

DISPERSED SPORES ASSOCIATED WITH *LECLERCQIA COMPLEXA* BANKS, BONAMO AND GRIERSON FROM THE LATE MIDDLE DEVONIAN OF EASTERN NEW YORK STATE (U.S.A.)

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ABSTRACT

Streel, M., 1972. Dispersed spores associated with *Leclercqia complexa* Banks, Bonamo and Grierson from the late Middle Devonian of eastern New York State (U.S.A.), *Rev. Palaeobot. Palynol.*, 14: 205–215.

Fifteen species of sporae dispersae are identified in the rock matrix containing the lycopod *Leclercqia complexa* from the Panther Mountain Formation of New York State. One of these, the most abundant, is identified as identical to the spore produced by this lycopod and is fully described in the genus *Aneurospora*.

The stratigraphic range of the sporae dispersae of those samples give a probable Middle to Late Givetian age. An attempt is made to correlate the presently known spore data of northern France and Belgium with the type sections of the Dinant basin where a nearby continuous succession of conodonts has recently been identified.

INTRODUCTION

Two samples (2002 1A and 2002 3A) of the rock matrix containing the new lycopod *Leclercqia complexa* Banks, Bonamo and Grierson, 1972 has been received for an analysis of the dispersed spores and for comment on their stratigraphic meaning.

The fossiliferous strata are located in the face of a newly-cut vertical cliff (900–960 ft. elevation) in the west flank of Brown Mountain, Schoharie County, New York State. They belong to the Panther Mountain Formation of the Cazenovia and Tionghuiooga stages (Erian Series) which correspond more or less to the Givetian stage of Europe.

SYSTEMATICS

The matrix of both samples has provided numerous spores, some being rather well preserved. Coalification of the organic matter, however, is generally high so that the organic residue has had to be oxidized by dry Schulze after removal of silica (for maceration technique, see Streel, 1965a). No significant qualitative nor quantitative differences occur between the two samples so that they are no longer considered separately.

Obviously, the most abundant species is identical to the spores found in situ in

Leclercqia complexa. Despite the fact that their relation with the natural classification is obvious, we believe they need description and typification in a sporae dispersae classification (Potonié, 1970).

Anteturma Proximegerminantes R. Potonié, 1970

Turma Triletes—Azonales R. Potonié, 1970

Subturma Azonotriletes Luber, 1935

Infraturma Apiculati (Bennie and Kidston) Potonié, 1956

Genus *Aneurospora* Strel, 1964

We had never placed *Aneurospora* in synonymy with *Geminospora*, as claimed by Richardson and Lister (1969, p.230). In addition, further examinations of co-type material of *Geminospora lemurata* has clearly shown the absence of banded curvaturae and the common development of a mesosporoid in the latter genus (Lele and Strel, 1969, p.95). Consequently, the legitimacy of *Strelispora* Richardson and Lister 1969, is questionable on that basis. We have never been able to prove whether the banded curvaturae of *Aneurospora* correspond to a crassitude or only to a denser, more rigid part of the exine. (See the original drawing in Strel, 1964, fig.6 and also Lele and Strel, 1969, fig.2). This was the reason why we excluded *Aneurospora* from the subturma Zonotriletes (Lele and Strel, 1969).

On the other hand Richardson and Lister (1969) have emphasized the equatorial crassitude of most of their species included in the three genera *Ambitisporites*, *Strelispora* and *Synorisporites*, all placed within the Zonotriletes, so that the identity of both concepts of *Aneurospora* and *Strelispora* does not seem to be quite evident.

Aneurospora (al. *Acanthotriletes*) cf. *heterodonta* (Naum.) comb. nov.

1953 *Acanthotriletes heterodontus* Naumova (table I, fig.21)

(Plate I, 1–3; Plate II, 1–7)

Description

Anisopolar miospore, the proximal part being more or less pyramidal, the distal part more or less hemispherical (equatorial diameter: 53–92 μ). The proximal pyramid measured on fifty specimens appears to make a slightly angular contact with the proximo-

PLATE I

Aneurospora cf. *heterodonta* (Naum. 1953) comb. nov.

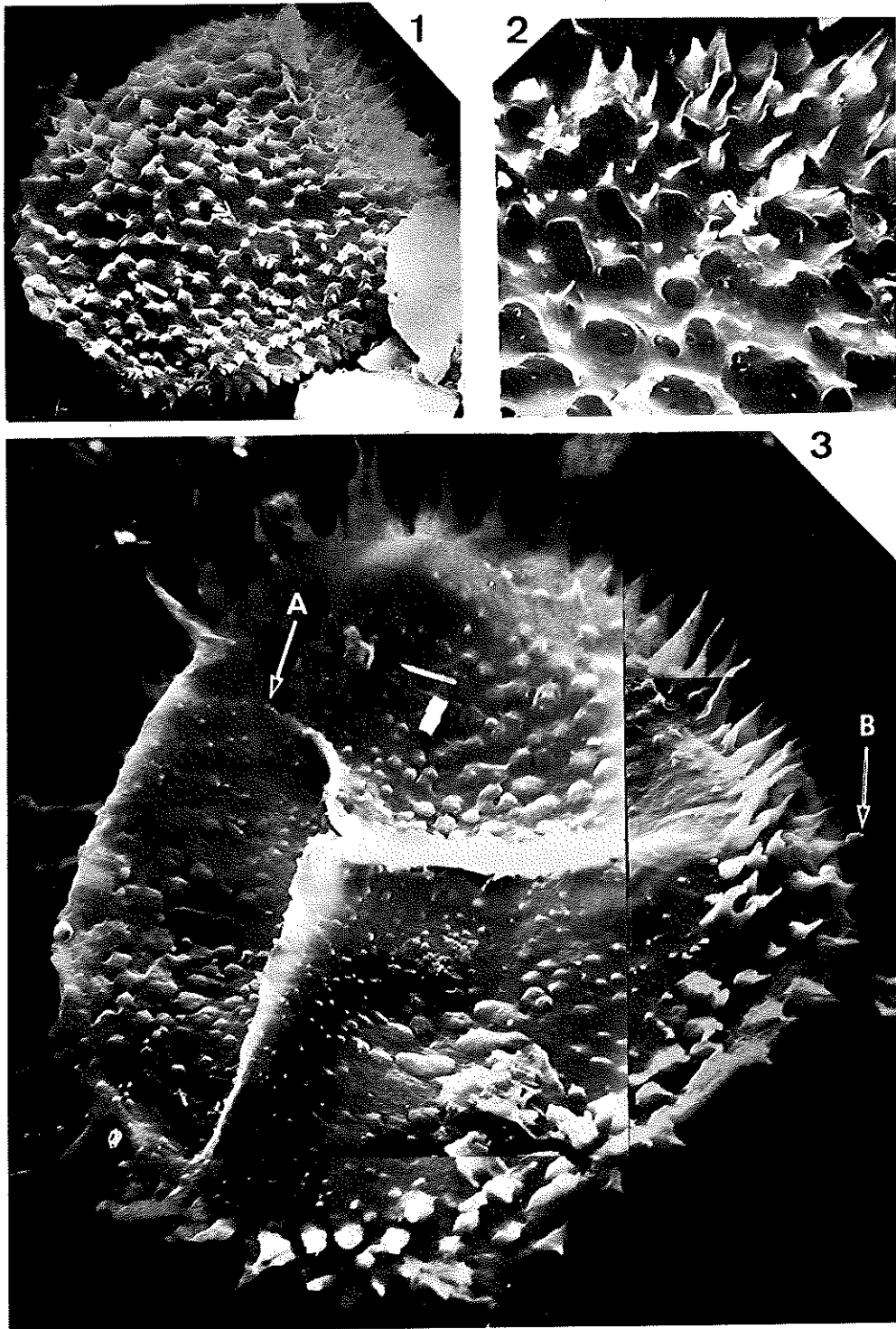
1. Distal face of a specimen; slide 1A: 1; \times 1,000.

2. Part of distal face of a specimen different of 3, slide 3A: 5; \times 2000.

3. Proximal face, same specimen as Plate II, 1, 2, slide 3A: 5; \times 2000. (A = curvaturae imperfectae ?; B = "cupule-like" thickening at the apex of one spine.)

All stereoscan pictures made by the author on a Cambridge Scanning Electron Microscope at the University of Liège.

PLATE I



equatorial part of the exine which is more rigid, maybe thickened, but appears anyway like a dark band when seen in transmitted light. The trilete rays, rather elevated at the proximal pole (up to $4\ \mu$ high), taper distally and merge near the equator into the band with occasionally a slight expansion which can be interpreted as *curvaturae imperfectae* (Plate I, 3, A; Plate II, 4). From the numerous specimens observed with the stereoscan microscope no line (*curvaturae perfectae*) nor ridge (wedge-shaped *curvaturae perfectae* sensu Richardson, 1965, p.563) can be ascertained connecting the distal ends of the trilete rays.

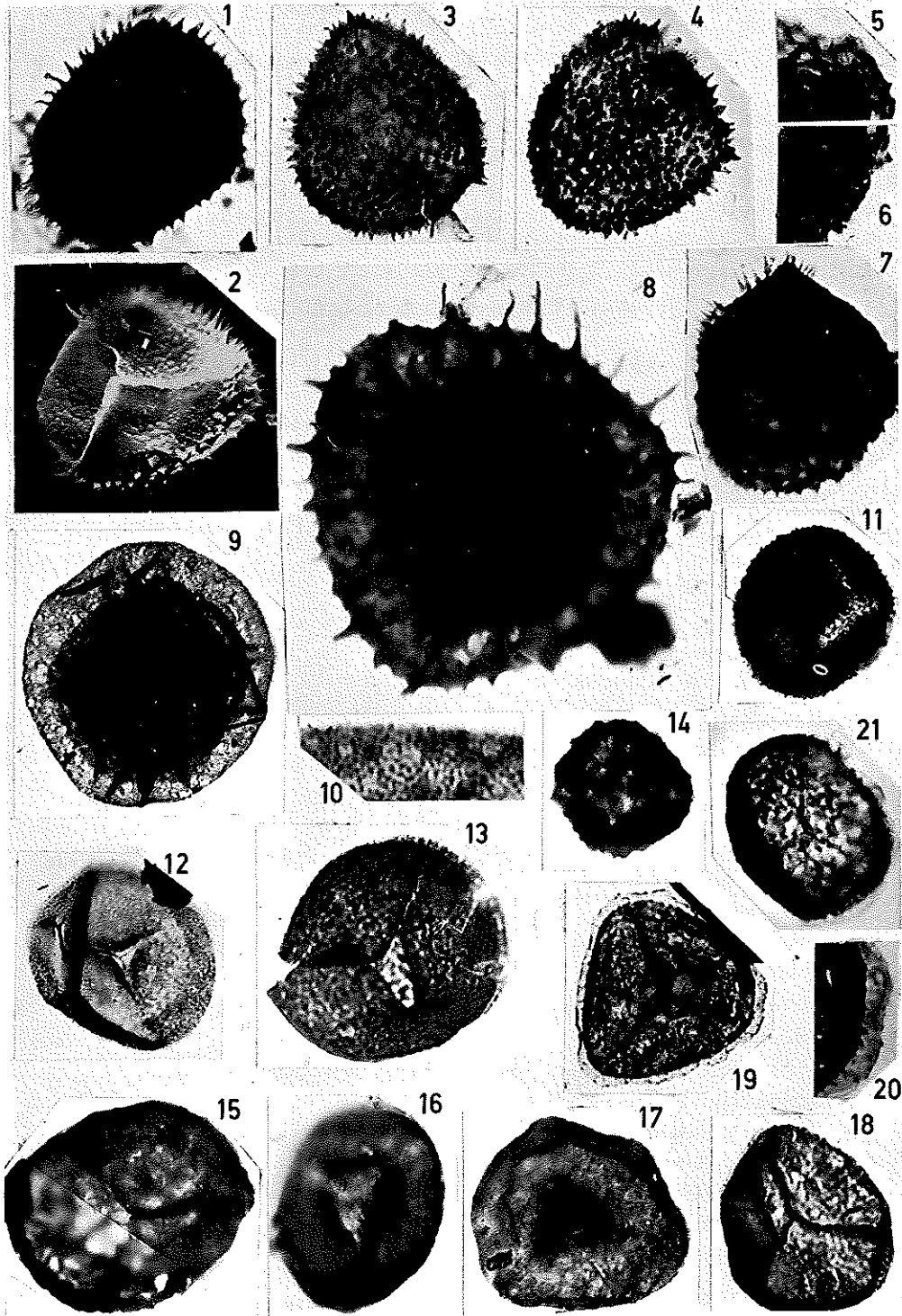
The proximal and distal surfaces of the spores are ornamented with very low verrucae sometimes anastomosing, bearing spines of different size and shape. Spines are the most conspicuous near the equator where they may reach $8\ \mu$ in length, often in the interradial area; they irregularly taper from a rather wide base (up to $2\ \mu$) to a thin apiculate tip. A few ones (see Plate I, 3, B) bear a "cupulelike" thickening at their apex. Spines are shorter ($1-3\ \mu$) on the distal surface where they occur on very low, somewhat plate-like, muri

PLATE II

- 1-7. *Aneurospora* cf. *heterodonta* (Naum. 1953) comb. nov.
 - 1, 2, Slide 3A:5—same specimen shown in transmitted light and by reflection.
 3. Disto-equatorial focus; slide 8739:2478.
 4. Distal focus; slide 8743:1697.
 - 5, 6, Distal focus; slide 8739:2047.
 5. Proximal exoexine partially removed, showing reticulate pattern of the sculpture on the distal surface.
 6. Same specimen where the reticulate pattern of the distal surface is obliterated when seen through the proximal surface.
 7. Specimen with obvious reticulate pattern on distal surface; slide 8742:1745.
8. ? *Spinozonotriletes* cf. *naumovii* (Kedo) Rich. 1965; slide 8742:2245; $\times 200$.
- 9, 10. ? *Rhabdosporites langi* (Eisenack) Rich. 1960.
 9. Slide 8742:1759; $\times 200$.
 10. Same specimen: conate to baculate sculpture, $\times 1000$.
11. *Dibolisporites* cf. *correctus* (Naum.) Rich. 1965; slide 8741:1795. Equatorial focus and distal focus through the opened trilete mark.
12. *Apiculiretusispora brandtii* Strel 1964; slide 8741:2278.
13. *Biornatispora dentata* (Str.) Lele and Strel, 1969; slide 8741:1133.
14. *Biornatispora pseudospinosa* (Str.) Lele and Strel, 1969; slide 8440:1708.
15. *Aneurospora semizonalis* (McGregor) Lele and Strel, 1969; slide 8740:2422.
16. *Retusotriletes rotundus* (Str.) Lele and Strel, 1969; slide 8743:3087.
17. *Retusotriletes goensis* Lele and Strel, 1969; slide 8739:2727;
18. ? *Emphanisporites* sp.; slide 8740:1504.
- 19, 20. *Perotrilites* cf. *conatus* Rich. 1965; slide 8779:1740
 20. Sculpture on the "perispore"; $\times 1000$.
21. *Perotrilites* sp.; slide 8743:2086.

Magnification $\times 500$ unless otherwise indicated. 2 is a stereoscan picture made by the author on a Cambridge Scanning Electron Microscope at the University of Liège, Belgium. Slides are preserved at the University of Liège and "Cornell University Paleobotanical Collection".

PLATE II



formed by the verrucae there, for the most part typically anastomosing (see Plate I, 1, 2). The contact areas are covered by very low verrucae of varying length and width a few ones anastomosing, irregularly distributed and most often bearing one or two very short spines on their top. The smallest verrucae are also basely distributed on the lips of the trilete mark.

Discussion

The "cupule-like" thickening at the apex of some spines is highly characteristic of *Acanthotriletes heterodontus* Naumova 1953, the drawing of which also shows a sub-equatorial dark band. The convoluted to reticulate pattern of the distal exine has not been mentioned by Naumova (1953) but it is fair to say that this pattern is hardly discernible with a light microscope (Plate II, 5, 6, 7).

The following additional list of fourteen species has been identified:

- Retusotriletes rotundus* (Streel) Lele and Streel, 1969 (Plate II, 16).
Retusotriletes goensis Lele and Streel, 1969 (Plate II, 17).
Aneurospora semizonalis (McGregor) Lele and Streel, 1969 (Plate II, 15).
Apiculiretusispora brandtii Streel, 1964 (Plate II, 12).
Dibolisporites cf. *correctus* (Naum.) Rich., 1965 (Plate II, 11).
Biornatispora dentata (Streel) Lele and Streel, 1969 (Plate II, 13).
Biornatispora pseudospinosa (Streel) Lele and Streel, 1969 (Plate II, 14).
 ? *Emphanisporites* sp. (Plate II, 18).
Perotrilites cf. *conatus* Rich., 1965 (Plate II, 19, 20).
Perotrilites sp. (Plate II, 21).
 ? *Spinozonotriletes* cf. *naumovii* (Kedo) Rich., 1965 (Plate II, 8).
 ? *Rhabdosporites langi* (Eisenack) Rich., 1960, (Plate II, 9, 10).
 cf. *Auroraspora macromanifestus* (Hacq.) Rich., 1960
 cf. *Calyptosporites velatus* (Eisenack) Rich., 1960

A few identifications need some comment on the systematic treatment:

? *Emphanisporites* sp. is a "retusoid" specimen, ornamented with very small coni (less than 1 μ high), some of which are arranged in a radial pattern on the proximal surface.

Perotrilites cf. *conatus* has a rather triangular amb but seems otherwise similar to the species of the Orcadian basin.

Perotrilites sp. is smooth.

? *Rhabdosporites langi* bears conate as well as parallel-sided ornaments (see Lele and Streel, 1969, p.102).

cf. *Auroraspora macromanifestus* and cf. *Calyptosporites velatus* are rather poorly preserved specimens.

Dibolisporites cf. *correctus* and ? *Spinozonotriletes* cf. *naumovii* are accepted here as defined by Richardson (1965).

A few other species, not yet identified, occur in this assemblage. One of these is an apiculate form (coni less than 1 μ high) that we have not been able to decide whether it is a cavate form, (like *Rhabdosporites parvulus* Rich. 1965, or *Geminospora svalbardiae* [Vigran] Allen, 1965) or a retusoid form like *Aneurospora* Streel, 1964 (for instance, *Retusotriletes greggsii* McGregor, 1964).

STRATIGRAPHY

The stratigraphic significance of this assemblage can be deduced from the occurrence of the above species in some European sections, generally accepted as Givetian or as Lower Frasnian. However, the most similar spore assemblages can be identified in the Givetian of two different regions:

? *Spinozonotriletes* cf. *naumovii* (and also *Rhabdosporites langi*, *Perotriletes conatus*, *Auroraspora macromanifestus*, *Calyptosporites velatus*) in the Eday Gr. of the Orcadian basin, Scotland; continental facies (Richardson, 1965).

Retusotriletes rotundus, *R. goensis*, *Aneurospora semizonalis*, *Apiculiretusispora brandtii*, *Biornatispora dentata*, *B. pseudospinosa*, ? *Rhabdosporites langi* in the so-called "Lower Givetian beds" at Goé, Belgium; marine near-shore facies (Streel, 1964; Lele and Streel, 1969).

The "Lower Givetian beds" at Goé occur below *Stringocephalus burtini* fauna but the exact position within the Givetian has never been proved on marine faunal evidence. The recent discoveries (Lele and Streel, 1969) of numerous ? *Rhabdosporites parvulus* Richardson, 1965 and its association with *Dibolisporites echinaceus* (= *Apiculiretusispora* sp. in Streel, 1964) suggest that these beds are equivalent to the Eday Gr. rather than to the Achanarras Fish beds as previously stated (Streel, 1964) with the uncompleted data formerly in hand.

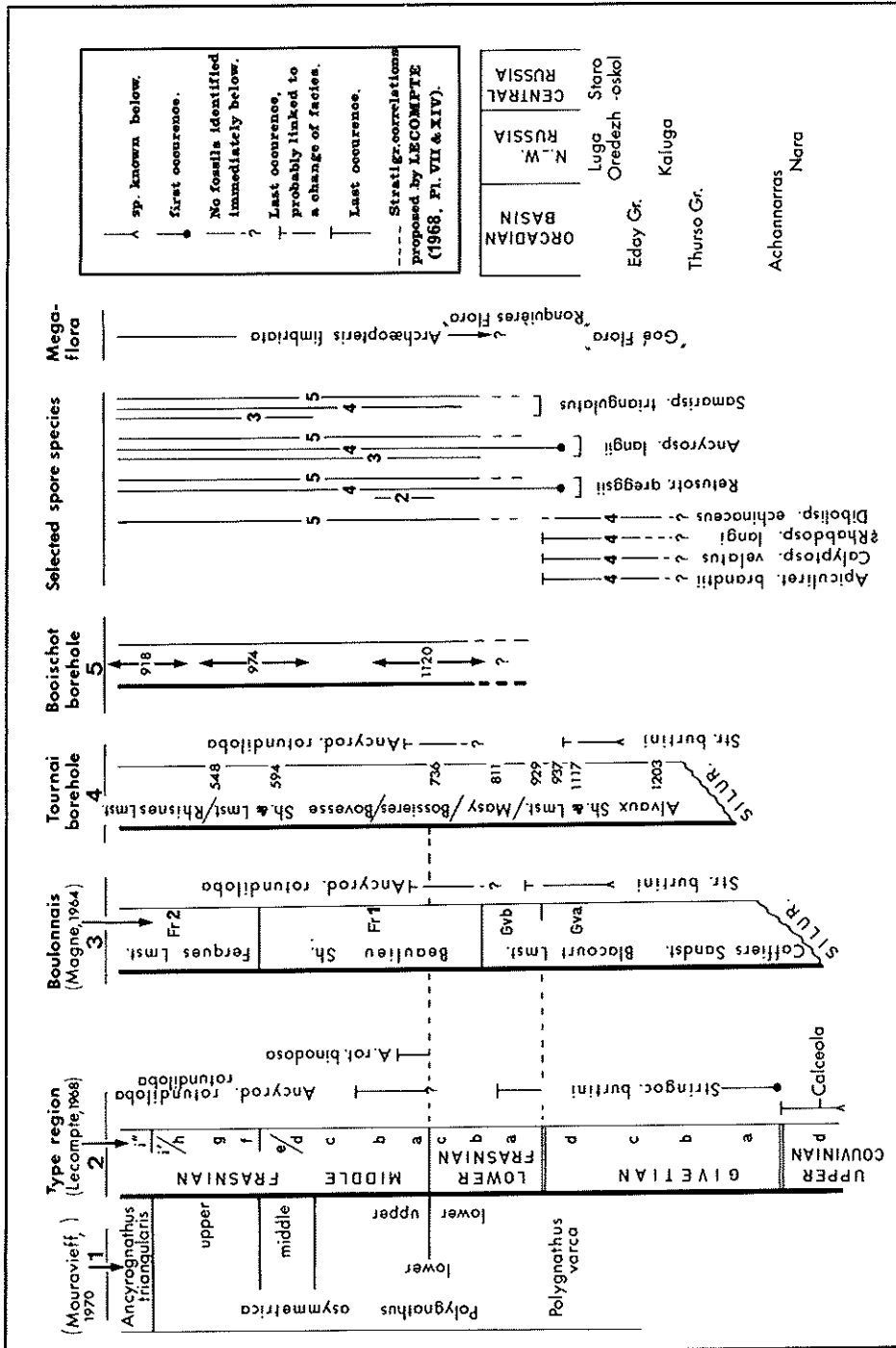
Acanthotriletes heterodontus has been described in the Starooskal beds of Central Russia (Naumova, 1953) but a very similar species, *Acanthotriletes serratus* Naumova 1953, which lacks the "cupule-like" thickening at the apex of the spines, is present not only in the Starooskal beds of Central Russia (Naumova, 1953; Raskatova, 1966) but also in lateral equivalents in other regions of the U.S.S.R. (Andreeva, et al., 1967, in northern Timan; Chibrikova, 1962, in western Bashkiria and southern Urals; Kedo, 1955, 1966, in the western part of the Russian Platform, etc.). The Starooskal beds of Central Russia contain *Stringocephalus burtini* (Raskatova, 1966).

On this evidence and the correlation chart proposed by Richardson (1965, fig.10), our assemblage from New York State, the Eday Gr. from Scotland, the "Goé beds" from Belgium and the Starooskal beds and equivalents from Russia occupy a rather high position in the Givetian: Middle or Upper Givetian, for instance Gic and/or Gid (see Fig.1).

However, a very early Frasnian age, in term of present Belgian stratigraphy, cannot be completely excluded.

A more precise biostratigraphy depends, in the first place, on the availability of spore-bearing, well-dated marine sections. But in addition, the question of the stratigraphic nomenclatural confusion at the boundary Middle-Upper Devonian unfortunately cannot be avoided.

The main purpose of the chart, Fig.1, is to make clear the stratigraphic correlation at least within the narrow geographic limit of northern France and Belgium where the type Givetian and Frasnian beds have long been defined. On this chart, two lithostratigraphic sequences belonging to the Namur synclinorium (Boulonnais and Tournai borehole) and one from the Campine basin (Booischoot borehole) are positioned in front of the sequence



from the type region in the Dinant synclinorium where Mouravieff (1970) has recently identified and described a nearly complete succession of conodont zones. The brachiopod *Stringocephalus burtini* and the conodont *Ancyrodella rotundiloba* are key species where rough distinction between Lower Frasnian beds and Givetian beds is concerned. But they cannot so far provide a very precise biostratigraphic limit because on one hand *S. burtini* becomes extinct in beds undoubtedly of Frasnian age and on the other hand, the first occurrence of *A. rotundiloba* is never stated in terms of a succession of conodonts which completely lack good characteristics in the basal Frasnian (Lower Fromelennes beds: F1a). Thus the correlations between and through the Dinant and Namur synclinorium here adopted are those accepted by Lecompte (1968) on a combination of lithological and biostratigraphical arguments. The recent spore data has, thus far, not invalidated these correlations.

We must first emphasize that French geologists (Magne, 1964) call Givetian (Gvb) in the Namur synclinorium at least the equivalent of the lower part of Lower Frasnian (F1a) in the type region and also call Lower Frasnian (Fr1), the equivalent of the lower part of Middle Frasnian (F2a to F2e). This is important because the most documented so-called Lower Frasnian spore succession in that region, published by Taugourdeau-Lantz (1960, 1967a, b) is for the most part Middle Frasnian in terms of Lecompte's succession.

The Tournai borehole studied by A. Combaz (unedited), that we have recently restudied, provides the first data which in that region allow the consideration of typical Givetian and Frasnian spore assemblages in succession in the same section, despite the fact that these spore assemblages are generally not well preserved.

In light of these new data and also of data available from the literature since 1965 (especially Allen, 1965, and Richardson, 1965), we have been able to reconsider the stratigraphic position of the beds containing *Archaeopteris fimbriata* in the Booischot borehole (Stockmans and Willièrè, 1965; Streeel, 1965b). (See Fig.1, 5.)

Three spore species have been selected in view of their particular importance for the delimitation of the Givetian/Frasnian boundary: *Retusotriletes greggsii* McGregor 1964, *Ancyrospora langii* (Taugourdeau-Lantz) Allen 1965, and *Samarisporites triangulatus*¹ Allen 1965. These species are absent from the Givetian assemblages considered above.

¹We consider *Samarisporites euglyphus* Taugourdeau-Lantz 1967b as a junior synonym of *S. triangulatus* Allen 1965.

Fig.1. Stratigraphical Correlation chart of the Middle–Upper Devonian transition measures in northern France and in Belgium.

(Faunal data from Magne, 1964; Lecompte, 1968; and Mouravieff, 1970.

Spores data from: type region, Hotton (Streeel, unpublished); Boulonnais (Taugourdeau-Lantz, 1960, 1967a, b); Tournai borehole (Combaz, unpublished; Streeel, unpublished); Booischot borehole (Streeel, 1965b, emend.).

(Correlation chart Scotland–U.S.S.R. from Richardson, 1965, fig.10.)

The first occurrence of *R. greggsii* and *A. langii* is known from the 937m level in the Tournai borehole, that is at a level higher than the last *Stringocephalus burtini* but which cannot be ascertained to be of latest Givetian age or earliest Frasnian age. *R. greggsii* could be present in the New York State assemblage (see above) and *Ancyrospora* which is abundant in some continental Givetian and Frasnian beds is here completely lacking, suggesting a sort of facies control.

Samarisporites triangulatus occurs in the Lower Frasnian of the Tournai borehole but a Givetian age for its first occurrence in the Booischot borehole is not excluded.

Thus, despite the fact that the evidence from our spore assemblage in New York State suggests a rather late Givetian age, a basal Frasnian age cannot be completely excluded. The associated megaflora would then occupy a stratigraphical position nearly equivalent to or between the "Goé flora" studied by Leclercq (1940, etc.) and the "Ronquières flora" recently studied by Stockmans (1969).

Plant remains have been recovered from about the same stratigraphical interval from northern Timan, U.S.S.R., in beds containing *A. serratus* (Andreeva et al., 1967).

On the American continent, the nearest spore assemblages are from the Ghost River Formation of western Alberta, associated with a *Svalbardia* megaflora (McGregor, 1964) and from the Bird Fiord Formation on Helena Island, Canadian arctic (McGregor, 1967, p.180).

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