse section. The walls between adjacent corallites are straight and thick with locally a dark median line.

The septa are non-carinate and dilated throughout their length. They may be continuous from the wall to the axis of the corallites; but they are sometimes discontinuous at the periphery with some presepiments. Occasionally, a stereoplasmic thickening is present against the wall or affects a layer of dissepiments between the septa. In the centre of the tabularium may be observed some thickened or rhopaloid axial ends of major septa as well as a few coarse trabeculae and fragments of septa. The minor septa traverse the entire dissepimentarium; sometimes, they are shorter, divided into segments or lacking.

The dissepimentarium consists of 1 to 3 rows of large inclined dissepiments. The tabulae are concave, narrow and closely spaced; they are occasionally disrupted by the axial ends of septa.

There are 26 to 34 septa per corallite. The diameter of the corallites ranges from 2.6 mm to 5.7 mm whereas the width of the tabularium varies between 1.2 mm to 3.2 mm.

Discussion
Beugniesastraea ligeriensis resembles *B. parvistella* whose lectotype has been figured by BIRENHEIDE (1962a, pl. 12, fig. 14)) and comes from the Early Givetian Loogh Formation in the Eifel Hills. The latter species is distinguished from the former by slightly fewer and thinner septa and by presepiments more frequent at the periphery. *B. parvistella* is closely related to *B. kunthi* which is characterized by strong stereoplasmic thickenings in the dissepimentarium. The lectotype of *B. kunthi* has also been illustrated by BIRENHEIDE (1962a, pl. 10, fig. 11 and pl. 11, figs 12-13) and has been found in the Loogh Formation from the Eifel Hills as *B. parvistella*. Both taxa have been described by COEN-AUBERT (1989) on the basis of material occurring in the Early Givetian from the south side of the Dinant Synclinorium in Belgium; in fact, they have been collected at the base of the Trois-Fontaines Formation where *B. kunthi* is locally abundant whereas *B. parvistella* is much rarer. It must be added that the colonies from the Late Eifelian Junkerberg Formation in the Eifel Hills, which have been assigned by SCHRÖDER (1998, p. 47) to *B. parvistella*, show some stereoplasmic thickenings like *B. kunthi*.

Geographical and stratigraphical occurrence
The species is only known in the Chalonnes Formation from the Southeastern Armorican Massif.

Family Fasciphyllidae SOSHKINA,1954
Genus *Fasciphyllum* SCHLÜTER, 1885

Type species: By monotypy, *Fascicularia conglomerata* SCHLÜTER, 1881.

Diagnosis
Fasciculate rugose corals with slender corallites. Peripheral stereozone more or less developed. Septa thin or slightly dilated beyond the stereozone, sometimes with sparse vepreculae. Major septa extending close to the axis of the corallites. Minor septa long to irregularly developed. Dissepimentarium more or less continuous, composed of one or two rows of large elongate dissepiments. Tabulae often complete, flat or concave.

Fasciphyllum* cf. *conglomeratum (SCHLÜTER, 1881)
Pl. 3, Fig. 10

cf. 1881 — *Fascicularia conglomerata* SCHLÜT. - SCHLÜTER, p. 99, pl. 13, figs 1-3.
cf. 1957 — *Battersbyia conglomerata* (SCHLÜTER) - GLINSKI, p. 101, figs 8-10.
cf. 1978 — *Battersbyia conglomerata* (SCHLÜTER 1881) - BIRENHEIDE, p. 126, fig 71.
cf. 1992 — *Fasciphyllum conglomeratum* (SCHLÜTER, 1881) - COEN-AUBERT, p. 10, pl. 1, figs 1-8.

Lectotype
Pl. 13, fig. 2 *in* SCHLÜTER (1881) and fig. 8 *in* GLINSKI (1957) chosen by GLINSKI (1957, p. 101). Thin sections 42a, 42a1 and 42b from the Schlüter collection stored in the Paläontologisches Institut from the University of Bonn in Germany. Early Givetian Loogh Formation from Berndorf in the Hillesheim Syncline, Eifel Hills, Germany.

Material and localities
Two specimens with two thin sections. Collection of LE MAÎTRE (1934): Station quarry at Chalonnes GFCL 650 (844LM) and Châteaupanne quarry at Montjean GFCL 847 (with the longitudinal section of *Microplasma bureaui* LE MAÎTRE, 1934 corresponding to her pl. 7, fig. 2).

Diagnosis
A species of *Fasciphyllum* with 22 to 32 septa at a diameter of 2 mm to 4 mm. Peripheral stereozone continuous, but restricted to the outer part of the corallites. Minor septa long.

Description
The material is restricted to two corallites in transverse sections. The outer wall is continuous, forming a prominent but rather narrow peripheral stereozone. Beyond this stereozone, the septa are thin or dilated throughout their length and bear a few spinose carinae. The major septa reach the centre of the tabularium where there are some pseudofossulae. The minor septa are usually long, but they may be also shorter or contratingent.

There are 34 to 40 septa per corallite whose diameter ranges from 4.7 mm to 6.9 mm.

Discussion
The two corallites from the Chalonnes Formation investigated in transverse section resemble some colonies of *Fasciphyllum conglomeratum* such as the Belgian one figured by COEN-AUBERT (1992, pl. 1, figs 1-2); more generally, they are distinguished from the material described by this author by slightly greater septal number and diameter. The Polish specimens from the Middle Givetian of Dziewki in Silesia assigned by WRZOLEK (1993, p. 224) to *F. conglomeratum* often show presepiments and must probably be excluded from the species. The sample from the Middle Devonian of Bohemia in the Czech Republic identified by GALLE (1994, p. 44) as *F.* cf. *conglomeratum* is more different in having short major and minor septa.

Geographical and stratigraphical occurrence
Besides the questionable material from the Chalonnes Formation in the Southeastern Armorican Massif, *Fasciphyllum conglomeratum* is known in the Early Givetian Loogh Formation from the Eifel Hills in Germany and close to the Eifelian-Givetian boundary, on the south side of the Dinant Synclinorium in Belgium. More precisely, it occurs in Wellin, at the base of the X Formation and at the base of the Trois-Fontaines Formation.

Fasciphyllum* cf. *katranicum
(GORIANOV, 1968 *in* BULVANKER *et al.*, 1968)
Pl. 1, Fig. 11

cf. 1968 — *Columnaria katranica* Gorianov sp. nov. - BULVANKER *et al.*, p. 36, pl. 17, fig. 4.
cf. 1972 — *Alaiophyllum katranicum* Gorianov sp. nov. - GORIANOV, p. 80, pl. 19, fig. 1.
cf. 1992 — *Fasciphyllum katranicum* (Gorianov, 1968) - COEN-AUBERT, p. 12, pl. 2, figs 4-7.

Holotype
Pl. 17, fig. 4 *in* BULVANKER *et al.* (1968). Specimen 11/271 stored in the Museum from the Department of Historical Geology at the Mining Institut of Saint Petersburg, Russia. Eifelian Katran Formation from the Katran ridge in South Fergana, Kirgizstan.

Material and localities
One specimen with two thin sections. Collection of LE MAÎTRE (1934): Châteaupanne quarry (3) at Montjean GFCL 851 (851LM).

Diagnosis
A species of *Fasciphyllum* with 9 to 12 major septa at a diameter of 3 mm to 5 mm. Wide peripheral stereozone investing the entire dissepimentarium. No minor septa observable.

Description
Only one corallite with a bad longitudinal section is available. The outer wall is preserved locally. A wide and continuous stereozone where the septa are contiguous laterally, invests the entire dissepimentarium. Beyond this stereozone, the major septa are thin and bear a few spinose carinae. They reach the centre of the tabularium where there are several pseudofossulae. No minor septa are observable within the stereozone.

On one side of the corallite, two rows of inclined dissepiments can be seen inside the stereozone. The tabulae seem to have a concave pattern and are interrupted by septa.

There are 20 major septa for a diameter of 5.2 mm to 5.3 mm whereas the width of the tabularium measures 3.2 mm to 3.4 mm.

Discussion
Qualitatively, the corallite from the Chalonnes Formation is similar to the colonies from the south side of the Dinant Synclinorium assigned by COEN-AUBERT (1992) to *Fasciphyllum katranicum*. Quantitatively, it is different in having more septa and a wider tabularium for a slightly greater diameter.

Geographical and stratigraphical occurrence
In Belgium, *Fasciphyllum katranicum* has been collected in the lower part of the Early Givetian Trois-Fontaines Formation from the south side of the Dinant Synclinorium. Besides Belgium and the questionable specimen from the Chalonnes Formation in the Southeastern Armorican Massif, the species is known in the Eifelian and the Givetian from South Fergana in Kirgizstan.

Stratigraphic correlations and conclusions

The most interesting fauna of rugose corals observed in the Chalonnes Formation is that from the Saint-Charles quarry at Chaudefonds with the association of *Acanthophyllum vermiculare*, *A. tortum* and *Stringophyllum acanthicum*. Indeed, these three species occur close to the Eifelian-Givetian boundary, on the south side of the Dinant Synclinorium in Belgium (Fig. 4). They are very abundant in the Hanonet Formation and they are still present at the base of the Trois-Fontaines Formation. One corallum of *S. acanthicum* has been found slightly lower, in the upper part of the Jemelle Formation, dated as Late Eifelian. Two corallites of *S. elongatum* together with two small corallites of *Fasciphyllum* cf. *conglomeratum* and *F.* cf. *katranicum* have been identified in the Châteaupanne quarry at Montjean. *Sociophyllum elongatum* is also characteristic of the base of the Trois-Fontaines Formation in Belgium, whereas *Fasciphyllum katranicum* and *F. conglomeratum* have been collected locally at the same level. However, the latter taxon has also been recorded lower, at the base of the X Formation, regarded as Late Eifelian. The Station quarry at Chalonnes has yielded one corallite of *F.* cf. *conglomeratum* and the holotype of *Beugniesastraea ligeriensis*. The latter is very similar to *B. parvistella* represented by a few colonies sampled at the base of the Trois-Fontaines Formation in Belgium and by its lectotype which is the only German specimen illustrated. So the variability of *B. parvistella* and *B. ligeriensis* restricted to his holotype is not well known and it is not possible to synonymize the two taxa.

It is remarkable to note that *B. parvistella*, *Stringophyllum acanthicum*, *Sociophyllum elongatum*, *Acanthophyllum vermiculare* and *Fasciphyllum conglomeratum* have been introduced in the Middle Devonian from the Eifel Hills in Germany and that they are reported in this area from the Late Eifelian Junkerberg Formation to the Lower Givetian Kerpen Formation (Fig. 4). Though their stratigraphical range is more extended in Germany than in Belgium, they are also distributed across the Eifelian-Givetian boundary. It can be added that the taxonomic names used by LE MAÎTRE (1934) such as *Stringophyllum acanthicum*, *Acanthophyllum vermiculare praecursor*, *A. gerolsteinense*, *A. torquatum* and *Cyathophyllum dianthus* (Fig. 3) are those of species defined in the Middle Devonian of the Eifel Hills. Moreover, LE MAÎTRE (1934, pp. 224, 227 and 244) herself considered that most of the solitary rugose corals investigated in the Chalonnes Formation are Eifelian in age and that

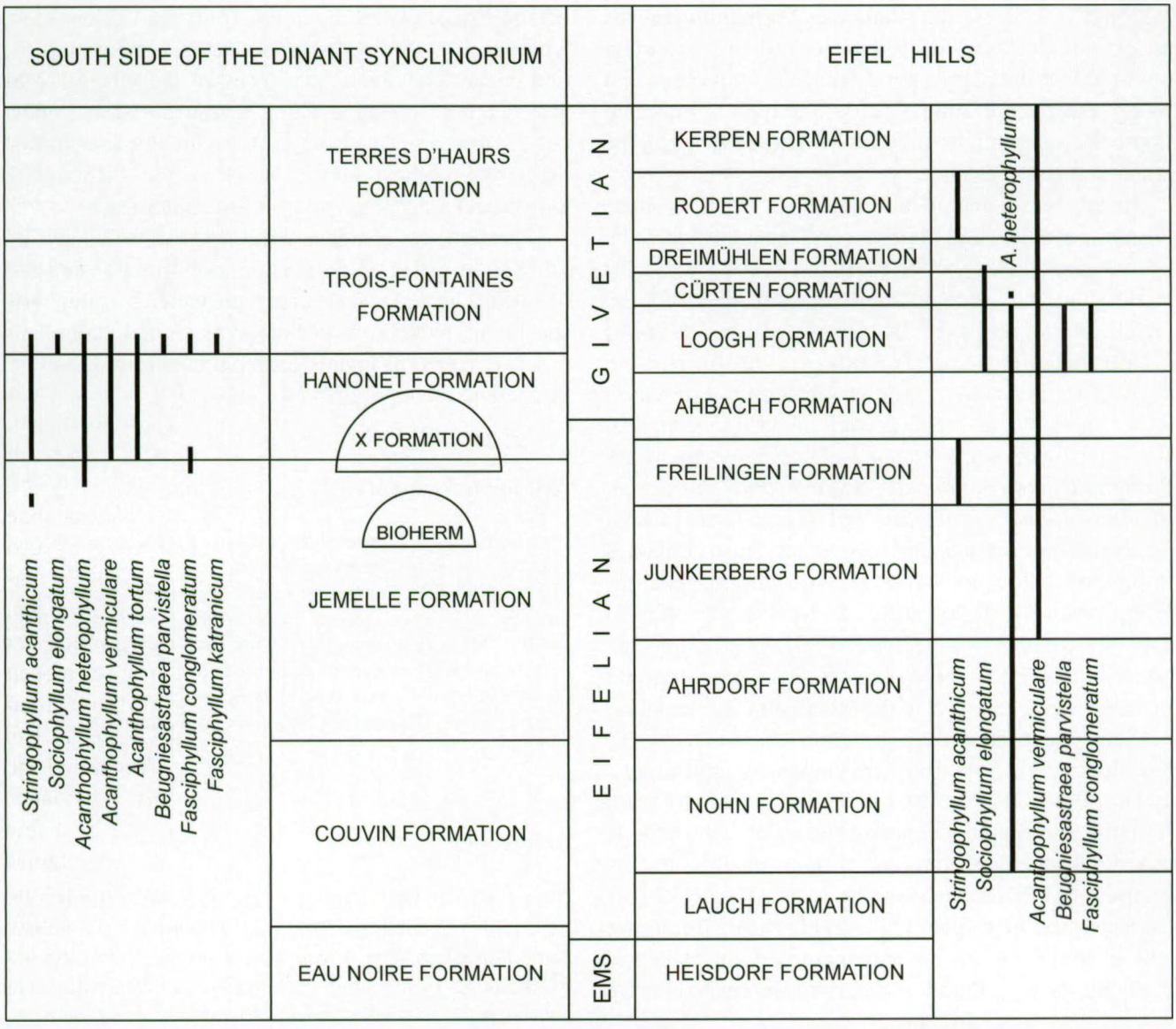

Fig. 4 – Stratigraphic distribution of the rugose coral species revised herein, in the Middle Devonian from the south side of the Dinant Synclinorium in Belgium and the Eifel Hills in Germany. The correlations between these two areas are based on WEDDIGE (1996) and BULTYNCK & COEN-AUBERT *in* WEDDIGE (2000: R 410 dm 00).

they are even present close to the Eifelian-Givetian boundary.

However, it is clear also that the rugose coral fauna of the Chalonnes Formation is not homogeneous in age. Indeed, LE MAÎTRE (1934 and 1960, p. 92) emphasized the presence of *Chlamydophyllum obscurum* POCTA, 1902 and *Acanthophyllum baculoides* (POCTA, 1902) in this lithostratigraphical unit. These two species whose lectotypes are coming from the Pragian Koneprusy Limestone of Bohemia in the Czech Republic, have been revised by OLIVER & GALLE (1971, pp. 43, 48 and 77). According to these authors, the assignment to *A. baculoides* made by LE MAÎTRE (1934) is questionable, whereas the corallum identified by her as *Chlamydophyllum obscurum* may be not congeneric with *Chlamydophyllum* POCTA, 1902. In my opinion, the latter corallum is probably a Lower Devonian kodonophyllid. As for the specimen referred by LE MAÎTRE (1934) to *Acanthophyllum baculoides*, I have not yet had the opportunity to investigate it as it was loaned to P. Semenoff-Tian-Chansky in 1970. As mentioned by OLIVER & GALLE (1971), *A. baculoides* resembles *A. heterophyllum,* which is also present close to the Eifelian-Givetian boundary, on the south side of the Dinant synclinorium. In the Eifel Hills, *A. heterophyllum* has been found as low as the Early Eifelian Nohn Formation (Fig. 4) and a young stage of this species has been collected by LE MAÎTRE (1934) at the place named Valet B, probably above the conodont samples of the Valet Limestone studied by LARDEUX &

WEYANT (1993). As the Chalonnes Formation reaches an overall thickness of 100 m to 150 m, it is quite possible that the rugose coral faunas from its base and its top are not the same. Clearly, the type of bulk and imprecise sampling used by LE MAÎTRE (1934) is to be taken into consideration.

In any case, the identification in the Chalonnes Formation of several rugose coral taxa, which have been collected close to the Eifelian-Givetian boundary in Belgium and Germany, must be compared with the Givetian age proposed by DUBREUIL & VACHARD (1979). According to BALLEVRE *et al.* (2010, p. 245), a Givetian attribution for the Chalonnes Formation is not possible as it is devoid of stringocephalids. However, on the south side of the Dinant Synclinorium, *Stringophyllum acanthicum*, *Sociophyllum elongatum*, *Acanthophyllum vermiculare* and *A. tortum* are present up to the base of the Early Givetian Trois-Fontaines Formation, below the first levels with stringocephalids. More precisely, GODEFROID & MOTTEQUIN (2005) have shown that the genus *Stringocephalus* appears rather high in the Trois-Fontaines Formation exposed in the Marenne quarry. On the other hand, a correlation between the Chalonnes Formation and the Givetian limestones of the Villedé d'Ardin in Vendée as discussed by DUBREUIL & VACHARD (1979) and BALLEVRE *et al.* (2010) is certainly not conceivable. Indeed, the Villedé d'Ardin Formation contains stringocephalids and its rugose coral fauna described by LE MAÎTRE (1937) is characterized by grypophyllids and fasciculate colonies with a strong stereozone, which are very different and probably younger than the material investigated herein in the Chalonnes Formation.

The discovery of Late Eifelian to Early Givetian rugose corals in the Chalonnes Formation is in disagreement with the recent dating of the overlying Sainte-Anne Formation. Indeed, the latter is considered to be Emsian to Early Eifelian in age by DUCASSOU *et al.* (2009) and BALLEVRE *et al.* (2010). One of their arguments is the determination of *Plectodonta minor* based on brachiopods collected by PENEAU (1928), close to a disrupted contact between the Chalonnes and Sainte-Anne Formations. Such a contradiction about the ages of these two lithostratigraphical units has already been outlined by MOREAU-BENOIT & DUBREUIL (1987, p. 41). According to these authors, there are no facies of transition between the two formations and the contacts between them are systematically faulted. More generally, the tectonic setting of the area between Montjean and Chaudefonds seems to be very complicated. DUBREUIL (1980) and MOREAU-BENOIT & DUBREUIL (1987) mentioned the occurrence of olistoliths in the Tombeau Leclerc Unit, whereas SHELLEY & BOSSIERE (2001) interpreted the Ordovician-Devonian sequence in the overall area as a tectonic mélange along a transpressional shear zone. However, as these authors do not use formal lithostratigraphical units, it is rather difficult to understand their descriptions of the outcrops.

The remaining rugose coral fauna investigated by LE MAÎTRE (1934) in the Chalonnes Formation consists of various genera and species represented by rather few specimens, which are not always in good state. This diversity concerns mainly the siphonophrentids and the fasciculate ptenophyllids.

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Explanation of the plates

All the specimens are figured at magnification x3.

PLATE 1

Stringophyllum acanthicum (FRECH, 1885)

Fig. 1 — IRScNB a12789. Houyet MC-1981-5-Z590. Transverse section.
Figs 2-3 — IRScNB a12790. Houyet MC-1981-5-Z174. Transverse and longitudinal sections.
Figs 4-5 — IRScNB a12791. Houyet MC-1981-5-Z448. Transverse and longitudinal sections.
Fig. 6 — GFCL 844. Saint-Charles quarry at Chaudefonds. Transverse section.

Acanthophyllum sp.

Fig. 7 — GFCL 833. Saint-Charles quarry at Chaudefonds. Transverse section.

Sociophyllum elongatum (SCHLÜTER, 1881)

Figs 8-10 — GFCL 646. Châteaupanne quarry at Montjean 780LM. Transverse and longitudinal sections.

Fasciphyllum cf. *katranicum* (GORIANOV, 1968 *in* BULVANKER *et al.*, 1968)

Fig. 11 — GFCL 651. Châteaupanne quarry at Montjean 851LM. Transverse section.

PLATE 2

Acanthophyllum vermiculare (GOLDFUSS, 1826)

Fig. 1 — GFCL 830. Saint-Charles quarry at Chaudefonds. Transverse section.
Figs 2-3 — GFCL 835. Saint-Charles quarry at Chaudefonds. Transverse and longitudinal sections.
Figs 4-5 — GFCL 831. Saint-Charles quarry at Chaudefonds. Transverse and longitudinal sections.

Acanthophyllum heterophyllum (MILNE-EDWARDS & HAIME, 1851)

Fig. 6 — GFCL 834. Valet quarry B at Chaudefonds. Transverse section.

Sociophyllum sp.

Fig. 7 — GFCL 840. Saint-Charles quarry at Chaudefonds. Transverse section.

Stringophyllum acanthicum (FRECH, 1885)

Figs 8-9 — IRScNB a12792. Houyet MC-1981-5-Z451. Transverse and longitudinal sections.

PLATE 3

Beugniesastraea ligeriensis (LE MAÎTRE, 1934)

Figs 1-3 — GFCL 845. Station quarry at Chalonnes. Transverse and longitudinal sections.

Stringophyllum acanthicum (FRECH, 1885)

Fig. 4 — IRScNB a12793. Houyet MC-1981-5-Z297. Transverse section.

Acanthophyllum tortum (TSIEN, 1969)

Fig. 5 — GFCL 648. Saint-Charles quarry at Chaudefonds 808LM. Transverse section.
Fig. 6 — GFCL 649. Saint-Charles quarry at Chaudefonds 811LM. Transverse section.

Sociophyllum cf. *elongatum* (SCHLÜTER, 1881)

Figs 7-8 — GFCL 837. Valet quarry A at Chaudefonds. Transverse and longitudinal sections.

Acanthophyllum vermiculare (GOLDFUSS, 1826)

Fig. 9 — GFCL 647. Saint-Charles quarry at Chaudefonds 810LM. Transverse section.

Fasciphyllum cf. *conglomeratum* (SCHLÜTER, 1881)

Fig. 10 — GFCL 650. Station quarry at Chalonnes 844LM. Transverse section.

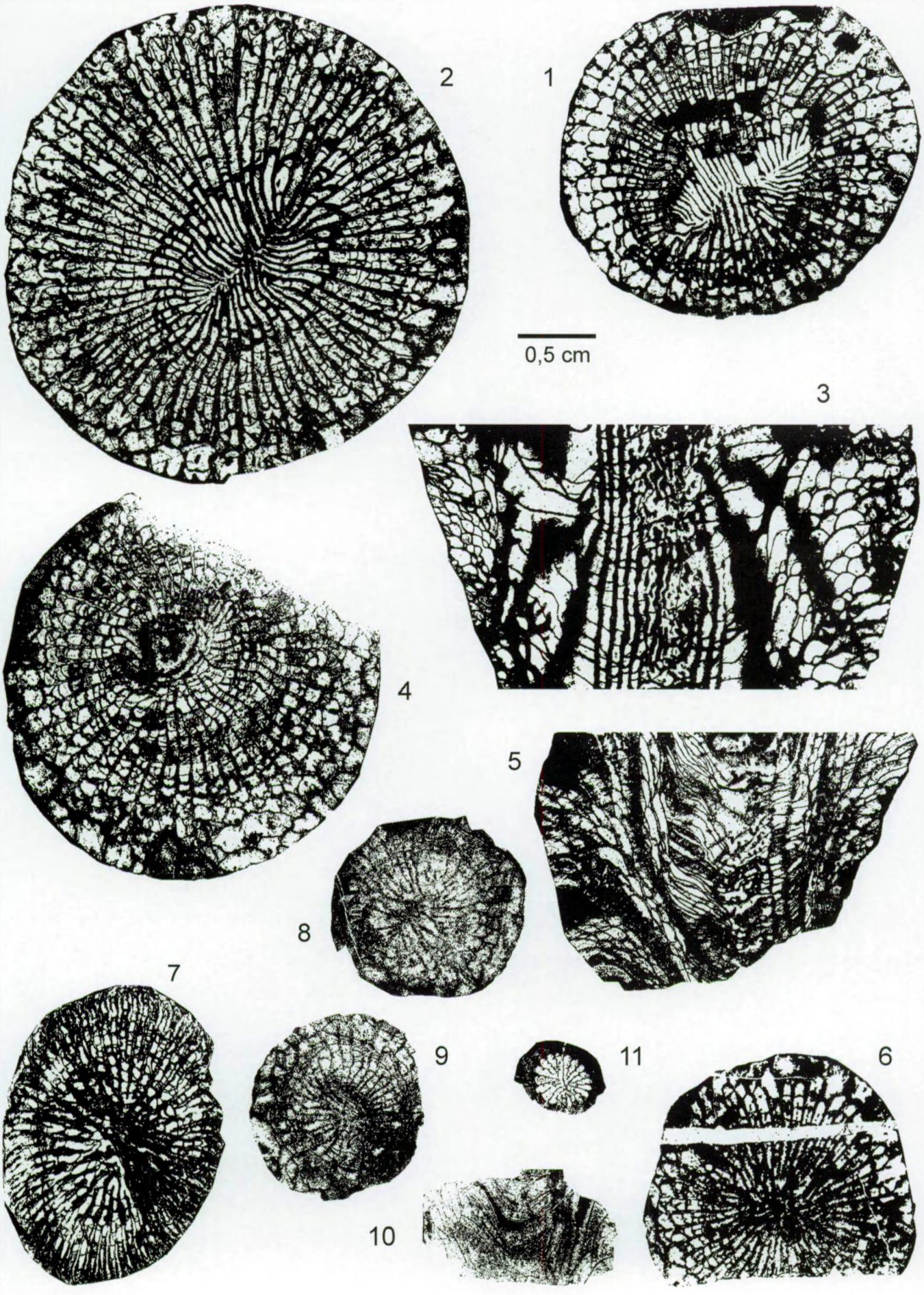

PLATE 1

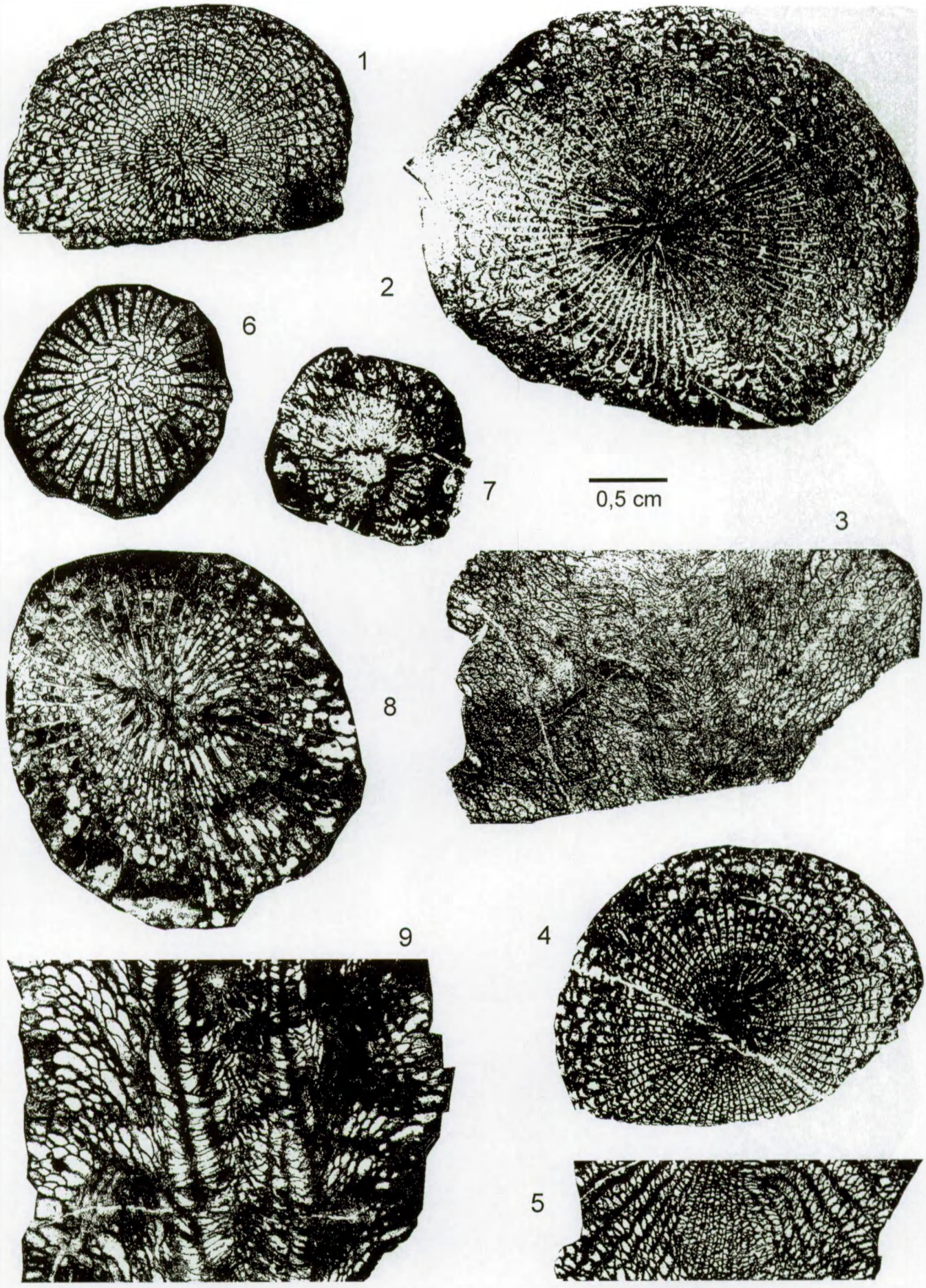

PLATE 2

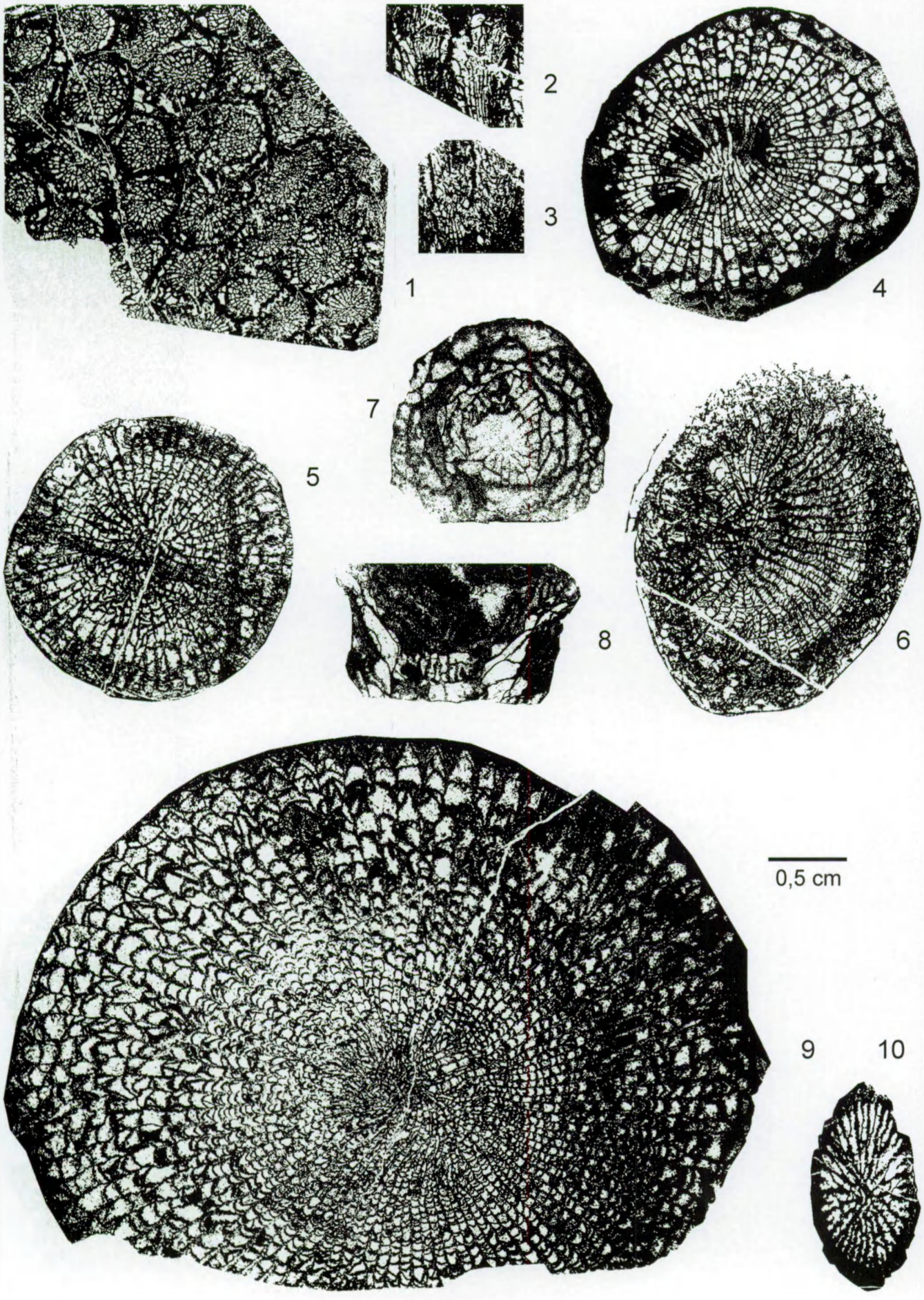

PLATE 3