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THE STRATIGRAPHY AND PALEOBIOGEOGRAPHY OF BELGIAN
VISÉAN CORALS

POTY, E.: The stratigraphy and paleobiogeography of Belgian Viséan corals. *Acta Palaeont. Polonica*, 25, 3/4, 587-595. January 1981.

Rugose coral assemblages may be used to characterize Belgian Viséan strata but there are some differences between contemporary coral assemblages from the Namur-Dinant basin and from the Visé area (Campine-Brabant basin). The Namur-Dinant basin was a relatively closed environment usually separated from the Visé area by some kind of barrier. Corals could have migrated into it from Ireland or are endemic. In contrast, the Visé area was an open environment with corals showing affinities with those of the British Central Province, the USSR and Africa.

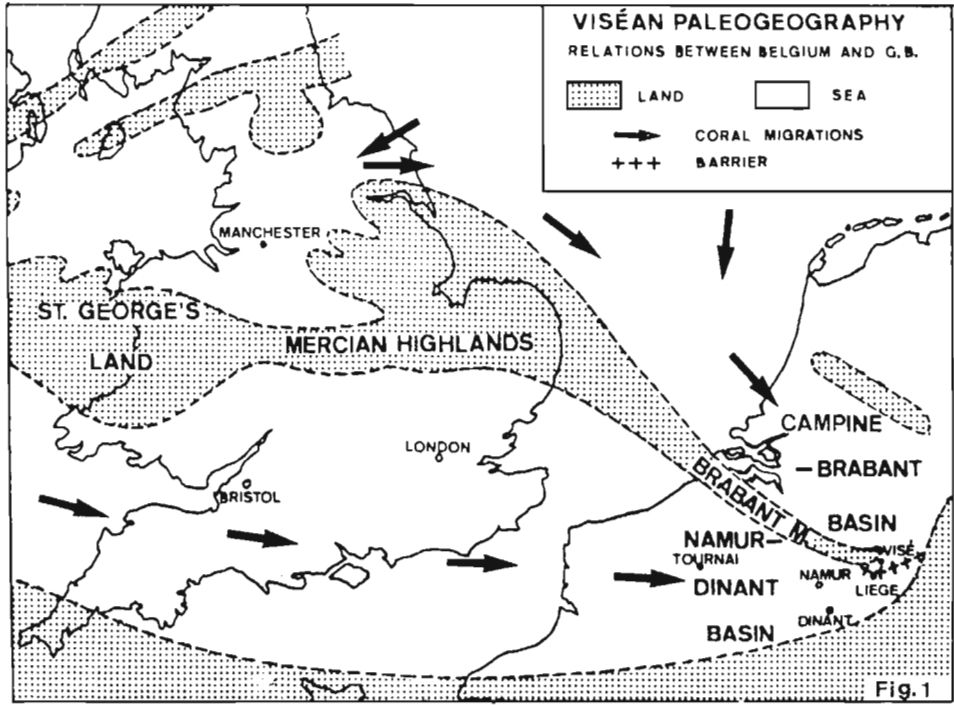
Key words: stratigraphy, coral paleobiogeography, Rugosa, Heterocorallia, Viséan, Belgium.

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PALEOGEOGRAPHY OF BELGIUM DURING THE VISÉAN

(fig. 1)

The existence in Belgium of two distinct paleogeographic regions during Dinantian times was first suggested by Delépine (1911) on the basis of lithological studies. This view was recently supported by the study of boreholes made in the Campine-Brabant Basin (Bless *et al.* 1976) and by a geological study of the Visé area (Kimpe *et al.* 1978). The southern region included the Namur-Dinant Basin and extended to the South-West Province in Great Britain; the northern one included the Campine-Brabant Basin (in which the Visé area lies) and extended to the British Central Province. These regions were separated from one another by the St. George's Land -- Mercian Highlands -- Brabant Massif. Faunal intercommunications between the two regions were possible in the Irish area, but were prevented in Belgium by some kind of barrier (Booze -- Le Val Dieu Ridge) as shown by the distinct assemblages of foraminifera (Conil



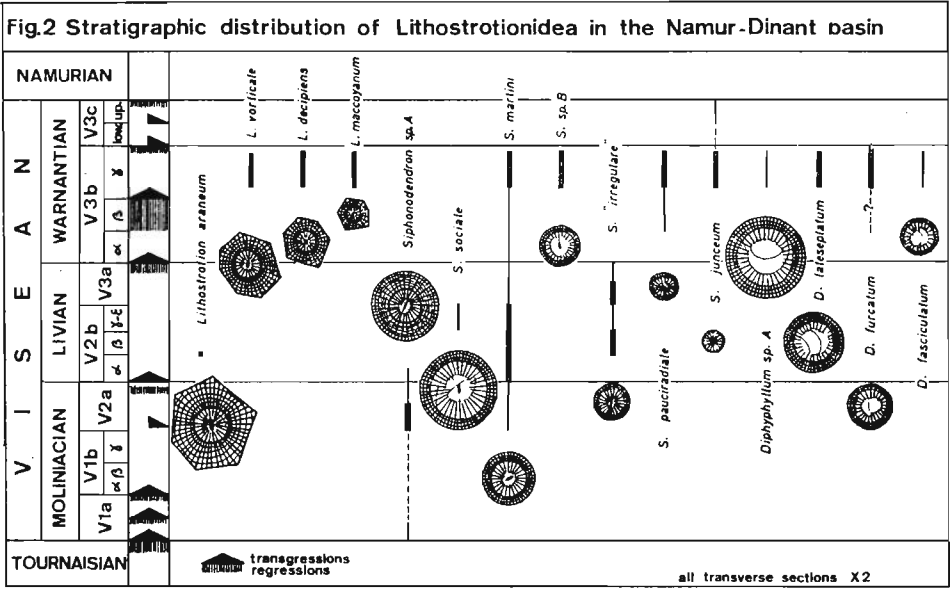
in Kimpe *et al.* 1978) and corals (Poty in Kimpe *et al.* 1978) found in the Visé area and in the Namur-Dinant basin. In view of this separation of the regions in Belgium, a coral zonation is given here for each one.

DISTRIBUTION OF RUGOSA AND HETEROCORALLIA IN THE VISÉAN OF THE NAMUR-DINANT BASIN

(fig. 2; table 1)

Remarks: The Viséan Series has been divided by Conil *et al.* (1976) into three stages defined in the Namur-Dinant Basin. The lowest is the Moliniacian (named after the River Molinee) which includes the V1 and V2a of the previously used Belgian scheme. It is characterized by the appearance of *Eoparastaffella*, *Dainella*, *Valvulinella* and *Mestognathus*. The second stage, the Livian (after a locality near Namur), includes the V2b and V3a. It is principally characterized by the appearance of *Koskinotextularia*. The last stage, the Varnantian (named after a locality near Dinant), includes the V3b and c. The appearance of *Asperodiscus* characterizes this stage.

Moliniacian. — Corals are sometimes common in the V1a. *Siphonodendron* sp. A, *Cyathoclisia modavense* Salée, *Palaeosmia munchinsoni* M.-E. et H. and *Axophyllum* sp. all appear at the base of this unit. Inherited Tournaisian species such as *Caninia cornucopiae* Michelin, *Canino-*



phyllum patulum (Michelin), *Siphonophyllia cylindrica* Scouler and *Amplexus coralloides* Sowerby are also present. This latter is only found in the Waulsortian reefs. Unstudied corals of the family Hapsiphyllidae can be common. Corals have not been found in the V1b except at the top where *Dorlodotia briarti* Salée forma α (see Poty 1975) occurs. This coral probably evolved from the British *Lonsdaleia praenuntia* Smith. In the lower part of the V2a, corals are again common: previous existing species like *Palaeosmilia munchisoni* M.-E. et H., *Caninophyllum patulum* (Michelin) and *Siphonodendron* sp. A are accompanied by new ones such as *Dorlodotia briarti briarti* (evolved from *D. briarti* forma α), *Clisio-phyllum* sp., *Axophyllum mendipense* (Sibly), *A. vauhani* (Salée), *Siphonodendron martinii* (M.-E. et H.), very rare *Heterophyllia ornata* Mc Coy and *Hexaphyllia mirabilis* (Duncan). In the middle part of the V2a, *Palaeosmilia munchisoni* M.-E. et H., *Caninophyllum patulum* (Mich.) and *Dorlodotia briarti* Salée disappear. However, the latter gave rise, in a very restricted area of the eastern part of the Namur Basin, to *Corphalia mosae* Poty, a small solitary coral which rapidly invaded the whole basin and had a short vertical range. During the upper V2a, the other corals became uncommon or disappeared temporarily.

Livian. — In the V2ba, we can observe gradual recolonisation by *Clisio-phyllum* sp., *Axophyllum vauhani* (Salée), *Siphonodendron martinii* (M.-E. et H.) and last by *Siphonodendron* sp. A.; *Caninophyllum archiaci* (M.-E. et H.) which appears in the upper part of the V2ba. The V2b β is marked by the appearance of a very rich coral fauna including *Siphono-*
dendron "irregulare" (Phillips), *Lithostroton araneum* (Mc Coy) (confined

Table 1

Stratigraphic distribution of Rugosa (except Lithostrotonidae) and Heterocorallia in the Viséan of the Namur-Dinant Basin

	TOUR	MOLINIACIAN			LIVIAN			WARNANTIAN			NAM	
		V1a	V1b		V2a	V2b		V3a	V3b			V3c
			α	β		γ	α		β	γ-ε		
<i>Cyathaxonia cornu</i> Michelin												
<i>Cyathaxonia rushiana</i> Vaughar.												
<i>Aulophyllum furgites</i> (Fleming)												
<i>Clisiophyllum</i> sp. A.												
aff. <i>C. keyserlingi</i> Grassie: <i>statum</i> Semenoff-Tian-Charsky												
<i>Dibunophyllum bipartitum</i> (Mc Coy)								?				
<i>Koninckophyllum</i> sp.												
<i>Carruthersella</i> (?) <i>garwoodi</i> (Salée)												
<i>Cvathoclisia modavense</i> (Salée)												
<i>Palaeosmia murchisoni</i> M.-E. & H.												
<i>Caninia cornucopiae</i> Michelin												
<i>Siphonophyllia samsonensis</i> (Salée)												
<i>S. cylindrica</i> Scouler												
<i>S. cf. siblyi</i> S.-T.-C.												
<i>Haplolasma</i> (?) sp. A.												
<i>Pseudozaphrentoides juddi</i> (Thor.)												
<i>Caninophyllum patulum</i> (Michelin)												
<i>Caninophyllum archiaci</i> (M.-E. & H.)												
<i>Bothrophyllum</i> sp.												
<i>Axophyllum mendipense</i> (Sibly)		?										
<i>A. vaughani</i> (Salée)												
<i>A. sp. A.</i>												
<i>A. sp. B.</i>												
<i>A. densum</i> (Ryder)												
<i>Lonsdaleia duplicata</i> (Martin)												
<i>Dorlodotia briarti briarti</i> (Salée)												
<i>Dorlodotia briarti forma</i> α												
<i>Corphalia mosae</i> Poty												
<i>Amplexus coralloides</i> Sowerty												
Famille Hapsiphyllidae Grabau												
<i>Heterophyllia ornata</i> Mc Coy												
<i>Hexaphyllia mirabilis</i> (Duncan)												

to the base of V2bβ), *Clisiophyllum* sp. A., *Axophyllum* sp. A and *A. sp. B*, and also by the abundance of *Siphonodendron martini* (M.-E. et H.), *Heterophyllia ornata* Mc Coy and *Hexaphyllia mirabilis* (Duncan) which individually or together can form local coral beds. *Caninophyllum archiaci* (M.-E. et H.), and *Axophyllum vaughani* (Salée) are also present. During the V2bγ, *Siphonodendron sociale* (Phillips) and *Haplolasma* (?) sp. A appear, and *Siphonodendron martini* (M.-E. et H.) has its maximum development, but the other rugose corals are not as common as in V2bβ and the heterocorals are now very uncommon. During the V2bδ-ε, there is a gradual decrease in the number of individuals, and *Siphonodendron sociale* (Phillips) and *Caninophyllum archiaci* (M.-E. et H.) disappear. At the base of V3a, *Carruthersella* (?) *garwoodi* Salée and *Siphonophyllia* cf. *siblyi* Semenoff-Tian-Charsky appear, and *Clisiophyllum* sp. A., *Axo-*

phyllum vaughani (Salée), *A. sp. A*, *A. sp. B* and *Siphonodendron* "irregularare" (Phillips) are again common, but *Siphonodendron martini* (M.-E. et H.), *Haplolasma* (?) *sp. A* and the heterocorals are very rare. *Azophyllum mendipense* (Sibly) is sometimes present. All of these corals disappear at the top of the V3a except for *Siphonodendron martini* (M.-E. et H.) which persists until V3b β .

Warnantian. — During the V3ba- β and the lower part of V3b γ , corals are not common because of unfavourable ecological conditions. However, some migrants appear from time to time: *Cyathaxonia cornu* Michelin (absent since the Tournaisian) and *Siphonophyllia samsonensis* (Salée) (= *S. benburbensis* Lewis) in the V3ba; *Siphonodendron pauciradiale* (Mc Coy), *Diphyphyllum* cf. *furcatum* Hill and *Dibunophyllum bipartitum* (Mc Coy) in the V3b β . *Siphonodendron martini* (M.-E. et H.) is present but uncommon. In the middle part of the V3b γ , a very varied coral fauna occurs, including previous species such as *Siphonophyllia samsonensis* (Salée), *Dibunophyllum bipartitum* (Mc Coy), *Siphonodendron martini* (M.-E. et H.), *S. pauciradiale* (Mc Coy), *Palaeosmilia murchisoni* M.-E. et H. (disappeared since the V2a), *Azophyllum* *sp. A*, *Heterophyllia ornata* Mc Coy and *Hexaphyllia mirabilis* (Duncan); and many new ones including *Lithostrotion vorticale* (Parkinson), *L. decipiens* (Mc Coy), *L. maccoyanum* M.-E. et H., *Siphonodendron junceum* (Fleming), *S. sp. B*, *Diphyphyllum lateseptatum* Mc Coy, *D. furcatum* Hill, *D. fasciculatum* (Fleming), *D. sp. A*, *Aulophyllum fungites* (Fleming), *Clisiophyllum* aff. *keyserlingi crassiseptatum* S.-T.-S., *Pseudozaphrentoides juddi* (Thomson), *Bothrophyllum* *sp.*, *Azophyllum densum* (Ryder) and some undetermined corals of the family Hapsiphyllidae. Later, in the upper part of the V3b γ , *Koninckophyllum* *sp.* and *Lonsdaleia duplicata* (Martin) also appear. All of these corals occur in the D1 subzone in Great Britain. They disappear at the top of V3b, except for the Hapsiphyllidae which are the only ones found in the lower V3c. Upper V3c is marked by the regression of the Viséan sea and only some rare *Cyathaxonia* cf. *cornu* Michelin, *C. rushiana* Vaughan, *S. junceum* (Fleming) and Hapsiphyllidae have been collected. There is usually a stratigraphic gap at the base of Namurian shales and sandstones which overlie the V3c and which do not contain corals.

DISTRIBUTION OF RUGOSA AND HETEROCORALLIA IN THE UPPER VISÉAN OF THE VISÉ AREA

(table 2)

In spite of recent works (Bless *et al.* 1976; Kimpe *et al.* 1978) which have largely clarified the complex geology of the Visé area, some problems remain in regard to the stratigraphy of the Dinantian. For this reason and also because many studied corals have been collected in the past from inaccurately known stratigraphic horizons, the coral ranges

Table 2

Stratigraphic distribution of Rugosa and Heterocorallia in the Upper Viséan of the Visé area

	V3a	V3 b	δ	V3c	
				low.	up.
<u>Cyathaxonia cornu</u> Michelin		—————			
<u>Cyathaxonia rushiana</u> Vaughan				---	?
<u>Rotiphyllum rushianum</u> Vaughan				---	?
<u>Lithostroton araneum</u> (Mc Coy)		—————			
<u>L. vorticale</u> (Parkinson)			---	?	
<u>L. decipiens</u> (Mc Coy)			---	---	?
<u>L. maccoyanum</u> M.-E. & H.			---	---	
<u>Siphonodendron martini</u> M.-E. & H.				?	
<u>S. sp. B.</u>			---	?	
<u>S. pauciradiale</u> (Mc Coy)		—————		?	
<u>S. cfr. sociale</u> (Phillips)			---	---	?
<u>Diphyphyllum furcatum</u> Hill			---	?	
<u>Solenodendron furcatum</u> (Smith)			---	---	?
<u>Carruthersella(?) garwoodi</u> (Salée)	---				
<u>C. keyserlingi</u> Mc Coy			?	---	?
<u>Dibunophyllum bipartitum</u> (Mc Coy)		—————		---	?
<u>Koninckophyllum sp.</u>			---	---	
<u>Aulokoninckophyllum (?) sp.</u>				---	?
<u>Palaeosmia murchisoni</u> M.-E. & H.				?	
<u>Amygdalophyllum sp.</u>				---	
<u>Siphonophyllia samsonensis</u> (Salée)		—————			
<u>Bothrophyllum sp.</u>			---	---	?
<u>Axophyllum densum</u> (Ryder)		—————		---	?
<u>A. lonsdaleiforme</u> (Salée)			---	---	?
<u>A. expansum</u> M.-E. & H.			---	---	?
<u>A. cf. pseudokirsopianum</u> S.-T.-C.			---	---	?
<u>Gangamophyllum sp.</u>			---	---	
<u>Lonsdaleia duplicata</u> (Martin)			---	---	
<u>L. floriformis</u> (Martin)					
<u>Pareynia splendens</u> S.-T.-C.			---	---	?
Famille Hapsiphyllidae Grabau					
<u>Amplexus coralloides</u> Sowerby			---	---	?
<u>Amplexus nodulosus</u> Phillips				?	
<u>Heterophyllia ornata</u> Mc Coy				?	
<u>Heterophyllia sp.</u>				---	
<u>Hexaphyllia mirabilis</u> (Duncan)				?	
<u>H. marginata</u> (Fleming)		—————			

————— observed distribution, --- probable distribution, ? uncertain distribution.

given here may be modified in the future. Since the Middle Viséan is missing in this area, only the Upper Viséan corals have been studied. The stratigraphic coral assemblages may be idealized as follows:

— a V3a assemblage including *Carruthersella* (?) *garwoodi* Salée, *Cyathaxonia cornu* Michelin, *Heterophyllia ornata* Mc Coy and *Hexaphyllia mirabilis* (Duncan);

— a V3ba — lower γ (?) assemblage including *Cyathaxonia cornu* Michelin, *Lithostrotion araneum* (Mc Coy), *Siphonodendron martini* (M.-E. and H.), *S. pauciradiale* (Mc Coy), *Dibunophyllum bipartitum* (Mc Coy), *Palaeosmilia purchisoni* M.-E. et H., *Amygdalophyllum* sp., *Siphonophyllia samsonensis* (Salée), *Axophyllum densum* (Ryder), *Heterophyllia ornata* Mc Coy, *Hexaphyllia mirabilis* (Duncan) and *H. marginata* (Fleming). Car-

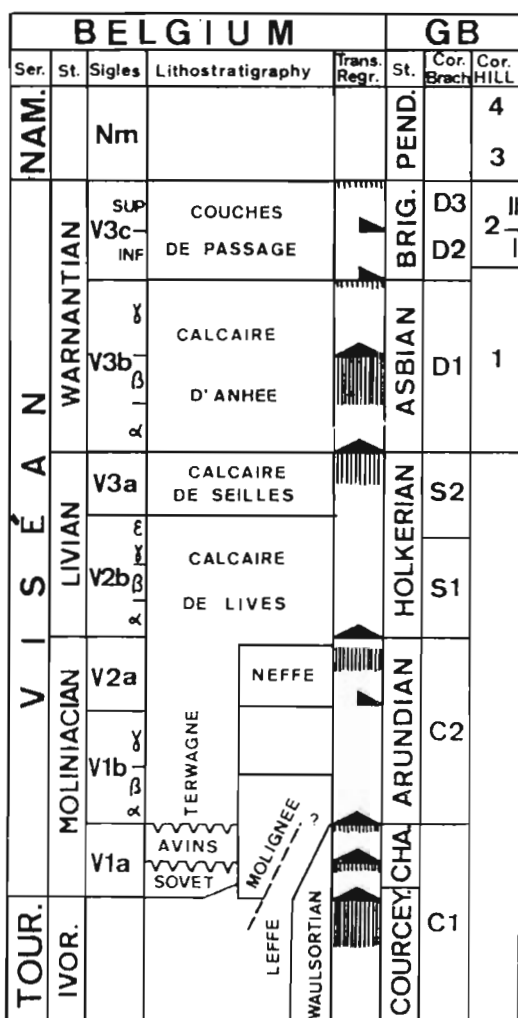


Fig. 3. Correlation of Viséan strata between Belgium and Great Britain.

ruthersella (?) *garwoodi* Salée can be present at the base of this assemblage which is that of the D1 subzone in Great Britain;

— an upper V3by assemblage including *Lithostrotion vorticale* (Parkinson), *L. decipiens* (Mc Coy), *L. maccoyanum* M.-E. et H., *Siphonodendron martini* M.-E. et H., *S. pauciradiale* (Mc Coy), *S. sp. B*, *Diphyphyllum furcatum* Hill, *Dibunophyllum bipartitum* (Mc Coy), *Koninckophyllum sp.*, *Palaeosmilia murchisoni* M.-E. et H., *Amygdalophyllum sp.*, *Axophyllum densum* (Ryder), *Gangamophyllum sp.*, *Lonsdaleia duplicata* (Martin), *Amplexus coralloides* Sowerby, *Heterophyllia ornata* Mc Coy and *Hexaphyllia mirabilis* (Duncan). This assemblage occurs at the top of the D1 subzone in Great Britain;

— a V3c assemblage including *Cyathaxonia rushiana* Vaughan, *Rotiphyllum rushianum* Vaughan, *Lithostrotion decipiens* (Mc Coy), *L. maccoyanum* M.-E. et H., *Siphonodendron cf. sociale* (Phillips), *Solenodendron furcatum* (Smith), *Clisiophyllum keyserlingi* Mc Coy, *Dibunophyllum bipartitum* (Mc Coy), *Koninckophyllum sp.*, *Aulokoninckophyllum* (?) *sp.*, *Amygdalophyllum sp.*, *Bothrophyllum sp.*, *Axophyllum densum* (Ryder), *A. lonsdaleiforme* (Salée), *A. expansum* M.-E. et H., *A. cf. pseudokirsonianum* S.-T.-C., *Gangamophyllum sp.*, *Lonsdaleia duplicata* (Martin), *L. floriformis* (Martin), *Pareynia splendens* S.-T.-C., *Amplexus coralloides* Sowerby, *A. nodulosus* Phillips and *Heterophyllia sp.* These corals occur in the D2 subzone of Great Britain.

CONCLUSIONS

The Belgian Viséan, now divided into three stages, may be characterized not only by foraminifer or conodont assemblages but also by coral assemblages as shown by the tables 1 and 2 and fig. 2. A coral zonation will not be defined here because a complete revision of Belgian Viséan corals is under way.

The fact that there was probably no faunal intercommunication between the Campine-Brabant Basin and the Namur-Dinant Basin partly explains the differences between their contemporary coral assemblages. For example:

Amplexus coralloides Sowerby is present in the Upper Viséan of the Visé area (Campine-Brabant Basin) but does not occur at levels higher than V1a in the Namur-Dinant Basin;

in the same way, *Lithostrotion araneum* (Mc Coy) and *Siphonodendron sociale* (Phillips) are present in the Upper Viséan of the Visé area but not of the Namur-Dinant Basin where they do not occur at levels higher than V2b;

some species present in the Visé area do not occur in the Namur-Dinant Basin and *vice versa* (compare table 1 and fig. 2 with table 2);

biometric values measured for *Lithostrotion* differ from one basin to the other (Poty, in preparation).

All this suggests that the Namur-Dinant Basin was a relatively closed environment during the Viséan. Corals could have migrated into it from Ireland during the various Viséan transgressions (V1a, V2a, V2b, V3ba, V3by, V3c). In contrast, the Visé area was a largely open environment as shown by the affinities of the corals with those of the British Central Province, the USSR and Africa.

Amendment

Siphonodendron sp. A appears at the base of V2a and not at the base of V1a as stated above (pp. 588—589). The beds of the section of Malonne (near Namur), where the supposed Lower Viséan *Siphonodendron* was collected, are now considered as belonging to V2a.

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