LATE DEVONIAN TO EARLY TOURNAISIAN RUGOSE CORALS

by

Eddy POTY

(1 figure and 4 tables)

ABSTRACT. - The distribution of Rugose Corals between the end of the Frasnian and the early Tournaissian is reviewed in four selected regions (Belgium and surrounding areas, German cephalopod facies, Poland, Omolon). Four "paleontological events" are distinguished: extinction of most of the Devonian-type Rugose Corals at the end of the Frasnian; development of a new fauna at the beginning of the Upper Famennian; increase and diversification of corals during Strunian; extinction of most of the Strunian corals and replacement by a Tournaissian-type coral fauna at the Devonian-Carboniferous boundary. These seems to be the result of eustatic and probably also climatic fluctuations (variations in sea water temperature).

RESUME. - L'analyse de la distribution des Tétracoralliaires entre la partie supérieure du Frasnien et le Tournaissien inférieur pour quatre régions de l'Eurasie (Belgique et aires voisines, faciès à Céphalopodes de l'Allemagne, Pologne, Omolon), a permis de dégager quatre "événements paléontologiques" : extinction de la plupart des Tétracoralliaires à la fin du Frasnien ; appariation d'une faune de type famennien au début du Famennien supérieur ; expansion et diversification des coraux au Strunien ; disparition de la plupart des coraux struniens et remplacement par une faune de type tournaissien à la limite Dévonien-Carbonifère. Ces événements sont liés à des fluctuations eustatiques et probablement aussi climatiques (variations de la température des mers).

A. - INTRODUCTION

The purpose of this paper is to review the main paleontological events affecting the Rugose Corals from the end of Frasnian to the early Tournaissian. Corals from that interval have been recorded throughout the Northern hemisphere. Frequently, however, the stratigraphic data are either inexact or questionable, e.g. the so-called Etroeungt fauna from the Shaodong Formation (South China) described by Wu Wang-shi et al. (1981) which might be rather of Lower (and Middle ?) Tournaissian age. For these reasons, only four regions have been selected here for comparisons and conclusions:

- Belgium and surrounding areas, including the Western European basins from the Etroeungt area to the undeep water facies of Western Germany, and the southern part of the Campine Basin;
- the German Cephalopod facies;
- Poland;
- The Omolon Region (NE-U.S.S.R.).

B. - BELGIUM AND SURROUNDING AREAS

(Fig. 1, Table I)

In Belgium, the Frasnian yields the last rich and diversified Rugose Coral assemblages of the Devonian. These corals were subject to numerous papers by Coen-Aubert (1974, 1977, 1980a, b, c, 1982, ...), Sorauf (1967), Tsien (1968, 1975, 1976, 1977a, b, ...), etc. and their stratigraphic ranges are usually well known. So, these formed the basis of the Frasnian biozonation by Tsien (1977a) and Coen et al. (1977).

In the upper part of the Frasnian considered here ("F2" and "F3"), the main components of the coral faunas are massive compound corals - especially Phillipsastrea and relative genera - and disseminated solitory corals of the genera Tabuliphyllum and Petrorhiza. In contrast, the fasciculate and the nondisseminated solitory corals are less common or rare.

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Figure 1. Rugose Corals near the Devonian–Carboniferous boundary between Dinant (Belgium) and Aachen (Federal Republic of Germany), and in the Maastricht borehole (The Netherlands).
except for the fasciculate genus Phacellophyllum in some "F2" bioherms, and for the non-disseminated solitary coral genera Metrophyllum and Neaxion in thin non-biohermal beds. Practically all these corals tolerated muddy waters and adapted to different environments by changing their morphology (shape, form of the calyx, ...). Therefore, they occur in biohermal limestones, in the surrounding shales or in the shelf facies (Coen-Aubert, 1980c).

Three assemblage zones have been defined by Coen et al. (1977) in the upper part of the Frasnian. The lower one is characterized by Frechastraea carinata and matches the upper A. triangularis conodont zone (sensu Coen, 1973). The second one includes F. pentagona microstrefa, F. limitata and Phillippsastrea ananas, and ranges in the lower part of the upper gigas conodont zone. The third (upper) zone is characterized by F. pentagona pentagona and ranges in the middle part of the upper gigas zone (Coen-Aubert, 1980c). The third zone is the youngest one recognized in the Frasnian and includes species of the genera Frechastraea, Phillippsastrea, Iowaphyllum, Hanksxis and Pterorrhiza. These genera become extinct just below the Frasnian-Famennian boundary, whereas only some small disseminated solitary corals (not yet described) range until that boundary. In Belgium, these extinctions mark the worldwide crisis that affected and practically exterminated the rich Devonian Rugose Coral fauna near the Frasnian-Famennian boundary. Here this coincided with the acme of the Frasnian transgression resulting in a deepening of the basin and a predominantly clay deposition. This crisis also matches the extinction of the biohermal build ups (Coen-Aubert, 1980c; Biron et al., 1983).

From the base of the Famennian to the Lowermost Strunian, the Rugose Corals are very rare because of unfavourable conditions for their development: argillaceous deep water deposits succeeded by coarse terrigenous regressive sediments. The "Fa1" has only yielded some specimens of Neaxion sp. But corals showing resemblances with those belonging to the "Campophyllum flexuosum group" (1) appear during the Fa2a and mark the first occurrence of the "Strunian-type" coral fauna. They form the first indications of a renewal after the extinction of the Frasnian-type coral fauna. Note also the presence of Tabulophyllum ? sp. in the lowest velifer conodont zone, and of Heterocorals (Heterophyllia cf. famenniana Rózkowska, 1969) in the Fa2c of the southern part of the Dinant Synclinorium.

Corals become abundant and diversified in the lower part of the LV spore zone (which coincides with the lower part of the Strunian stage) in the Etroeuungt area. Following the "Strunian transgression", they progressively extended into the other areas of the Dinant Synclinorium and to the Vesder Massif which were fully colonised in the upper part of the Strunian ("Tn1a").

The Strunian coral fauna is almost exclusively composed of disseminated solitary corals (of the "Caninid-Clinophyllid fauna" type of Hill, 1938) and includes (Poty, 1984):

- a few species which can be attributed to genera surviving the latest Frasnian crisis such as Tabulophyllum (2);
- corals which can be related to an Upper Frasnian ancestor; e.g. "Dibunophyllum" praecursor and "Clinophyllum" omalius show resemblances with respectively "Tabulophyllum" implicatum from the Upper Frasnian of Belgium and with Fedorowskycathus similis from the Upper Frasnian of Poland (for the latter, see particularly Rózkowska, 1979, pl. 6, fig. 1, 2), and might have evolved from them. Both these Strunian and Upper Frasnian species possess an axial structure of Carboniferous type;
- species attributed to Dinantian genera such as Palaeosmilia aquisgranensis;
- peculiar corals such as Campophyllum flexuosum, Campophyllum ? sp. nov. (Poty, 1984, pl. 2, fig. 4), gen. & sp. nov. A (ibid., pl. 2, fig. 5) or "Caninia" doriodoti.

The Rugose Coral zone 0 defined by Poty (1984, 1985) is characterized by this assemblage.

In the Dinant Synclinorium, the Strunian coral fauna disappears at the top of the Etroeuungt Formation, but a few species (Campophyllum flexuosum, Palaeosmilia aquisgranensis) persist in the lower part of the massive limestone bed which marks the base of the Hastière Formation ("Tn1b") and which contains also Strunian-type foraminifers, brachiopods and trilobites (Conil et al., 1986). The upper part of that bed did not yield any corals and separates these Strunian-type assemblages from the level with the first appearance of Caninia tregaeensis (type-species of the Rugose Coral zone 1) and Melanophyllum kremersi. But in the Kastanjeel-2 borehole (Maastricht, The Netherlands, situated in the Campine-Brabant Basin) - where no important lithological change occurs at the Famennian-Tournaisian transition - Caninia tregaeensis appears slightly earlier, in a bed with the last Palaeosmilia aquisgranensis.

Melanophyllum kremersi dissapears quickly above the base of the Tournaisian, and a little higher Siphonophyllia cylindrica auct. appears.

Thus, the replacement of the Strunian corals by Tournaisian ones matches or is near the conodont-defined Devonian-Carboniferous boundary.

(1) including Campophyllum flexuosum (Goldfuss 1826), Caninia doriodoti Saile 1913, and comparable species.

(2) Dehée (1929, p. 47, pl. VII, fig. 6) has described and figured a specimen of Pterorrhiza aff. rozowskiae (Coen-Aubert 1982) from the Strunian of Etroeuungt under the name of Cyathophyllum sp. It is the only report of that genus in the Strunian and it needs a confirmation by collecting other specimens.
Table I. – Late Frasnian to early Tournaisian Rugose Corals in Belgium and surrounding areas (from Coen, Coen et al., Coen-Aubert, Tsien and Poty).

<table>
<thead>
<tr>
<th>Stages</th>
<th>FRASN. PARS</th>
<th>FAMENNIAN</th>
<th>STRUNIAN</th>
<th>TN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Coral zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b Low</td>
<td>up</td>
<td>gigas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c Conodont zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d Spore zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e Litho and/or symbols</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Non disseminated solitary corals

- *Metriophrilla* M.-E. & H. 1850
- *Nalivkinella* Soshkina 1939
- *Neaxon* Kullman 1965
- *Cyathaxonia* Michelin 1847
- *Saleelasma* Weyer 1970

Disseminated solitary corals

**Without axial structures**

- *Pterorrhiza* Ehrenberg 1834
- *Tabulophrilla* Fenton & Fenton 1924
- *T. ? sp.*
- *Campophrilla* M.-E. & H., 1850
  - "*C. flexuosum* (Goldfuss 1826) group"
  - *C. ? sp.* nov. Poty 1984
- *Melanophrilla* Gorsky 1951
- *M. kremersii* (Poty 1982)
- *Caninia* Michelin in Gervais 1840
- *C. tregensis* (Poty 1982)
- *Siphonophylla* Scouler in Mc Coy 1844
- *Palaeosmilia* M.-E. & H. 1848
- *P. aquisgranensis* (Frech 1885)
- Undetermined genera
  - Tabulophrillomorph
  - gen. & sp. nov. A. Poty 1984

**With axial structures**

- *Hankaxis* Bireheide 1978
- Doubtful or undetermined genera
  - "*Tabulophrilla* implicatum" Tsien 1977
  - "*Dibunophrilla* praecursor" Frech 1885
  - "*Clistophyllum* omalusi" Haime 1855
  - Gen. ? & sp. nov. B Poty 1984

Compound corals

**Massive**

- *Hexagonaria* Gürich 1896
- *Wapitiophrilla* Mc Lean & Pedder 1984
- *Scruttonia* Cherepina 1974
- *Argutastrea* Grickmay 1960
- *Phillipastrea* d’Orbigny 1849
- *Frechastrea* Scrutton 1968
- *Iowanophyllum* Stumm 1949

**Fasciculate**

- *Peneckia* Soshkina 1939
- *Phaeophrilla* Gürich 1909
- *Sencelastrea* Tsien 1968
- *Thanmophrilla* Penecke 1894

**Heterocorallia**

- *Heterophyllia* Mc Coy 1849
The Tournaian fauna is less diversified than the previous one [e.g. among the Strunian fauna were numerous disseminated corals having an axial structure of Carboniferous-type ("Cisiothryphum", "Dibunophyllum", ...) or belonging to the large-sized Carboniferous genus *Palaeosmilia*. However, such corals are uncommon or absent in Tournaian coral assemblages, being reintroduced only in the Uppermost Tournaian or Lower Viséan assemblages]. This impoverishment suggests an important change in the marine environments from the Devonian–Carboniferous boundary until the upper part of the Tournaian.

So, four main palaeontological events affecting the Rugose Corals can be distinguished from the Upper Frasnian to the Lower Tournaian:

1. Extinction of the majority of the Devonian-type corals just below the Frasnian–Famennian boundary.
2. Appearance of the first Strunian-type corals during the Fa2a.
3. Diversification of Strunian corals from the lower part of the LV zone onwards.
4. Replacement of the Strunian-type corals by Tournaian-type corals at or near the Devonian–Carboniferous boundary.

C.- FAMENNIAN AND LOWER TOURNAISIAN GERMAN CEPHALOPOD FACIES

(Table II)

All the Rugose Corals recorded from the Famen- nian Cephalopod facies of Germany are small horned, not or poorly disseminated, solitary corals (deep water corals of the "*Cathaxonia* fauna" type of Hill, 1938). Two assemblages have been recognized by Weyer (1984) in the Variscan Thrust Belt in Western Germany. The first one includes only 3 genera (*Neaxon*, *Thecaxan* and *Kozlowskini*) and marks the *Cheiloceras* Stufe (do II). The second assemblage includes 8 genera among which the "Carboniferous" *Cathaxonia*. It characterizes the Clymenia–Wocklerumeria Stufe (do V, VI). Practically no coral occurs in the *Platyglymenia* Stufe (do III, IV).

The do V/VI corals (except *Cathaxonia*) do not cross the *Wocklerumeria–Gatterndorfia* boundary and are replaced by a Tournaian similar "*Cathaxonia* fauna" including 7 genera among which the disseminated *Caninia tregenaensis* Poty 1982 (= *Guerichiphyllum prisum* (Monater, 1840) of Weyer, 1979, 1984; and Bartsch & Weyer, 1982). In the Saalfeld area (Thueringia), *C. tregenaensis* appears in the Protognathodus conodont zone, at the base of the "Obersten Kalkknollschiefer" (the lateral equivalent of the "Hangenberg Kalk"), and ranges into the *sandbergi* zone. This is exactly the same range as in Belgium.

Table II. - Famennian and Lower Tournaian deep water Rugose Corals of the German cephalopod facies
(from Weyer, 1979, 1984; Bartsch & Weyer, 1982).

<table>
<thead>
<tr>
<th>Species</th>
<th>Cheiloceras</th>
<th>Petraiella</th>
<th>Thuringia</th>
<th>Wetterthal</th>
<th>Gotland</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Neaxon richteri</em> (Ludwig 1865)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>N. thuringiacus</em> (Weisermel 1939)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>N. cheilos</em> Weyer 1984</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>N. regulus</em> (Richter 1848)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>N. bartschi</em> Weyer 1978</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>N. sp.</em></td>
<td>+</td>
<td>+</td>
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</tr>
<tr>
<td><em>Thecaxan rozkowskiae</em> Weyer 1978</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
</tr>
<tr>
<td><em>Kozlowskini</em> sp.</td>
<td>+</td>
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<td>+</td>
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</tr>
<tr>
<td><em>Neaxonella</em> n. sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Famennelasma</em> rhenanum Weyer 1973</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>F. sp.</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
</tr>
<tr>
<td><em>Petraila cf. decussata</em> Munster 1839</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Metriophyllum</em> n. sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Cathaxonia</em> sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
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</tr>
<tr>
<td><em>C. n. sp.</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
</tr>
<tr>
<td><em>Famaxonia reuteri</em> Weyer 1971</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Pentaphyllum</em> n. sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<tr>
<td><em>P. (Commuitia)</em> sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Laccophyllum</em> n. sp.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Thuriantha muelleri</em> Weyer 1981</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Bathybalva crassa</em> Weyer 1981</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Caninia tregenaensis</em> Poty 1982</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Drewerelasma</em> schindewolfii Weyer 1973</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

D.- POLAND (Table III)

The Frasnian Rugosa of Poland were recently revised by Rózkowska (1979) and their ranges have been recorded with regard to the *P. asymmetricus* and *P. gigas* conodont zones recognized by Sculczewski (1971) in the Frasnian of Poland. Their exact succession in these zones has not been defined.

Despite some differences, the corals of the *P. gigas* zone are similar to those found in the Belgian "F2"-"F3". The majority of these does not cross the Frasnian–Famennian boundary in Poland which is marked by a change in the marine environment: the "clean, well-aerated, transparent water of the Frasnian seas" is replaced by "a turbid, calm and poorly aerated water" (Rózkowska, 1969, 1981).

In the lower part of the Famennian, only *Petraila* has been recorded in the *triangularis* and *crepida* conodont zones, and *Guerichiphyllum* in the *rhomboida* conodont zone. But, the *marginifera* to *costatus* conodont zones have yielded rich, peculiar, Rugose Coral faunas (Rózkowska, 1989).
Table III. – Upper Frasnian to early Tourmaisian rugose corals in Poland
(from Różkowska, 1969, 1979; Fedorowski, 1973 and Szulczewski, 1973). Legend see Table I.

<table>
<thead>
<tr>
<th>Stages</th>
<th>Frasnian</th>
<th>Famennian</th>
<th>Lower Toursan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conodont zones</td>
<td>gigas</td>
<td>triang</td>
<td>crepa</td>
</tr>
</tbody>
</table>

**Dissepimented solitary corals**

*Without axial structures*

- Craterophyllum Foerste 1909
- Debnikiella Różkowska 1979
- Trigonella Różkowska 1979
- Charactophyllum Simpson 1900
- Piceaphyllum Różkowska 1979
- Temnophyllum Walther 1928
- Micophyllum Lang & Smith 1939
- ? Chonophyllum M.-E. & H. 1850
- Pterorrhiza Ehrenberg 1834
- Tabulophyllum Fenton & Fenton 1924
- Guericophilum Różkowska 1969
- Kiegeothamnus Różkowska 1969
- Kołowskiinia Różkowska 1969
- Prosmilia Koker 1924
- Pseudomicroplasma Soshkina 1949
- Hillaxon Różkowska 1969
- Pseudoclasaphyllum Vassiljuk 1964
- ? Caninophyllum Lewis 1929

*With axial structures*

- Federowskicyathus Różkowska 1979
- Hankaxis Birenheide 1978

**Compound corals**

- Marisastrum Różkowska 1965
- Diphyllum De Fromentel 1861
- Aristophyllum B., Sp. & Kr. in lv. 1975
- Sudetia Różkowska 1960
- Smithicyathus Różkowska 1979
- Frechastraea Scrutton 1968
- Iowaphyllum Stumm 1949
- Ruchaniephyllum Różkowska 1979
- Thammophyllum Penecke 1894
- Peneiellia Soshkina 1939
- Phillipsastrea d’Orbigny 1849
- Smithiphyllum Birenheide 1962
- Pseudamplexus Weisermel 1897

**Heterocorallia**

- Oligophyllaides Różkowska 1969
- Heterophyllia Mc Coy 1849
Two assemblages have been distinguished. The first one developed in and above the *marginifera* conodont zone and characterized a calm, turbid water environment. The second one occurs in the *costatus* conodont zone and presumably lived in a shallow, pure and well-aerated water. These assemblages include mainly small, horned solitary, disseminated or not, species which belong to long lived genera such as *Metriophyllum*, peculiar Famennian genera such as *Petraiella*, *Kielcephyllum*, *Kozlowskia*, and "Carboniferous" genera such as *Cyathaxonia*. They also include a few species of Frasnian-type solitary or compound genera.

However, some remarks should be made about the species listed by Różkowska (1969) and/or about their stratigraphic ranges:

- Some corals may have been misidentified. For example, *Pseudoplexus granulatus* Różkowska 1969 is probably not a Rugosa but a Tabulata of the family Palaeaceidae Roemer 1883. Moreover, the recognition of Carboniferous or Permian genera such as *Amplexus*, *Amplexizaphrentis*, *? Caninophyllum*, *Duplophyllum*, *Prosmilia*, . . . seems doubtful particularly because of the low number of the studied specimens (often only one) and sometimes their bad conservation.

- Some corals may have been reworked from older deposits. Thus, the rare specimens of *Peneckiella* and *? Phillipsastrea* from the Upper Famennian (*costatus* conodont zone) of the very condensed Galezice section might have been reworked from the Frasnian as suggested by their fragmentary shape and the nature of the deposits (3).

(3) The Galezice section includes within an only about 2 m thick sequence the four late Famennian conodont zones (*marginifera*, *velifer*, *styriaeus* and *costatus*) and a Tournaisian clayey bed. It overlies Givetian (or Lower Frasnian?) and has been considered by Różkowska (1981) as deposited on a submarine threshold in a shallow water environment. Maybe it is the result of a turbiditic type sedimentation?
The neptunian dykes of Dalnia have yielded (Szulczewski, 1973) numerous small, horned solitary corals (some of these were described by Fedorowski, 1973) both with a mixed conodont fauna ranging from the costatus to the crenulata zone. The presence of Saileasoma (Lower and Middle Tournaisian) suggests that a part of the coral assemblage encompasses the Lowermost Tournaisian to the crenulata conodont zone. In contrast, other corals (not checked on the table) such as Petraiella, Kielosphyllum, Kozłowskinia, ... are only known in lower conodont zones than those recognized with the corals in the dykes. The lack of other informations concerning the Rugose Corals around the Devonian-Carboniferous boundary does not allow to fix their stratigraphic position more exactly. Even taking into account the above problems, we can recognize the following main paleontological events in the Upper Frasian to the Upper Famennian of Poland:

- extinction of the Frasian-type corals at the end of the Frasian;
- development of two distinct rich faunas of small, horned solitary corals in respectively the marginifera conodont zone and in the costatus conodont zone.

### E. - UPPER FAMENNIAN AND LOWER TOURNAIAN RUGOSE CORALS OF THE OMOLON REGION (NE-U.S.S.R.)
(Table IV)

The Upper Famennian and Tournaisian deposits of the Omolon Region have yielded numerous Rugose Corals (Onoprienko, 1979, ...; Conil et al., 1982; Simakov et al., 1983; Poty & Onoprienko, 1984). Collaboration between European and Soviet specialists enabled accurate comparisons between Omolon and Europe. The ranges of the Omolon corals are defined here by using the local conodont zonation established by Gayev (1979) and tentatively correlated with European stratigraphic zonation.

<table>
<thead>
<tr>
<th>Stages</th>
<th>Famennian</th>
<th>Tournaian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foram and spore zones</td>
<td></td>
<td></td>
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<tr>
<td>Conodont</td>
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<td>local zones</td>
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#### Table IV. - Upper Famennian to Middle Tournaisian Rugose Corals in the Omolon Region
(Conodont zones from Gayev in Shilo et al., 1984). Legend, see Table I.

| Non disseminated solitary corals. | | |
|----------------------------------| | |
| ? Nalivkinella Soshkina 1939 | | |
| ? Gorizdronia Rozowska 1969 | | |
| ? Amplexus Sowerby 1814 | | |

| Disseminated solitary corals | | |
|-----------------------------| | |
| without axial structure | | |
| Tabulophyllum Fenton & Fenton 1924 | | |
| Siphonophyllia Scouler in McCoy 1844 | | |
| S. latetabulata (Onoprienko 1979) | | |
| S. cylindrica Scouler in Griffith 1842 | | |
| Campophyllum M.-E. & H. 1850 | | |
| Molophyllum Onoprienko 1979 | | |
| Parasiphonophyllia Onoprienko 1979 | | |
| Caninia Michelin in Gervais 1840 | | |
| C. tregensis Poty 1982 | | |

| with an axial structure | | |
|------------------------| | |
| Undetermined genus | | |
| Aff. "Dibunophyllum" praeursor Frech 1885 | | |
| "Clisiphyllide" | | |

| Compound corals | | |
|-----------------| | |
| Melanophyllum (Melanophyllidium) Kropacheva 1966 | | |
The oldest Famennian Rugosa occur in the obliquosstatus conodont zone. These are either (locally abundant) small, disseminated solitary corals probably belonging to only one species (Tabulophyllum simakovii Poty & Onopriienko 1984), or (rare) small, non-disseminated solitary corals determined as Nalivikinia ? sp. by Poty & Onopriienko (1984).

The corals become common in the delicatus and inornatus inornatus conodont zones, and among them are various small non-disseminated solitary corals, numerous Siphonophyllia latetabulata (Onopriienko 1979) which are the oldest representatives of this "Carboniferous" genus (delicatus and inornatus inornatus zones), and Campophyllum cylindricum (Onopriienko, 1979), a species close to the European C. flexuosum group (inornatus inornatus zone). The differences observed in the lateral and/or vertical distribution of these corals are partly controlled by the diversity of the facies (ranging from relatively deep subtidal to shallow subtidal or even intertidal environments). Within the inornatus inornatus zone this fauna is replaced by a new assemblage, which is mainly composed of numerous big, disseminated solitary corals belonging to a few species of Molophyllum Onopriienko 1979, and includes also caninomorphic (Tabulophyllum sp. Poty & Onopriienko 1984) and rare columnate corals. This second assemblage ranges until the inornatus rostratus conodont zone.

The next (third) coral assemblage ranges from the upper part of the inornatus rostratus zone until the top of the lenticularis zone. It mainly includes the big disseminated Parasiphonophyllia, colonies of Melanophyllum (Melanophyllidium), and Caninia tregaensis (4) in the upper part of the lenticularis zone. Siphonophyllia cylindrica appears above this assemblage at the base of the Siphonodella quadruplicata zone.

Thus, after the development of an Upper Famennian fauna, there is a first renewal of the Rugosa in the upper part of the inornatus inornatus zone. Possibly this renewal coincides with (or is below) the Devonian-Carboniferous boundary, as suggested by the occurrence of spores of the VI zone some meters higher up, in the lower part of the parapetus zone.

A second change is in the upper part of the inornatus rostratus zone which is tentatively correlated with the upper part of the duplicata standard conodont zone.

F. - CONCLUSIONS

1. The worldwide crisis producing the extinction of most of the Devonian-type corals takes place during the acme (Uppermost Frasnian-Lowermost Famennian) of the Frasnian marine transgression. This acme was marked by a deepening of the seas and predominantly clayey deposits. This environment only permitted the development of a Cyathaxonia-type fauna (sensu Hill, 1938) such as that in the Cheiloceras Stufe in the German Cephalopod facies. However, the scarcity of corals at that time, even in the shallow water environments of the sea margins, suggests that possibly also another phenomenon – along with the effects of the positive eustatic fluctuations – prevented the development of corals (fall in sea water temperature?).

2. This period of crisis persisted until about the rhomboida or the marginifera conodont zone in which corals tend to be more common and show the development of new, typical Famennian species (Belgium, Poland). The first Carboniferous representatives appear at this time. During the Fa2Bc (velifer-styriacus zones, Platyctylenia Stufe) the regressive terrigenous facies are unfavourable for corals which become uncommon even in the deep water environments.

3. Rugosa become abundant and diversified during the Strunian transgression both in the shallow water environments of Belgium and in the deeper water facies of Germany and Poland. Their acme is in the upper part of the Strunian ("Tn1a"). A similar distribution can be observed in the Upper Famennian of the Omonion Region.

4. The majority of the Strunian corals disappears first far below or at the Devonian-Carboniferous boundary (Belgium, Germany, Omonion and probably Poland), and is replaced by a usually common but not so diversified Tournaisian fauna which suggests that there is an important impoverishment of the coral niches possibly because of a climatic change (fall in sea water temperature as in the end of the Frasnian?).

(4) C. tregaensis might be present as early as the lobatus zone as suggested by dolomitized samples.

REFERENCES


ROKOWSKA, M., 1979. Contribution to the Famennian Tetracoralloids from Poland. Palaeontol. Polonica, 40 : 3-66, figs. 1-13, tabl. 1, 2; pl. I-X.


