Annales de la Société géologique de Belgique, T. 115 - fasc. 2 - 1992, pp. 453-458 Juin 1993

CORRELATION OF UPPERMOST DEVONIAN AND LOWER CARBONIFEROUS MIOSPORE ZONATIONS IN BYELORUSSIA, POLAND AND WESTERN EUROPE

by

Violet .I. AVCHIMOVITCH[1], Elzbieta TURNAU[2] & Geoffrey CLAYTON[3]

(2 figures)

ABSTRACT.- Several palynostratigraphic events can be recognised in the uppermost Devonian and basal Carboniferous of Byelorussia, Poland and Western Europe, permitting correlation of the miospore zonations in these regions at certain key stratigraphic horizons. In ascending stratigraphic order these events are : 1. The first appearance of *Knoxisporites literatus.* 2. The first appearance of *Hymenozonotriletes explanatus.* 3. The first appearance of *Verrucosisporites nitidus* and *Vallatisporites verrucosus.* 4. The disappearance of *Retispora lepidophyta.*

INTRODUCTION

Miospore zonations have been established independently in Byelorussia, Pomerania and Western Europe (Ireland, Britain, Belgium and Germany) in sections spanning the Devonian-Carboniferous boundary. Although these zonal schemes utilise many of the same miospore taxa, some species appear in different sequences in the regions considered. Also, different approaches to palynostratigraphy have been adopted; the similar zonal notations used in the various schemes disguising radical differences in the nature of the biozones. The Byelorussian zonation comprises assemblage and acme zones, the Pomeranian scheme consists of oppel zones and the British Isles scheme is based on partial range and concurrent range zones. Despite the difficulties outlined above, it is possible to suggest tentative correlations between the zonal schemes, based partly on ranges of the more important miospore taxa, and partly on independent faunal evidence.

In Byelorussia, the Devonian-Carboniferous boundary beds are known from the Pripyat Depression (Fig. 1). Spore assemblages from these deposits were first described by Kedo who established a spore zonal scheme (1957, 1963). Further subdivision of that scheme was introduced by Avchimovitch (1986, 1993, this volume) and Avchimovitch *et al.* 1988b. The component zones of this scheme are in most cases assemblage zones, and in other cases acme zones. The scheme is correlated with the standard conodont zonation (Fig. 2) based on biostratigraphic correlations with central regions of the Russian Platform, Dnieper-Donetsk Depression, southern Urals, Mugodzhary and the Timano-Pechora Region, using spores.

In Poland, spore assemblages from the Devonian-Carboniferous boundary beds have been described from Western Pomerania, and the Holy Cross Mountains (Fig. 1). These are mainly carbonates with marine faunas (Korejwo, 1975, 1979; Matyia, 1976; Zakowa, Nehring, 1983; Zakowa *et al.,* 1985). In Western Pomerania, Turnau (1975, 1978, 1979) established a local miospore zonal scheme of oppel zones. For the Holy Cross Mountains, this author

1. *BelNIGRI Staroborisovski tr. 14, 220114, Minsk, Byelorussia.*
2. *Polish Academy of Science, ul. Senacka 3, 31-002, Krakow, Poland.*
3. *Department of Geology, Trinity College, Dublin, Ireland.*

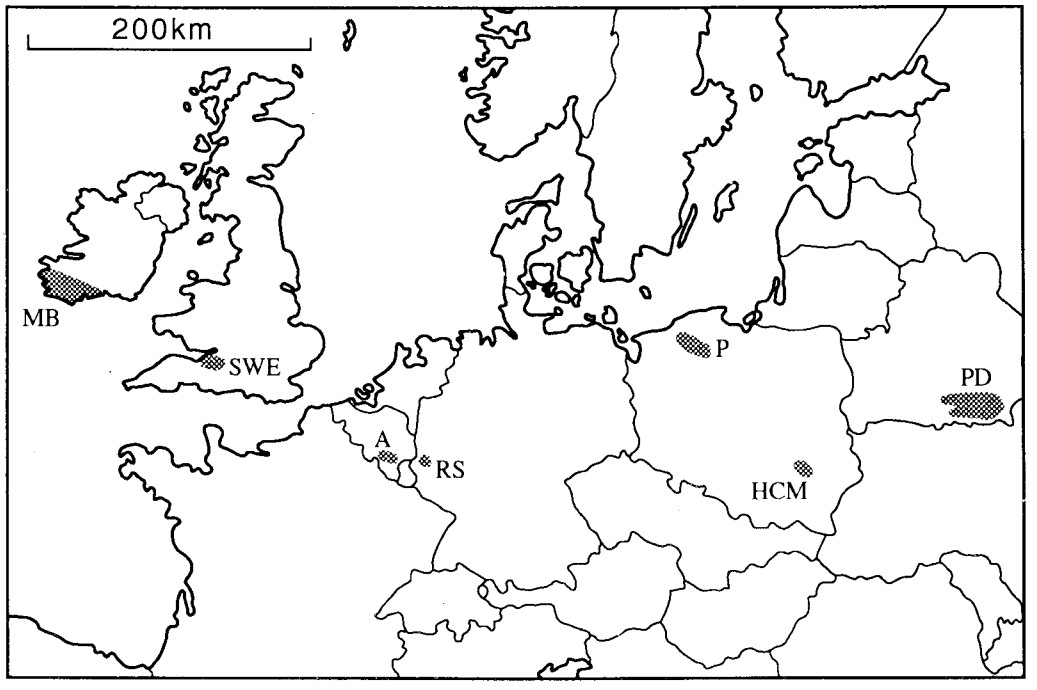

Fig. 1.- Location of areas discussed in text. MB = Munster Basin, SWE = Southwest England, A = Ardenne, RS = Rheinisches Schiefergebirge, P = Pomerania, PD = Pripyat Depression.

(1985, 1990) utilised the West European zonal scheme (Streel *et al.*, 1987; Higgs *et al.*, 1988).

In Western Pomerania and the Holy Cross Mountains, the spore assemblages are associated in places with conodont faunas (Matyja & Turnau, in press; see also Fig. 2). The spore successions of the Devonian-Carboniferous boundary beds described so far from Poland contain discontinuities resulting from stratigraphical breaks and sample gaps. Several of the miospore zones established in Byelorussia have equivalents neither in Western Pomerania nor in the Holy Cross Mountains.

In Western Europe, the miospore succession in the uppermost Devonian and Lower Carboniferous is probably best known from southern Ireland and southwest England (Higgs *et al.*, 1988). However, in this region few conodont or cephalopod faunas have been recorded from miospore-bearing parts of the sequence. The relationships between the miospore and conodont zonations have been established in the Ardenne and the Rheinisches Schiefergebirge (Paproth & Streel, 1971; Higgs & Streel, 1984).

In the following acount, the definitions of the boundaries of the various Byelorussian miospore zones and subzones are briefly discussed, and correlations with Poland and Western Europe proposed. The Byelorussian zonation is discussed elsewhere in this volume (Avchimovitch). Relative positions of key conodont faunas are indicated (Fig. 2), but detailed discussion of the relationships between miospore and conodont zones is beyond the scope of the present paper.

Retispora lepidophyta-Grandispora facilis (LF) Biozone

In this zone *Retispora lepidophyta* (Kedo) Playford is well established (this species also occurs infrequently below this level). *R. lepidophyta* var. *tenera, Tumulispora malevkensis* (Kedo) Turnau and *T. rarituberculata* (Luber) Potonié appear for the first time.

In Pomerania, the oldest two miospore zones containing assemblages with *Retispora lepidophyta* are the *Diducites versabilis* (Ve) Biozone and *Grandispora lupata* (Lu) Biozones. Assemblages from these zones have been described from one section only; they appear to be facies controlled and are of very low diversity. *Diducites versabilis* (Kedo) Van Veen appears at the base of the Ve Biozone together with *Retispora lepidophyta* var. *typica. Grandispora lupata* Turnau, the index species for the *Grandispora lupata* (Lu) Biozone appears somewhat higher.

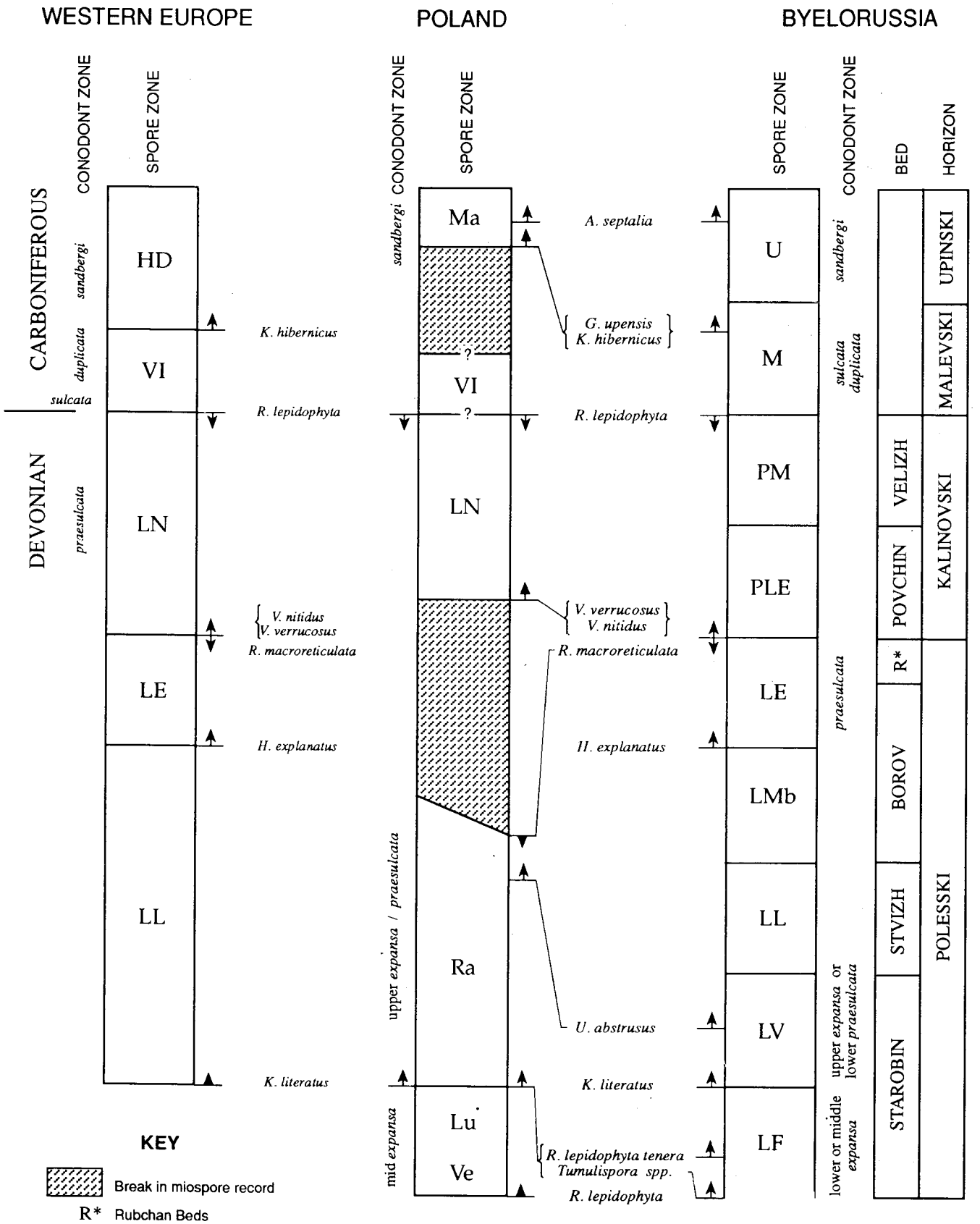

Fig. 2.- Summary of the proposed correlation of the miospore zonations in the late Devonian and early Carboniferous of Byelorussia, Poland and Western Europe.

The sequence of appearances in Western Pomerania described above is not considered significant, as in the European part of the C.I.S., and in the Polish Holy Cross Mountains, *Diducites versabilis* and *Grandispora lupata* appear below the level of the first appearance of *Retispora lepidophyta*. *D. versabilis* occurs near the base of the Famennian in the Boulonnais (Loboziak *et al.*, 1983).

In Western Europe, the first appearance of *R. lepidophyta* defines the base of the *Retispora lepidophyta - Apiculiretusispora verrucosa* (LV) Biozone and in Belgium defines the base of the Fa2d Chronozone (Streel *et al.*, 1987). Since the base of both the LV Biozone in Western Europe and the Ve Biozone in Poland are defined by the **absolute** first appearance of *R. lepidophyta,* they may not correlate exactly with the base of the Byelorussia LF Biozone. In the British Isles, the base of the *Retispora lepidophyta - Knoxisporites literatus* (LL) Biozone is not seen, and its relationship with the LV Biozone in Belgium is uncertain (Streel *et al.*, 1987; Higgs *et al.*, 1988).

Retispora lepidophyta - Apiculiretusispora verrucosa (LV) Biozone

This zone is characterised by assemblage including *Apiculiretusispora verrucosa* (Caro-Moniez) Streel, *Grandispora lupata, Endoculeospora gradzinski* Turnau, *Knoxisporites hederatus* (Ischenko) Playford, *Retispora lepidophyta* var. *typica* and var. *tenera,* and *Tumulispora raritubercula*ta. *Knoxisporites literatus* appears at the base of this biozone, permitting correlation of this level with the base of the Ra Biozone in Poland, and the base of the *Retispora lepidophyta - Knoxisporites literatus* (LL) Biozone in Western Europe. *Umbonatisporites abstrusus* (Playford) Clayton first appears within the LV Biozone in Byelorussia, and at a comparable stratigraphic level in Poland, within the Ra Biozone. It appears somewhat higher, within the LN Biozone in Western Europe. The newly proposed LV Biozone in Byelorussia is not synonymous with the existing LV Biozone in Western Europe, the base of which is defined by the first appearance of *R. lepidophyta.*

Retispora lepidophyta - Knoxisporites literatus (LL) Biozone

The base of this zone in Byelorussia is marked by the first appearance of *R. lepidophyta* var. *minor.* There is a proliferation of murornate spores such as *Convolutispora harlandii* Playford, *C. usitata* Playford, *C. vermiformis* Hughes & Playford, *Dictyotriletes grandiformis* Kedo, *D. scrobiculatus* Kedo, *Knoxisporites literatus* and other species of the genus *Knoxisporites. R. lepidophyta* var. *tenera, Grandispora echinata* Hacquebard, *Grandispora lupata* and *Tumulispora* spp. are also common. It should be noted that the newly proposed LL Biozone in Byelorussia is not synonymous with the existing LL Biozone in Western Europe, the base of which is defined by the first appearance of *K. literatus.*

Retispora lepidophyta - Tholisporites mirabilis (LMb) Biozone

This is the acme zone of *Tholisporites mirabilis* (Tschibrikova) Byvsheva. *Retispora lepidophyta* var. *tenera* is more common in this zone than *R. lepidophyta* var. *typica.* Murornate spores are less common while *Tumulispora* spp. are abundant. *Tumulispora variverrucata* Staplin & Jansonius and *T. varia* (Kedo) Byvsheva appear within this zone for the first time. *Tholisporites mirabilis* does not extend higher than the top of this zone. The LV, LL and LMb Biozones in Byelorussia are equivalent to the Ra Biozone in Poland and the LL Biozone in Western Europe.

Retispora lepidophyta - Hymenozonotriletes explanatus (LE) Biozone

The base of this zone is marked by the appearance of *Hymenozonotriletes explanatus* (Luber) Kedo. This level correlates with the base of the *Retispora lepidophyta - Hymenozonotriletes explanatus* (LE) Biozone in Western Europe. In Poland the LE Biozone has not been recognised, probably due to the development of unfavourable lithologies for spore preservation.

In Byelorussia, the LE Biozone is subdivided into two subzones. The lower subzone, the *Retispora lepidophyta-Raistrickia ramiformis* (LRa) Subzone is characterised by the presence of abundant *Raistrickia ramiformis.* The upper subzone, the *Retispora lepidophyta - Cymbosporites minutus* (LMi) Subzone is characterised by abundant *Cymbosporites minutus.* These subzones cannot be distinguished in either Poland or Western Europe.

Vallatisporites pusillites - Retispora lepidophyta - Hymenozonotriletes explanatus (PLE) Biozone

This zone is characterised in Byelorussia by the first appearance of *Vallatisporites vallatus* Hacquebard, *V. verrucosus* Hacquebard and *Verrucosisporites nitidus* (Naumova) Playford. In Western Europe,

the first appearance of *V. verrucosus* and *V. nitidus* defines the base of the *Retispora lepidophyta - Verrucosisporites nitidus* (LN) Biozone, suggesting firm correlation of the base of the PLE Biozone with the base of the LN Biozone. Some confusion still exists concerning the morphographic circumscription of the taxa *Vallatisporites vallatus* and *V. pusillites* (Kedo) Dolby & Neves emend Byvsheva which may explain the anomalously late first appearance of the former taxon within the mid Tournaisian PC Biozone in Western Europe.

In the Holy Cross Mountains, spore assemblages containing *Retispora lepidophyta* var. *tenera, Vallatisporites pusillites, V. vallatus, V. verrucosus, Cymbosporites minutus, Rugospora radiata, Verrucosisporites nitidus* and *Hymenozonotriletes explanatus* have been recorded (Turnau, 1985, 1990). These correspond to the PLE or PM Biozones of Byelorussia.

Vallatisporites pusillites-Tumulispora malevkensis (PM) Biozone

The index taxon *V. pusillites* is used here *sensu V. pusillites* (Kedo) *emend* Byvsheva. This is the highest zone in which *Retispora lepidophyta* occurs (represented here by var. *minor*). The base of the succeeding biozone is defined by the disappearance of *R. lepidophyta,* and can therefore be correlated with the base of the *Vallatisporites verrucosus - Retusotriletes incohatus* (VI) Biozone in Western Europe and Poland. In terms of boundary definition, the PM and PLE Biozones in Byelorussia are together the correlatives of the *Retispora lepidophyta - Verrucosisporites nitidus* Biozone in Western Europe and Poland. This correlation is supported by the conodont evidence. In Western Europe, the boundary between the LN and VI Biozones appears to be approximately coincident with the Devonian-Carboniferous boundary.

Tumulispora malevkensis (M) Biozone

The *Tumulispora malevkensis* Biozone is characterised by the lack of *Retispora lepidophyta;* The base of the zone is marked by the first appearance of *Diaphanospora submirabilis* (Kedo) Byvsheva, *Dictyotriletes trivialis* Kedo and *Spelaeotriletes balteatus.*

Kraeuselisporites hibernicus Higgs appears in the upper part of the M Biozone. This level can therefore be correlated with the base of the *Kraeuselisporites hibernicus - Umbonatisporites distinctus* (HD) Biozone in Western Europe. In Poland, *K. hibernicus* appears at the base of the Ma Biozone. The boundary between the Ma Biozone and the preceeding VI Biozone is not seen, however, due to a substantial gap in the miospore record.

The M Biozone is divided into two subzones. The base of the lower *Tumulispora malevkensis - Spelaeotriletes balteatus* (MB) Subzone is marked by the appearance of *Spelaeotriletes balteatus.* The base of the higher *Tumulispora malevkensis - Apiculiretusispora rarispinosa* (MR) Subzone is characterised by the first appearance of *Apiculiretusispora rarispinosa* (Jushko) Byvsheva. In Western Europe *Spelaeotriletes balteatus* first appears much higher in the succession, at the base of the mid-Tournaisian *Spelaeotriletes balteatus - Rugospora polyptycha* (BP) Biozone.

Grandispora upensis (U) Biozone

The base of this zone in Byelorussia is marked by the first appearance of *Grandispora upensis* (Kedo) Byvsheva. *Apiculiretusispora septalia* (Jushko) Byvsheva makes its first appearance in the upper part of the zone. Correlation with Western Europe is not possible at this level, since the index species has not been recorded. In Poland, *G. upensis* first appears in the lowest assemblages assigned to the Ma Biozone.

CONCLUSIONS

The late Devonian - early Carboniferous miospore zonation established by Avchimovitch in Byelorussia can be correlated at several horizons with the zonal schemes in Poland and Western Europe. The most important of these are :

1. The first appearance of *Hymenozonotriletes explanatus* which defines the base of the LE Biozone within the Strunian of both Byelorussia and Western Europe.

2. The first appearance of *Verrrucosisporites nitidus* in the uppermost Strunian, marking the base of the PLE Biozone in Byelorussia, and defining the base of the LN Biozone in Western Europe.

3. The disappearance of *Retispora lepidophyta* approximately at the Devonian-Carboniferous boundary, defining the base of the M Biozone in Byelorussia and the base of the VI Biozone in both Poland and Western Europe.

BIBLIOGRAPHY

AVCHIMOVITCH, V.I., 1986.- Spores of Devonian-Carboniferous boundary deposits of East European Platform. *In:* Model profiles and correlation of Devonian-Carboniferous boundary of Eurasia. Magadan : 125-146.

AVCHIMOVITCH, V.I., BYVSCHEVA, T.V., HIGGS, K., STREEL, M. & UMNOVA, V.T., 1988a.- Miospore systematics and stratigraphic correlation of Devonian-Carboniferous boundary deposits in the European part of the USSR and Western Europe. *Cour. Forsch.-Inst. Senckenberg,* 67 : 169-171.

AVCHIMOVITCH, V.I., GOLUBTSOV, V.K. & DEMIDENKO, E.K., 1988b.- The type section of the Devonian and Carboniferous boundary deposits occurring in the Pripyat Depression. *In:* V.K. Golubtsov (Ed.): Devonian-Carboniferous boundary in the territory of USSR. *"Nauka i Tekchnika",* Minsk 40-53 (in Russian).

AVCHIMOVITCH, V.I., 1992.- Zonation and spore complexes of Devonian-Carboniferous boundary beds of the Pripyat Depression. *Ann. Soc. géol. Belg.,* 115 (2).

HIGGS, K., CLAYTON, G. & KEEGAN, J.B., 1988.- Stratigraphic and systematic palynology of the Tournaisian rocks of Ireland. *Geological Survey of Ireland, Special Paper* no. 7 : 93 p.

HIGGS, K. & STREEL, M., 1984.- Spore stratigraphy at the Devonian-Carboniferous boundary in the northern Rheinisches Schiefergebirge. *Cour. Forsch.-Inst. Senckenberg,* 67 : 157-179.

KEDO, G.I., 1957.- Spores of the suprasalt Devonian deposits of the Pripyat depression and their stratigraphical significance. *Palaeontology and Stratigraphy of BCCR,* 2 : 3-41 (in Russian).

KEDO, G.I., 1963.- Spores of Tournaisian Stage of the Pripyat Depression and their stratigraphical significance. *Palaeontology and Stratigraphy of BSSR,* 4 : 3-121 (in Russian).

KOREJWO, K., 1975.- The lowermost Dinantian from the Babilon 1 column (Western Pomerania). *Acta Geol. Polon.,* 25 : 451-504 (in Polish, English summary).

KOREJWO, K., 1979.- Biostratigraphy of the Carboniferous sediments from the Wierzchowo area (Western Pomerania). *Acta Geol. Polon.,* 29 : 457-473.

LOBOZIAK, S., STREEL, M. & VANGUESTAINE, M., 1983.- Miospores et acritarches de la Formation d'Hydrequent (Frasnien supérieur à Famennien inférieur), Boulonnais, France. *Ann. Soc. géol. Belg.,* 106 : 173-183.

MATYJA, H., 1976.- Biostratigraphy of the Devonian-Carboniferous passage beds from some selected profiles of NW Poland. *Acta Geol. Polon.,* 26 : 489-539.

MATYJA, H. & TURNAU, E., 1989.- Conodonts and spores from Devonian-Carboniferous boundary beds in Poland. *Proc. XI-th Congr. Intern. Strat. Geol. Carb.,* Beijing (1987), 3 : 61-72.

PAPROTH, E. & STREEL, M., 1971.- Corrélations biostratigraphiques près de la limite Dévonien/Carbonifère entre les faciès littoraux ardennais et les faciès bathyaux rhénans. *Coll. Strat. Carb., Congr. Coll. Univ. Liège,* 55 : 365-398.

STREEL, M., HIGGS, K., LOBOZIAK, S., RIEGEL, W. & STEEMANS, Ph., 1987.- Spore stratigraphy and correlation with faunas and floras in the type marine Devonian of the Ardenne-Rhenish regions. *Rev. Palaeobot., Palynol.,* 50 : 211-229.

TURNAU, E., 1975.- Microflora of the Famennian and Tournaisian deposits from boreholes of northern Poland. *Acta Geol. Polon.,* 25 : 505-528.

TURNAU, E., 1979.- Correlations of Upper Devonian and Carboniferous deposits of Western Pomerania, based on miospore study. *Rczn. Pol. Tow. Geol.,* 49 : 231-269 (in Pölish, English summary).

TURNAU, E., 1985.- Devonian-Carboniferous boundary in the borehole Kowala 1 (southern Holy Cross Mts, Poland). Spores. *Bull. Pol. Akad. Sci., Ser. Earth Sci.,* 33 : 2-5.

TURNAU, E., 1990.- Spore zones of Famennian and Tournaisian deposits from the Kowala 1 borehole. *Kwart. Geol.,* 34 : 291-304 (in Polish, English summary).

ZAKOWA, H., MALEC, J. & NEHRING-LEFELD, M., 1985.- Devonian-Carboniferous boundary in the borehole Kowala 1 (southern Holy Cross Mts, Poland). Macro- and microfauna. *Bull. Pol. Acad. Sci., Ser. Earth Sci.,* 33 : 87-95.

ZAKOWA, H. & NEHRING-LEFELD, M., 1983.- Results of stratigraphical-palaeontological studies on Upper Devonian deposits of the borehole Kowala 1. *Kwart Geol.,* 27 : 886-887 (in Polish, English summary).