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SKOLIOPHYLLUM LAMELLOSUM AND *WEDEKINDOPHYLLUM MARGINATUM* INTERPRETED AS ECOLOGICAL FORMS OF MANY SPECIES OF *CYSTIPHYLLOIDES* (*)

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(1 map + 31 figures)

ABSTRACT

Seven species of *Cystiphylloides* are described in all of which « *lamellosum* » and « *marginatum* » forms are found. Problems concerning « septal cones » and the validity of the so-called « *Wedekindophyllum* » and « *Skoliophyllum* » are discussed. The possession of « septal cones » is not a specific characteristic, but an internal structure adjusted to the external forms of the corals which are directly influenced by ecological conditions. The so-called « *Wedekindophyllum* » and « *Skoliophyllum* » are shown to be two special forms of *Cystiphylloides* developed in unusual conditions.

RÉSUMÉ

Dans la présente note, quelques espèces du genre *Cystiphylloides* parmi lesquelles on trouve des formes « *lamellosum* » et « *marginatum* » font l'objet d'une étude détaillée. Les problèmes concernant les « cônes septaux » et la validité des genres « *Wedekindophyllum* » et « *Skoliophyllum* » sont discutés et étudiés. Les « cônes septaux » n'ont pas de valeur spécifique, ils constituent simplement un caractère écologique. Les genres « *Wedekindophyllum* » et « *Skoliophyllum* » ne sont que deux formes écologiques du genre *Cystiphylloides*. Les formes « *lamellosum* » et « *marginatum* » se rencontrent aussi bien dans le bassin de Dinant que dans le bassin de l'Eifel, en Espagne, en Amérique du Nord, au Sénégal et en Russie.

INTRODUCTION

The corals described in this paper were mainly collected by the author in the course of preparing his doctorate thesis at the University of Louvain, and in mapping the area of Chimay-Couvin and Olloy-Treignes, under the direction of Professor M. Lecompte. In studying the vertical and lateral distribution of rugose corals and their ecological controls, the author discovered some intermediate forms between the so-called « *Skoliophyllum* » and the normal forms of *Cystiphylloides vesiculosum*, *C. fongi*, *C. pseudofongi*, *C. lecomptei* and *C. cylindricum*. Later, some intermediate forms between the so-called « *Wedekindophyllum marginatum* » and the normal *Cystiphylloides fongi*, *C. pseudofongi*, *C. lecomptei* and *C. cylindricum* were also discovered. Numerous specimens of different species of « *lamellosum* » and « *marginatum* » forms were thereafter collected and studied, special attention being paid

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to their environmental conditions. « *Lamellosum* » and « *marginatum* » forms also exist at various horizons in other basins under the same special environmental conditions : In Eifel, Germany, the same « *lamellosum* » and « *marginatum* » forms are found in Ahrdorf-Schichten and Junkerberg-Schichten. In Dakar, Sénégal, « *lamellosum* » and « *marginatum* » forms are present in the Upper Couvinian. In North Spain, « *marginatum* » form is found in Upper Couvinian. In North America, these two forms occur in the Middle Devonian, Jeffersonville limestone (Stumm, 1961). In Transcaucasia, USSR, the « *marginatum* » form is found from D_2^2 1 to D_2^2 2; « *lamellosum* » form is found in the D_2^1 2 (Ulitina, 1968).

ACKNOWLEDGMENTS

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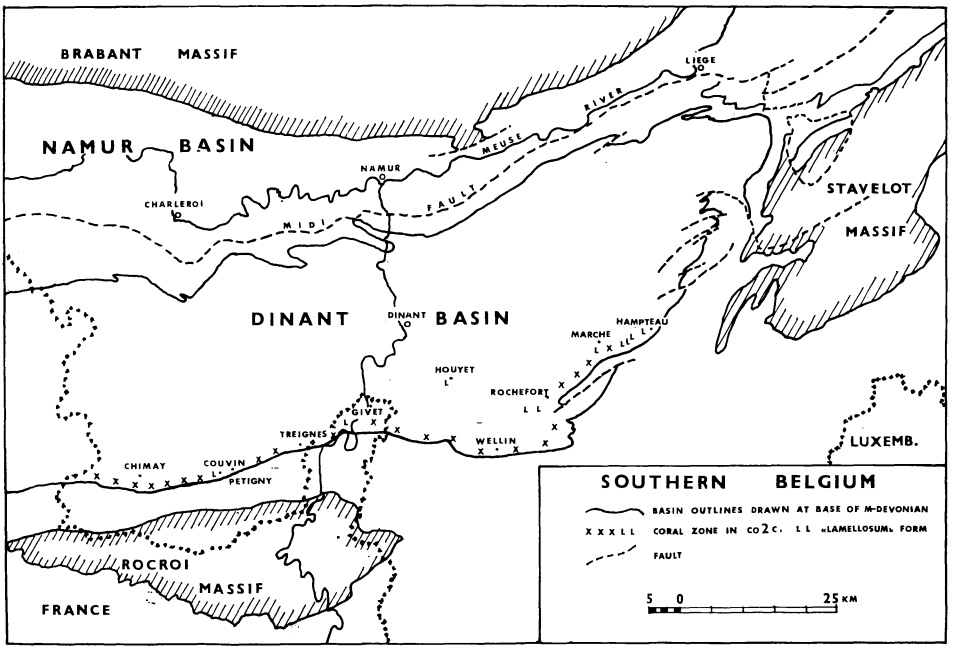
HISTORICAL REVIEW

Goldfuss (1826, p. 55 et 58, pl. 18, figs. 3a et 3b; pl. 16, fig. 3) placed the « *lamellosum* » and « *marginatum* » forms as two new species of *Cyathophyllum*. In 1882 Schulz (p. 243, pl. 23, figs. 5-6) considered all the « *lamellosum* » forms as *Cystiphyllum lamellosum*. Figures 5 and 6 of Schulz (1882, pl. 23) must be two different species. Wedekind (1925, p. 32) assigned *Cystiphylloides* with a lateral tabularium to a new species, namely *Lithophyllum marginatum*. In 1937, he defined



Map 1. — Sketch map of Southern Belgium showing the outcrop of the Co2c coral zone and the approximate positions of localities mentioned in the text.

the coral with the appearance of a slanting stack of coins as *Skoliophyllum* (Wedekind, 1937, p. 52). Stumm (1949, p. 39) designed Wedekind's *Lithophyllum marginatum* as the genotype of *Wedekindophyllum*. Lecompte (1952, p. 461) accepted *Wedekindophyllum*. But Hill (1956, p. 314) put Wedekind's *Lithophyllum marginatum* as one species of *Zonophyllum*. In 1961 Stumm (1961, p. 235) regarded the forms described by Nicholson (1875, p. 31), Greene (1901, p. 45) and Herzer (1902, p. 138) as *Skoliophyllum*. Birenheide (1962, p. 138) stated that *Mesophyllum* (*Cystiphylloides*) *lamellosum* grew in an environment of « Rüben riff » where the currents were strong and always in the same direction. But, he concluded that the *Mesophyllum* (*Cystophylloides*) *lamellosum* has the character of unilateral increase and considered *Nardophyllum excentricum* of Wedekind as a species derived from species « *lamellosum* ». In his more recent work (Birenheide, 1964), he subdivided *Plasmophyllum* (*Pl.*) *lamellosum* sensu Birenheide, into two sub-species : *Pl.* (*Pl.*) *lamellosum lamellosum* and *Pl.* (*Pl.*) *lamellosum placentiforme*. However, he remarked « Die Nominat-Unterart ist wahrscheinlich aus *Plasmophyllum* (*Pl.*) *secundum schlueteri* hervorgegangen. Hingegen kommt als Ursprung für das *lamellosum placentiforme* wohl das *Pl.* (*Pl.*) *limbatum* in Frage » (Birenheide, 1964, p. 31).

MATERIAL

All the material was collected from the Upper Couvinian at the following localities :

Belgium : (Co2c) Couvin, Petigny, Rochefort, March, Houyet, Hampteau. (Map 1).

France : (Co2c) Les Trois Fontaines, Givet.

Dakar, Sénégal : (Upper Couvinian) Agnelt Ondiat el Khyam, Douilk el Akhdhar.

Eifel, Germany : (Upper Couvinian) Gerolstein.

North Spain : (Upper Couvinian) Candas.

All collections and thin-sections are deposited in the Paleontological Laboratory of the University of Louvain, Belgium (Lv.) and in the Institut royal des Sciences naturelles de Belgique in Brussels (Bx.).

STRATIGRAPHY AND BATHYMETRICAL ZONAL SCHEMES

The stratigraphical scheme proposed by E. Maillieux (1928) will be used. Remarks on facies are based on the bathymetrical zonation established in publications of M. Lecompte (1954-1965).

SYSTEMATIC DESCRIPTIONS

Genus *Cystiphylloides* Chapman, 1893

e.p. 1826 *Cyathophyllum*; Goldfuss : p. 55.
*1893 *Cystiphylloides*; Chapman : p. 46.
1937 *Skoliophyllum*; Wedekind : p. 52.
1949 *Cystiphylloides*; Stumm : p. 39.
1961 *Cystiphylloides*; Stumm : p. 231.
1961 *Skoliophyllum*; Stumm : p. 235.
1964 *Cystiphylloides*; Stumm : p. 54.

1964 *Skoliophyllum*; Stumm : p. 52.
1964 *Plasmophyllum* (*Plasmophyllum*); Birenheide : p. 16.
1968 *Pseudomicroplasma*; Ulitina : p. 46.
1968 *Nardophyllum*; Ulitina : p. 55.
e.p. 1968 *Atelophyllum*; Ulitina : p. 78.
1969 *Cystiphylloides*; Tsien : p. 71.

Type species : By original designation and monotype, *Cystiphyllum aggregatum* Billings.

Locus typicus : Near Simcoe, Ontario, Canada.

Stratum typicum : Middle Devonian, Onondaga limestone.

REMARKS ON THE GENERAL CHARACTERISTICS

Some authors have regarded the septal cones, calyx forms and the external forms of the corals as specific characteristics. However, it is here considered that all these features respond to changes in ecological conditions and are not, therefore, specific characteristics.

External form : In general, for a given species, populations of small individuals indicate growth in an unfavorable environment; large individuals indicating more favorable conditions. Ma (1937) pointed out that the growth rate of the coral exoskeleton in the subtropical zone varies according to season. Hence the exoskeleton displays alternating thin, dense layers, the product of winter growth (unfavorable conditions) and thick, porous layers, the product of summer growth (favorable conditions). The winter and summer layers together make up a « year layer ». Such periodicity in coral growth can be recognized in the genus *Cystiphylloides* by the development of external constrictions corresponding to adverse conditions.

Vesicules : In general, vesicules are relatively large and thin-walled in corals which grew in a favorable environment whereas they are small and thick-walled in those which grew in unfavorable conditions. (Compare Fig. 1 and Fig. 2).

Septal cones : Wedekind and Vollbrecht (1931) considered the « septal cones » to be diagnostic of the Lytophyllidae. Hill (1942) regarded them as periodic skeletal dilatation caused by successive episodes of internal rejuvenescence. Ma (1937) believed them to be internal structural modifications of the skeleton resulting from annual, seasonal changes : a view also held by the present author (Tsien, 1967). The position of the « septal cones » is expressed in the external form (Fig. 19 and Fig. 20) which, it has been suggested, is strongly influenced by the ecological conditions.

Form of the calyx : The form of the calyx is a character controlled by the environment (Tsien, 1967).

Cystiphylloides vesiculosum (Goldfuss), 1826

(Figs. 1-2)

e.p. *1826 *Cyathophyllum vesiculosum* Goldfuss : p. 58, pl. 17, figs. 5c, 5d; non figs. 5a, b and e; pl. 18, figs. 1a and b; non figs. 1c and 1d.

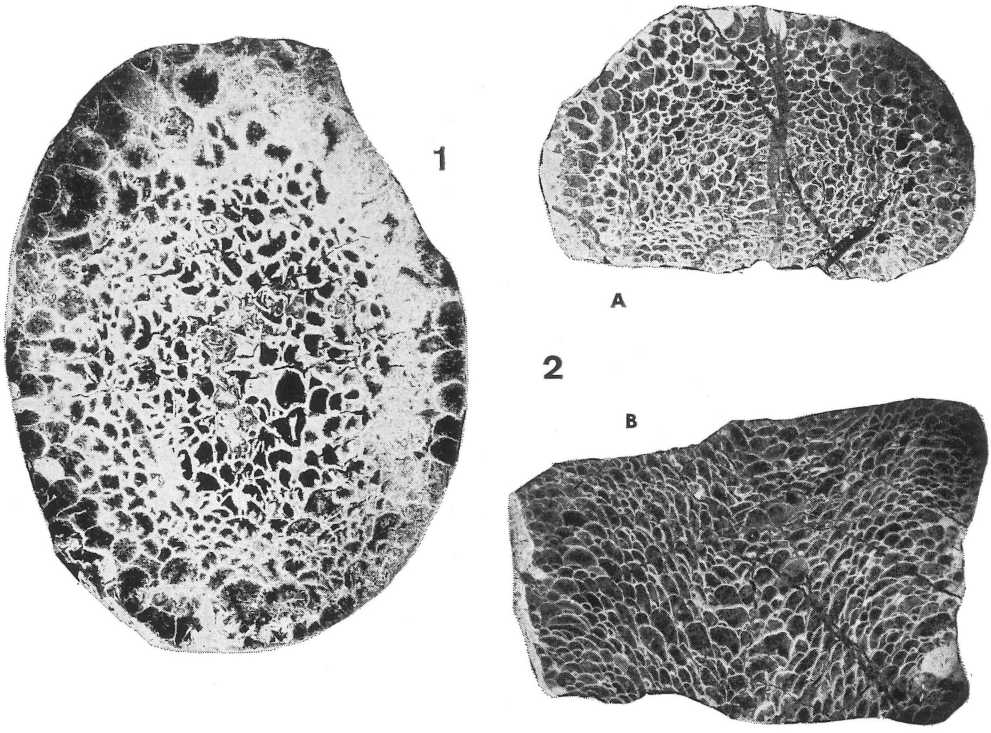
e.p. 1964 *Plasmophyllum* (*Pl.*) *secundum* (Goldfuss); Birenheide : p. 23, pl. 3, fig. 2; pl. 4, figs. 8, 10; pl. 14, fig. 67; pl. 15, fig. 68; pl. 17, fig. 81.

e.p. 1964 *Plasmophyllum* (*Pl.*) *lamellosum lamellosum* (Goldfuss); Birenheide : p. 31, pl. 10, fig. 50; pl. 20, fig. 98; pl. 26, fig. 129.

1969 *Cystiphylloides vesiculosum* (Goldfuss); Tsien : p. 74, pl. 30, figs. 1-2; pl.31, fig. 1; pl. 52, fig. 17.

Remarks : Birenheide (1964, p. 25, p. 39) considered *Cystiphylloides vesiculosum* as a synonym of *Plasmaphyllum* (*Pl.*) *secundum* (Goldfuss), and subdivided *Pl.* (*Pl.*) *secundum* into 7 subspecies. He chose the original Goldfuss' pl. 17, fig. 5e as lectotype of *Pl.* (*Mesophyllum*) *vesiculosum vesiculosum*, and cancelled *Cystiphylloides vesiculosum*. I here select the original of Goldfuss' pl. 17, figs. 5c, d as lectotype of *Cystiphylloides vesiculosum* and consider that the name is still valid as generally accepted.

Ecological environment : In Belgium, *Cystiphylloides vesiculosum* first appears in Co2a, it is very abundant in Co2c and Co2d and still exists occasionally in



Figs. 1 and 2. — *Cystiphylloides vesiculosum* (Goldfuss).

1. Specimen from Co2d, Couvin, Belgium; large globose and thin-walled vesicules indicate a favourable environment : i.e. somewhat agitated conditions. N° 22827, × 2, Inst. Roy. Sci. nat., Bx.

2. Specimen from Co2a, Couvin, Belgium; smaller vesicules indicate a quiet environment. N° 1108A and B, × 1, Labo. de Paléont., Univ. de Louvain.

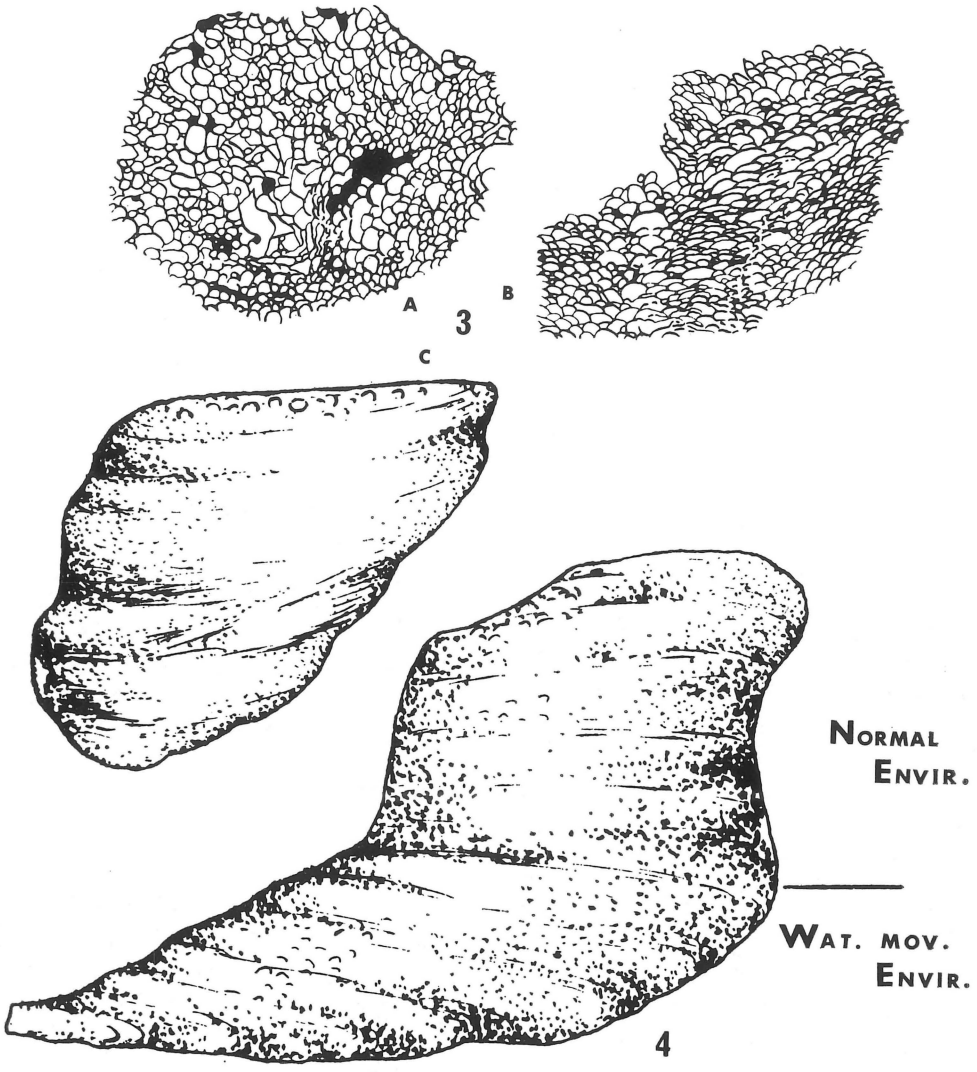


Fig. 3. — *Cystiphylloides vesiculosum* (Goldfuss) forma *lamellosum* (Goldfuss). From Co2c at Tien al'Chapelle, Couvin, Belgium, poorly developed laminated form indicates that the water movement was not strong enough to produce the typical « *lamellosum* » form. (Tsien Coll. N° 5717). 3a. transverse section, 3b. longitudinal section, 3c. side view. All figures $\times 1$, Lv.

Fig. 4. — *Cystiphylloides vesiculosum* (Goldfuss) forma *lamellosum* (Goldfuss). From Co2c at Hamoule, Hampteau, Belgium, showing the corallum started in one-well defined environment (with strong water movement) and then shifted to the normal condition. (Tsien Coll. N° 790011), $\times 1$, Lv.

the middle Frasnian. The most favorable habitat for this species was in the *sous-turbulente* zone. Under such favorable conditions, the coral is large with a well-developed porous inner structure. Otherwise, it is smaller and with a denser inner structure. Sometimes, both the well-developed porous structure indicative of favorable conditions and the badly developed, dense structure typical of growth in unfavorable conditions, can be found in the same corallum. This indicates environmental change during the life of the animal.

Cystiphylloides vesiculosum (Goldfuss) forma *lamellosum* (Goldfuss)
(Figs. 3-4)

*1826 *Cyathophyllum lamellosum* Goldfuss : p. 58, pl. 18, fig. 3a, b.
e.p. 1964 *Plasmophyllum* (*Pl.*) *lamellosum lamellosum* (Goldfuss); Birenheide : pl. 31, only pl. 3, fig. 4; pl. 20, fig. 97; pl. 26, fig. 129.
1969 *Cystiphylloides vesiculosum* (Goldfuss) forma *lamellosum* (Goldfuss); Tsien : p. 76, pl. 18, fig. 2a, b; pl. 51, fig. 4.

Description : *Cystiphylloides vesiculosum* the external appearance of which resembles a slanting stack of coins.

Remarks : For a long time the corallum with a laminated form has been considered to be one species (*Cystiphylloides lamellosum*) or even one genus (*Skoliophyllum*). There is evidence that the laminated form is only an ecological character (fig. 4). In the environments represented in Co2c of the southern and eastern parts of the Dinant Basin (Belgium), the Upper Couvinian of Dakar, Senégal, and in Ahrdorf-Schichten and Junkerberg-Schichten of the Eifel basin, several different species exhibit this form. Birenheide's figures (1964, pl. 23, fig. 111 and pl. 24, fig. 112) must be of two different species.

Cystiphylloides fongi (Yoh), 1937
(Fig. 5)

*1937 *Microplasma fongi* Yoh : p. 48, pl. 4, figs. 4a-b, 5a-b, 6.
1969 *Cystiphylloides fongi* (Yoh); Tsien : p. 84, pl. 12, fig. 4a-c; pl. 18, fig. 1a-c.

Diagnosis : Simple, relatively small, cylindrical or subcylindrical corals with very large globose vesicules and with the septal elements generally absent.

Ecological environment : In Belgium, this species occurs commonly in the shales of Co2c age; the most favourable environmental conditions were apparently in the upper part of the quiescent zone.

Cystiphylloides fongi (Yoh) forma *marginatum* (Wedekind)
(Figs. 6-7)

v. 1947 *Cystiphylloides* (*Lythophyllum*) *marginatum* (Wedekind); Le Maitre : p. 56, pl. 7; figs. 9, 10.
1969 *Cystiphylloides fongi* (Yoh) forma *marginatum* (Wedekind); Tsien : p. 85, pl. 12, fig. 5a-b; t-fig. 22.

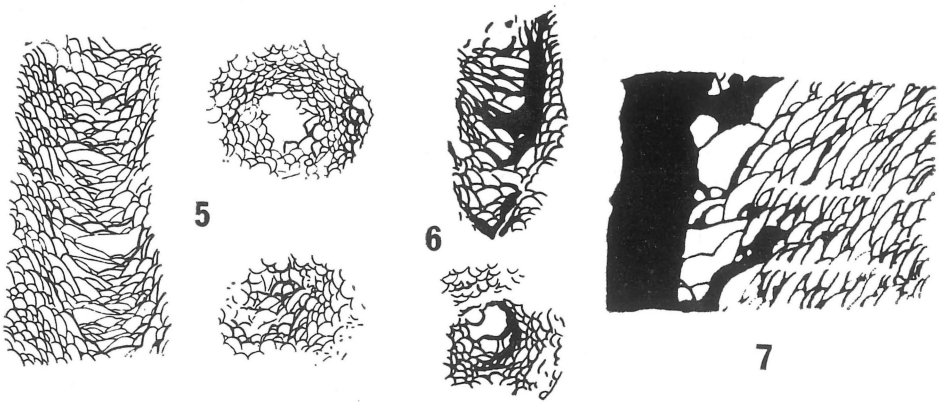


Fig. 5. — *Cystiphylloides fongi* (Yoh).
Transverse and longitudinal sections; from Co2c at Chapelle de Notre-Dame de la Consolation, Couvin, Belgium. (Tsien Coll. N° 1073 14), ×1, Lv.

Fig. 6. — *Cystiphylloides fongi* (Yoh) forma *marginatum* (Wedekind).
Transverse and longitudinal sections; from Co2c of Chemin de Boussu, Couvin, Belgium. (Tsien Coll. N° 4000 B134), ×1, Lv.

Fig. 7. — *Cystiphylloides fongi* (Yoh) forma *marginatum* (Wedekind), after Le Maitre 1947, Pl. 7, fig. 10, ×2.

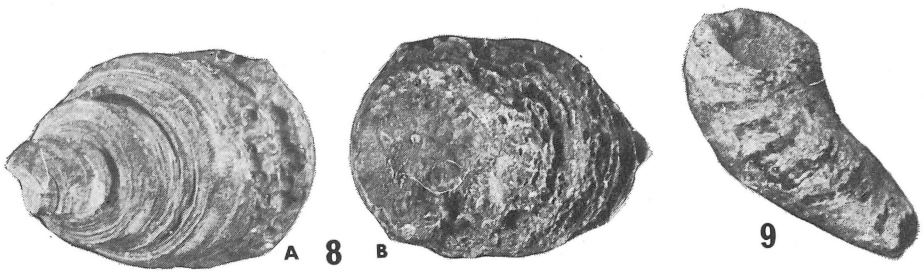


Fig. 8. — *Cystiphylloides fongi* (Yoh) forma *lamellosum* (Goldfuss).
Views of exteriors; from Upper Couvinian, Agnelt Ondial el Khyam, Dakar, Senégal, (DK 009), ×1, Lv.

Fig. 9. — *Cystiphylloides pseudofongi* Tsien.
Side view; from Co2c of Ch. de Boussu, Couvin, Belgium (Tsien Coll. N° 1005), ×1, Lv.

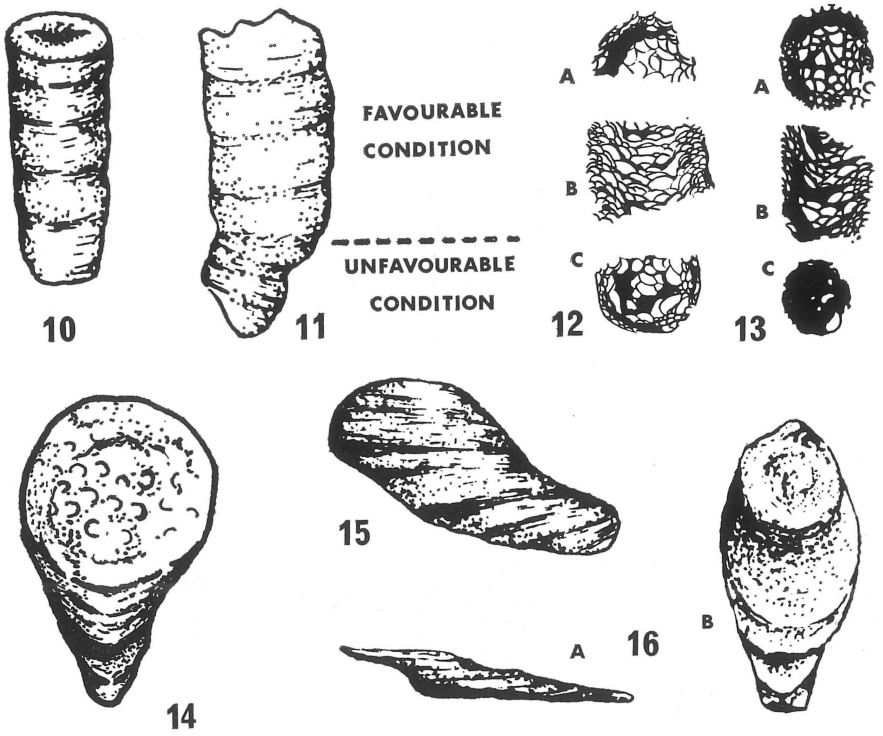
Description : *Cystiphylloides fongi* with a laterally shifted tabularium.

Ecological environment : The presence of a « lateral tabularium » and « septal cones » along one side of the corallum, are functions of the external form of the corallum and are related environmental conditions. Two different factors could be responsible for the development of these forms : (1) directional water movement (fig. 6); (2) the presence of local, unfavourable conditions on one side of the corallum (fig. 7).

Cystiphylloides fongi (Yoh) forma *lamellosum* (Goldfuss)
(Fig. 8)

Description : *Cystiphylloides fongi* the external appearance of which resembles a slanting stack of coins.

Ecological environment : Similar to that of *Cystiphylloides vesiculosum* forma *lamellosum* : i.e. in conditions where the water movement was strong and always unidirectional.



Figs. 10-12. — *Cystiphylloides pseudofongi* Tsien.
10. Side view; from Co2c at Trou Bodet, Couvin, Belgium (Tsien Coll. N° 4112 14), ×1, Lv.
11. Side view shows the corallum started growth in an unfavourable condition and then shifted to a favourable condition; from Co2c at La Croix St-Jean, Rochefort, Belgium (Tsien Coll. N° 4117 101), ×1, Lv.
12. Transverse and longitudinal sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 4149 1009), ×1, Lv.

Fig. 13. — *Cystiphylloides pseudofongi* Tsien forma *marginatum* (Wedekind).
Tranverse and longitudinal sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 3877 B111), ×1, Lv.

Figs. 14-16. — *Cystiphylloides pseudofongi* Tsien forma *lamellosum* (Goldfuss).
14. Calyx view; from Upper Couvinian, Agnelt Ondiat el Khyam, Dakar, Senégal, (DK 004), ×1, Lv.
15. Side view shows poorly developed « *lamellosum* » form; from Co2c of Rochefort, Belgium (Tsien Coll. N° 2003), ×1, Lv.
16. Side and calyx views show well developed « *lamellosum* » form; from Co2c at Les 3 Fontaines, Givet, France (Tsien Coll. N° 26), ×1, Lv.

Cystiphylloides pseudofongi Tsien, 1969
(Figs. 9-13)

1969 *Cystiphylloides pseudofongi* Tsien : p. 86, pl. 12, fig. 1-3; pl. 51, fig. 18, 19; t-fig. 9.

Diagnosis : Simple, cylindrical to subcylindrical coral similar to *Cystiphylloides fongi*, except that the size is smaller and septal elements are much more remarkable.

Internal characters : In transverse section, small globose peripheral vesicules and large axial vesicules are clearly defined. In longitudinal section, « septal cones » with the same cross-sectional form as the calyx are very clearly visible. The distance between « septal cones » is 5 mm.

Ecological environment : *Cystiphylloides pseudofongi* was very sensitive to environmental conditions. External morphology, calyx form and septal cone positions all change with the environment. In the quiescent zone, the corallum is cylindrical, the calyx is bell-shaped with a well-rounded edge, and the septal cones occupy the axial part of the corallum (Figs. 10-13). In some environments where the water movement was strong and unidirectional and the sea bottom was soft, the corallum increased unilaterally, producing « *marginatum* » or « *lamellosum* » forms, according to the strength of the water movement (figs. 17-18).

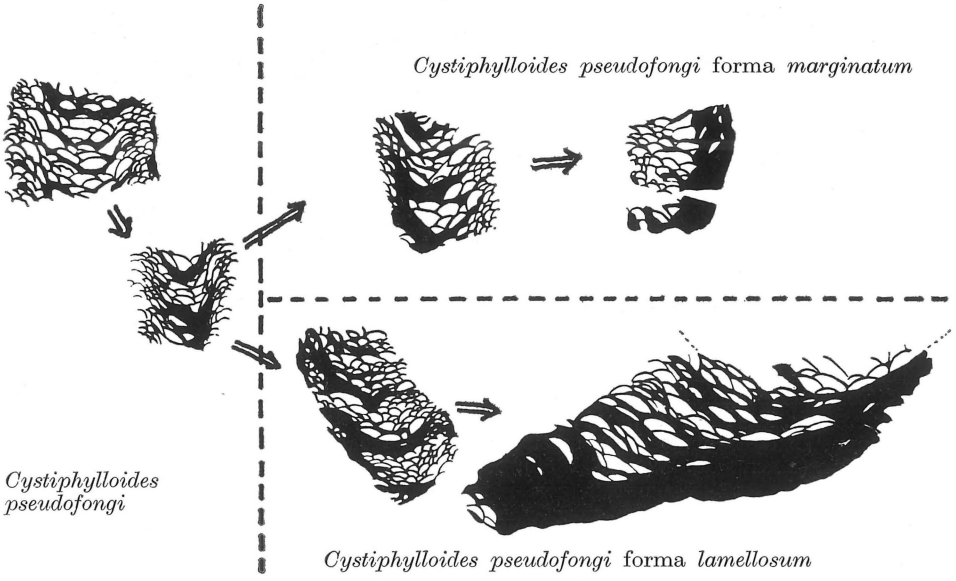


Fig. 17. — A series of thin-sections showing longitudinal sections of *Cystiphylloides pseudofongi* from rocks deposited under different environmental conditions, and the relationship between normal form, « *marginatum* » form and « *lamellosum* » form. From these it is obvious that the so-called *Skoliophyllum lamellosum* and *Wedekindophyllum* marginatum are merely environmentally controlled forms.

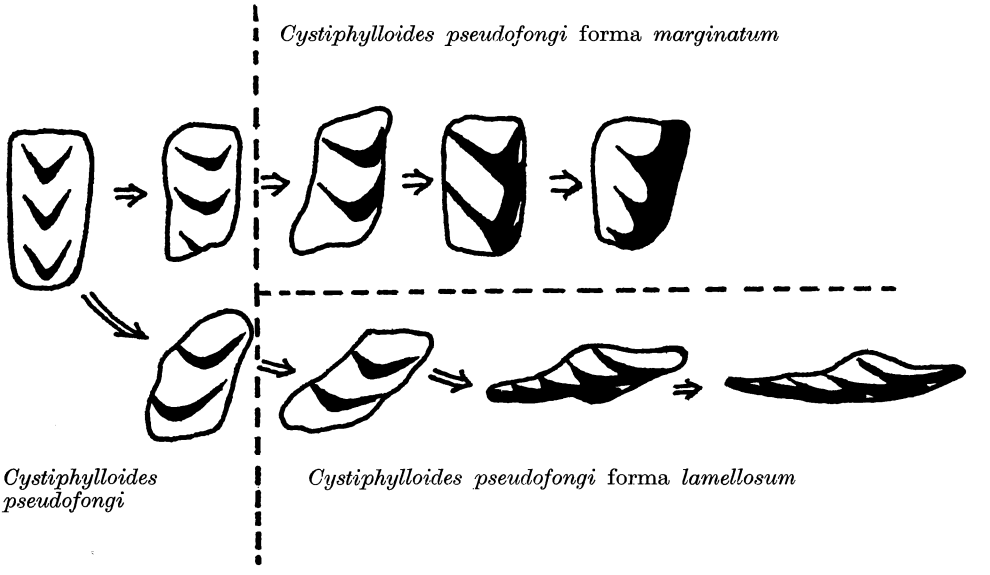


Fig. 18. — Diagram showing the position of « septal cones » (black areas) in longitudinal sections of *Cystiphylloides pseudofongi* from rocks deposited under different environmental conditions, and the relationship between normal form, « *marignatum* » form and « *lamellosum* » form.

Cystiphylloides pseudofongi Tsien forma *marginatum* (Wedekind)
(Fig. 13)

1969 *Cystiphylloides pseudofongi* Tsien forma *marginatum* (Wedekind); Tsien : p. 87, pl. 12, fig. 6; pl. 13, figs. 7-11; pl. 33, fig. 2; pl. 52, fig. 13.

Description : *Cystiphylloides pseudofongi* with a lateral tabularium and septa cones on one side of the corallum.

Ecological environment : see p. 10.

Cystiphylloides pseudofongi Tsien forma *lamellosum* (Goldfuss)
(Figs. 14-16)

1969 *Cystiphylloides pseudofongi* Tsien forma *lamellosum* (Goldfuss); Tsien : p. 87, pl. 12, figs. 7, 8; pl. 19, figs. 2, 3; pl. 51, figs. 1-3, 5; t-figs. 23, 24.

Description : *Cystiphylloides pseudofongi* the external appearance of which ressembles a slanting stack of coins.

Ecological environment : This form grew in the same general conditions as those of *Cystiphylloides vesiculosum* forma *lamellosum* but in a deeper zone. Figures 17-19 show how the external forms express growth direction and indicate different environmental conditions.

Cystiphylloides lecomptei Tsien, 1969
(Figs. 20 and 21)

1969 *Cystiphylloides lecomptei* Tsien : p. 88, pl. 13, figs. 4, 5 ; pl. 31, fig. 7.

Diagnosis : Small simple cylindrical to subcylindrical corallum, similar to *Cystiphylloides pseudofongi* but with septal crests strongly developed.

Internal characters : In transverse section, the peripheral vesicules can be seen to be small while the axial ones are relatively large. Septal crests are prominent in the axial part. In longitudinal section, septal crests are strongly developed to form septal cones.

Ecological environment : The ecological requirement appear to have been the same as those of *Cystiphylloides pseudofongi*; the two species are often found together.

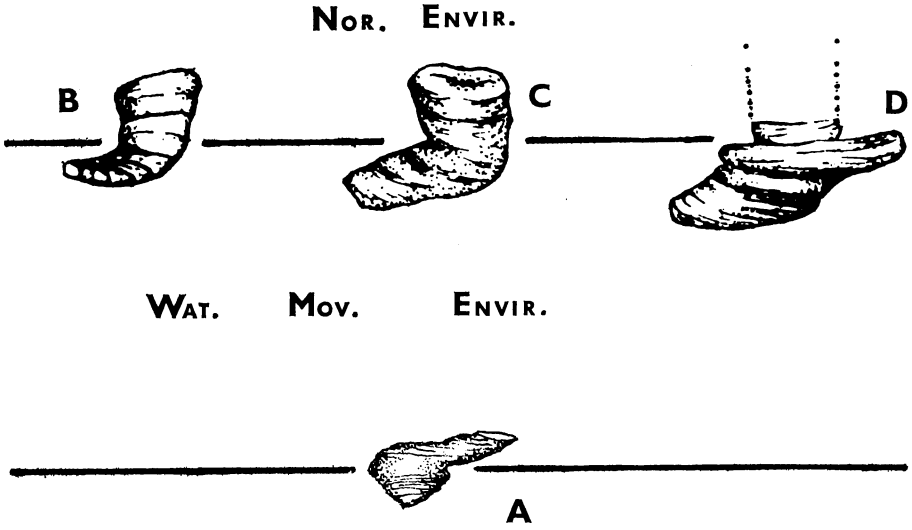


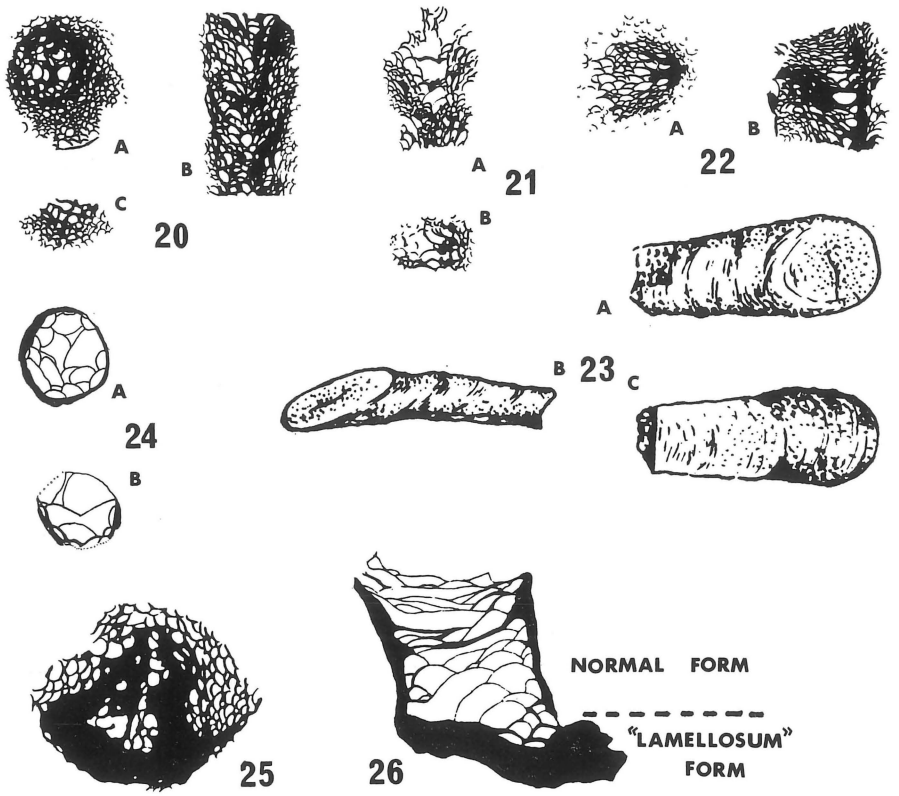
Fig. 19. — *Cystiphylloides pseudofongi* Tsien *lamellosum* (Goldfuss) further illustrations showing how external form expresses growth direction and indicates different environmental conditions.

A. After Wedekind 1937, pl. 7, fig. 2 showing that the corallum started in the normal condition and then shifted to the « *lamellosum* » condition.

B. From Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 7031), ×1, Lv.

C. From Co2c of Grand'route vers Couvin, Petigny, Belgium (Tsien Coll. N° 7002), ×1, Lv.
B and C showing that the corals started in « *lamellosum* » condition and then shifted to normal condition.

D. From Co2c at Clinique de Couvin, Couvin, Belgium (Tsien Coll. N° 3009), ×1, Lv. The form of the new bud indicates an environmental change.



Figs. 20 and 21. — *Cystiphylloides lecomptei* Tsien.

20. Transverse and longitudinal sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 3790 B150), ×1, Lv.
21. Longitudinal and transverse sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 4008 B148), ×1, Lv.

F. 22. — *Cystiphylloides lecomptei* Tsien forma *marginatum* (Wedekind).
Transverse and longitudinal sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 3792 B103), ×1, Lv.

Fig. 23. — *Cystiphylloides lecomptei* Tsien forma *lamellosum* (Golfduss).
View of exteriors; from Co2c of La grand'route vers Couvin, Petigny, Belgium (Tsien Coll. N° 7001), ×1, Lv.

Fig. 24. — *Cystiphylloides cylindricum* (Wedekind and Vollbrecht).
Transverse sections; from Co1c, Eau noire, Couvin, Belgium (Tsien Coll. N° 24093 a and b), ×1, Lv.

Fg. 25. — *Cystiphylloides* sp. forma *marginatum* (Wedekind).
Transverse sections; from Co2c of Chemin de Boussu, Couvin, Belgium (Tsien Coll. N° 4185 B165), ×1, Lv.

Fig. 26. — *Cystiphylloides cylindricum* (Wedekind and Vollbrecht) forma *lamellosum* (Goldfuss).
Longitudinal section; from Upper Couvinian, Agnelt Ondial el Khyam, Dakar, Senégal (N° 9133 399F II), ×1, Lv.

Cystiphylloides lecomptei Tsien forma *marginatum* (Wedekind)
(Fig. 22)

1969 *Cystiphylloides lecomptei* Tsien forma *marginatum* (Wedekind) ; Tsien : p. 88, pl. 13, fig. 6.

Description : *Cytiphylloides lecomptei* with a lateral tabularium and with septal cones only on one side of the corallum.

Ecological environment : This form is found together with *Cystiphylloides pseudofongi* forma *marginatum* and *Cystiphylloides fongi* forma *marginatum*. Presumably the ecological controls were the same in all cases.

Cystiphylloides lecomptei Tsien forma *lamellosum* (Goldfuss)
(Fig. 23)

1969 *Cystiphylloides lecomptei* Tsien forma *lamellosum* (Goldfuss); Tsien : p. 88, pl. 19, fig. 5.

Description : *Cystiphylloides lecomptei* the external appearance of which ressembles a slanting stack of coins.

Ecological environment : As it is found together with *Cystiphylloides pseudofongi* forma *lamellosum*, the ecological controls were presumably the same in both cases.

Cystiphylloides cylindricum (Wedekind and Vollbrecht), 1931
(Fig. 24 and 27)

*1931 *Lytophyllum cylindricum* Wedekind and Vollbrecht : p. 98, pl. 23, figs. 11-12.

1969 *Cystiphylloides cylindricum* (Wedekind and Vollbrecht); Tsien : p. 81, pl. 12, fig. 9; pl. 23, figs. 5-8; pl. 30, figs. 11-12; pl. 48, fig. 4 ; pl. 52, fig. 5.

Remarks : This species is common in beds of Co1 age in the Southern part of the Dinant basin. Specimens are found both in shale and limestone. The « *marginatum* » and « *lamellosum* » forms of this species are not found in the Dinant basin; but they are common in the Upper Couvinian in Sénégal.

Cystiphylloides cylindricum (Wedekind and Vollbrecht)
forma *marginatum* (Wedekind)
(Fig. 28)

Description : *Cystiphylloides cylindricum* with a lateral tabularium and with septal cones on only one side of corallum.

Ecological environment : The ecological setting was the same as that of *C. pseudofongi* forma *marginatum*.

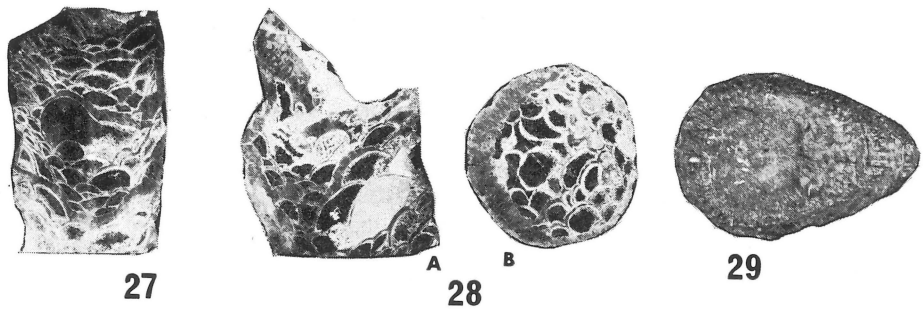
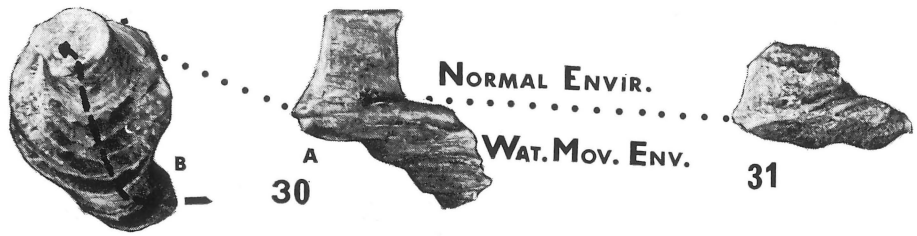


Fig. 27. — *Cystiphylloides cylindricum* (Wedekind and Vollbrecht).
Longitudinal section; from Upper Couvinian, Dakar, Senégal (N° 7109 VII), ×2, Lv.

Fig. 28. — *Cystiphylloides cylindricum* (Wedekind and Vollbrecht) forma *margintum* (Wedekind).
Longitudinal and transverse sections; from the same locality as the original of figure 27, ×2, Lv.

Fig. 29. — *Cystiphylloides* sp. forma *lamellosum* (Goldfuss).
Calyx view; from Upper Couvinian, Agnelt Ondiat el Khyam, Dakar, Sénégal, (DK 004), ×1, Lv.



Figs. 30-31. — *Cystophylloides cylindricum* (Wedekind and Vollbrecht) forma *lamellosum* (Goldfuss).

30. From Upper Couvinian, Agnelt, Ondiat el Khyam, Dakar, Senégal, (DK 001), ×1, Lv.
    A. Side view showing that the corallum started growth in one well defined environment (with water movement) and then shifted to the normal condition.
    B. Same specimen showing the change in the direction of lateral growth (marked by dashed line).
31. Side view of another specimen from the same locality as that in figure 30, (DK 002), ×1, Lv.

Cystiphylloides cylindricum (Wedekind and Vollbrecht)
forma *lamellosum* (Goldfuss)
(Figs. 26, 29 and 30)

Description : *Cystiphylloides cylindricum* the external appearance of which ressembles a slanting stack of coins.

Ecological environment : In Senégal, this form is found together with *C. pseudofongi* forma *lamellosum*, *C. lecomptei* forma *lamellosum*, *C. fongi* forma *lamellosum* and *C. sp.* forma *lamellosum* in the Upper Couvinian. Presumably the ecological controls were the same in all cases.

Cystiphylloides sp. 1 forma *marginatum* (Wedekind)
(Fig. 25)

1969 *Cystiphylloides* sp. forma *marginatum* (Wedekind); Tsien : p. 88, pl. 13, fig. 12.

Description : Sample is not good enough to determine the species. However, the characters of a lateral tabularium and septal cones on only one side of corallum are recognized. Transverse section shows characters similar to those of *Cystiphylloides pseudofongi* forma *marginatum*, except that the size is larger and the vesicules are smaller.

Cystiphylloides sp. 2 forma *lamellosum* (Goldfuss)
(Fig. 29)

Description : Corallum simple, similar in external appearance to *Cystiphylloides pseudofongi* and *Cystiphylloides lecomptei*. Calyxes relatively flat with slightly reflexed margins, septal crests moderately thick. Internal structures of several specimens are composed entirely of stereoplasmic thickening.

Ecolical environnement : The ecological requirement appear to have been the same as for *C. pseudofongi* forma *lamellosum*.

CONCLUSIONS

« *Lamellosum* » and « *marginatum* » forms exhibited by seven species of *Cystiphylloides* indicate that the so-called *Skoliophyllum* and *Wedekindophyllum* are merely environmentally controlled forms. The stratigraphic distribution of « *lamellosum* » and « *marginatum* » forms exhibited by *Cystiphylloides* is shown in Tables I-V. The « *lamellosum* » form is only found in Upper Couvinian. The « *marginatum* » form is found in Couvinian and Givetian. The « *lamellosum* » form of several different species is found in the Co2c of the Dinant basin; in the Upper Couvinian of Senégal; Upper Couvinian of the Eifel basin; Middle Devonian, Jeffersonville limestone of North America, and in the D_2^1 2 of Transcaucasia in USSR. This can be taken to indicate that the similar environmental conditions existed in these basins during this period.

TABLE I

Stratigraphic range of « *lamellosum* » and « *marginatum* » forms exhibited by *Cystiphylloides* in Dinant Bassin, Belgium.

	Co 1			Co 2				Gi
	a	b	c	a	b	c	d	
C. vesiculosum				+	+	+	+	+
C. v. f. *lamellosum*						+		
C. fongi						+		+
C. f. f. *marginatum*						+		
C. pseudofongi						+		
C. p. f. *marginatum*						+		
C. p. f. *lamellosum*						+		
C. lecomptei						+		
C. l. f. *marginatum*						+		+
C. l. f. *lamellosum*						+		
C. cylindricum		+	+	+	+	+	+	

TABLE II

Stratigraphic range of « *lamellosum* » and « *marginatum* » forms exhibited by *Cystiphylloides* in Eifel, Gemany.

	Nohn-Sch.	Ahrdorf-Sch.	Junkerberg-Sch.	Freilingen-Sch.	Ahbach-Sch.	Loogh-Sch.	Cürten-Sch.
C. vesiculosum	+	+	+	+	+	+	+
C. v. f. *lamellosum*		+	+				
C. fongi	+	+	+	+	+	+	+
C. f. f. *marginatum*		+	+	+	+		
C. f. f. *lamellosum*		+	+				
C. pseudofongi		+	+				
C. p. f. *lamellosum*		+	+				
C. sp. f. *lamellosum*		+	+				

TABLE III

Stratigraphic range of « *lamellosum* » and « *marginatum* » forms exhibited by *Cystiphylloides* in Dakar, Senégal.

	Lower Couvinian	Upper Couvinian	Givetian
C. fongi		+	+
C. f. f. *lamellosum*		+	
C. pseudofongi		+	
C. p. f. *marginatum*		+	
C. p. f. *lamellosum*		+	
C. lecomptei		+	
C.l. f. *marginatum*		+	
C. f. *lamellosum*		+	
C. cylindricum		+	
C. c. f. *marginatum*		+	
C. c. f. *lamellosum*		+	
C. sp. f. *lamellosum*		+	

TABLE IV

Stratigraphic range of « *marginatum* » forms exhibited by *Cystiphylloides* in North Spain.

	Lower Couvinian	Upper Couvinian	Givetian
C. fongi		+	+
C. f. f. *marginatum*		+	
C. cylindricum		+	+ ?
C. c. f. *marginatum*		+	

TABLE V

Stratigraphic range of « *lamellosum* » and « *marginatum* » forms exhibited by *Cystiphylloides* in Transcaucasia USSR.

	D_2^1 2	D_2^2 1	D_2^2 2
C. fongi	+	+	+
C. f, f. *marginatum*		+	+
C. pseudofongi	+		
C. p. f. *lamellosum*	+		

REFERENCES

BIRENHEIDE, Rudolf, 1962. — Entwicklungs- und umweltbedingte Veränderungen bei den Korallen aus dem Eifeler Devon. *Natur und Museum*, 92 (3), pp. 87-94, Frankfurt a. M.

BIRENHEIDE, Rudolf, 1964. — Die « Cystimorpha » (Rugosa) aus dem Eifeler Devon. *Abh. senckenb. naturf. Ges.*, vol. 507, 120 pp., 28 Taf., 23 abb., 2 Tab., Frankfurt a. M.

CHAPMAN, E. J., 1893. — On the corals and coralliform types of Palaeozoic strata. *Trans. roy. Soc. Canada*, vol. 10, pt. 4, pp. 39-48, Ottawa.

GOLDFUSS, G. August, 1826. — Petrefacta Germaniae. 252 pp., LXXI Tab., Düsseldorf.

GREENE, George K., 1898-1906. — Contributions to Indiana paleontology. *New Albany, Ind., Ewing and Zeller*, vol. 1, pt. 1-20, 204 pp., 60 pls.; vol. 2, pts. 1-3, 38 pp., 9 pls.

HALL, James, 1882. — Fossil corals of the Niagara and upper Helderberg group (Advance sheets). *New York State Mus. Nat. History*, 35th Ann. Rept., pp. 1-59.

HERZER, H., 1902. — Fossils from the Corniferous, Hamilton, and Medina series. *Ohio State Acad. Sci. Ann. Rept.*, N° 10, pp. 49-66, pls. 23-30.

LECOMPTE, Marius, 1952. — In Piveteau, J. (Ed.). *Traité de Paléontologie*, vol. 1. Madréporaires Paléozoiques, pp. 419-538, t-figs. 1-154 + 1-75, Paris.

LECOMPTE, Marius, 1954. — Données relatives à la genèse et aux caractères écologiques des « récifs » du Franien de l'Ardenne. Vol. Jubilaire *Victor Van Straelen*, Inst. roy. Sci. nat. Belgique, vol. 1, pp. 151-181.

LECOMPTE, Marius, 1962. — Facies marins et Stratigraphie dans le Dévonien de la Belgique. *Ann. Soc. géol. Belg.*, t. 85, Bull. N° 1, pp. 17-57.

LECOMPTE, Marius, 1965. — Quelques concepts généraux sur les récifs, Résultant de l'étude du Dévonien de la Belgique. *La Scuola in Azione*, N° 2 pp. 144-180, pls. 1-4, figs. 1-14, San Donato Milanese.

LE MAITRE, Dorothée, 1947. — Contribution à l'étude du Dévonien du Tafifalet, II. Le récif coralligène de Ouihalane. *Notes et Mém. Serv. géol. Maroc*, 76, 112 pp., 24 pls., 2 Tab., Lille.

MA, Ting Ying H., 1937. — On the seasonal growth in Palaeozoic tetracorals and the climate during this period. *Palaeontol. Sinica*, (B) 2 (3), 99 pp., 22 pls., 1 map. Peiking.

MAILLIEUX, Eugène and DEMANET, Felix, 1928. — L'échelle stratigraphique des terrains primaires de la Belgique. *Bull. Soc. belg. Géol.*, t. 38, pp. 124-131, pl. I-III.

NICHOLSON, H. A., 1875. — Description of the Corals of the Silurian and Devonian Systems. *Rept. Geol. Surv. Ohio, Paleontol.*, vol. 2, pt. 2, pp. 181-242.

SCHULZ, Eugen, 1882. — Die Eifelkalmulde von Hillesheim. *Jb. Preuss. Geol. Landes.*, pp. 158-250, pls. 19-23.

STUMM, Erwin, C., 1949. — Revision of the Families and Genera of the Devonian Tetracorals. *Geol. Soc. Amer.*, Mem. 40, 92 pp., 15 pls.

STUMM, Erwin, C., 1961. — North American Genera of the Devonian Rugose Coral Family Digonophyllidae. *Contrib.. Mus. Paleont.*, Univ. Mich., vol. 16, N° 4, pp. 225-243, pls. 1-6.

TSIEN, Hsien-Ho, 1967. — Distribution of rugose corals in the Middle and Upper Devonian (Fasnian) reef complex of Belgium. *Intern. Symp. Dev. Syst., Alberta Soc. Petr. Geol.*, vol. 2, pp. 273-293, figs. 1-15, Tab. I, Calgary ,Alberta.

TSIEN, Hsien-Ho, 1969. — Contribution à l'étude des Rugosa du Couvinien dans la région de couvin. *Mém. Instit. Géol. Univ. de Louvain*, t. XXV, 173 pp., 52 pls.

WEDEKIND, Rudolf, 1925. — Das Mitteldevon der Eifel. 2. Teil. Materialien zur Kenntnis des mittleren Mitteldevon. Schr. Ges. Beförderung ges. Naturw., vol. 14, N° 4, 85 pp., 17 Taf., 1 Tab.

WEDEKIND, Rudolf, 1937. — Einführung in die Grundlagen der Historischen Geologie, Band 2, Mikrobiostratigraphie die Korallen- und Foraminiferenzeit., pp. 1-136, Taf. 1-16, 35 Abb., Stuttgart.

WEDEKIND, Rudolf and VOLLBRECHT, Emmi, 1931. — Die Lytophyllidae des mittlerens der Eifel. I. Teil. *Paleontographica*, vol. 75, pp.81.-110, Taf. 15-46 (1-32).

YOH, Sen-Shing, 1937. — Die Korallenfauna des Mitteldevons aus der Provinz Kwangsi, Südchina. *Palaeontographica*, Band 87, Abt. A, Lief. 1-2, pp. 45-76, pl. 4-9.

ULITINA, L. M., 1968. — Devonskie korally Cystiphyllinae Zakavkazia. *Akad. Nauk., SSSR.* Tom. 113, pp. 98, pls. 1-20, figs. 1-21, 2 Tab. Moskva. [Devonian Cystiphyllinae (Rugosa) from the Transcaucasia.]

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