MIOSPORES IN MIDDLE—UPPER FRASNIAN TO FAMENNIAN SEDIMENTS PARTLY DATED BY CONODONTS (BOULONNAIS, FRANCE)

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ABSTRACT


The middle—upper part of the Formation de Beaulieu exposed in the new railroad trench at Caffiers—Ferques and the Formation de Ferques exposed in the Tartinskal quarries contain well-preserved miospore assemblages. They are here restudied in comparison with new conodont data ranging from the middle asymmetricus to the Ancyrognathus triangularis Zone. The conodonts allow precise correlations with the type Frasnian area as well as with the Russian Platform and Timan—Pechora provinces. The miospore assemblages of the Formation d'Hydrequent are also considered and their age discussed in term of the Frasnian/Famennian boundary.

In the systematic part, two new combinations are proposed: Ancyrospora lysii (Taugourdeau-Lantz, 1960) nov. comb., and Pustulatisporites rugulatus (Taugourdeau-Lantz, 1967) nov. comb.

INTRODUCTION

An Upper Devonian rock sequence outcrops in the Boulonnais, between Calais and Boulogne in the northernmost area of France. This area belongs to a western extension of the Namur syncline which is mainly developed in Belgium.

Taugourdeau-Lantz (1960, 1967a, b and 1971) has described miospores from the succession of the Schistes de Beaulieu, Calcaire de Ferques and Schistes d’Hydrequent in the Boulonnais. Most of the investigated “Lower Frasnian” Schistes de Beaulieu were core-drill samples with no mention about their exact stratigraphical position regarding the base of these beds. The “Middle Frasnian” Calcaire de Ferques was studied by Taugourdeau-Lantz in the La Parisienne and Bois de Beaulieu (Beaulieu Nord) quarries, the “Upper Frasnian” in the Briqueoterie de Beaulieu quarry. Her samples were noted in relation to an (unpublished) general section used by Magne (1964).
Recent works by D. Brice and collaborators, which have culminated in a formal definition of the lithological units of the Devonian of Ferques (Brice et al., 1979a), have also allowed better correlations within the Tartinskali quarries. Therefore most of these quarries as well as the upper part of the Ferques railroad section have been resampled for conodont and spore analysis. The lower part of the Formation de Beaulieu and the underlaying Formation de Blacourt which has been well dated by conodonts (Bultynck in Brice et al., 1976, 1979b), was palynologically studied by us in this railroad section (Loboziak and Streel, 1980).

Productive spore samples are located on Fig.1. Letters Q to S refer to lithological units in Brice et al. (1976), while letters VW, WY and Z refer to lithological units or intervals in Brice et al. (1977). The conodont results have been published by Coen (in Brice et al., 1981). They are shown on Fig.1 with additional data from Magne (1964) and Bultynck (in Brice et al., 1979b). A few ostracod data of the Formation d'Hydrequent are taken from Lethiers (in Bonte et al., 1974).

SYSTEMATIC NOTES

_Ancyrospora lysii_ (Taugourdeau-Lantz 1960) nov. comb. (Plate IV, 5).

_Basionym:_ _Densosporites lysii_ Taugourdeau-Lantz 1960, Rev. Micropaléontol. 3: 146, pl. 2, figs.29–30, pl. 3, figs.40–42.


There is a complete gradation from specimens with true bifurcated spines to nearly smooth specimens. The exine structures are otherwise similar to other _Ancyrospora_. Corroded specimens are comparable to forms assigned to _Pseudowilsonia naoumovae_ by Taugourdeau-Lantz 1960 and later compared (Taugourdeau-Lantz, 1971) with the megaspore _Wybostisporites variabilis_ Mortimer et Chaloner 1967.

_Auroraspora_ sp. A. (Plate III, 6)

_Synonym:_ A. sp. cf. _Diaphanospora perplexa_ Balme et Hassell 1962 in Becker et al. 1974, pl. 21, figs.12–14.

_Cymbosporites_ sp. A (Plate I, 13–14)

_Diameter:_ 45–55 μm.

Ornamentation of biform elements (1–2 μm high) consisting of rounded verrucae (1–2 μm wide) with a narrow tip (less than 1 μm high). The distribution of the ornaments entirely distal is typically irregular (2–8 μm apart).

_Cymbosporites_ sp. B (Plate I, 15–16)

_Diameter:_ 40–50 μm.

Ornamentation of coarse coni (2 μm wide and high) on the distal surface. The ornaments are evenly distributed (3–4 μm apart), denser at the equator.
**Grandispora** sp. A (Plate II, 16)


Intexine, thin, eccentrically detached from the thick (3–4 μm) exoexine. Distal surface and equatorial region ornamented with prominent spinae, 6–12 μm high, tapering sharply. Ornaments evenly distributed with 30–40 elements prominent at equator. Sutureae accompanied by typical largely flexuous ray folds at the apex.

**Pustulatisporites rugulatus** (Taugourdeau-Lantz 1967) nov. comb. (Plate I, 3–4)


We consider the equatorial darkening to be the result of the general exine thickness and not to correspond to a true cingulum.

**Rugospora** cf. *flexuosa* (Juschko) Streel in Becker et al. 1974 (Plate I, 11)

The typical convoluted ornaments of the species are not quite discernible on this material.

**Samarisporites triangulatus** Allen 1965 (Plate II, 1–5)


Compared to the material studied and illustrated in the Formation de Blacourt, there is a trend in the distal ornaments to fuse in a more or less reticulate pattern. A few specimens of the latter are encountered in the Formation de Beaulieu but they are dominant in the Formation of Ferques.

**Samarisporites** cf. *triangulatus* Allen 1965 (Plate II, 6)

A nearly smooth specimen, otherwise similar to the species.

**Samarisporites** sp. A (Plate II, 7–8)


This form is structurally similar to *Samarisporites triangulatus* from which it could be derived. It has a thick, often dark, spherical central body and a thin
narrow equatorial wing, slightly expanding in front of the ends of the trilete rays. Ornaments are mainly composed, on the distal and equatorial surfaces, of narrow spines, 2–3 μm high.

FAUNAL AND MOIOSPORE EVIDENCES

The stratigraphical distribution of the most significant miospores is given in Fig. 1. In the following discussion the identification numbers applied in this distribution chart are given between brackets. It should be noted that, where adequate, the same numbers have been used as on the distribution chart of Loboziak and Streel (1980, fig. 1).

Before considering the distribution of the miospores, we must remember (Loboziak and Streel, 1980) the occurrence of a spore assemblage characterised by *Chelinospora concinna* (38), *Cirratriradites jekhovskyi* (39) and *Geminospora lemurata* (40) in the upper part of the Formation de Blacourt (with a *P. varcus* conodont fauna) and in the lower part of the Formation de Beaulieu.
(with a lower asymmetricus conodont fauna including Ancyrodella rotundiloba).

An almost similar spore assemblage is present in the samples taken below and above the first limestone with “Pentamères” (Unit P) in the Ferques railroad section. This limestone has a middle asymmetricus conodont fauna, with Ancyrodella gigas. Among the seventeen miospore species belonging to this assemblage are Corysisporeites multispinosus (42), Grandispora inculta (21), Chelinospora concinna (38), Ancyrospora ancyrea var. brevispinosa (14), Verrucosisporites cf. uncatus (27) and Archaeozonotriletes variabilis (2), six species which were given a too short stratigraphical range by Loboziak and Streel (1980). This assemblage may however be distinguished by marking the first occurrence of Verrucosisporites bullatus (45), Ancyrospora simplex (46), Hystricosporites multifurcatus (47), Convolutispora tegula (48) and Planisporites scaber (49).

Other miospores occur in the lower part of the Formation de Ferques which has an upper asymmetricus conodont fauna with Ancyrodella curvata (Magne, 1964). The joint first incoming of Lophozonotriletes media (50), Pustulatisporites rugulatus (51) and Ancyrospora lysii (52) was also noted by Taugourdeau-Lantz (1971, tableau 1) in the same Bois quarry as well as the disappearance of Cirratiradites jekhowskyi (39), a typical zonate form, at the top of the Formation de Beaulieu in the La Parisienne quarry. Verrucosisporites bullatus was found in the upper part of the Formation de Ferques by Taugourdeau-Lantz (1971) in the La Parisienne quarry, the same locality where Coen (in Brice et al., 1981) has identified Ancyrognathus triangularis euglypheus specimens. These last conodont specimens definitely belong to the Ancyrognathus triangularis zone sensu Ziegler. (See the related note in Brice et al., 1981.) They are present in the conodont assemblage characterising the upper part (“F2gh”) of the “assise de Frasnes” in Belgium.

Productive samples of the Formation d’Hydrequent were obtained only from immediately below and above the dolomitic bed and also from the uppermost part of the Formation.

Near the dolomitic bed (121 and 119 within 2 m below; 117 and 116 within 20 cm above) occur a few typical species most of which are mentioned here in open nomenclature. They are Grandispora cf. tenuispinosa (53), Samarispornites sp. A (54), Diducites poljessicus (55), Grandispora sp. A (56), Cymbosporites sp. B (57) and Rugospora cf. flexuosa (58). Many species disappear above that level, particularly Samarispornites triangulatus (36), Grandispora tomentosa (32), Convolutispora disparalis (4), Pustulatisporites rugulatus (51) and Ancyrospora lysii (52).

More significant is the change of microflora observed in the uppermost part of the Formation d’Hydrequent (109, 114 and 113 within 3 m below the top). Thirteen taxa occur in these samples: Knoxispornites dedaleus (59), K. cf. hederatus (60), Corbulispora sp. (81), Auroraspora hyalina (62), A. macra (63), Diducites plicabilis (64), D. versabilis (65), Auroraspora sp. A (66), Retusotriletes planus (67), Cymbosporites sp. A (68), Grandispora gracilis (69), Auroraspora solisorta (70) and Densosporites spp. (71).
There are no conodont data available from the Formation d'Hydrequent and we have to rely on brachiopods and ostracods.

Most of the Formation including the dolomitic bed should still belong to the Frasnian as this bed contains the last *Ripidiorhynchus ferquensis* (Gosselet), a very typical brachiopod of the underlying Formation de Ferques (Brice and Meats, 1972), and also several Frasnian ostracods (Lethiers in Bonte et al., 1974). Indeed the change in the spore content near the dolomitic bed is not very important compared with the Formation de Ferques assemblage. The ostracod *Favulella lecomptei* is present only in the lower part of the Formation d'Hydrequent. But, in the Ardennes (Casier, 1977) the *Favulella lecomptei* zone ends near the contact of the Formation de Frasnes and the Formation de Neuville where the upper *Ancyrognathus triangularis* subzone sensu Coen (1973) occurs. Therefore we assume that our samples near the dolomitic beds should correspond more or less to that conodont subzone.

On the other hand, the last spore assemblage from the uppermost part of the Formation d'Hydurent is very different and this suggests a sediment gap or condensation between the dolomitic bed and these samples. To date this uppermost part of the Formation d'Hydurent which is devoid of any other fossils, it is necessary to rely on the evidence of the spores themselves.

THE BOULONNAIS SPORE ASSEMBLAGES AND THEIR CORRELATION WITH OTHER REGIONS

(1) Loboziak and Streel (1980) recognised the Formation de Blacourt and basal Formation de Beaulieu to contain a *Triangulatus* spore assemblage, firstly described in Spitsbergen by Allen (1965, 1967, 1973) and retained by Richardson (1974) as a major assemblage zone of Givetian—Frasnian age. The joint appearance of *Verrucosisporites bullatus* (45) and *Hystricosporites multifurcatus* (47) within the Formation de Beaulieu introduces another major assemblage zone, the *optivus—bullatus* assemblage (Richardson, 1974) of Frasnian age. We consider the latter to extend at least to the top of the Formation de Ferques. These major spore assemblages may now be more accurately dated in terms of the conodont zones: the *triangulatus* assemblage ranging at least from the *obliquimarginatus* Zone to the lower *asymmetricus* Zone¹, the *optivus—bullatus* assemblage corresponding to the middle and upper *asymmetricus* Zone and, at least, the lower part of the *Ancyrognathus triangularis* Zone (see Fig. 2).

Both of these assemblages may however be easily subdivided into several regional phases sensu Van der Zwan and Van Veen (1978). From the base to the top of the rock sequences the following may be recognised:

¹Not to be confused with the lowermost *asymmetricus* Zone.
Fig. 2. Correlation chart of the Boulonnais sequence with other regions.
The TLa phase (Samarisporites triangulatus—Rhabdosporites langii phase). This phase is reflected by the composition of sample G-02 at the base of the Formation de Blacourt (Griset quarry). It has many species in common with the Givetian Orcadian sequence (see Loboziak and Streel, 1980, p.296).

The TCo phase (Samarisporites triangulatus—Chelinospora concinna phase). Synonym: sequence number I in Brice et al. (1981). This phase is reflected by the composition of sample 26 in unit H in the upper part of the Formation de Blacourt (Ferques railroad trench). It is characterized by the joint occurrence of Chelinospora concinna (38), Cirratriradites jekhowskyyi (39), Geminospora lemurata (40), and several so-called “Givetian” species like Aneurospora goensis (11), Ancyrospora ancyrea var. ancyrea (13), Aurora- spora macromanifesta (16), Cymbosporites cf. cyathus (20), Grandispora velata (22) and Samarisporites inaequus (23).

The BJ phase (Verrucosisporites bullatus—Cirratriradites jekhowskyyi phase). Synonym: sequence number II in Brice et al. (1981). This phase is typified by the composition of sample sequence Q52 to Q56 in the Formation de Beaulieu (Ferques railroad trench). It may be characterised by the joint occurrence of Verrucosisporites bullatus (45), Hystricosporites multifurcatus (47) and Cirratriradites jekhowskyyi (39).

The BM phase (Verrucosisporites bullatus—Lophozonotriletes media phase). Synonym: sequence number III in Brice et al. (1981). The phase is typified by the composition of samples VW5 and 8 in the Formation de Ferques (Bois quarry). It has a joint occurrence of Verrucosisporites bullatus (45), Lophozonotriletes media (50) and Pustulatisporites rugulatus (51). Ancyrospora lysii (52) is sometimes a very typical element of this phase.

Which of the above-mentioned species have to be selected to establish true concurrent range zones will be discussed in a later paper. Then we hope to be able to use this scheme for accurate correlation with other regions. At this stage, however, it is important to emphasize that the triangulatus assemblage of Allen in Spitsbergen might cover a slightly different time span than the triangulatus assemblage of Richardson. The former one has Chelinospora concinna as a characteristic species of its lower part and therefore could well be mainly Frasnian. The langi—triangulatus assemblage of Streel in Becker et al. (1974) has a long stratigraphic range extending from the TCo phase of the triangulatus assemblage into at least the optivus—bullatus assemblage. Its subdivision in two subzones (LTi and LTs; Streel in Becker et al., 1974) based on a continental sequence in the Campine Basin (Belgium) has to be revised in the light of the present new data.

₁TLa: not TL, to avoid a confusion with the former LT Zone of Streel in Becker et al. (1974).
₂TCo: not TC, to avoid a confusion with the Visean TC Zone in Clayton et al. (1977).
(2) The spore assemblage occurring near the dolomitic bed of the Formation d'Hydrequent is too poorly known to be given an accurate definition (see sequence number IV in Brice et al., 1981). This assemblage might be characterised by the joint occurrence of *Samarisporites triangulatus* and *S.* sp. A, the latter being possibly a species derived from the former.

Long-distance correlation on spore evidence are difficult in Frasnian time. This is clearly substantiated by parallelising (see Fig. 2) the spore succession of the Boulonnais with the time equivalent (on conodont evidence) but otherwise very different spore succession of southern Timan (Kushnareva et al., 1978) and their lateral equivalent on the Russian Platform (Sennova, 1974). They most probably belonged to separate phytogeographical areas (Streel, 1981).

(3) The spore assemblage occurring at the uppermost part of the Formation d'Hydrequent (sequence number V in Brice et al., 1981) has several characteristics of the Lower Famennian in the type area of Senzeilles in Belgium (sequence number 7; Streel in Becker et al., 1974) where *Diducites plicabilis* (64) and *D. versabilis* (65) occur in sediments with conodonts of the *crepida* Zone. In the same area the ostracod *Jenningsina lethiersi* Becker ends earlier (at Senzeilles in the underlying *P. triangularis* conodont zone), a situation which is more or less reflected in the Formation d'Hydrequent.

*Knöxisporites* (*Archaeozonotriletes* *dedaleus*) and small saccate spores like *Hymenozonotriletes hyalinus, H. pallidus, H. varius, H. immensus, H. zadonicus*, etc., are common spores of the Zadonsk—Elets “horizons” in various regions of the U.S.S.R. (see Naumova, 1953; Sennova, 1972; Rastakova, 1974; Chibrikova and Naumova, 1974). The Zadonsk—Elets “horizons” were almost always considered to be basal Famennian by Russian authors until new conodont material in the Volga—Ural province (Ovantanamo, 1979; and in Chijova et al., 1979) gave a *P. crepida* Zone as the oldest conodont zone for these “horizons”. Compared with the Belgian type sequence, the Zadonsk—Elets “horizons” are better correlated with the “Fa1b” rather than with the “Fa1a” at Senzeilles (see Fig. 2).

Providing that the dolomitic bed of the Formation d'Hydrequent corresponds at least to the upper *A. triangularis* conodont subzone sensu Coen (1973) (which has still to be observed), and the uppermost part of the same Formation to the *P. crepida* Zone (which is probable on spore evidence), there would be in the Boulonnais a large gap in the spore record between our assemblages IV and V where we have no sample. This interval would correspond, on the Russian Platform, to the spore assemblage sequences XIV—XVIII of Raskatova (1974) or more simply to the “super-assemblage” 7 of Chibrikova and Naumova (1974).

It is hoped that further study on the Formation d'Hydrequent will be done in the future.
PLATE I (Description on p. 63)
PLATE II (Description on p. 63)
PLATE III (Description on p. 63–64)
PLATE IV (Description on p. 64)
PLATE I (p. 59)

All photographs × 500, except where otherwise stated*. Identification numbers (Fig.1) are given between brackets; IC = interference contrast.

1. 2. (67) Retusotriletes planus Dolby et Neves. 1. IC, Slide 114(7), 26/58; 1a, IC, detail of 1, x 1000, 2. IC, Slide 109(6), 23/12.
3. 4. (51) Pustutatisporites rugulatus (Taugourdeau-Lantz) nov. comb. 3. Slide VW 8(2), 18/75. 4. Slide 114(3), 23/81.
5. Corbuliaporas Slide 114(2), 19/09.
6. Convolutispora sp. Slide S 1(2), 05/58.
12. (49) Planisporites scaber Taugourdeau-Lantz. Slide 117(1), 09184.

PLATE II (p. 60)

All photographs × 500. Identification numbers (Fig.1) are given between brackets; IC = interference contrast.

9. Samarisporites sp. Slide Q52(1), 21/02.
14. (21) Grandispora inculta Allen. IC, Slide 117(1), 14/44.

PLATE III (p. 61)

All photographs × 500, except where otherwise stated*. Identification numbers (Fig.1) are given between brackets; IC = interference contrast.

1. (35) Rhabdosporites parvulus Richardson. Slide 05(1) 19102.
2. (40) Geminospora lemurata Balme. Slide VW 8(1), 26/27.
4. (63) Auroraspora macra Sullivan, Slide 114(1), 14/86. 4a, IC.
6. (66) Auroraspora sp. A. Slide 114(2), 17/19. 6a, central body.
8. (64) Diducites plicabilis Van Veen. IC, Slide 114(2), 16/50.
9. (65) Diducites versabilis (Kedo) Van Veen. IC, Slide 114(5), 14/59.
12. (60) Knoxiosporites cf. hederatus (Ishchenko) Playford. Slide 114(2), 16/03.

PLATE IV (p. 62)

All photographs × 300, except where otherwise stated*. Identification numbers (Fig. 1) are given between brackets.
1. (42) Corystisporites multispinosus Richardson. Slide 05(1), 21/50, × 500.
5. (52) Ancyrospora lysii (Taugourdeau-Lantz) nov. comb. Slide VW 22(1), 10/22.

REFERENCES


