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SUGGESTIONS FOR THE SUBDIVISION OF THE DEVONIAN-CARBONIFEROUS BOUNDARY DEPOSITS

by

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ABSTRACT

The Devonian-Carboniferous boundary deposits may be subdivided into three glones (global zones ; chronostratigraphic units of a lower rank than stages), in ascending order : Strunian, Hangenbergian and Gattendorfian. Their characteristics are briefly discussed.

KEY WORDS

Biostratigraphy, correlations, Devonian, Carboniferous

1. INTRODUCTION

Recently, specialists in stratigraphy have mainly considered the problems concerning the recognition of chronostratigraphic boundaries. As a result, differentiation between boundary deposits of neighbouring chronostratons has received less attention. There are at least two aspects in it, i.e. a complete and continuous representation of the geologic record according to the chronostratigraphic scale, and identification of possibly minimized chronostratigraphic units. Questions related to these aspects have been examined by the International Working Group (IWG) on the Devonian-Carboniferous boundary headed by E. Paproth since 1976.

2. SUBDIVISION CONCEPTS

Before initiation of the IWG D/C activity the Devonian-Carboniferous boundary deposits were considered to be represented everywhere by nearly the same time-span, that approximately corresponded to the Etroeungt Formation. Different paleontological features among "Etroeungt" ("Strunian") deposits from various paleobasins were explained by their paleobiogeographic differentiation (Bouckaert & Simakov, 1979). The information obtained recently (Higgs & Streel, 1984 ; Simakov, 1986 ; Avchimovitch *et al.*, 1988 ; etc..) has shown that the Devonian-Carboniferous boundary deposits are not of the same stratigraphic range in different areas and that deposits of quite different ages are referred to the "Etroeungt" ("Strunian") (Simakov, 1985).

For clarification of these differences I have proposed to distinguish three glones (Gladenkov, 1981) i.e. Strunian, Hangenbergian and Gattendorfian within the Devonian-Carboniferous boundary deposits. I regard glones (global zones) as chronostratigraphic subdivisions, which are of a lower rank than stages. They correspond to such evolutionary stages among orthochronologic faunal groups which coincide with compositional and/or structural alterations among other fossil groups of concurrent ranges covering the whole spectrum of facial and ecologic conditions. Identification of glone boundaries in terms of compositional and/or structural alterations among the whole paleobiota but not only within an orthochronologic group serves as a basis for the chronostratigraphic status of glones. This permits their global tracing.

To distinguish between glones and biostratigraphic units I have proposed to give them geographic (but not paleontonomic) names. It is quite clear that the terms used previously for a long time are not really desirable here. But, in the case of the Devonian-Carboniferous stratoecotone, I don't see any other solution, though I am ready to accept any suggestions concerning renaming the identified units. For example, we could waive the priority of Ruzhentsov (1965) and replace his term "Gattendorfian" for "Balvian", which was introduced by Schmidt (1972) and is preferably used now (Paproth, 1986).

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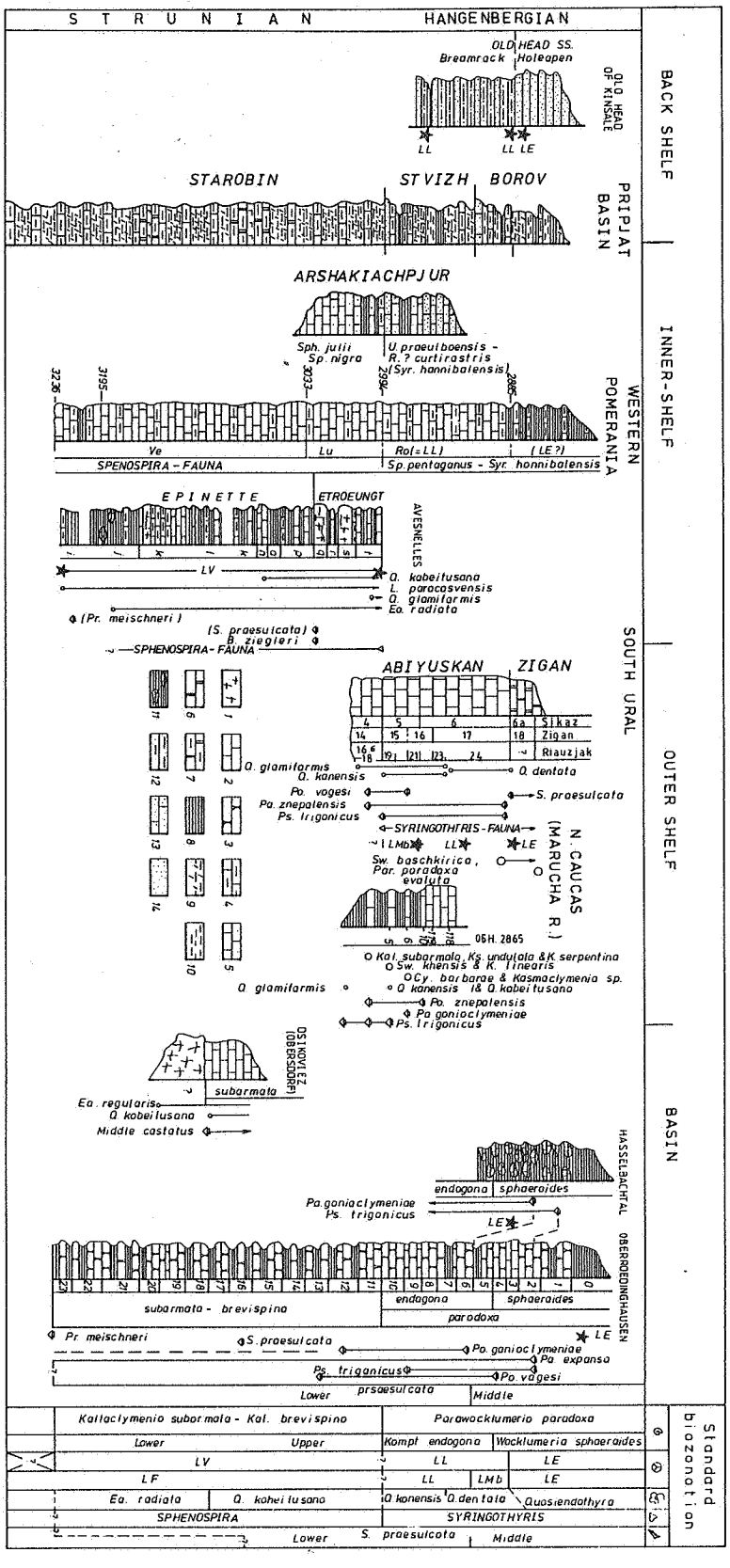

Figure 1. : Biostratigraphic correlations of Strunian and Hangenbergian deposits in some selected sections of different facies reallms (sections not to scale !). Data for all sections from Simakov.

Limestones : 1. bioherm ; 2. detrital ; 3. nodular ; 4. shelly ; 5. sandy ; 6. dolostones ; 7. shelly dolomite ; 8. mudstones ; 9. calcareous shales ; 10. shale ; 11. shale with carbonate nodules ; 12. siltstones ; 13. calcareous sandstones ; 14. sandstones.

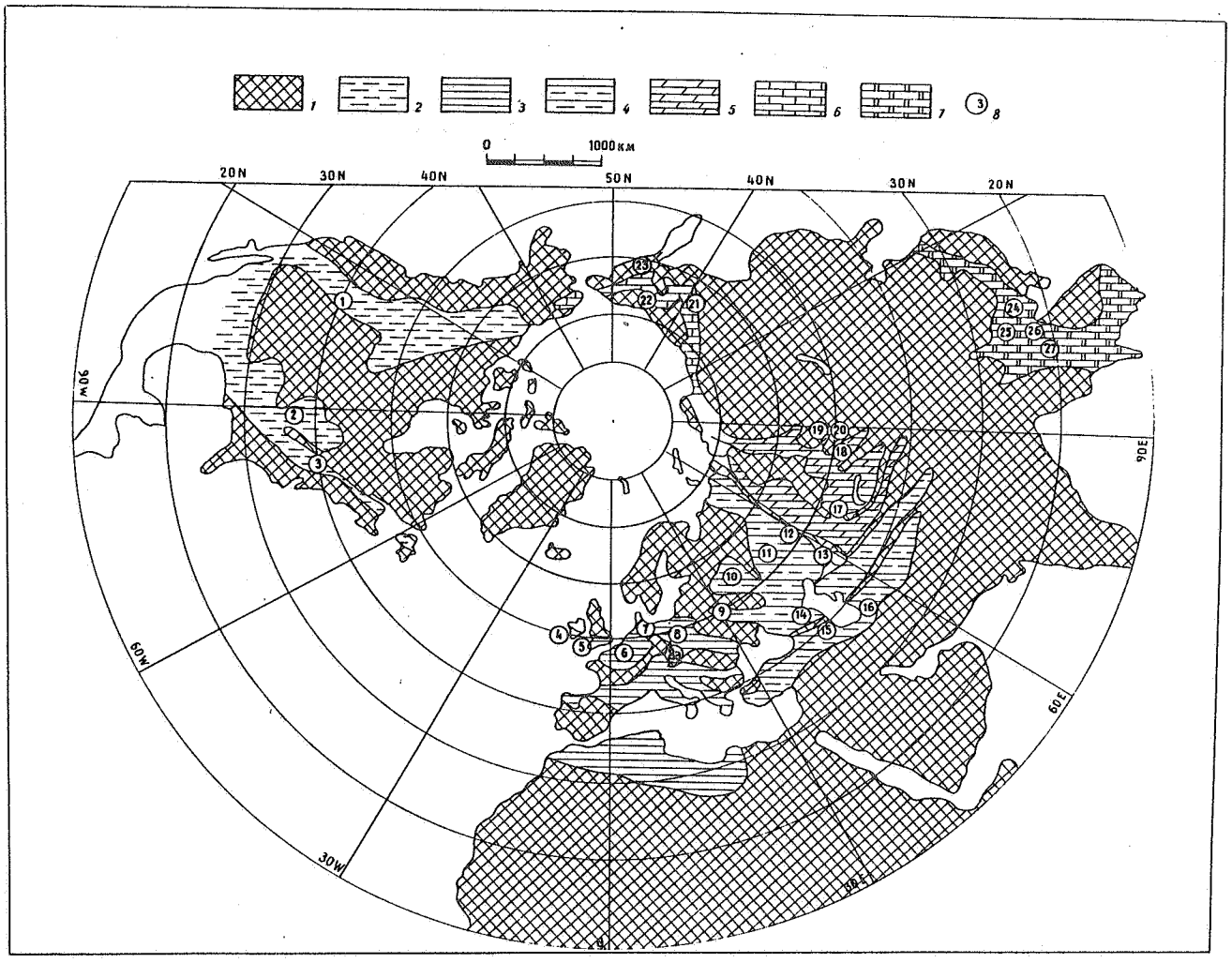

Figure 2. : Paleobiogeographic scheme for the Devonian-Carboniferous transition.

1 - uplifts and areas undergoing erosion ;
marine realms :
Atlantic :
2 - North American province, 3 - West European province, 4 - East European province ;
Pacific :
5 - Kazakhstan-Altayan province ; 6 - East Siberian province ; 7 - South-Chnensian province ;
paleobasin reference sections:
1 - Cordillera system ; 2 - Inner (Mississippian) system, 3 - Atlantic (Appalachian) system, 4 - Münster basin, 5 - Cornwall basin, 6 - Dinant basin, 7 - Ruhr basin, 8 - Pomerania basin, 8a - Silesia basin, 9 - Pripjat basin, 10 - Submoscowian basin, 11 - Volgo-Uralian basin, 12 - South-Urals system, 13 - Mugodzhary basin, 14 - North Caucasian basin, 15 - Transcaucasian basin, 16 - Elbourz basin, 17 - Central-Kazakhstanian basin, 18 - Rudny-Altayan basin, 19 - Kuznets basin, 20 - Minusa basin, 21 - Prekolymian basin, 22 - Omolon basin, 23 - Gizhiga basin, 24 - Hunan, 25 - Guizhou (inner shelf facies), 26 - Guangxi, 27 - Guizhou (basinal facies).

3. PALEONTOLOGICAL FEATURES OF IDENTIFIED GLONES AND THEIR BOUNDARY CRITERIA

3.1. Strunian

According to modern concepts (Paproth *et al*, 1983 ; Conil *et al.*, 1986), the lower boundary of the Strunian is matched with the base of LV palynozone. It may also be traced by the first occurrence of endothyrids (*"E." concavacamerata - "E" paracosvensis*) and quasiendothyrids with inconstant two-layer wall (*Q. radiata*) among Foraminifera, sphenospiras among Brachiopoda, *Protognathodus meischneri*, which marks the base of the Lower *praesulcata* subzone (Ziegler & Sandberg, 1984), among Conodonta. Judging from co-occurrence of *Pr. meischneri* and miospores from the lower portion of the LV palynozones in the Yves-Gomezee section (Dreesen *et al.*, 1976) and in Bed 23 in the Oberrödinghausen section, the base of the Strunian is coincident with the *Clymenia/Wocklumeria* zone boundary.

The glone Strunian can be compared to the Formation bearing the same name in the Dinant basin, or, in other words, to the "Fa2d - Tn1a", except the upper (u) member of the Strunian in the Avesnelles section parastratotype. The black shales of this upper member containing *Cymaclymenia evoluta* and *Verrucosisporites mesogrumosus* are considered as analogous to the Hangenberg Shale and are worthy of identification as a separate Formation

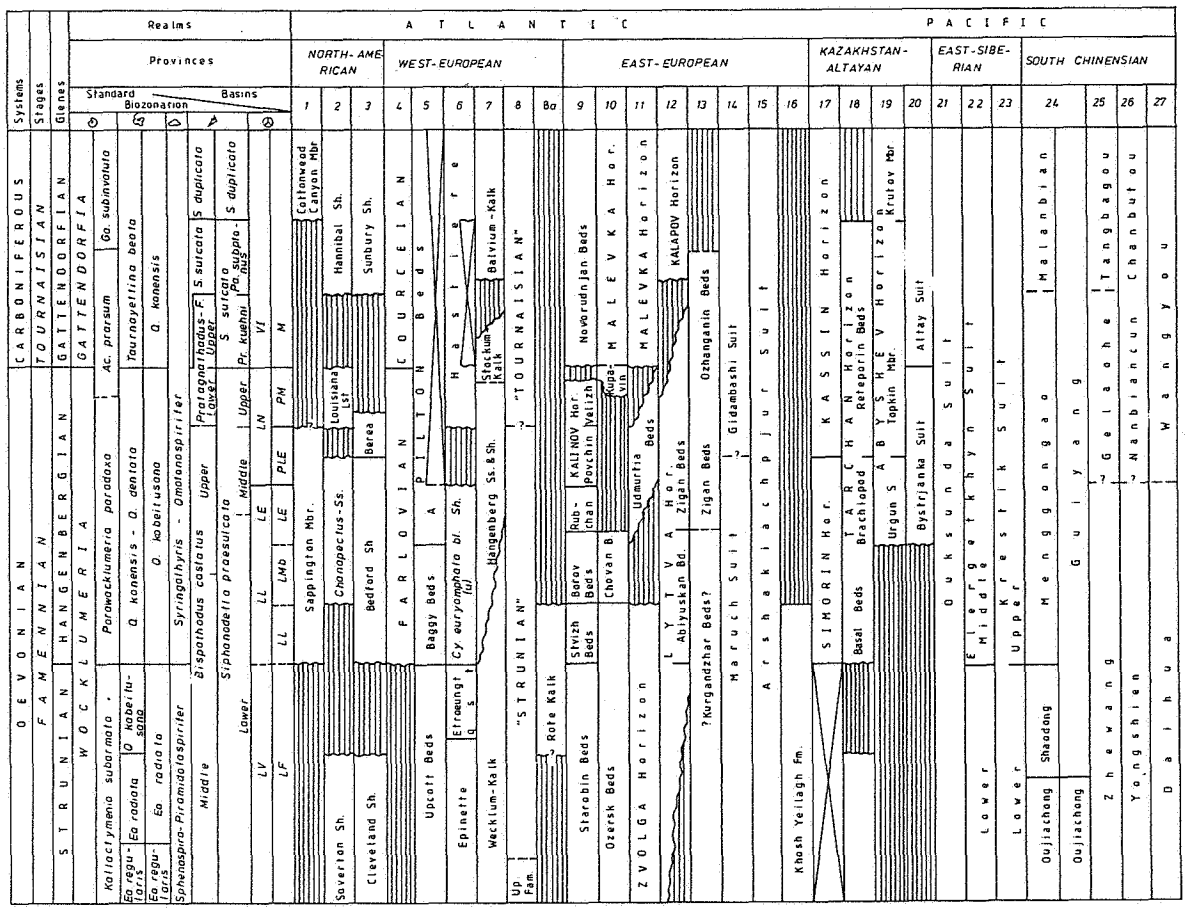

Figure 3. : Correlation scheme of the Devonian-Carboniferous transitional deposits (numbers of the column correspond to the numbers in Fig. 2)

(Simakov, 1986). Outside the stratotype region the Strunian is identified according to fauna distribution, i.e. early quasiendothyras (s. l.) represented by two-layer forms with clear though thin vitreous layer (*Q. kobeitusana* group) among Foraminifera, sphenospiras including representatives of *Validospirifer, Molandispirifer, Sphenospira, Unispirifer, Hamlingella, Whidbornella, Planoproductus, Mesoplica, Spinocarinifera* and other genera among Brachiopoda, *subarmata* assemblage zone among Ammonoidea, lower *praesulcata* subzone assemblages among Conodonta, microflora from *LV* palynozone among Miospores (Simakov, 1986).

3.2. Hangenbergian

On the basis of factual data on co-occurrence of different fossil groups in various regional sequences (Fig. 1) the boundary between Strunian and Hangenbergian can be drawn by the first occurrence of quasiendothyras with two-layer wall and thick vitreous layer (*Q. konensis - Q. dentata* group) among Foraminifera, syringothyris fauna among Brachiopoda, *Wocklumeriidae* and *Parawocklumeriacea* representatives characteristic of the *paradoxa* zone among Ammonoidea, palynoflora characteristic of the upper (?) portion of *LL* palynozone (= *LMb* ? - Avchimovitch *et al.*, 1988) among Miospores. This boundary is drawn within the stratigraphic range of conodont faunas characteristic for the lower *praesulcata* subzone, ; at present it can't be traced more precisely in terms of this group.

I consider Hangenbergian within the volume of ammonite *paradoxa* zone, which includes the upper portion of Wocklum Limestone and Hangenberg Shale in the Rhenish Slate Mountains. Outside the stratotype region Hangenbergian deposits are identified by occurrence of faunas i.e. late quasiendothyras (s. l.) among Foraminifera, syringothyras including representatives of *Molandispirifer, Prospira, Parallelora, Unispirifer, Syringothyris, Brachythyris, Omolonospirifer, Semiproductus, Ovatia* and other genera among Brachiopoda, assemblage of *paradoxa* zone among Ammonoidea, palynofloras of *LMb, LE, LN* (= *PLE* + *PM* - Avchimovitch *et al.*, 1988) among Miospores. In terms of conodont fauna identification of Hangenbergian is reliable only for middle and upper *praesulcata* subzones, since the Strunian/Hangenbergian boundary passes through the upper portion of the lower *praesulcata* subzone.

3.3. Gattendorfian

The Hangenbergian/Gattendorfian boundary coincides with the Devonian/Carboniferous boundary.

In the USSR it is drawn within the stratigraphic range of so-called "Stockum" *Acutimitoceras* fauna. According to the IWG D/C recommendations it should be matched with the base of *sulcata* conodont zone. I have already made some critical observations concerning this boundary determination in terms of conodonts (Simakov, 1984, 1986). Essentially, these observations lead to the conclusion that this boundary can be traced without problems only in basinal deposits containing Siphonodellid biofacies. It is practically impossible to identify the *praesulcata/sulcata* limit in shallow shelf deposits, which are widely distributed in the USSR, China, Canada and other countries. Before microflora investigations were considered very promising as an alternative. But, according to data from South-East China (Hou *et al.*, 1985 ; Streel, 1986), microflora of zone *VI* appearing there in co-occurrence with conodonts of the middle *praesulcata* subzone contains no *Lepidophytus*. This makes it doubtful that the base of palynozone *VI* could be used for global tracing of the Devonian-Carboniferous System boundary.

At present, the Gattendorfian (Balvian) is best identified with the help of ammonoids, conodonts and miospores. It corresponds to the full *Gattendorfia* zone in terms of the ammonite scale, to the *sulcata* - *sandbergi* interval in terms of conodont scale and to palynozone *VI* (at least within the Atlantic realm) in terms of miospore scale. Within the Atlantic realm so called *Bisphaera* fauna became predominant among Foraminifera, whereas within the Pacific realm one-chamber forms and quasiendothyras co-existed till the end of Gattendorfian. Among Brachiopoda no drastic change took place at the Devonian-Carboniferous limit.

4. CONCLUSIONS

In all regions, where Devonian-Carboniferous boundary deposits are identified (Figs. 2, 3), deposits corresponding to the proposed glones are evident. Their recognition permits a more complete reconstruction of paleobasin history and of interconnections between global and regional processes. For example, the contrary evolutionary trends related to transgressions and regressions in paleobasins of Atlantic and Pacific realms are worthy of attention. Within the Atlantic realm the transgression maximum falls in the Strunian, and the regression maximum falls in the Hangenbergian, whereas in the Pacific realm the regression took place during Strunian time, and the transgression during Hangenbergian time. For this reason the Devonian-Carboniferous boundary stratotype is easier to choose among the sequences east of the Ural Mountains than in West Europe.

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