APERÇU GEOLOGIQUE DES FORMATIONS DU CARBONIFÉRE BELGE

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CHAPTER I.

The Devonian Carboniferous boundary in Belgium and Northern-France

by

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Introduction

Increasing difficulties have recently arisen among paleontologists searching for the more accurate definition of the boundary between the Devonian and Carboniferous Systems, and intending to identify this limit with the Famennian-Tournaisian limit. Difficulties of nomenclature confusion between chrono-, bio- and lithostratigraphy, use of same symbols for different concepts, diversification of use in terminology, and boundaries of the stages and subdivisions, all make the setting of the limit difficult. Difficulties also arising from new detailed faunal and floral biostratigraphies which question the former sharp and welldefined limit, coincide with changes of the lithological facies.

The base of the Tournaisian Stage in Belgium has been given at least three conflicting definitions since the end of the last century:

1) Base of T1a (RUPONT 1882, legend of geological map of Belgium) located in the lower portion of the so called Hastière Limestone, in Hastière.

2) Base of T1a (CONIL & al. 1967; NAMET 1968) located at the base of the Etroesingt Limestone GOSSELET, sensu lato, in the outcrops at Avesnelles (Northern France).

3) Base of T1aα (CONIL) 1964 located at the top of Evieux-beds in the type-locality of the Ourthe valley.
In the meantime, the base of the Carboniferous System has moved (since Heerlen 1935) to the Hönne valley in Germany where it is located at the base of the Hangenberg Limestone at Oberrödinghausen railroad-section.

Recent micropaleontological and palynological researches have challenged most of the biostratigraphical limits involved in an effort to trace the different basis of System or Stage through the Ardenno-Rhine basins. It is the main purpose of this paper to summarise this new data.

Biostratigraphical correlations between the type-localities of Northern France, Belgium, and Germany.

The now most generally accepted base of the Tournaisian Stage in Belgium and Northern France is the base of the Etroenicht Limestone. This base has been proved older than the base of the Carboniferous System as defined at Heerlen (1935).

This is substantiated by the following considerations which also demonstrate, if still necessary, the marked diachronism between lithostratigraphy and biostratigraphy based on microfossils (See Fig. 1).

In the Ourthe valley (Fig. 1 section 7) the biostratigraphical equivalent of the base of the Etroenicht Limestone s.l. can be approximately located near (above) the bed 115 (first occurrence of _Quasiendothrya Kobeitusana_).

Below this limit can be observed twenty meters of alternating limestone and shale beds with sandstone beds which do not belong to the typical Famennian Evieux Formation and had been named "Th'a and (CONIL 1964). We have renamed the major part of these beds (BOUCKAERT, STREEL & THOREZ, 1968) as follows:

Fa2d, the base of which corresponds at "Rivage-gare section with the first occurrence of _Hymenozotriletes lepidophytus_, a spore species whose
first occurrence has proved to be of worldwide stratigraphic signifi-
cance. These beds (Fa2d) contain Quasiendothyracommunis radiata and
are characterized by the occurrence "en masse" of Endothyridae. They
also contain Spathognathodus costatus ultimus which allow a good cor-
relation with the Kalloclymeniacwohlerumeria beds (tovi) of the Hönne
valley in Germany.

As formerly shown (CONIL & LYS 1964) and now confirmed by the new
conodonts and spores data, equivalent beds are more than 60 meters
thick at Hastière (Fig. 1 section 2) and more than 90 meters thick at
Avesnelles (Fig. 1 section 1). These correlations invalidate the work
of MAMET, MORTELMANS and SARTENAER, (1965, Fig. 2) whose correlations
on the same section were based mainly on lithological evidence.

Rocks of Fa2d and Th1a age have their thickest and probably most
complete exposures in the Avesnois area (+ 150 meters). Their thick-
ness decreases not only eastward but also northward. In the Wepion
borehole (Southern margin of the Namur synclinorium, (Fig. 1 section
4 and 5) these beds are only 25 meters thick; they probably lack (see
below) almost completely in the northpart of the Namur Synclinorium
despite the fact that lithological equivalents of the Evieux and
Etroengt beds have been identified in the Tournai borehole (LBOURAND,
MAMET & MORTELMANS, 1966; MORTELMANS, 1969). Recently, CONIL & LYS
1970) have found and illustrated Quasiendothyrakobeitauana at Aves-
nelles, about 30 meters below the limit that they, and MAMET 1968, had
proposed as the base of Th1a. So that the index fossil of this chrono-
stratigraphic unit is no longer helpful in locating precisely this li-
mit in other sections.

Authors generally agree to consider the top of Th1a at the limit
between the Etroengt Limestone and Black Limestone of Avesnelles, in
the Avesnelles section, assuming (MAMET 1968, p 1000) that the corre-
lation between this limit and the base of the Hastière Limestone at
Hastièrè is established. However, we must emphasize that this correlation lies on pure lithostratigraphical criteria and is therefore questionable is detail if nevertheless roughly acceptable.

The base of the Hastièrè Limestone at Hastièrè is also lithostratigraphically correlatable eastwards with the sections of the Eocq and Hoyoux valleys. This is also acceptable as most of the alternating shales and limestone beds can be followed bed after bed, from one quarry to another. The lower part of the Hastièrè Limestone in the Hoyoux valley contains *Patrognathus variabilis* and *Siphonodella* (*AUSTIN, CONIL, RHODES & STREEEL, 1970). These *Siphonodella* are unculated species which must be reported from the *Siphonodella triangula-triangula* zone in Germany (ZIEGLER 1970). So it is clear now that the base of the Carboniferous System has to be investigated between the *Siphonodella-Patrognathus* fauna in the lower part of the Hastièrè Limestone in the Hoyoux valley and the upper part of the Etoeunget beds in Avesnois area where *Cymaclymenia euryomphala* has been identified by DELHINE (1929). This correlation is substantiated by the palynological zonation (PAPROTH & STREEEL, 1970) : the upper part of the Etoeunget beds and equivalents in the Dinant synclinorium contain an upper *pus. lepidophytus* subzone (*Florizone PLSI*) which is older than the upper *pus. lepidophytus* subzone (*Florizone PLs2-3*) which characterizes the Hängenberg shales in the Hönne valley in Germany (type section of Oberrödinghausen). The sequence of rocks where the base of the Carboniferous system *sensu* Heerlen 1935 has to be defined is thus 2 meters thick in the Hoyou valley and about 10 meters thick in the Anseremme-Hastièrè region (Fig. 1 sectio 2). The base of T1a DUFONT 1862 falls within this interval. This sequence of rocks could be thicker in the Namur-Syncline where work in progress tends to confirm the first assessment made by STREEEL (1966, 1969) that the Hastièrè Limestone equivalent could reach 75 meters high in the Tournai region. (*BOUCKAERT & CONIL, 1970, CHABOT 1970*).
The base of the Middle Tournaisian rocks are uniformly characterized throughout the Namur and Dinant Synclines by the "Paracuta Shales" and are also generally correlated with "Liegende Alaunschiefer" which interrupts the goniatite (Gattendorfia-Cu I) zonation in the Höhne valley in Germany. Thus, the Hangenberg Limestone in Oberrödinghausen is roughly equivalent to the Hastière Limestone.

The base of the next goniatite zone (Pericyclus-Cu II) has, recently been considered by SCHMIDT (1970) as an equivalent of the base of the Upper Crenulata zone, characterized for instance by the first occurrence of Gnathodus semiglaber (See MEISCHNER 1970).

As G. semiglaber occurs in the lower part of Upper Tournaisian (See CONIL & PIRLET 1970) in Belgium, it seems that all Middle Tournaisian, more than 160 meters thick in the region which corresponds partly to the Ch. glomiformis zone, lacks so far any good goniatite characteristics.

Criteria for an accurate definition of the boundary Tournaisian/Famennian.

The standard Cephalopod succession of Famennian and Tournaisian rocks in Germany provides doubtless the best criteria for an accurate definition of a biostratigraphical limit which approaches chronology. This is true also at the Tournaisian/Famennian boundary.

Fig. 2 shows that this succession is the most precise and detailed. 12 of the 14 subdivisions of the stratigraphical scale (Fig. 2) have Cephalopod-characteristics. But it must be emphasized that those limits lose their accuracy like every fossil group, when they coincide with changes of lithological facies. The present definition of the base of the Carboniferous system is therefore questionable as the first occurrence of Gatt. subinvoluta is obviously linked to the change
of facies between Hangenberg shales and Hangenberg limestone, at the type section of Oberrödinghausen. The succession *Balvia prorsum, Balvia acutum* (Lower subzone of the *C. subinvoluta* zone (SCHMIDT, 1971) has never been proved in one continuous section (See WEYER 1969 PAPROTH & STREEFL 1970).

So, we believe that amongst the three major limits of the Cephalopod-succession (toV/toVI; toVI/CuI; Cu I/ Cu II), the lowest (toV/toVI) is the least questionable. But, in our opinion many subdivision of these major biostratigraphical units (for instance 3/4, 4/5, 9/10, 10/11, 11/12) would alternatively provide an accurate definition of the Devonian/Carboniferous boundary. We have not to consider whether or not these subdivisions are easy to trace in other regions because of general scarcity of the characteristic Cephalopods.

Indeed, this is unfortunately a common characteristic for all Cephalopods. To reach the efficiency in correlation we have to consider the conodont fossil group, whose zonation has been erected in the Cephalopod facies.

So, we are convinced that at the present the best criteria to define the Devonian/Carboniferous boundary will be at a levee where a Cephalopod and Conodont limit match together. No doubt the limit 9/10 would seem the best so far in the light of our present knowledge of these two fossil-group succession. This corresponds to a succession in a same Conodont-genies (*Siph. sulcata duplicata*). Another possibility is at the limit toV/toVI. But it is fair to say the succession of the toVI interval is not yet completed and that new research will probably soon provide other good limits within this interval.
For instance, conodont research in Belgium is in progress and it is felt helpful to provide a chart of the present day (mai 1971) knowledge on conodont succession in Belgium (See fig. 3). It is unfortunate that all numerous research on conodonts in the Avesnois type region have provided at this time so few results. The present information reinforces our feeling that the classic Dinant region (for instance Ansereemme-Haastière) has the best sections where a para-stratotype could be located which would contain platform faunas and floras.
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Icriodus rectus
Icriodus sp A in ACRS
Icriodus cf cornutus
Icriodus oliv.sp
Spathogn.costatus costatus
Spathogn.cost.spinulicostatus
Spathogn.cost.ultimate
Spathogn.aculeatus
New genus in B.Z.
Spathogn.bischoffi
Spathogn.strigosus
Spathogn.cf costatus
Spathogn.tridentatus
Spathogn.plumulus
Spathogn.crassidentatus
Pseudopol.vogesi
Polygnathus communis
Pseudopol.dentilineatus
Polygnathus taxophorus
Pelekysgnathus sp in ACRS
Spathogn.div.sp
Polygnathus cf spicatus
Spathogn.cf bischoffi in ACRS
Pseudopol.nodomarginatus
Pseudopol.longiposticus
Spathogn.inornatus
Protognathodus kockeli
Spathogn.anteposicornis
Patrognathus variabilis
Spathogn.cost.sulciferus
Polygnathus inornatus
Polygnathus symmetricus
Polygnathus cf percarinatus
Polygnathus sp C Bruce
Polygnathus cf permarginatus
Siphonodella cooperi
Polygnathus lobatus
Siphonodella div.sp
Siphonodella obsoleta
Polygnathus inornatus rostr.