BULLETIN DE L'INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE
BULLETIN VAN HET KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN

SCIENCES DE LA TERRE, 78: 31-50, 2008
AARDWETENSCHAPPEN, 78: 31-50, 2008

Fasciculate Disphyllids (Rugosa) from the Early Givetian Trois-Fontaines Formation in Belgium

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COEN-AUBERT, M., 2008 – Fasciculate Disphyllids (Rugosa) from the Early Givetian Trois-Fontaines Formation in Belgium. *In*: STEURBAUT, E., JAGT, J.W.M. & JAGT-YAZYKOVA, E.A. (Editors), Annie V. Dhondt Memorial Volume. *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **78**: 31-50, 3 pls, 6 figs, Brussels, October 31, 2008 – ISSN 0374-6291.

Abstract

Disphyllum caespitosum (GOLDFUSS, 1826), which is the type species of *Disphyllum* DE FROMENTEL, 1861, *D. oekentorpi* n. sp. and *Coenophyllum groessensi* n. gen., n. sp., which is the type species of *Coenophyllum* n. gen., are described in detail and come from the Early Givetian Trois-Fontaines Formation, on the south side of the Dinant Synclinorium. Both genera are representatives of the family Disphyllidae HILL, 1939. *Disphyllum oekentorpi* is widely distributed in the upper part of the Trois-Fontaines Formation; it is found at the same level as *Argutastrea quadrigemina* (GOLDFUSS, 1826) and is locally associated in Hotton with *Coenophyllum groessensi*. *Disphyllum caespitosum* has only been collected at the locality of Pondrôme to the east of Givet. In the more eastern area of Marenne and Ménil-Favay, the lower part of the Trois-Fontaines Formation is partly composed of silty limestones; however, these detrital deposits have not been observed in the nearby section of Hotton. As a whole, the Trois-Fontaines Formation belongs to the *Polygnathus hemiansatus* conodont Zone.

Keywords: Rugose corals, Givetian, Taxonomy, Stratigraphy, Belgium.

Résumé

Disphyllum caespitosum (GOLDFUSS, 1826), qui est l'espèce-type de *Disphyllum* DE FROMENTEL, 1861, *D. oekentorpi* n. sp. et *Coenophyllum groessensi* n. gen., n. sp., qui est l'espèce-type de *Coenophyllum* n. gen., sont décrits en détail et proviennent de la Formation de Trois-Fontaines (Givetien inférieur), au bord sud du Synclinorium de Dinant. Les deux genres sont des représentants de la famille Disphyllidae HILL, 1939. *Disphyllum oekentorpi* est largement répandu dans la partie supérieure de la Formation de Trois-Fontaines; il a été trouvé au même niveau qu'*Argutastrea quadrigemina* (GOLDFUSS, 1826) et est associé localement à Hotton à *Coenophyllum groessensi*. *Disphyllum caespitosum* n'a été récolté que dans la localité de Pondrôme à l'est de Givet. Dans la région plus orientale de Marenne et de Ménil-Favay, la partie inférieure de la Formation de Trois-Fontaines se compose partiellement de calcaires silteux; toutefois, ces apports détritiques n'ont pas été observés dans la section voisine de Hotton. Dans l'ensemble, la Formation de Trois-Fontaines appartient à la Zone à Conodontes à *Polygnathus hemiansatus*.

Mots-clefs: Rugueux, Givetien, Taxinomie, Stratigraphie, Belgique.

Introduction

Colonial rugose corals are abundant at the base of the Early Givetian Trois-Fontaines Formation from the south side of the Dinant Synclinorium and have been investigated by COEN-AUBERT (1989, 1990 and 1998). They are still present, but they become more scattered higher in the lithostratigraphic unit. Three species of fasciculate rugose corals coming from these levels are described herein: *Disphyllum caespitosum* (GOLDFUSS, 1826), *D. oekentorpi* n. sp. and *Coenophyllum groessensi* n. gen., n. sp. which is the type species of the new genus *Coenophyllum*. Moreover, *Disphyllum caespitosum* is the type species of *Disphyllum* DE FROMENTEL, 1861 and both genera are representatives of the family Disphyllidae HILL, 1939. These fossils have been collected in two different areas (Fig. 1): firstly the localities of Pondrôme, Wellin and Resteigne located to the east of Givet, then the localities of Marenne, Ménil-Favay and Hotton situated in the southeastern part of the Dinant Synclinorium where the facies are slightly different and not very well known.

According to BULTYNCK & DEJONGHE (2002, p. 51) and PREAT & BULTYNCK (2006, p. 15), the Trois-Fontaines Formation belongs to the *Polygnathus hemiansatus* conodont Zone, above the Eifelian-Givetian boundary. It must also be mentioned that the Givetian on the south side of the Dinant Synclinorium is represented in ascending order, by the upper part of the Hanonet

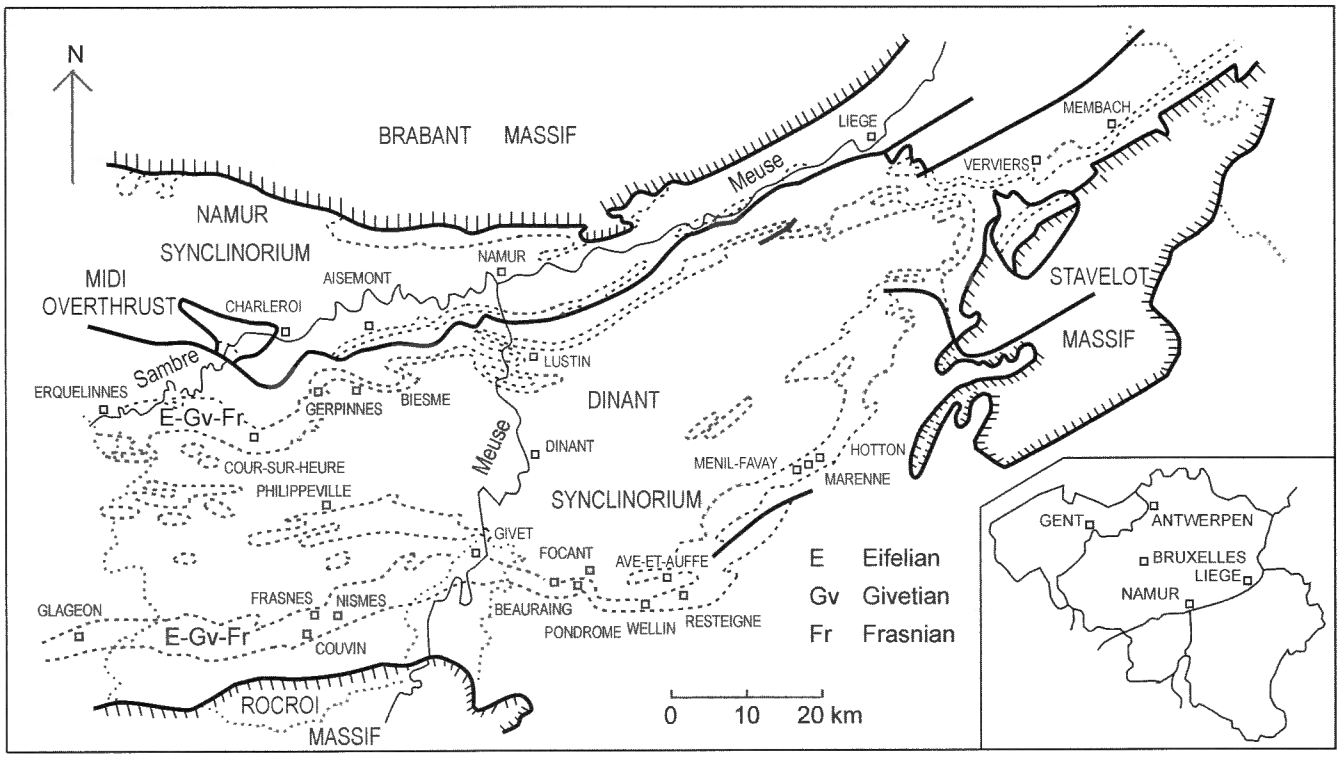

Fig. 1 — Geological setting and locality map in the southern part of Belgium.

Formation, the Trois-Fontaines, Terres d'Haurs, Mont d'Haurs and Fromelennes Formations.

The main part of the material was collected by the author *in situ* during geological surveys made bed by bed. The types of the new species and the figured specimens are stored in the collections of the Institut royal des Sciences naturelles de Belgique (IRScNB).

Description of the outcrops

RESTEIGNE QUARRY (Wellin MC-1974-95; Fig. 2)

A complete section of the Trois-Fontaines Formation is exposed in the disused and well known quarry of Resteigne investigated among others by BIRENHEIDE *et al.* (1991, p. 10) and COEN-AUBERT (1998, p. 9 and 2003, p. 12). At the base of the lithostratigraphic unit, there are 10.5 m to 22.5 m of coarsely crinoidal limestones with reefal lenses rich in corals and stromatoporoids. The highly diversified rugose coral fauna of this level has been figured by COEN-AUBERT (1997, fig. 3 and 1998, fig. 2) and includes several colonial forms such as *Columnaria intermedia* COEN-AUBERT, 1990, *Beugniesastraea kunthi* (SCHLÜTER, 1880), *Sociophyllum elongatum* (SCHLÜTER, 1881) and *Thamnophyllum occlusum* (TSIEN, 1969). A few small corallites of *Coenophyllum groessensi* have also been collected at the top of this unit. Then occurs a biostrome with massive stromatoporoids which is about 4 m thick and capped by a stringocephalid coquina.

The upper part of the Trois-Fontaines Formation is represented by 73 m of well-bedded and mostly lagoonal limestones, especially close to its top. Below these restricted facies characterized notably by laminites and rare colonies of *Argutastrea quadrigemina* (GOLDFUSS, 1826), there are several bioclastic intercalations with some massive stromatoporoids, rugose and tabulate corals; a few specimens of *Disphyllum oekentorpi* have been found 31 m below the base of the Terres d'Haurs Formation.

This lithostratigraphic unit has been described in detail by COEN-AUBERT (2003). It starts with a coralliferous biostrome containing numerous colonies of *Argutastrea quadrigemina* associated with a few coralla of *Temnophyllum wellinense* COEN-AUBERT, 2003. A bed rich in *Disphyllum mcleani* COEN-AUBERT, 2003 is present 22.5 m above the base of the Terres d'Haurs Formation.

WELLIN FOND DES VAUX EAST AND WEST (Wellin MC-1983-9 and 12; Fig. 2)

To the north of the village of Wellin, there are two active quarries named Fond des Vaux East (Wellin MC-1983-9) and Fond des Vaux West (Wellin MC-1983-12) which have been investigated among others by COEN-AUBERT (1990, 1998 and 2003). At the base of the Trois-Fontaines Formation, four different sections have been described by COEN-AUBERT (1990) and COEN-AUBERT *et al.* (1991). As in Resteigne, the lithostratigraphic unit starts with coarsely crinoidal limestones which are much more developed at Wellin with a thickness varying between 32 m and

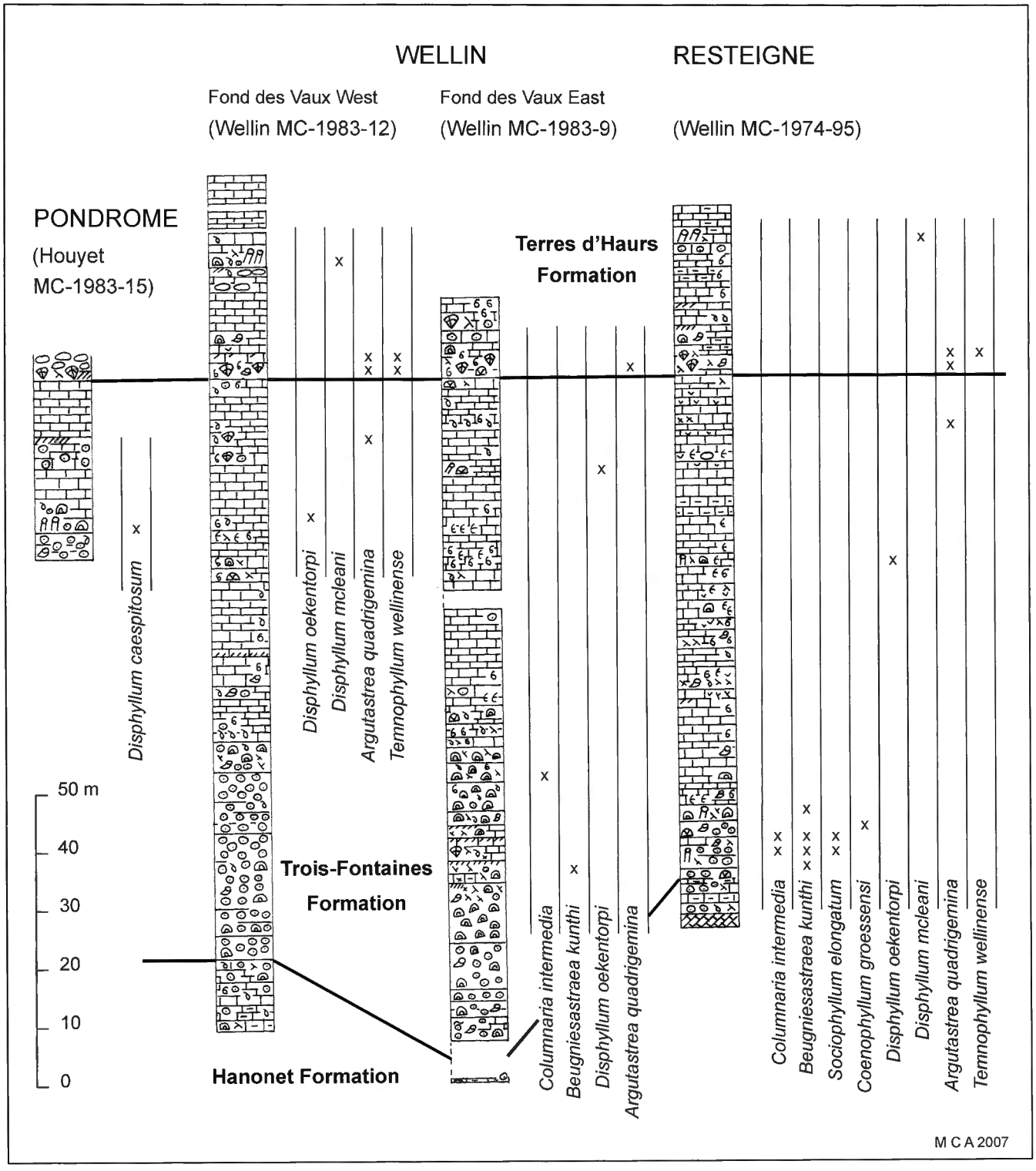

Fig. 2 — Comparative logs of the Trois-Fontaines Formation at Pondrôme, Wellin and Resteigne with the distribution of the rugose corals. (For explanation of conventional signs, see Fig. 3).

65,5 m. This level shows also important facies variations and a big reefal lens with abundant massive stromatoporoids was observed in the Fond des Vaux East quarry. With the progress of the quarrying activity, the situation changed and recently another biohermal lens built by corals and stromatoporoids has been studied by MAMET & PREAT (2005) in the Fond des Vaux West quarry. The particular rugose coral fauna of these coarsely crinoidal limestones has been identified by COEN-AUBERT

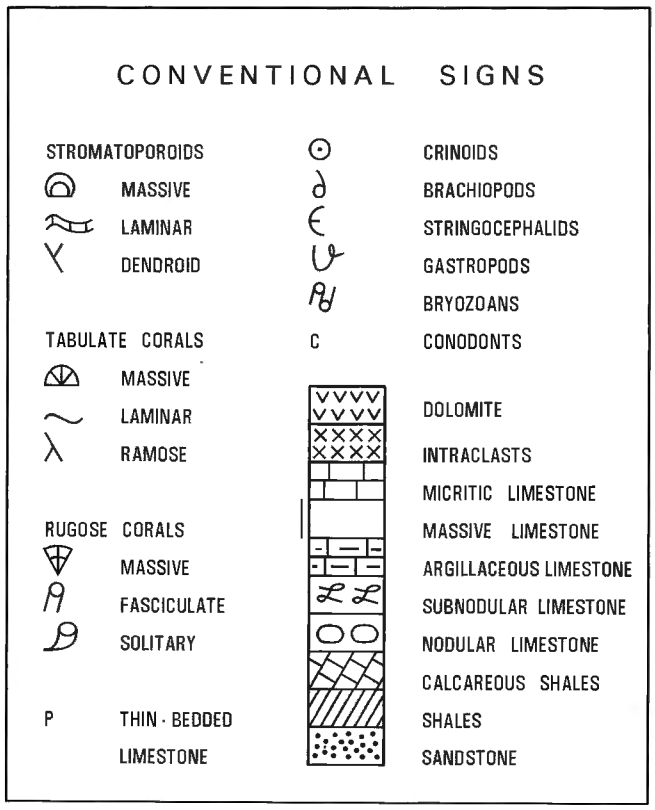

Fig. 3 — Explanation of conventional signs used in Figs 2 and 5.

(1990) and includes a few specimens of *Beugniesastraea kunthi* and *Columnaria intermedia*. Higher occurs as in Resteigne a biostrome with massive stromatoporoids and a stringocephalid coquina. These two units are about 7 m thick.

The upper part of the Trois-Fontaines Formation is characterized by 60 m of lagoonal limestones with again some laminites and colonies of *Argutastrea quadrigemina* close to its top. Beautiful specimens of *Disphyllum oekentorpi* have been collected in the Fond des Vaux East and West quarries, respectively 16 m and 24 m below the base of the Terres d'Haurs Formation. As mentioned by COEN-AUBERT (2003, p. 14), the latter lithostratigraphic unit starts with a coralliferous biostrome rich in *Argutastrea quadrigemina* and solitary coralla of *Temnophyllum wellinense*. The bed with *Disphyllum mcleani* has been observed 21 m above the base of the Terres d'Haurs Formation, in the Fond des Vaux West quarry.

BOIS LE BAN QUARRY AT PONDROME (Houyet MC-1983-15; Figs 2 and 4)

In the Bois Le Ban or Malakof quarry located to the northwest of Pondrôme (Fig. 4), the situation is very different from that of Resteigne and Wellin. This old excavation, where the layers are overturned with a dip of 64° to 76° towards the south, has been investigated by PEL (1975, p.85) and also by A. PREAT and F. TOURNEUR during the eighties. In this outcrop, the Trois-Fontaines is represented by:

- 4.5 m: well-bedded and crinoidal limestone with brachiopods present locally and rare fragments of *Cystiphylloides*;
- 2.2 m: bedded and argillaceous limestone containing crinoids and mostly in the lower part: massive and dendroid stromatoporoids, thamnoporids, scolioporids, aulopo-

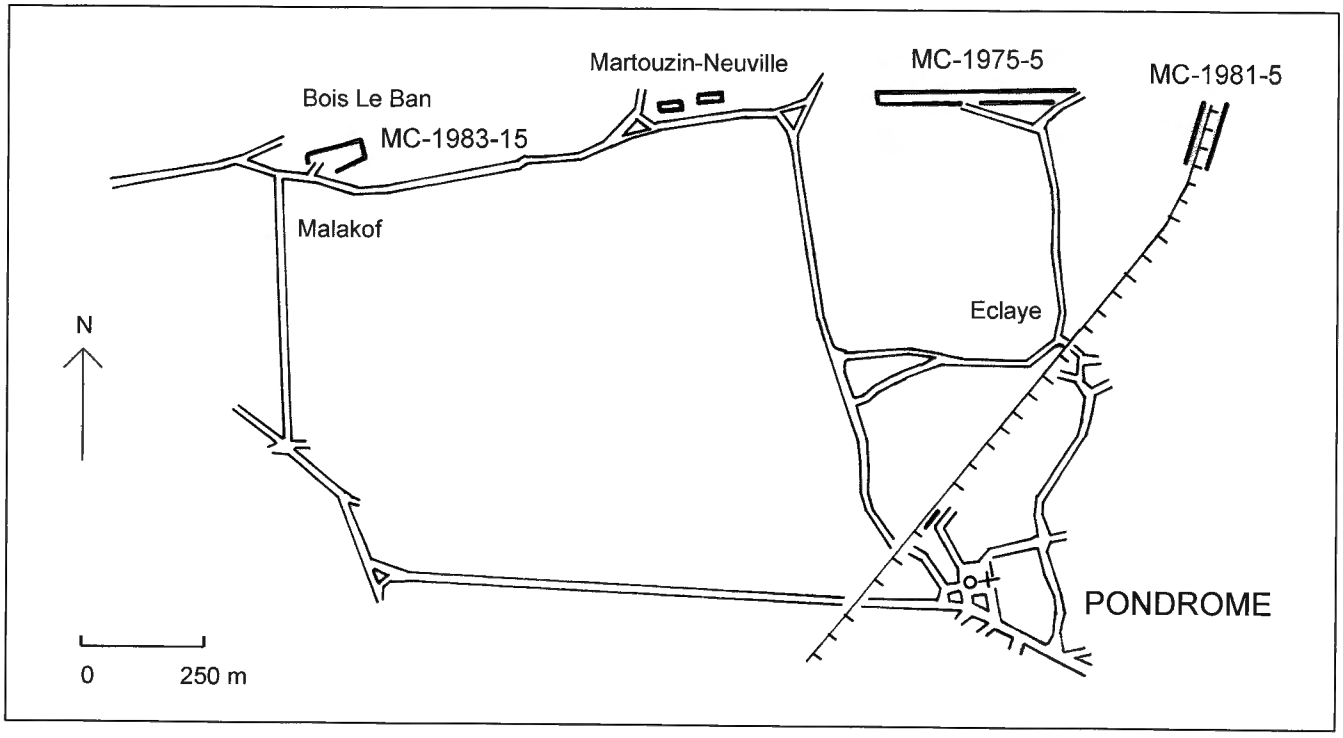

Fig. 4 — Location of Bois Le Ban or Malakof quarry at Pondrôme.

rids, solitary rugose corals and brachiopods; at the base, occurrence of beds with colonies and isolated corallites of *Disphyllum caespitosum*;

- 3.75 m: fine or bioclastic limestone with brachiopods, crinoids and even a small lens composed of massive stromatoporoids;
- 5.0 m: well-bedded and fine limestone;
- 4.3 m: well-bedded and more or less crinoidal limestone showing cross bedding in the lower part;
- 10.8 m: well-bedded and fine limestone locally laminated with layers of shale at the base.

Then the Terres d'Haurs Formation starts with 1.5 m of argillaceous limestones with shaly intercalations and large colonies of *Argutastrea* accompanied by *Pachyfavosites* and rare *Alveolites*; these corals form two levels of patch reefs in the upper part of this sequence which is capped by nodular limestones.

This succession is similar to that described by COEN-AUBERT (2003, pp. 14-15) in the old quarry of Beauraing (Vencimont MC-1975-4) open in the wood above the road to Winenne and in the Eclaye quarry at Pondrôme (Houyet MC-1975-5) located to the east of Bois Le Ban quarry (Fig. 4). In these three outcrops, the thickness of the lagoonal limestones from the Trois-Fontaines Formation seems to be rather reduced and the crinoidal limestones with some reef building organisms occurring at the base of the Beauraing and Bois le Ban sections recall already the facies of the coarsely crinoidal limestones observed at the base of the lithostratigraphic unit between Wellin and Resteigne. The discovery of *Disphyllum caespitosum* at Bois Le Ban quarry, unknown elsewhere in Belgium, is probably related to these unusual conditions.

In the three quarries of Bois Le Ban, Eclaye and Beauraing, the Terres d'Haurs Formation starts with two levels of patch reefs rich in *Argutastrea quadrigemina*, *Pachyfavosites polymorphus* and *Thamnopora cervicornis*. As mentioned by COEN-AUBERT (2003, p. 12), these patch reefs are also present in the Les Limites quarry at Ave-et-Auffe (Wellin MC-1983-14) together with the biostrome that characterizes normally the base of the Terres d'Haurs Formation between Wellin and Resteigne.

MARENNE QUARRY (Marche MC-89; Fig. 5)

With the progress of the quarrying activity, the Marenne quarry has much changed since the publication of BARCHY *et al.* (2004). At the present time, it shows, in the eastern part of the excavation and to the north of the Marenne Fault, a complete succession from the lower part of the Trois-Fontaines Formation to the base of the Mont d'Haurs Formation.

As mentioned by BARCHY *et al.* (2004, p. 60), the lower part of the Trois-Fontaines Formation is made up of 26.5 m of well-bedded, dark and bioclastic limestones with several silty or crinoidal levels. This particular facies has been assigned to the Marenne Member by MABILLE *et al.* (2008). However, this new lithostratigraphic subdivision is not very well defined as its base and the contact with the Hanonet Formation are not exposed in the Marenne quarry, due to the occurrence of the Marenne Fault. Laterally to the upper part of these more or less silty limestones, a reefal lens crops out along the southwest wall of the quarry. It is characterized by coarsely crinoidal limestones often rich in big massive stromatoporoids, thamnoporids and colonial rugose corals represented by *Columnaria intermedia*, *Beugniesastraea kunthi* and *Sociophyllum elongatum*.

These more or less silty limestones are succeeded by:

- 11 m: bioclastic limestone still crinoidal at the base, with a few corals and stromatoporoids in the upper part;
- 23 m: bedded and fine limestone with several beds consisting of brachiopod shells and several intercalations containing corals and brachiopods;
- 3.2 m: bedded and crinoidal limestone very rich in bushes of *Scoliopora* accompanied by isolated corallites and even colonies of *Disphyllum oekentorpi* as well as by some favositids and thamnoporids. The beautiful collection of spinatrypid and athyrid brachiopods investigated by GODEFROID & MOTTEQUIN (2005) comes also from this level which was remarkably exposed along a small fault until 2003;
- 26 m: bedded and fine limestone, locally bioclastic and containing a few corals and stromatoporoids; in the upper part, occurrence of several layers with laminites or leperditid ostracodes.

At the base of the Terres d'Haurs Formation, there are coarsely crinoidal limestones which may reach a thickness of 4.3 m; locally are present numerous branches of *Thamnopora* and *Scoliopora* associated with some brachiopods, *Pachyfavosites*, *Favosites*, colonies of *Argutastrea quadrigemina* and solitary coralla of *Temnophyllum wellinense*. Then the lithostratigraphic unit shows the same succession as that described by COEN-AUBERT (2003, p. 15) and BARCHY *et al.* (2004, pp. 64 and 66) at Hampteau close to Hotton. That means that the lower part of the Terres d'Haurs Formation is characterized in the Marenne quarry by fine or bioclastic limestones including several beds with corals, laminites, stringocephalid coquinas or leperditid ostracods. A few specimens of *Disphyllum mcleani* have been found 29 m above the base of the Terres d'Haurs Formation.

MENIL-FAVAY (Hotton MC-94; Fig. 6)

Two specimens of *Disphyllum oekentorpi* have been collected by M. Coen in the outcrop Hotton MC-94 lying to the north of the village of Ménil-Favay, along the west side of the Agauche stream (Fig. 6). This exposure is situated opposite to the disused quarry of Ménil-Favay investigated by COEN *et al.* (1974, pp. 14-16), whose main part is now filled in with waste. In the discontinuous section of Hotton MC-94, the samples of *D. oekentorpi* come from the upper part of the Trois-Fontaines Formation, below he beds with laminites and leperditid ostracods. These lagoonal limestones overlie silty limestones which characterize the lower part of the lithostratigraphic unit just as in the Marenne quarry.

HAMPTEAU QUARRY AT HOTTON (Hotton MC-33; Fig. 5)

As stated by COEN-AUBERT (2003, p. 15) and BARCHY *et al.* (2004, p. 64), the Hampteau quarry located 1.5 km to the southeast of Hotton is subdivided into two parts by a strongly

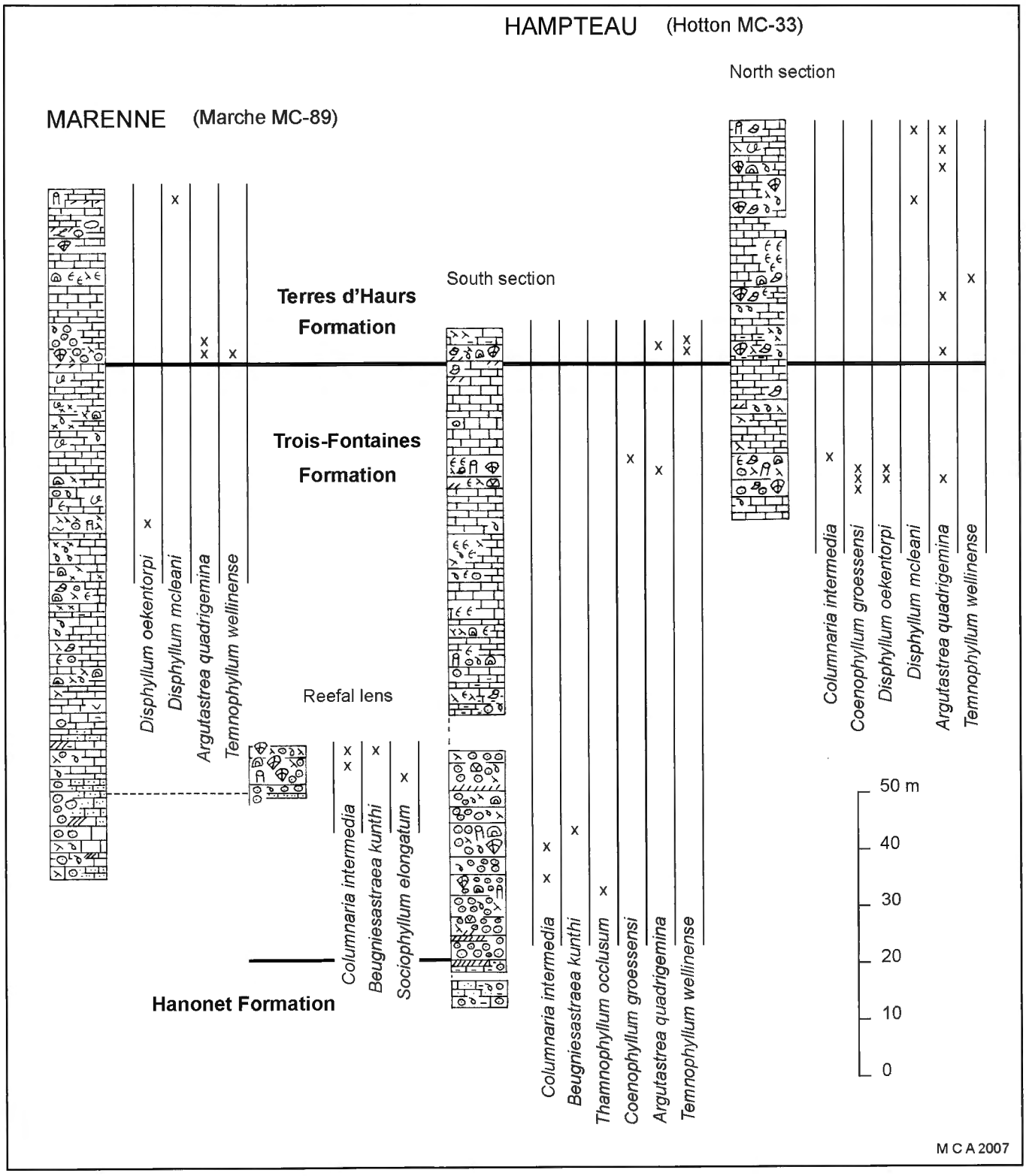

Fig. 5 — Comparative logs of the Trois-Fontaines Formation at Marenne and Hampteau close to Hotton with the distribution of the rugose corals. (For explanation of conventional signs, see Fig. 3).

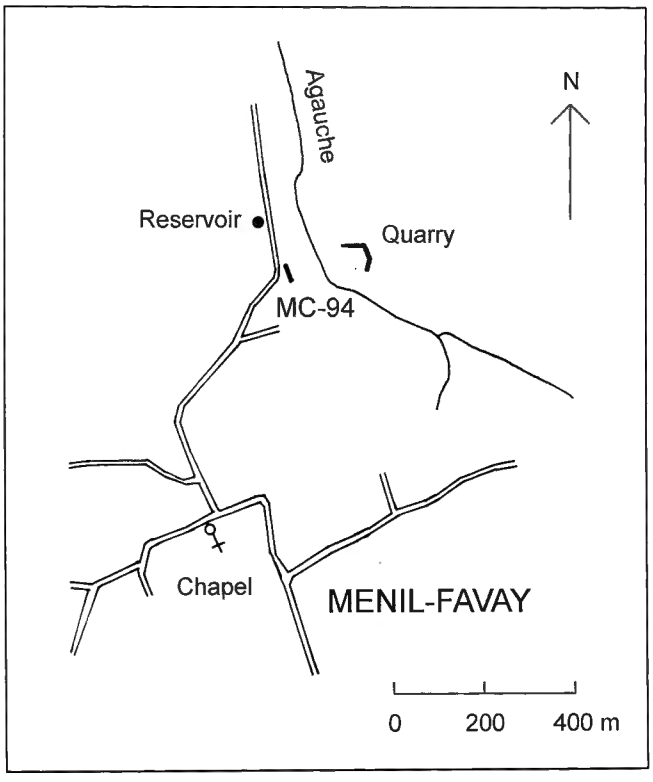

Fig. 6 — Location of the outcrop Hotton MC-94 at Ménil-Favay.

folded and faulted zone. All the Trois-Fontaines Formation crops out in the southern part of the excavation whereas the Terres d'Haurs Formation is exposed in its northern part. Below the Trois-Fontaines Formation, the upper part of the Hanonet Formation is represented at the southwest end of the quarry, along the path climbing in the wood by:

- 14.3 m: bedded and argillaceous limestone with a few brachiopods, crinoids and trilobites;
- 4.75 m: thin-bedded and crinoidal limestone at the base overlain by silty or argillaceous limestone containing locally some brachiopods and crinoids.
- 1.40 m: gap;
- 2.35 m: silty or argillaceous limestone with some crinoids at the base; occurrence of shales at the top.

All this sequence has been assigned by PREAT & KASIMI (1995, fig. 3) to the Lomme Formation. According to BULTYNCK *et al.* (1991, p. 33), this lithostratigraphic unit, underlying the Hanonet Formation in the southeastern part of the Dinant Synclinorium, is mostly characterized by sandy shales and sandstones. On the contrary, the Hanonet Formation is typically composed of dark argillaceous limestones.

In contact with the Hanonet Formation, the Trois-Fontaines Formation starts in the southern part of the Hampteau quarry with nearly 37 m of coarsely crinoidal limestones. Some intercalations of shales are present close to their base whereas various reef builders are locally abundant in their middle part. These organisms include massive stromatoporoids, massive and ramose alveolitids, favositids, thamnoporids, solitary rugose corals as well as colonies of *Columnaria intermedia*, *Beugniesastraea kunthi* and *Thamnophyllum occlusum*. In the upper part of this sequence, the corals and stromatoporoids become sparser whereas the fragments of crinoids are smaller. It must also be mentioned that the lower part of these coarsely crinoidal limestones has been ascribed to the Hanonet Formation by PREAT & KASIMI (1995, fig. 3). In fact, my interpretation for the boundary between the Hanonet and Trois-Fontaines Formation follows that of COEN *et al.* (1974, p. 17).

After a lack of outcrop which is about 6 m thick, the upper part of the Trois-Fontaines Formation consists of:

- 15.3 m: fine or bioclastic limestone which may be argillaceous in the lower part; occurrence of three levels with scolioporids, thamnoporids and massive stromatoporoids accompanied locally by *Stachyodes*, fasciculate rugose corals, crinoids, stringocephalids and also atrypids close to the base;
- 14.9 m: fine or locally bioclastic limestone with several beds of stringocephalid coquinas;
- 9.20 m: fine and dark limestone containing some big brachiopods close to the base;
- 5.80 m: bioclastic limestone with massive stromatoporoids, favositids, thamnoporids, solitary rugose corals, colonies of *Coenophyllum groessensi* and *Argutastrea quadrigemina* associated with some crinoids and brachiopods including stringocephalids especially numerous at the top;
- 16.6 m thin-bedded and fine limestone with shaly interbeds at the top.

The base of the Terres d'Haurs Formation is characterized by:

- 2.75 m: dark limestone first argillaceous with some brachiopods and shales, then bioclastic with massive stromatoporoids, favositids, thamnoporids, scolioporids, solitary coralla of *Temnophyllum wellinense* and colonies of *Argutastrea quadrigemina*;
- 3 m: dark argillaceous limestone at the base which becomes bioclastic upwards with some beds containing thamnoporids and hillaeporids in the upper part.

This south section ends against the complicated folded and faulted zone present in the middle of the Hampteau quarry. To the north of this structure, the north section described by COEN-AUBERT (2003, p. 15) shows in particular the more or less reefal level occurring 16.2 m below the top of the Trois-Fontaines Formation; in this part of the outcrop, its rich and diversified rugose coral fauna is represented by *Disphyllum oekentorpi*, *Coenophyllum groessensi*, *Columnaria intermedia* and *Argutastrea quadrigemina*. As noted by COEN-AUBERT (2003), the base of the Terres d'Haurs Formation is made up of argillaceous limestones with various tabulate corals and *A. quadrigemina*. Higher in the lithostratigraphic unit, *Disphyllum mcleani* occurs between 28 m and 40 m above the Trois-Fontaines Formation.

Facies variations and stratigraphic distribution of the rugose corals

In the Hampteau quarry close to Hotton, the Trois-Fontaines Formation is 105 m thick whereas its thickness varies between 85 m and 100 m at Resteigne and between 99 m and 126 m at Wellin. These changes are mainly due to the facies variations affecting the lower part of the lithostratigraphic unit which is characterized by coarsely crinoidal and more or less reefal limestones. Large biohermal lenses with corals and stromatoporoids have been observed in the Fond des Vaux quarries at Wellin, but small ones are also present at Resteigne and Marenne. In the latter locality as in Ménil-Favay, the lower part of the Trois-Fontaines Formation is partly invaded by silty limestones. However, the sedimentation of this detrital material seems to be rather local as it does not reach the nearby section of Hotton. Among a highly diversified fauna of rugose corals, the occurrence of *Columnaria intermedia*, *Beugniesastraea kunthi*, *Sociophyllum elongatum* and *Thamnophyllum occlusum* is typical for the lower part of the Trois-Fontaines Formation. A few corallites of *Coenophyllum groessensi* have also been collected in Resteigne, at the top of the coarsely crinoidal limestones.

The upper part of the Trois-Fontaines Formation is more uniform in the different outcrops investigated. It is mostly composed of lagoonal limestones with shallower and more restricted facies. However, there are some intercalations with bioclasts and reef building organisms. *Disphyllum oekentorpi* and to a lesser extent *Argutastrea quadrigemina* are widely distributed in the upper part of these lagoonal limestones. In the Hampteau quarry at Hotton occur also at the same level *Columnaria intermedia* and more especially colonies of *Coenophyllum groessensi*.

In the Bois Le Ban or Malakof quarry at Pondrôme, the Trois-Fontaines Formation is represented by about 30 m of limestones below the Terres d'Haurs Formation. At the base of the section, there are crinoidal limestones capped by a few beds containing *Disphyllum caespitosum*. This facies is more or less similar to that of the base of the Trois-Fontaines Formation. However, it is not sure whether the thickness of the Trois-Fontaines Formation is so much reduced in the Bois Le Ban quarry as the contact with the Hanonet Formation was not observed.

The base of the Terres d'Haurs Formation is marked in all localities by a coralliferous biostrome rich in various tabulate corals and colonies of *Argutastrea quadrigemina* associated with some solitary coralla of *Temnophyllum wellinense*. Small patch reefs with the same corals have been recognized at this level, in the area of Beauraing and Pondrôme. Higher in the Terres d'Haurs Formation, *Disphyllum oekentorpi* is succeeded by *D. mcleani*.

Systematic palaeontology

Family Disphyllidae HILL, 1939
Genus *Disphyllum* DE FROMENTEL, 1861

Type species: By subsequent designation of LANG & SMITH (1934, p. 80), *Cyathophyllum caespitosum* GOLDFUSS, 1826.

Diagnosis
Fasciculate rugose corals. Septa of two orders, occasionally carinate, more or less dilated in the dissepimentarium and thin in the tabularium. Major septa reaching the axis of the corallites or leaving an open space in the centre of the tabularium. Minor septa traversing the entire dissepimentarium. Dissepimentarium composed of several rows of globose dissepiments, often arranged in horizontal layers in its outer part and inclined towards the axis of the corallites in its inner part. Tabulae usually incomplete or compound.

Disphyllum caespitosum (GOLDFUSS, 1826)
Pl. 1, Figs 1-2, Pl. 2, Figs 7-9, Pl. 3, Figs 7-8

v*p. 1826 — *Cyathophyllum caespitosum* nobis - GOLDFUSS, p. 60, pl. 19, fig. 2b (non figs. 2a, 2c-d).
v 1846 — *Cladocora Goldfussii* Gein. - GEINITZ, p. 569.
v 1934 — *Cyathophyllum caespitosum* Goldfuss - LANG & SMITH, p. 80.
v 1935 — *Disphyllum goldfussi* (Geinitz) - LANG & SMITH, p. 568, figs. 2-3, 23-24, pl. 35, figs 4-8.
non 1937 — *Cyathophyllum (Disphyllum) Goldfussi* Geinitz - LE MAÎTRE, p. 108, pl. 7, figs. 8-9.
v 1945 — *Disphyllum goldfussi* Geinitz - SMITH, p. 21, pl. 8, fig. 8.
non 1947 — *Disphyllum goldfussi* (Geinitz) - YU, p. 127, pl. 2, fig. 3.
non 1948 — *Disphyllum* cf. *goldfussi* (Geinitz) - WANG, p. 7, pl. 3, figs 5-6.
non 1961 — *Disphyllum goldfussi* (Geinitz)? - LENZ, p. 501, pl. 1, figs. 11-12.
v 1969 — *Cyathophyllum caespitosum* Goldfuss 1826 - BIRENHEIDE, 38, pl. 2, fig. 7, pl. 5, fig. 14.
non 1970 — *Disphyllum goldfussi* (Geinitz H.B., 1845) - BRICE, p. 271, pl. 15, figs. 14-15.
v *non* 1970 — *Disphyllum goldfussi* (Geinitz), 1846 - TSIEN, p. 164, figs. 3-4.
v *non* 1974 — *Disphyllum goldfussi* (Geinitz) - COEN-AUBERT, pl. 2, figs. 4-5.
1975 — *Disphyllum goldfussi* (Geinitz 1846) - JOSEPH & TSIEN, p. 193, fig. 5, pl. 2, fig. 2, pl. 6, fig. 4.
v *non* 1977 — *Disphyllum goldfussi* - TSIEN, fig. 5l.
v 1978 — *Disphyllum caespitosum* (Goldfuss 1826) -

BIRENHEIDE, p. 90, fig. 47.
non 1978 — *Disphyllum goldfussi* (Geintz) - KONG & HUANG, p. 72, pl. 23, fig. 5.
v 1981 — *Disphyllum caespitosum* (Goldfuss) - HILL, fig. 169, 2a-d.
? 1988 — *Disphyllum caespitosum* (Goldfuss 1826) - LÜTTE & OEKENTORP, p. 218.
non 1990 — *Disphyllum* sp., aff. *caespitosum* (Goldfuss 1826) - BIRENHEIDE, pl. 3, fig. 9.
1998 — *Disphyllum caespitosum* (Goldfuss 1826) - SCHRÖDER, p. 41, pl. 5, fig. 35.
? 2004 — *Disphyllum* cf. *caespitosum caespitosum* (Goldfuss, 1826) - SCHRÖDER, p. 618.

Remark

As there are so many and rather heterogeneous references about *Disphyllum caespitosum* and *D. goldfussi* (GEINITZ, 1846), this list of synonymy is not complete. It concerns mainly Givetian references which can be used without further revision.

Lectotype

Pl. 2, fig. 19b *in* GOLDFUSS, 1826, pl. 35, figs 4-6 *in* LANG & SMITH (1935), pl. 2, fig. 7 and pl. 5, fig. 14 *in* BIRENHEIDE (1969) and figs. 169, 2a-d *in* HILL (1981), chosen by LANG & SMITH (1934, p. 80). Specimen GMBo 205 of the Goldfuss collection stored in the Paläontologisches Institut from the University of Bonn in Germany. Probably Givetian of "Bensberg", Bergisch Gladbach in the Bergisches Land, Germany. Contrary to BIRENHEIDE (1969), I have been lucky to investigate recently at Bonn the thin sections of the lectotype figured by LANG & SMITH (1935) and BIRENHEIDE (1969).

Material and localities

Ten specimens with 21 thin sections. Personal sampling: Houyet MC-1983-15-B11, B121, B122, B124, B126, B127, B13, B14, B15 and B16.

Diagnosis

A species of *Disphyllum* with 46 to 52 septa at a diameter of 7 mm to 12 mm. Major and minor septa long. Tabulae incomplete, usually with axial flat-topped parts.

Description

The material consists of cylindrical corallites and fragments of fasciculate colonies whose height varies between 2 cm and 10,5 cm; the largest piece reaches an area of 11 x 5 cm. The outer wall is not always very well preserved. It is characterized by a dark median line when the cylindrical corallites are locally in contact and it is occasionally encrusted by thin laminar stromatoporoids. A few lateral and axial offsets occur in some colonies.

The septa are normally non-carinate or bear rarely some small spinose and knobbly carinae. They are dilated in the dissepimentarium and become thin in the tabularium or slightly beyond their entry into it. A weak deposit of stereoplasma is sometimes present between the septa, against the outer wall, on a layer of dissepiments or at the inner margin of the dissepimentarium. In a few corallites, a continuous stereozone invades partly the outer dissepimentarium.

The major septa leave an open space in the centre of the tabularium; in some cases, they nearly reach the axis of the corallites. Sometimes their axial ends are divided into isolated fragments or fusing to form pseudofossulae. The minor septa traverse the entire dissepimentarium or even enter into the tabularium where they may be contratingent or discontinuous; they are rarely shorter.

The dissepimentarium consists of 1 to 5 or even 0 to 6 rows of small globose dissepiments which are in horizontal layers at the periphery and inclined in its inner part. Locally the dissepiments are obscured by spots of coarse and contiguous trabeculae. The tabulae are incomplete and intersecting laterally; their axial parts are frequently flat-topped.

There are 42 to 48 or even 40 to 50 septa per corallite. The diameter of the corallites ranges from 5.1 mm to 10.5 mm. The width of the tabularium varies commonly between 4 mm and 6.5 mm and more generally between 3.7 mm and 7.1 mm.

Discussion

The Belgian Givetian material investigated herein differs from the lectotype of *Disphyllum caespitosum* in having slightly smaller septal number and diameters of the corallites. Due to these two quantitative data, it is more closely related to the colonies from the Givetian Cürten Formation of the Eifel Hills in Germany assigned to *D. caespitosum* by SCHRÖDER (1998), which show as in my sampling some weak stereoplasmic thickenings and axial offsets. As it was already mentioned by SCHRÖDER (1998), *D. caespitosum* resembles the specimen of *Disphyllum* sp. B described by LÜTTE & OEKENTORP (1988, p. 222) which comes also from the Cürten Formation in the Eifel Hills.

At the Belgian scale, there are some affinities between *D. caespitosum* and *D. semenoffi* COEN-AUBERT, 2000 from the Mont d'Haurs Formation in the middle part of the Givetian. However, the latter taxon is distinguished from the former by larger corallites with more numerous and highly attenuated septa as well as by more rows of dissepiments which are often inclined. It is well known since LANG & SMITH (1935, p. 569) that *D. goldfussi* is a junior objective synonym of *D. caespitosum*. The

Frasnian colony identified as *D. golfussi* by COEN-AUBERT (1974, pl. 2, figs. 4-5) and collected at the base of the Lustin Formation belongs in fact to *D. hilli* TSIEN, 1970 whereas the Belgian Frasnian material ascribed to the first species by TSIEN (1970 and 1977) is separated from *D. caespitosum* by greater size and septal number, thinner septa and broader dissepimentaria.

With the exception of the Pyrenean sampling of JOSEPH & TSIEN (1975), the other Givetian references of *D. caespitosum* and *D. goldfussi* outside Germany are excluded from the synonymy list for various reasons:
- smaller corallites with fewer septa for KONG & HUANG (1978);
- a wide open space in the centre of the tabularium for the Middle Devonian colony of YU (1947);
- occurrence of a peripheral stereozone for LE MAÎTRE (1937);
- thicker and sometimes also carinate septa for WANG (1948), LENZ (1961), BRICE (1970) and BIRENHEIDE (1990); additionally, there are more numerous septa in the first two references.

Geographic and stratigraphic occurrence
The material collected by the author comes from the Trois-Fontaines Formation at Pondrôme, on the south side of the Dinant Synclinorium.

Outside Belgium, *Disphyllum caespitosum* occurs certainly in the Givetian from the Pyrenees in France, in the Givetian Cürten Formation from the Eifel Hills and in the Givetian from the Bergisches Land, both areas in Germany.

Disphyllum oekentorpi n.sp.
Pl. 1, Figs 3-10, Pl. 2, Figs 3-6

v 1991 — *Disphyllum aequiseptatum* (Milne-Edwards & Haime, 1851) - BIRENHEIDE *et al.*, p. 10.
v 2004 — *Disphyllum* sp. A - BARCHY *et al.*, p. 60, fig. 5.

Derivatio nominis
The species is dedicated to Klemens Oekentorp, a distinguished German specialist of Palaeozoic corals.

Holotype
IRScNB a12467 (= Pl. 1, Figs 3-5). Specimen Wellin MC-1983-12-Z997 collected by M. Coen-Aubert in 1983, 24.5 m below the top of the Trois-Fontaines Formation.

Locus typicus
Active quarry Fond des Vaux West at Wellin located in figure 2 of COEN-AUBERT (1999). Map sheet Wellin IGNB 59/6, Lambert coordinates: x = 203.525 and y = 87.2, south side of the Dinant Synclinorium, Belgium.

Stratum typicum
Upper part of the Trois-Fontaines Formation, Early Givetian.

Material and localities
Twenty-four specimens with 52 thin sections. Personal sampling with that of M. Coen: Wellin MC-1983-9-Z988, Z989 and Z990; Wellin MC-1983-12-Z997, Z998, Z999, A100, A101 and A102; Wellin MC-1974-95-Z766 and Z767; Marche MC-89-D441, D442, D445, D447, D464, D484, D504 and D505; Hotton MC-94-MF1 and MF2; Hotton MC-33-B433, B440 and B442.

Diagnosis
A species of *Disphyllum* with 46 to 58 septa at a diameter of 7 mm to 17 mm. Major septa slightly dilated in the dissepimentarium and leaving an open space in the centre of the tabularium. Minor septa variable in length, but often long.

Description
The material consists of fragments of big fasciculate colonies whose height varies between 3 cm and 18 cm; the largest piece reaches an area of 17 x 9 cm. The corallites are arranged in a parallel manner with growth lines and longitudinal ribs. There are also some isolated cylindrical or even ceratoid corallites. Several colonies of Wellin show some crushed or broken corallites. The outer wall is more or less well preserved. It is characterized by a dark median line when the cylindrical corallites are in lateral contact and it is locally encrusted by thin laminar stromatoporoids or auloporids. Lateral offsets occur in some colonies.

The septa are normally non-carinate or bear rarely a few small spinose or knobbly carinae. They are more or less dilated in the dissepimentarium and become thin in the tabularium or slightly beyond their entry into it. Occasionally, the septa are slender or rather thick throughout their length. In some corallites, a narrow stereozone is more or less continuous at the inner margin of the dissepimentarium; very locally, a stereoplasmic thickening is present against the outer wall or between the septa within the dissepimentarium.

The major septa are hardly projecting into the tabularium or leave an extensive open space in its centre; their axial ends are rarely discontinuous. The minor septa are often long, traversing all or nearly all the dissepimentarium; sometimes they are shorter, discontinuous at their inner ends or entering into the

tabularium where they may be contratingent. Some herringbone dissepiments have been observed in a few corallites.

The dissepimentarium consists of 1 to 6 rows of small globose dissepiments which are usually in horizontal layers at the periphery and inclined in its inner part. The tabulae are incomplete and intersecting laterally; occasionally, they are horizontal, more or less deeply concave, irregular, wavy or characterized by axial flat-topped parts. In the colonies of Wellin and Marenne, the tabulae are frequently broken.

There are 42 to 62 septa per corallite. The diameter of the corallites ranges from 5.6 mm to 21 mm. The width of the tabularium varies commonly between 5 mm and 10.5 mm and more generally between 4 mm and 12.5 mm.

Discussion

D. oekentorpi is readily separated from *D. caespitosum* by:

- greater septal number and diameters of corallites and tabularia;
- a wide open space occurring systematically in the centre of the tabularium;
- minor septa which may not traverse the entire dissepimentarium;
- incomplete tabulae of variable patterns.

There are some similarities between *Disphyllum oekentorpi* and the specimen from the Givetian of West Somerset in Great Britain identified as *D. aequiseptatum* (MILNE-EDWARDS & HAIME, 1851) by LANG & SMITH (1935, fig. 27, pl. 35, fig. 14). For the holotype of the latter species coming from the Givetian of the North Devon in Great Britain, only an external view has been given by MILNE-EDWARDS & HAIME (1853, pl. 52, fig. 2). According to LANG & SMITH (1935, p. 572), the corallites of this colony are much crushed and their internal structures are thoroughly destroyed by recrystallization; moreover, the septa are less numerous in the material described by MILNE-EDWARDS & HAIME (1851 and 1853). Several specimens collected in the Givetian Cürten Formation from the Eifel Hills in Germany seem to be closely related to *D. oekentorpi*. This concerns:

- the sampling assigned to *Disphyllum* sp. A by LÜTTE & OEKENTORP (1988, p. 220);
- the colony referred to the same *Disphyllum* sp. A by SCHRÖDER (1998, p. 42);
- the two specimens ascribed to *D. geinitzi* LANG & SMITH, 1935 by SCHRÖDER (1998, p. 42).

On the contrary, the holotype of *D. geinitzi*, which comes from the Givetian of the Bergisches Land in Germany and which has been illustrated by LANG & SMITH (1935, pl. 36, fig. 1-3) and BIRENHEIDE (1969, pl. 3, fig. 8 and pl. 5, fig. 13) is different as it is characterized by a narrow dissepimentarium with inclined and locally lacking dissepiments. It can be remembered that *D. geinitzi* is the type species of *Pantophyllum* LAKHOV, 1982 and that this genus is not well defined and is very likely a synonym of *Disphyllum* as stated by SCHRÖDER (1998, p. 41), ROHART (1999, p. 51) and COEN-AUBERT (2003, p. 18).

The material of *D. oekentorpi* with rather thin septa shows some affinities with *D. intermedium* KONG, 1978 from the Givetian of the Guizhou Province in China, *D. salicis* McLAREN & NORRIS, 1964 from the Givetian of the Northwest Territories in Canada and *D. panicum* (WINCHELL, 1866) from the Givetian of Michigan in USA. In *D. intermedium* however, the dissepiments are inclined whereas the major and minor septa are longer than in *D. oekentorpi*. *D. salicis* is distinguished from the new taxon by very thin septa throughout their length and by minor septa traversing the entire dissepimentarium. *D. panicum* investigated by EHLERS & WHITE (1932, p. 93) and EHLERS & STUMM (1949, p. 27) is more different in having weak carinae and slightly smaller corallites.

Geographic and stratigraphic occurrence

The species is only known in the Early Givetian of Belgium. The material collected by the author and M. Coen comes from the upper part of the Trois-Fontaines Formation at Wellin, Resteigne, Marenne, Ménil-Favay and Hotton, on the south side of the Dinant Synclinorium.

Genus *Coenophyllum* n. gen.

Type species: *Coenophyllum groessensi* n. gen., n. sp.

Derivatio nominis

The genus is dedicated to my husband Michel Coen (1943-2006), a distinguished field geologist and specialist of Devonian as well as Carboniferous ostracods and conodonts.

Diagnosis

Fasciculate rugose corals. Septa of two orders, non-carinate, dilated in the dissepimentarium and thin in the tabularium. Both orders of septa frequently in lateral contact in the dissepimentarium so as to form a wide peripheral stereozone which is complete or partial. Major septa leaving an open space in the centre of the tabularium or reaching the axis of the corallum. Minor septa traversing the entire dissepimentarium. Dissepimentarium composed of a few rows of globose

dissepiments arranged in horizontal layers in its outer part and inclined towards the axis of the corallum in its inner part. Tabulae incomplete, compound or sometimes complete.

Discussion

Coenophyllum forms typical fasciculate colonies like *Disphyllum*, but differs from this genus by a strong stereozone investing the dissepimentarium and by rather few dissepiments. Due to the first feature, *Coenophyllum* is closely related to *Temnophyllum* WALTHER, 1929 whose several species from the Givetian of Belgium and Germany have been described or revised by COEN-AUBERT (2002, 2003 and 2004). But *Temnophyllum* is mostly represented by solitary rugose corals with much larger coralla and much more small globose dissepiments. Even the size of *Alaiophyllum jarushevskyi* GORIANOV, 1961 from the Givetian of Tien Shan in Kirghizistan and type species of *Alaiophyllum* GORIANOV, 1961 is greater than the corallites of *Coenophyllum groessensi*. It must be mentioned that *Alaiophyllum* is placed in synonymy with *Temnophyllum* by COEN-AUBERT (2004, p. 26) though *Alaiophyllum jarushevskyi* is possibly weakly fasciculate.

The species *Disphyllum liumaense* YU, 1947 that is ascribed herein to *Coenophyllum*, was transferred to the genus *Temnophylloides* KONG & HUANG, 1978 by KONG & HUANG (1978, p. 76). However, this is a *nomen nudum* as its type species *T. devoniana hunanensis* KONG & HUANG, 1978 was neither described nor illustrated. According to LIAO & BIRENHEIDE (1989, p. 87) and ZHEN (1995, p. 222), the generic name *Temnophylloides* was introduced by KONG & HUANG (1978) for fasciculate rugose corals distinguished from *Disphyllum* by a wide and consistent peripheral stereozone formed by thickened septa. For ZHEN (1995) also, *Temnophylloides* is a junior synonym of *Solominella* IVANIA, 1952 whose type species is *S. soshkinae* IVANIA, 1952 from the Frasnian of the Kuznetsk Basin in Russia. But this species refigured by ZHELTONOGOVA & IVANIA (1960, pl. 30, fig. 3) is separated from *Coenophyllum* by a narrower stereozone and very few dissepiments.

Species assigned to the genus

In addition to the type species *Coenophyllum groessensi* from the Early Givetian of Belgium, the following taxa are assigned to the genus *Coenophyllum*:

- *Disphyllum wirbelauense* PICKETT, 1967 from the Frasnian of the Lahn Synclinorium in Germany;
- *D. wirbelauense regulare* ROZKOWSKA & FEDOROWSKI, 1972 from the Upper Givetian of the Silesia Cracow Upland and the Holy Cross Mountains in Poland;
- *D. wirbelauense bonae* ROZKOWSKA & FEDOROWSKI, 1972 from the Upper Givetian and probably the Frasnian of the same areas;
- *D. liumaense* from the Frasnian of Guangxi in China.

Coenophyllum groessensi n. gen., n.sp.
Pl. 2, Figs 1-2, Pl. 3, Figs 1-6

Derivatio nominis

The species is dedicated to Eric Groessens, a distinguished specialist of Carboniferous conodonts and Belgian marbles.

Holotype

IRScNB a12473 (= Pl. 3, Figs 1-3). Specimen Hotton MC-33-B515 collected by M. Coen-Aubert in 1993, 20 m below the top of the Trois-Fontaines Formation.

Locus typicus

Disused Hampteau quarry lying 1.5 km to the southeast of Hotton and located in figure 6 of COEN-AUBERT (2003). Map sheet Hotton IGNB 55/5, Lambert coordinates: x= 228 and y= 106.1, southeast side of the Dinant Synclinorium, Belgium.

Stratum typicum

Upper part of the Trois-Fontaines Formation, Early Givetian.

Material and localities

Eleven specimens with 23 thin sections. Personal sampling: Wellin MC-1974-95-Z63 and Z64; Hotton MC-33-B435, B443, B507, B509, B510, B512, B514, B515 and C223.

Diagnosis

A species of *Coenophyllum* with 42 to 48 septa at a diameter of 7 mm to 11 mm. Major septa rather long. Tabulae incomplete, usually with axial flat-topped parts.

Description

The material consists of fragments of fasciculate colonies whose height varies between 1.5 cm and 4 cm; the largest piece reaches an area of 14 x 8 cm. There are also a few isolated corallites with longitudinal ribs. The outer wall is often preserved. It is characterized by a dark median line when the cylindrical corallites are in lateral contact and it is locally encrusted by thin laminar

stromatoporoids or auloporids. Axial quadripartite and sometimes tripartite offsets occur in several colonies.

The septa are normally non-carinate though a few small knobbly carinae occur in some specimens. The septa are dilated in the dissepimentarium and become thin in the tabularium or beyond their entry into it; they are rarely thick throughout their length. A wide and more or less continuous stereozone, where the septa are contiguous laterally, invests the entire dissepimentarium, its outer part, its inner margin or both of them. However, a few corallites are devoid of these stereoplasmic thickenings or are only affected partly by them.

The major septa reach the axis of the corallites or leave an open space in the centre of the tabularium; sometimes their axial ends are divided into isolated fragments or fusing to form pseudofossulae. The minor septa traverse the entire dissepimentarium or even enter into the tabularium where they may be contratingent or discontinuous; they are rarely shorter.

The dissepimentarium consists of 1 to 4 or even 5 rows of globose dissepiments which are in horizontal layers at the periphery and inclined in its inner part. The dissepiments are partly obscured by coarse and contiguous trabeculae which are occasionally subhorizontal or slightly inclined towards the outer wall. The tabulae are incomplete and intersecting laterally; their axial parts are frequently flat-topped and rarely horizontal or convex.

There are 40 to 52 septa per corallite. The diameter of the corallites ranges from 5.5 mm to 11.5 mm. The width of the tabularium varies commonly between 4.3 mm and 7 mm and more generally between 3.3 mm and 7.4 mm.

Discussion

Coenophyllum regulare differs from the new species by major septa hardly projecting into the tabularium and by tabulae frequently complete. The first feature characterizes also *C. wirbelauense* which is additionally separated from *C. groessensi* by a narrower dissepimentarium and a broader tabularium. *C. bonae* is distinguished from *C. groessensi* by major septa leaving systematically an open space in the centre of the tabularium and by dissepiments poorly developed. In *C. liumaense*, the major septa reach the axis of the corallites as in the new species, but the dissepimentarium is once more narrower.

C. groessensi shows some affinities with *Temnophyllum ramosum* COEN-AUBERT, 2004 from the Upper Givetian Fromelennes and Le Roux Formations in Belgium. However, the latter taxon which is represented by solitary coralla and small fasciculate colonies, is different from the former in having:

- greater septal number and diameters of the corallites and tabularia;
- minor septa of rather variable length;
- several rows of small inclined dissepiments.

Finally, it must be mentioned that *Coenophyllum groessensi* has similar quantitative data as *Disphyllum caespitosum*; but the new species is easily distinguished by the wide stereozone investing the dissepimentarium as well as by larger and slightly fewer dissepiments often obscured by stereoplasma.

Geographic and stratigraphic occurrence

The species is only known in the Early Givetian of Belgium. The material collected by the author comes from the Trois-Fontaines Formation at Resteigne and Hotton, on the south side of the Dinant Synclinorium.

Acknowledgments

G. Heumann (Bonn) gave me the opportunity to look at the lectotype of *Disphyllum caespitosum*. R.A. McLean (Calgary) and B. Mistiaen (Lille) kindly reviewed the manuscript. The thin sections were prepared by R. Cremers (IRScNB) and by the Laboratory of E. Poty (Liège) whereas the photographs were printed by W. Miseur (IRScNB). I am most grateful to all these persons.

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Typescript submitted: August 24, 2007
Revised typescript received: May 7, 2008

Explanation of Plates

All the specimens are figured at magnification x 3.

PLATE 1

Disphyllum caespitosum (GOLDFUSS, 1826)

Fig. 1 — IRScNB a12462. Houyet MC-1983-15-B122. Transverse section.
Fig. 2 — IRScNB a12463. Houyet MC-1983-15-B15. Transverse section.

Disphyllum oekentorpi n. sp.

Figs 3-5 — Holotype. IRScNB a12467. Wellin MC-1983-12-Z997. Transverse and longitudinal sections.
Figs 6-7 — Paratype. IRScNB a12468. Marche MC-89-D445. Transverse and longitudinal sections.
Figs 8-9 — Paratype. IRScNB a12469. Wellin MC-1983-12-A100. Transverse and longitudinal sections.
Fig. 10 — Paratype. IRScNB a12470. Marche MC-89-D441. Transverse section.

PLATE 2

Coenophyllum groessensi n.gen., n. sp.

Figs 1-2 — Paratype. IRScNB a12474. Hotton MC-33-B509. Transverse and longitudinal sections.

Disphyllum oekentorpi n. sp.

Fig. 3 — Paratype. IRScNB a12471. Wellin MC-1983-9-Z988. Transverse section.
Figs 4-6 — Paratype. IRScNB a12472. Marche MC-89-D442. Transverse and longitudinal sections.

Disphyllum caespitosum (GOLDFUSS, 1826)

Fig. 7 — IRScNB a12464. Houyet MC-1983-15-B16. Longitudinal section.
Figs 8-9 — IRScNB a12465. Houyet MC-1983-15-B11. Transverse sections.

PLATE 3

Coenophyllum groessensi n.gen., n. sp.

Figs 1-3 — Holotype. IRScNB a12473. Hotton MC-33-B515. Transverse and longitudinal sections.
Figs 4-5 — Paratype. IRScNB a12475. Hotton MC-33-C223. Transverse and longitudinal sections.
Fig. 6 — Paratype. IRScNB a12476. Hotton MC-33-B510. Transverse section.

Disphyllum caespitosum (GOLDFUSS, 1826)

Figs 7-8 — IRScNB a12466. Houyet MC-1983-15-B121. Transverse and longitudinal sections.

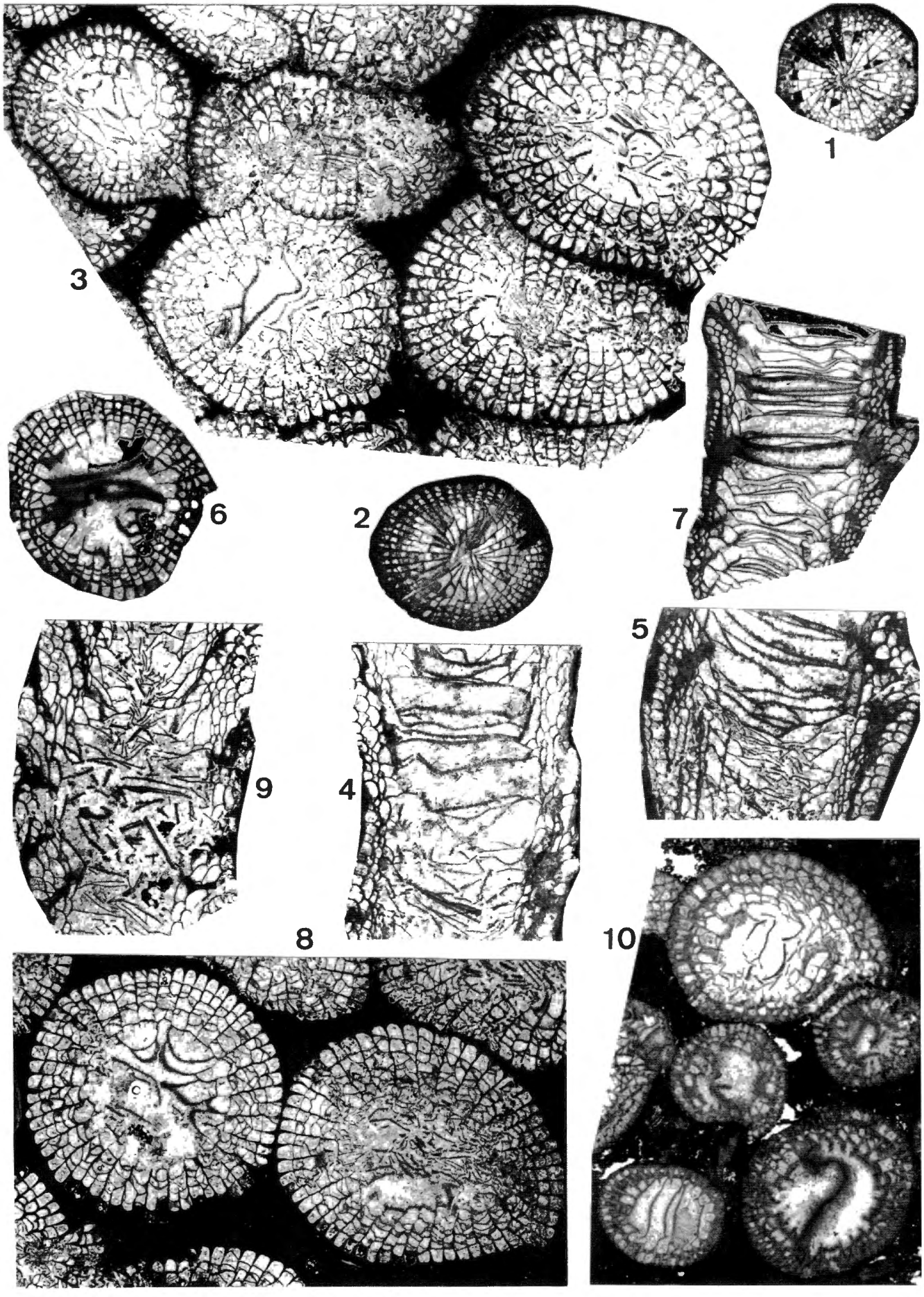

PLATE 1

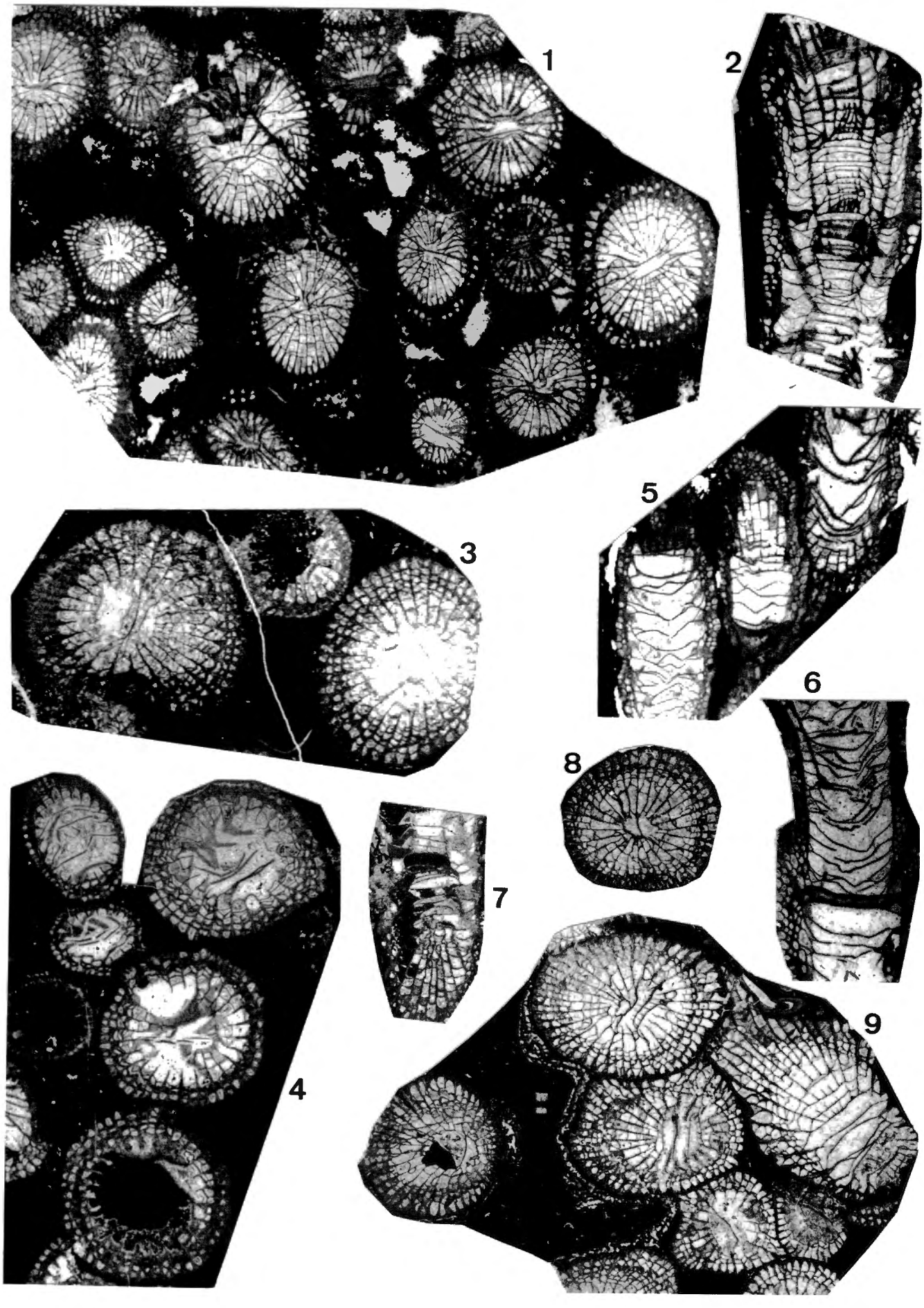

PLATE 2

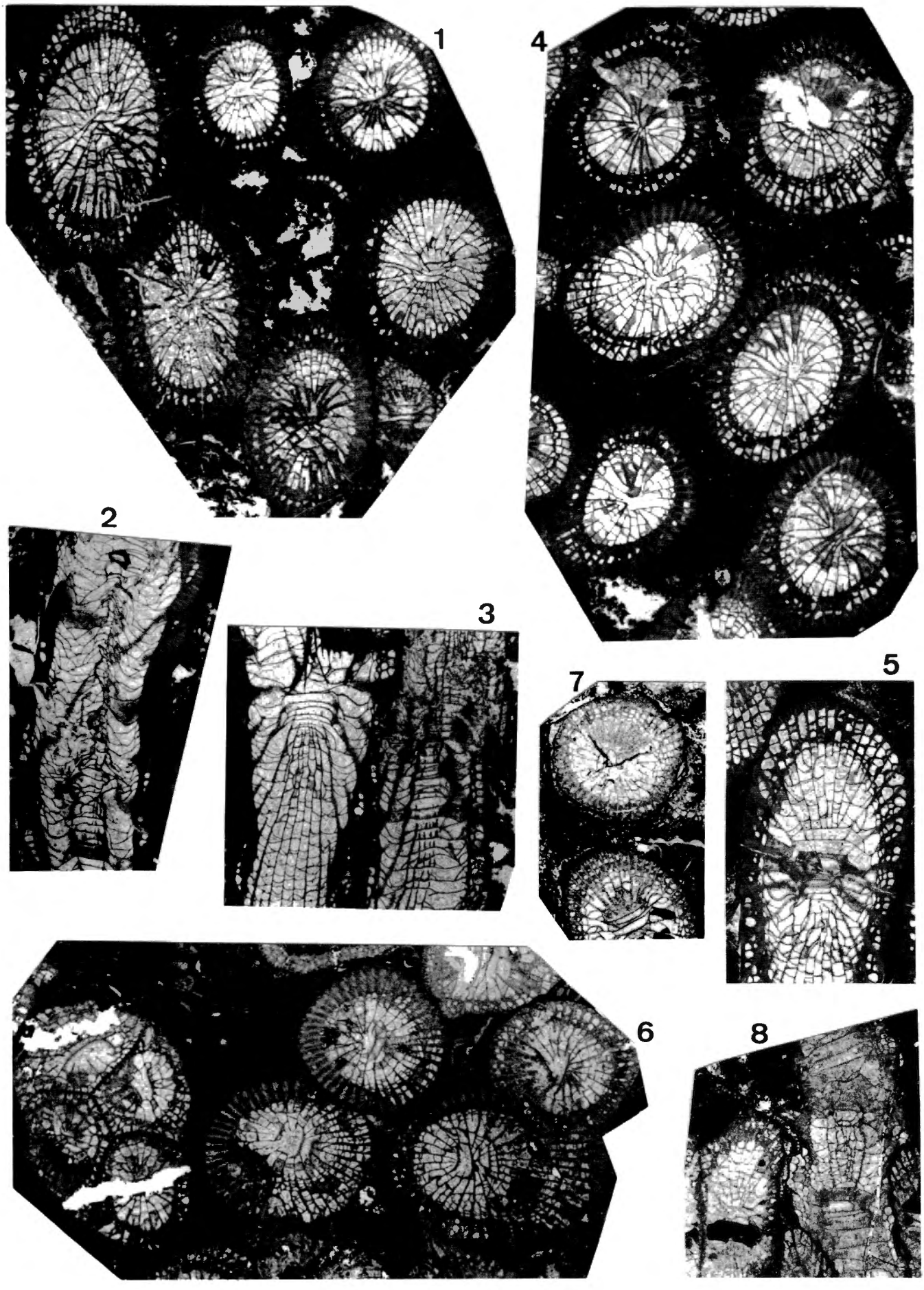

PLATE 3