An older Devonian stromatoporoid from the Ardennes, St. Joseph Formation, Emsian (Vireux, France)

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Abstract: The oldest stromatoporoids recorded in the Devonian from the Ardennes until now are reported by (Bultynck, 1970) from the Eau Noire Formation, upper Emsian. Recently, a large stromatoporoid sample was collected below this level, in the St. Joseph Formation (also upper Emsian), near Vireux-Molhain (Ardennes, France). The specimen is referred to *Stromatoporella* aff. *S. eriensis* (Parks, 1936). Presently it is the oldest stromatoporoid known to occur in the Devonian of the Ardennes.

Key words: stromatoporoids, Emsian, Ardennes

Contents

1. INTRODUCTION: HISTORICAL ASPECT

In an important monograph titled "Les Stromatoporoïdes du Dévonien moyen et supérieur du Bassin de Dinant" Lecompte (1951–52) did not report any stromatoporoid

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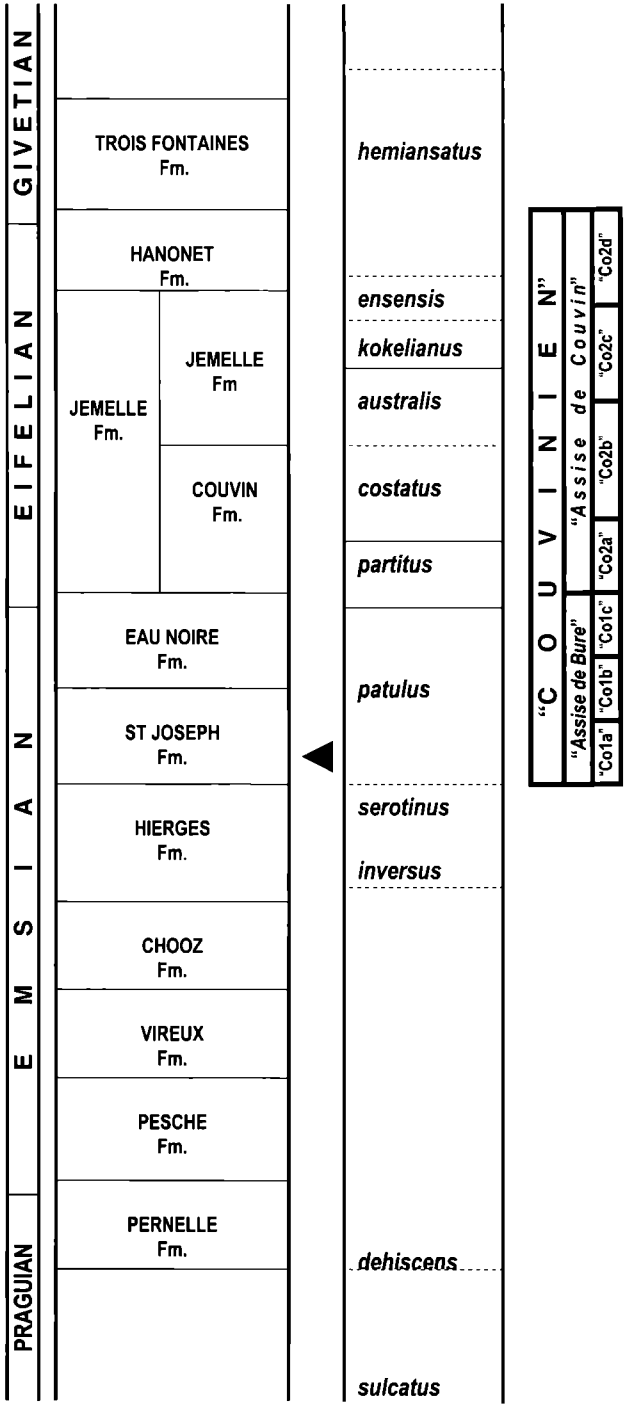

Fig. 1:
Lower to Middle Devonian formations of the Dinant Synclinorium, with the present conodont zones and old divisions; location of the sample ◀

PRAGUIAN	E M S I A N						E I F E L I A N		
PERNELLE Fm.	PESCHE Fm.	VIREUX Fm.	CHOOZ Fm.	HIERGES Fm.	ST JOSEPH Fm.	EAU NOIRE Fm.	JEMELLE Fm. COUVIN Fm.		HANONET Fm.

Distribution of the stromatoporoids in the Dinant synclinorium, according to Lecompte 1951-1952

location of the sample ▲ — *Index species* — *Other species*

	"C O U V I N I A N"							
	Lower Couvinian			Upper Couvinian				
	ASSISE DE BURE à *Spirifer cultrijugatus*			ASSISE DE COUVIN à *Calceola sandalina*				
	Grauwacke à *Stropheodonta piligera*	Schistes calcareux à *Uncinulus orbignyanus*	Calcaires argileux à *Dielasma loxogonia*	Schistes à *Spirifer speciosus*	Calcaire à Stromatopores et « récifs »	Schistes à *Spirifer ostiolata*	Schistes et calcaire stratifiés ou massifs à *Spiroceras nodulosum*	
	'Co1a'	'Co1b'	'Co1c'	'Co2a'	'Co2b'	'Co2c'	'Co2d'	→
Actinostroma conglomeratum LECOMPTE, 1951.						■		
Actinostroma couvinense LECOMPTE, 1951					■			
Actinostroma geminatum LECOMPTE, 1951.					■			
Actinostroma reversum LECOMPTE, 1951					■			
Actinostroma stellulatum NICHOLSON,1886								Givetian
Actinostroma verrucosum (GOLDFUSS, 1826)								'Gi F1'
Atelodictyon fallax LECOMPTE, 1951.								'Gib'
Atelodictyon strictum LECOMPTE, 1951								
Clathrodictyon amygdaloïdes LECOMPTE, 1951								
Clathrodictyon amygdaloïdes subvesiculosum LECOMPTE, 1951								
Clathrodictyon aff. *cellulosum* NICHOLSON & MURIE, 1875				■				
Parallelopora aff. *bücheliensis* (BARGATZKY, 1881)								'Gib Gid'
Stachyodes gracilis LECOMPTE, 1952					■			
Stromatopora concentrica GOLDFUSS, 1826								
Stromatopora hüpschii (BARGATZKY, 1881)								Givetien 'F2g'
Stromatopora pachytexta LECOMPTE, 1952.					■			
Stromatoporella granulata (NICHOLSON, 1873)								
Stromatoporella obliterata LECOMPTE, 1951								
Stromatoporella socialis NICHOLSON, 1892								
Stromatoporella solitaria NICHOLSON, 1892								
Syringostroma percanaliculata LECOMPTE, 1951								'Gid F1bc F2gh'
Syringostroma perfectum LECOMPTE, 1951.					■			

Fig. 2: Distribution of stromatoporoids in the Dinant synclinorium, according to Lecompte (1951–1952)

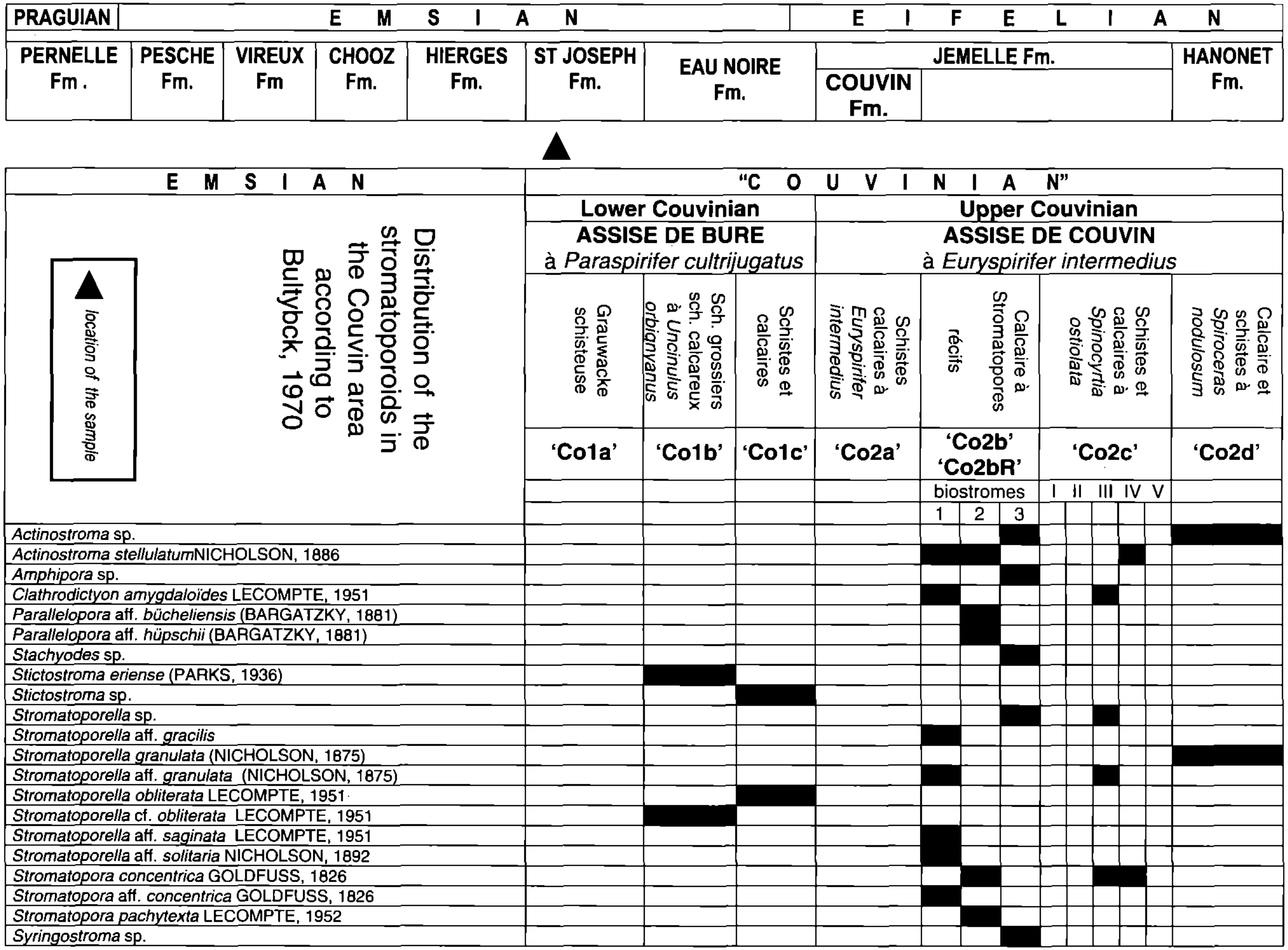

Fig. 3: Distribution of stromatoporoids in the Couvin area (Dinant synclinorium), according to BULTYNCK (1970).

species in the "Assise de Bure" = Lower "Couvinian" = essentially the upper part of the Emsian and the lowermost part of the present Eifelian (Fig. 1). He reported only one species (Fig. 2) in the "Co2a" (= lower part of the "Assise de Couvin" essentially the lower part of the present Eifelian). But LECOMPTE reported 21 species in the "Co2b, Co2c, Co2d" (= middle and upper part of the "Assise de Couvin" essentially the middle and upper part of the present Eifelian and lower part of the Givetian).

Later, in 1970, BULTYNCK (Fig. 3) also reported 21 stromatoporoid taxa in the "Couvinian", and noted that they were particularly numerous in the "Assise de Couvin" (= present Jemelle and Hanonet Formations) of the Nismes area. BULTYNCK is apparently the first to report the occurrence of stromatoporoids in the middle and upper part of the "Assise de Bure" (= Eau Noire Formation = upper part of the *patulus* Zone) but with 4 taxa. Until now, no stromatoporoid have been reported from the lower part of the "Assise de Bure" (= St. Joseph Formation = lower part of the *patulus* Zone)

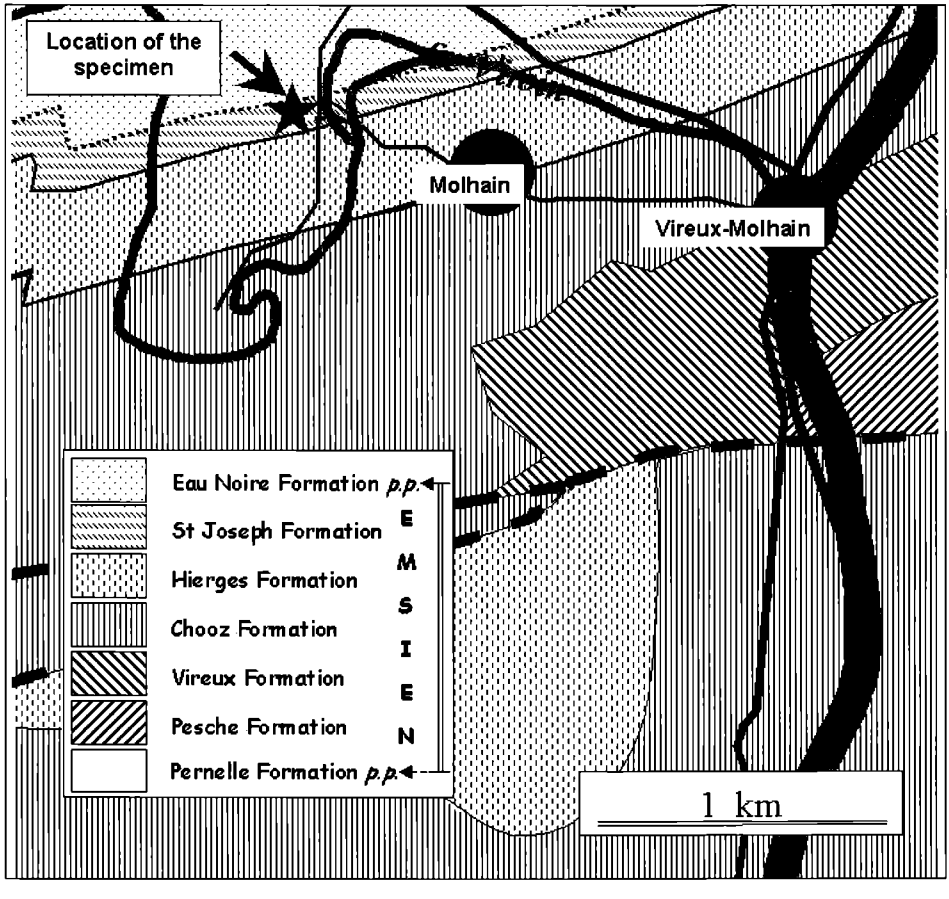

Fig. 4: The Emsian formations on the southern margin of the Dinant Synclinorium, near Vireux-Molhain, South of Givet (after GODEFROID & STEINER, 1988).

Moreover, according to a summary paper intitled "Les Formations du Dévonien moyen de la Belgique" (Bultynck et al., 1991), the first Devonian stromatoporoids are reported in the lower part of the Couvin Formation, lower part of the Eifelian (*partitus* Zone).

2. GEOGRAPHICAL SITUATION

In May 2003, during a field trip along the Meuse River, a stromatoporoid was collected from an outcrop (Fig. 4) situated about 1.5 km westnorthwest of the Vireux-Molhain city (500 m. W-NW of Molhain village), Ardennes, France. The locality is on the left side of the Viroin River, just in front of a small bridge over the river, along a path that leads to the famous "mur des douaniers" fossiliferous locality (Réserve de Vireux-Molhain).

3. STRATIGRAPHICAL SITUATION

Beds of the lower part of St. Joseph Formation are exposed in this locality. The St. Joseph Formation (Fig. 1) is equivalent to the lower part of the previously named "Assise de Bure". For a long time, especially in Belgium, the base of the "Assise de Bure" (= "Co1a" of Belgian authors, = d3a of the French Givet geological map), was considered as the beginning of Middle Devonian (the previously so-called "Couvinian" stage). The "Couvinian" stage marked the beginning of carbonate sedimentation following the typical detrital deposits which characterize the Lower Devonian in the Ardennes.

According to the 1982 S.D.S. (Subcommission on Devonian Stratigraphy) decision (cf. Bultynck et al., 1991) the base of the Middle Devonian is stratigraphically higher and corresponds to the first appearance of the conodont *partitus*. Thus, the St. Joseph Formation is in the upper part of the Emsian and is equivalent to the lower part of the *patulus* Zone.

Consequently, the specimen collected in the lower beds of the St. Joseph Formation and described in this paper is apparently the oldest stromatoporoid currently known from the Devonian of the Ardennes.

4. DESCRIPTION OF THE SPECIMEN

Genus *Stromatoporella* Nicholson, 1886
Type species: *Stromatopora granulata* Nicholson, 1873

Stromatoporella aff. *eriensis* (Parks, 1936)
Pl. 1, Fig. 1–12.

1934 *Clathrodictyon striatellum* (d'Orbigny) – Le Maître, p. 185, Pl. 9, Fig. 8.
* 1936 *Stictostroma eriense* sp. nov. – Parks, p. 81, Pl. V, Figs. 1–4.
1949 *Stictostroma eriense* Parks – Le Maître, p. 517.
• 1951 *Stictostroma eriense* Parks (= *Clathrodictyon*) – Lecompte, p. 137, Pl. XX, Figs.2, 2a, 2b.

- 1957 *Stromatoporella eriensis* (PARKS) – GALLOWAY & ST JEAN, p. 145, Pl. 10, Figs. 2a, 2b.
- 1957 *Stromatoporella eriensis* (PARKS) – GALLOWAY, p. 436–437, Pl. 31, Fig. 8, Pl. 34, Fig. 1.

  1958 *Str. eriense* – FLÜGEL, E., p. 180.
- 1960 *Stromatoporella eriensis* (PARKS) – GALLOWAY, p. 622, pl. 71, fig. 3a, b, 3a, b.

  1961 *Stromatoporella eriensis* (PARKS) – FLÜGEL, p. 48.

  1968 *Stromatoporella eriense* (PARKS) – FLÜGEL & FLÜGEL-KAHLER, p. 151.

  1970 *Stictostroma eriense* (PARKS) – BULTYNCK, p. 25.

? 1975 *Clathrodictyon amygdaloïdes* LECOMPTE – CORNET, Pl. II, Fig. 2.

? 1982 *Stromatoporella eriense* (?) (PARKS) – FAGERSTROM, p. 39, Pl. 7, Fig. 5.

4.1. Material

One specimen: GFCL 1305. 4 thin sections.

4.2. External features

The specimen is an elongated nodule, about 10 cm long, and 8 and 6 cm in the other dimensions. It is broken, revealing that the stromatoporoid encrusted a brachiopod shell.

The brachiopod shell, inside the nodule, is observable on a surface of about 3.5 cm by 5 cm. The visible part of the shell corresponds to the ventral valve of *Paraspirifer* sp. characterised by a large and hollow sinus and well developed muscle field; few large costa can also be observed; according to Denise Brice (pers. com.) the specimen resembles to *P. sandbergeri* SOLLE, 1971.

Few external features are observable on the surface of the stromatoporoid, only some irregularities but no typical mamelons. Generally, the weathered aspect reveals a thin meshed structure and some sectioned laminae. In some places a very thin (0.5 mm thick) layer of argil-ferruginous and slightly micaceous matrix covers the stromatoporoid.

The complete brachiopod shell was encrusted by the stromatoporoid. In one place (possible the lower part?) the stromatoporoid is only 0.6 cm thick, but in other places the stromatoporoid thickness is generally 2 cm and reaches 3.2 cm on the side opposite to the presumed lower part.

In the broken lateral part of the nodule, where laminae are observable, a very thin organism, probably a tabulate coral, only about 0.5 mm thick but 2.5 cm long, is associated with the stromatoporoid. Preferentially, in the presumed upper part of the nodule, some interlaminar spaces are pyritized, and, locally several of them form lenticular structures, up to 2.8 cm wide and 0.8 cm high.

4.3. Internal features

In vertical section, the skeletal elements are clearly visible. Laminae, are variable in thickness, usually 50 to 80 µm, but sometimes only 30 or up to 150 µm. Due to the numerous

ring-pillars (see below) the laminae appear very irregular and undulated (particularly in oblique section, showing a zigzag structure typical of *Clathrodictyon*). Pores through the laminae are very scarce. Usually there are 20 to 22 laminae in 5 mm, rarely more (23–24).

Pillars are typically confined to an interlaminar space and not superposed. They are less numerous than laminae (13 to 15 in 5 mm), and variable in thickness because they are differentiated into normal and ring-pillars. Normal pillars (or ring-pillars cut laterally?) are spool shaped and 60 to 120 µm in diameter. Ring-pillars are numerous, and in some interlaminar spaces up to 7 or 8 out of 10 pillars are ring shaped. They are 200 to 250 µm in diameter, sometimes up to 350 µm, with a hollow centre 75 to 90 µm in diameter.

Interlaminar spaces are usually rounded and variable in diameter (usually 120 to 180 µm). Some larger (up to 250 µm) and elongated interlaminar spaces, with scarce pillars (sometimes absent in a length of 4.5 mm), probably correspond to astrorhizal galleries, but astrorhizae are not really developed. Dissepiments are very scarce.

Remarks: Few interlaminar spaces are filled with matrix (Pl. 1, Figs. 3, 7, 8). They are more or less regularly distributed, separated by from 2 or 3 mm or more. Moreover, some small organisms are also associated with the stromatoporoid, especially crinoids holdfasts and tabulate corals.

The crinoids holdfasts are more or less truncated cones (Pl. 1, Figs. 5–6): the largest one is 7 mm wide and about 2.5 mm high. The location of the crinoids holdfasts within the stromatoporoid, doesn't correspond with the levels where the interlaminar spaces are filled with matrix.

One of the tabulate corals is the one directly observed on the exterior of the specimen (cf. above, external features). In thin section (Pl. 1, Fig. 7) it appears to be a thin encrusting favositid, about 2 cm wide but only 1 mm high, with more or less flat regular tabulae. In one thin section, just at the anterior commissure of the brachiopod shell, near the sulcus, there are two circular sections of a syringoporid tabulate coral, 1.2 to 1.8 mm in diameter, with thick walls (250–300 µm), thick tabulae (60–90 µm) and well developed spines. These syringoporid tubes are not the usual caunopore tubes present in some stromatoporoids.

In tangential section, complete or C shaped ring-pillars are clearly visible. They are 210–240 µm, up to 300 µm, in diameter, with a large central hole (75 to 90 µm, sometimes 120 µm in diameter). Sections of normal pillars are usually rounded, 60 to 150 µm wide, but sometimes more elongated. Some stellate astrorhizal canals are also discernable.

4.4. Microstructure

The preservation of the specimen is good and in most parts of the thin sections, the microstructure of the skeletal elements is generally cellular to microreticulate, but in some places, ordinicellular microstructure can also be observed.

5. DISCUSSION

The presence of clearly developed and numerous ring-pillars and also the microstructure are typical for specimens belonging to *Stromatoporella* NICHOLSON, 1886.

According to the following features: undulated laminae, abundant ring-pillars, density of skeletal elements, absence of mamelons, poorly developed astrorhizae, and rare dissepiments, the specimen is very similar to *S. eriensis* (PARKS, 1936). It just differs from the type specimen by having slightly thicker skeletal elements, giving a less evident zigzag character to the laminae. But specimens are limited (only one sample), so I propose to use aff. *S. eriensis*.

CORNET (1975, Pl. II, Fig. 2) illustrated a vertical section of *Clathrodictyon amygdaloides* LECOMPTE, 1951 that appears very similar to the specimen described herein, however, the astrorhizal canals are well developed; CORNET's specimen, with numerous ring pillars, does not belong to *Clathrodictyon* but to *Stromatoporella*. LECOMPTE's original specimen of *C. amygdaloïdes* possesses straight laminae and no ring-pillars, so it does not belong to *Stromatoporella*.

The specimen from Vireux-Molhain is somewhat similar to *C. amygdaloides subvesiculosum* LECOMPTE, 1951, that is characterized by ring-pillars and classified by GALLOWAY & ST JEAN (1957) in the genus *Stromatoporella*, but, in the Vireux-Molhain specimen, laminae are more undulated.

The Vireux-Molhain specimen also resembles *S. selwyni* NICHOLSON, 1892 but does not possess large mamelons and is characterized by thinner and less numerous skeletal elements.

6. GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

The genus *Stromatoporella* is a typical Devonian genus, with about 56 known species (STEARN et al., 1999). It is present from Pragian up to ? Frasnian, and very abundant during Givetian. During Emsian, out of Europe, the genus is known from North America (Canada and U.S.A.), Australia (Queensland), Afghanistan and Russia. In Europe, it was recently described from the Santa Lucia Formation, mainly Upper Emsian, in the Cantabrian Mountains (MENDEZ-BEDIA & MISTIAEN, 1997).

Stromatoporella eriensis occurs in the Columbus Limestone (Ohio), the lower part of the Eifelian and part of the "boundary zone" below.

In the Ardennes the species could be present in the lower part of the Eau Noire Formation (Upper Emsian).

The species could also be present in the Middle Devonian of Austria (Graz) and France (Massif Armoricain).

7. CONCLUSION

The here described specimen of *Stromatoporella* aff. *S. eriensis* is the oldest stromatoporoid presently known from the Ardennes. It is a large nodule (not just a small en-

crusting form), certifying that at the beginning of late Emsian times in the vicinity of Vireux-Molhain were carbonate environments favourable to some reef development.

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Plate 1

Figs. 1–12: *Stromatoporella* aff. *S. eriensis* (PARKS, 1936) [GFCL 1305]

Fig. 1: General view of the specimen; x 0.5

Fig. 2: Thin section, showing the relation between the stromatoporoid *Stromatoporella* aff. *S. eriensis* (PARKS, 1936) and the brachiopod, *Paraspirifer sandbergeri* SOLLE, 1971; x 2

Fig: 3: Vertical section showing the irregular zigzag aspect of laminae and the well developed and numerous ring-pillars; x 5

Fig. 4: Vertical section. Detail of Fig. 3; x 20

Fig. 5: Vertical section. Crinoid holdfast within the stromatoporoid; x 5

Fig. 6: The same as Fig. 5 in polarized and analysed light.

Fig. 7: Vertical section. Intercalation of a thin favositid tabulate coral inside the stromatoporoid. See also latilamination, in the lower part; x 5

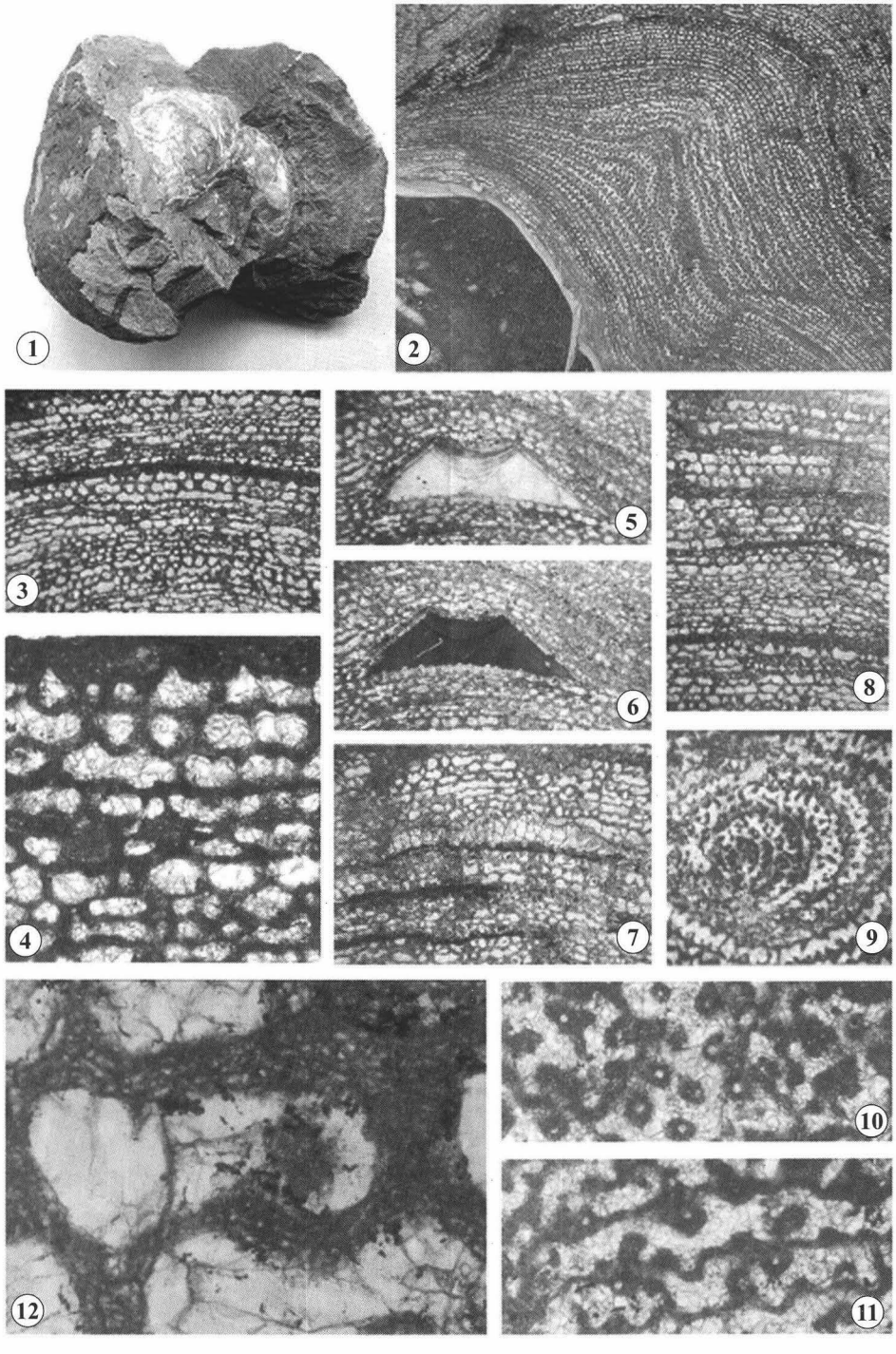
Fig. 8: Vertical section. Latilamination usually characterized by one or two interlaminar spaces full of matrix; x 5

Fig. 9: Tangential section. Punctuated structure with numerous ring-pillars; x 5

Fig. 10: Tangential section. Place with numerous ring-pillars; x 20

Fig. 11: Tangential to oblique section. Ring-pillars and irregular laminae; x 20

Fig. 12: Vertical section. Typical microreticulate microstructure; x 75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