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APERÇU GEOLOGIQUE DES FORMATIONS DU CARBONIFERE BELGE

Bouckaert J. - Conil R. - Delmer A.
Groessens E. - Mortelmans G. - Pirlet H.
Streel M. - Thorez J.

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CHAPTER I.

The Devonian Carboniferous boundary in Belgium and Northern-France

by

J. Bouckaert, M. Streel and J. Thorez

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 (DUPONT 1882, legend of geological map of Belgium) located in the lower portion of the so called Hastière Limestone, in Hastière.
2) Base of Tn1a (CONIL & al. 1967; MAMET 1968) located at the base of the Etroeungt Limestone GOSSELET, sensu lato, in the outcrops at Avesnelles (Northern France).
3) Base of $Tn1a_{\alpha}$ (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 biostatigraphical 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 Etroeungt 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 Etroeungt Limestone s.l. can be approximately located near (above) the bed 115 (first occurence of Quasiendothyra 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 "Tn1a 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 sygnificance. These beds (Fa2d) contains Quasiendothyra communis radiata and are characterized by the occurrence "en masse" of Endothyridae. They also contain Spathognathodus costatus ultimus which allow a good correlation with the Kalloclymenia-Wochlumeria 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 60meters 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 Tn1a age have their thickest and probably most complete exposures in the Avesnois area (± 150 meters). Their thickness 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 Etroeungt beds have been identified in the Tournai borehole (LEGRAND, MAMET & MORTELMANS, 1966; MORTELMANS, 1969). Recently, CONIL & LYS 1970) have found and illustrated Quasiendothyra Kobeitusana at Avesnelles, about 30 meters below the limit that they, and MAMET 1968, had proposed as the base of Tn1a. So that the index fossil of this chronostratigraphic unit is no longer helpful in locating precisely this limit in other sections.

Authors generally agree to consider the top of Tn1a at the limit between the Etroeungt Limestone and Black Limestone of Avesnelles, in the Avesnelles section, assuming (MAMET 1968, p 1000) that the correlation between this limit and the base of the Hastière Limestone at

Hastière 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 Hastière Limestone at Hastière is also lithostratigraphically correlatable eastwards with the sections of the Bocq and Hoyoux valleys. This is also acceptable as must of the alternating shales and limestone beds can be followed bed after bed, from one quarry to another. The lower part of the Hastière Limestone in the Hoyoux valley contains Patrognathus variabilis and Siphonodella (AUSTIN, CONIL, RHODES & STREEL, 1970). These Siphonodella are evoluted 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 Hastière Limestone in the Hoyoux valley and the upper part of the Etroeungt beds in Avesnois area where Cymaclymenia euryomphala has been identified by DELEPINE (1929). This correlation is substantiated by the palynological zonation (PAPROTH & STREEL, 1970) : the upper part of the Etroeungt 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 Hangenberg 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-Hastière region (Fig. 1 sectio 2). The base of T1a DUPONT 1882 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 STREEL (1966, 1969) that the Hastière 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 "Peracuta Shales" and are also generally correlated with "Liegende Alaunschiefer" which interrupts the goniatite (Gattendorfia-Cu I) zonation in the Hönne 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 approachs chronology. This is true also at the Tournaisian/Famennien 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 coïncide with changes of lithological facies. The present definition of the base of the Carboniferous system is therefore questionable as the first occurrence of Gat. 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 G. subinvoluta zone (SCHMIDT, 1971) has never been proved in one continuous section (See WEYER 1969 PAPROTH & STREEL 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 wheter 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 seems 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 Anseremme-Hastière) has the best sections where a para-stratotype could be located which would contain platform faunas and floras.

BIBLIOGRAPHIE

ANCION, Ch. & LECKWIJCK, W.P. van (1968) : Le Strunien de la vallée de la Méhaigne.
Ann.Soc.géol.Belg. (Bull.) 81 : 507-520.

AUSTIN, R.L., CONIL, R., RHODES, F.H.T. & STREEL, M. (1970) : Conodontes, Spores et Foraminifères du Tournaisien inférieur dans la vallée du Hoyoux,
Ann. Soc.géol.Belg. (sous presse).

AUSTIN, R.L. & RHODES, F.H.T. (1971) : New Dinantian conodont faunas of France and Belgium. A preliminary note. In "Colloque sur la stratigraphie du Carbonifère". Congrès et colloques Univ. Liège, 55.

BOUCKAERT, J. & CONIL, R. (1970) : Les couches de passage du Dévonien au Carbonifère dans la vallée de la Dendre; découverte de Conodontes à Brugelette.
Bull.Soc.belge Géol., Paléont., Hydrol. 79, 1 : 1-4.

BOUCKAERT, J. & ZIEGLER, W. (1965) : Conodont stratigraphy of the Famennian Stage (Upper Devonian) in Belgium.
Service géol.Belg. 5 : 1-40, pl. 1.

BOUCKAERT, J., STREEL, M. & THOREZ, J. (1968) : Schéma biostratigraphique et coupes de référence du Famennien belge. Note préliminaire. Ann. Soc. géol. Belg., 91, 3 : 317-336.

BOUCKAERT, J., STREEL, M. & THOREZ, J. (1971) : Le Famennien et les couches de transition dévono-carbonifère dans la vallée de l'Ourthe (sud de Liège, synclinorium de Dinant, Belgique). In "Colloque sur la Stratigraphie du Carbonifère". Congrès et colloques Univ. Liège, 55.

CARO-MONIEZ, M. (1962) : Sur un niveau à spores du Dévonien supérieur du Sondage de Tournai (Belgique).
Ann.Soc.géol.Nord, 82 : 111-115 .

CHABOT, A. (1970) : Description d'un sondage effectué à Gages au voisinage de la limite dévono-carbonifère.
Bull.Soc.belge Géol., Paléont., Hydrol., 79, 1 : 5-10.

CHABOT, A. (1971) : Le sondage de Ujoverguies, première description - (Inédit).

CHIGOVA, V.A. (1970) : Correlation of Devonian and Carboniferous boundary beds in Eastern and Western Europe according to data resulting from the study of ostracoda.
C.R. 6e Congrès Carbonifère, Sheffield 1967, II : 547-556.

CONIL, R. (1959) : Recherches stratigraphiques sur les terrains dinantiens dans le bord nord du bassin de Namur. Mém.Acad. R. Belg., Cl. Sci., 2, XIV, 5 : 1-176, pls. 1-18.

CONIL, R. avec la collaboration de LYS, M. & PAPROTH, E. (1964) : Localités et coupes-types pour l'étude du Tournaisien inférieur.
Mém.Acad.Roy.Belg., Cl.Sci., 15, 4 : 1-87, pls. 1-14.

CONIL, R. (1968) : Le Calcaire Carbonifère depuis le Tn1a jusqu'au V2a.
Ann.Soc.géol.Belg. (Bull.) 90 : 687-726.

CONIL, R., PIRLET, H., LYS, M. & coll. (1967) : Echelle biostratigraphique du Dinantien de la Belgique.
Service Géol.Belg., Prof. Paper, 13 : 1-56.

CONIL, R. & LYS, M. (1971) : Données nouvelles sur les Foraminifères des couches de passage du Famennien au Tournaisien dans l'Avesnois. In "Colloque sur la Stratigraphie du Carbonifère". Congrès et colloque Univ. Liège, 55.

CONIL, R. & PIRLET, M. (1971) : Le Calcaire Carbonifère du Synclinorium de Dinant et le sommet du Famennien - in "Colloque sur la Stratigraphie du Carbonifère".
Congrès et colloque Univ. Liège, 55 : 47-64.

DELEPINE, G. (1929) : Sur la présence de Cymaclymenia camerata Schind. dans la zone d'Etroeungt à Séméries (nord de la France), Ann.Soc.Géol.Nord, LIV, 99-103.

DUPONT, E. (1882) : Explication de la feuille de Ciney. Carte géologique de la Belgique.

FORIR, H., SOREIL, G. & LOHEST, M. (1899) : Compte rendu de la session extraordinaire de la Société Géologique tenue à Hastière, à Beauraing et à Houyet, le 31 août et les 1er, 2 et 3 septembre 1895.
Ann.Soc.géol.Belg., 26 : 241-306.

FRANSEN, L. (1967) : Données nouvelles sur les foraminifères du Tournaisien et du Viséen.
Ann.Soc.géol.Belg., 90 : 571-583.

GRAULICH, J.M. (1960) : Le Sondage de Wépion.
Mém.Expl.Cartes géologiques et Min.Belgique, 2 : 1-102.

LEGRAND, R., MAMET, B. & MORTELMANS, G. (1966) : Sur la stratigraphie du Tournaisien de Tournai et de Leuze. Problèmes de l'étage tournaisien dans sa localité-type.
Bull.Soc.Belg.Géol.Paléont.Hydrol., 74, 2-3 : 140-188.

MAMET, B. (1968) : The Devonian-Carboniferous boundary in Eurasia.
Proc. Intern. Symposium Devonian System, Calgary 1967, II : 995-1007.

MAMET, B., MORTELMANS, G. & SARTENAER, P. (1965) : Réflexions à propos du Calcaire d'Etroeungt.
Bull.Soc.belge Géol., Paléont., Hydrol., 64, 1 : 41-51.

MEISCHNER, D. (1970) : Conodonten-Chronologie des Deutschen Karbons - C.R. 6e Congrès Carbonifère, Sheffield 1967, III : 1169-1180.

MORTELMANS, G. (1969) : L'étage Tournaisien dans sa localité-type. C.R. 6e Congrès Carbonifère, Sheffield 1967, 1 : 19-43.

MOURLON, M. (1875) : Monographie du Famennien. Bull.Acad.Roy.Belg., 2e série, 39, 5 : 602-659.

PAPROTH, E. & STREEL, M. (1971) : Corrélations biostratigraphique près de la limite Dévonien-Carbonifère entre les faciès littoraux ardennais et les faciès bathyaux rhénans. In "Colloque sur la Stratigraphie du Carbonifère". Congrès et colloques Univ. Liège, 55.

SARTENAER, P. & MAMET, B. (1964) : Le Calcaire d'Etroeungt à Etroeungt - C.R. 5e Congrès Carbonifère, Paris 1963, II : 755-761.

SCHMIDT, H. (sous presse) : Balvium : neuer Name für Unterkarbon I.

STREEL, M. (1966) : Critères palynologiques pour une stratigraphie détaillée du Thla dans les bassins ardenno-rhénans. Ann.Soc.géol.Belg., 89 : 65-95, pls. 1-2.

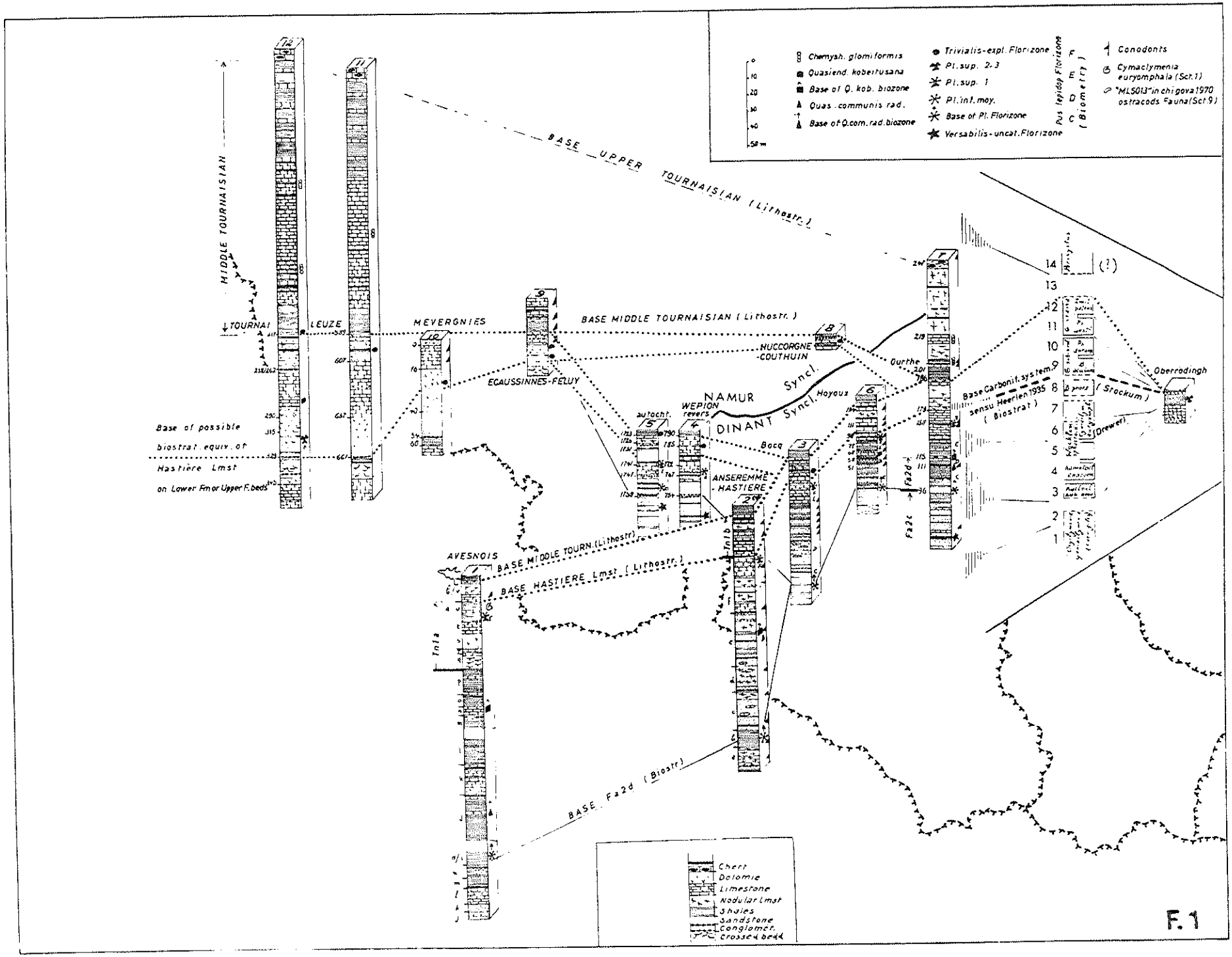
STREEL, M. (1969) : Corrélations palynologiques entre les sédiments de transition Dévonien/Dinantien dans les bassins ardenno-rhénans. C.R. 6e Congrès Carbonifère, Sheffield 1967, 1 : 3-18.

STREEL, M. (1971) : Distribution stratigraphique et géographique d'Hymenozonotriletes lepidophytus Kedo, d'Hymenozonotriletes pusillites Kedo et des assemblages tournaisiens. In "Colloque sur la Stratigraphie du Carbonifère". Congrès et colloques Univ. Liège, 55.

THOREZ, J. : Sédimentologie du Famennien supérieur dans le Synclinorium de Dinant.
Thèse de Doctorat, 1369, Liège, inédit.

WEYER, D. (1965) : Etroeungt im Morvan (Zentralfrankreich).
Mitteilungen ZGI, 1 : 289-302, Taf. XXIV A.

ZIEGLER, W. (1969) : Eine neue Conodontenfauna aus dem höchsten Ober-Devon.
Fortschr. Géol. Rheinld. Westf., 17 : 343-360, Abb. 1-4.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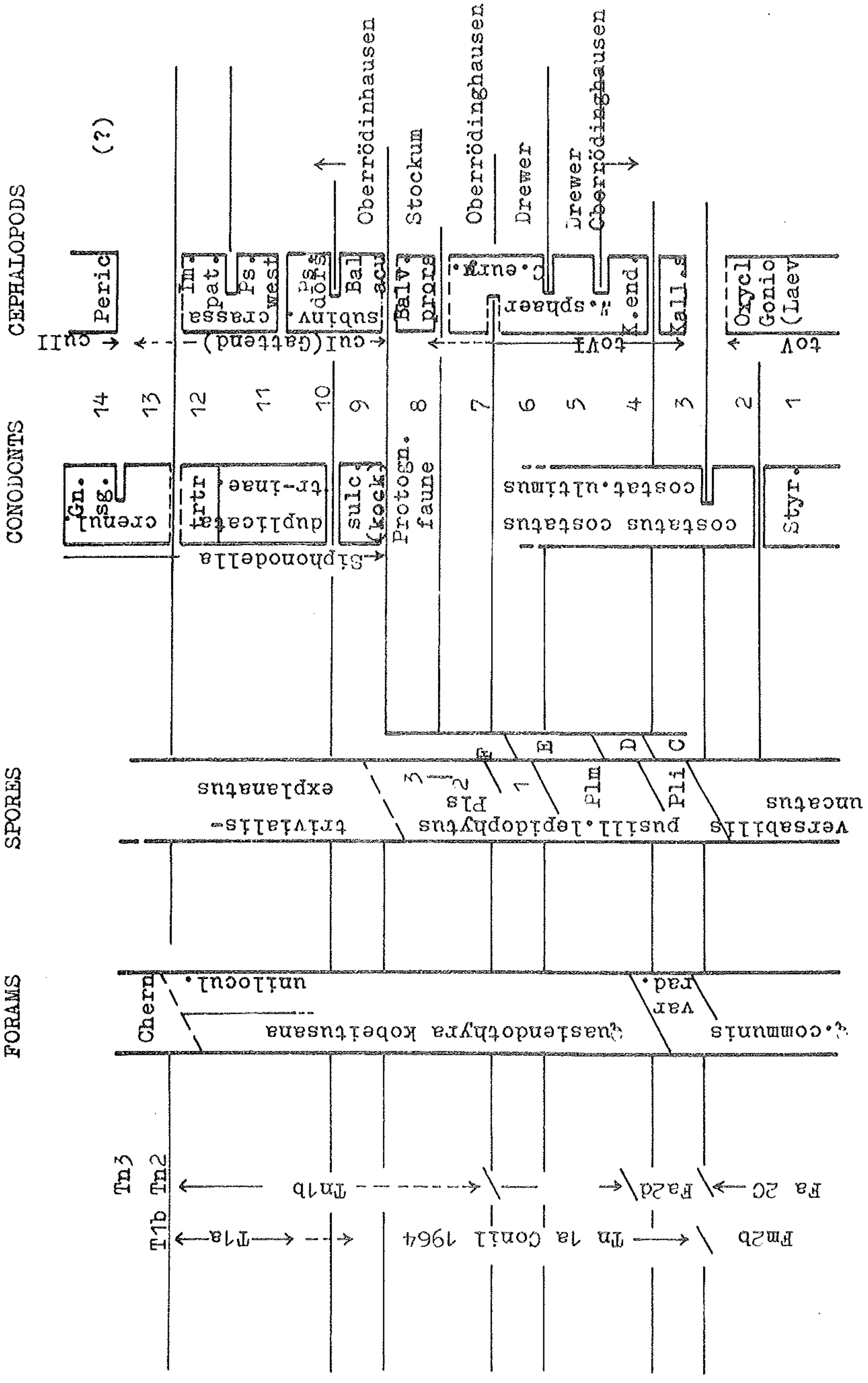
Base of Q.com.rad.biozone
Trivialis-expl. Florizone
Pl. sup. 2-3
Pl. sup. 1
Pl. inf. moy.
Base of Pl. Florizone
Versabilis-uncat. Florizone
Pus lepidop Florizone
Conodonts
Cymaclymenia euryomphala (Sct.1)
"MLS013" in chigova 1970 ostracods Fauna (Sct.9)
BASE UPPER TOURNAISIAN (Lithostr.)
MIDDLE TOURNAISIAN
TOURNAI
LEUZE
MEVERGNIES
BASE MIDDLE TOURNAISIAN (Lithostr.)
HUCCORGNE
COUTHUIN
ECAUSSINNES-FELUY
NAMUR
Synel.
WEPION
reverse
DINANT
Synel.
Hoyoux
Bocq
ANSEREMME
HASTIERE
Base of possible
biostrat. equiv. of
Hastière Lmst
on Lower Fm or Upper F. beds
AVESNOIS
BASE MIDDLE TOURN. (Lithostr.)
BASE HASTIERE Lmst (Lithostr.)
BASE Fa2d (Biostr.)
Base Carbonif. system
sensu Heerlen 1935
(Biostrat.)
Oberrodingh
(Stockum)
(Drewer)
Chert
Dolomie
Limestone
Nodular Lmst
Shales
Sandstone
Conglomer.
Crossed beds
F. 1

F2



CEPHALOPODS
CONODONTS
SPORES
FORAMS
Oberrödinhausen
Stockum
Oberrödinghausen
Drewer
Drewer
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Im. pat. crassa
Ps. west
Ps. dörs. subinv.
Bal acu
Balv. prors
K.end.
Kall.s
Oxycl Gonio (Laev
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cu I (Gattend)
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1
Gn. sg. crenul
trtr duplicata
tr-lnae
sulc (Kock)
Protogn. faune
costatus costatus
costat.ultimus
Styr.
Siphonodella
F
E
D
C
explanatus
trivialis-
Pls
Plm
Pli
pusill.lepidophytus
versabilis
uncatus
Chern
unilocul.
Quasiendothyra kobeitusana
var rad.
Q.communis
Tn3
Tn2
T1b
Tn1b
Fa2d
Fa 2C
T1a
Tn 1a Conil 1964
Fm2b

F3

Icriodus rectus
Icriodus sp A in ACRS
Icriodus cf cornutus
Icriodus oliv.sp
Spathogn.costatus costatus
Spathogn.cost.spinulicostatus
Spathogn.cost.ultimus
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New genus in B.&Z.
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Spathogn.crassidentatus
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Polygnathus communis
Pseudopol.dentilineatus
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Pelekysgnathus sp in ACRS
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Siphonodella cooperi
Polygnathus lobatus
Siphonodella div.sp
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Polygnathus inornatus rostr.