Geologica et Palæontologica

Sonderdruck

The Frasnian - Famennian Boundary in Belgium

Joseph Bouckaert, Alexis Mouravieff,
Maurice Streel, Jacques Thorez and Willi Ziegler

Geologica et Palaeontologica	6	S. 87 - 92	3 Abb.	Marburg, 15. 8. 1972

The Frasnian - Famennian Boundary in Belgium

Joseph BOUCKAERT, Alexis MOURAVIEFF, Maurice STREEL, Jacques THOREZ and Willi ZIEGLER

With 3 Textfigures

Joseph BOUCKAERT, Alexis MOURAVIEFF, Maurice STREEL, Jacques THOREZ & Willi ZIEGLER: The Frasnian-Famennian Boundary in Belgium. — Geologica et Palaeontologica 6: 87–92, 3 Abb., Marburg, 15. 8. 1972.

Three sections across the Frasnian-Famennian boundary in Belgium are reviewed. Lithological, facial and biostratigraphical aspects (brachiopods, conodonts, goniatites and palynological data) are discussed. The boundary in the section of Senzeilles (GOSSELET, 1877) is to be considered with reluctance. Therefore, it is suggested to establish a new boundary stratotype in the Hony section.

Drei Profile mit der Grenze Frasnium/Famennium in Belgien werden diskutiert. Die lithologischen, faziellen und biostratigraphischen Aspekte werden verglichen. Die Grenze zwischen Frasnium und Famennium im Profil von Senzeille (GOSSELET, 1877) muß mit Zurückhaltung betrachtet werden. Es wird deshalb darauf hingewiesen, einen neuen Grenz-Stratotypus im Profil von Hony aufzustellen.

Addresses of authors: Dr. J. BOUCKAERT, Service Géol. de Belgique, Bruxelles, Dr. A. MOURAVIEFF, Univ. de Louvain, Dr. J. THOREZ, Dr. M. STREEL, Univ. de Liège, Belgium, Prof. Dr. W. ZIEGLER, Univ. Marburg, Germany.

Summary: Paleontological evidence in the type section of Senzeille (Matagne Facies) is not sufficient to fix the Frasnian-Famennian boundary satisfactorily. Therefore sections across the Frasnian-Famennian boundary in the Barvaux Facies (Hony) and in the Matagne-Barvaux transitional facies are explored. Lithological and biostratigraphical aspects are discussed. On the basis of brachiopods, conodonts, goniatites and Acritarcha the respective sections are compared with one another. The presence of the Lower *triangularis*-Zone is demonstrated and according to all evidence it is suggested to establish a new boundary stratotype in the Barvaux Facies at Hony.

I. Introduction

In Belgium a series of dark coloured, soft, blackish to greenish shales with *Buchiola palmata* and *B. retrostriata*, described as "Schistes de Matagne", are considered to correspond to the uppermost part of the Frasnian Stage.

The term "Schiste de Matagne" was introduced by J. GOSSELET (1871) and subsequently used by the authors of the Geological Survey map of Belgium.

The facies of the "Schiste de Matagne" is well developed in the southern part of the country, but in the east it is replaced by the facies of the "Schiste de Barvaux", a more reddish and violet shale, with large specimens of *Spirifer verneuili*.

The superimposition of the Frasnian and Famennian sequences is well exposed in the section of Senzeille. The "Schistes de Matagne" are overlain by the "Schiste de Senzeille" with *Pampoecilorhynchus lecomptei*.

The boundary between the Frasnian and Famennian stages in the section of Senzeille could not be satisfactorily fixed with conodonts because the "Schistes de Matagne" below the base of the Famennian have not been investigated in that section as limestones are lacking.

The lowermost beds of the Famennian of this section, according to BOUCKAERT & ZIEGLER (1965), yielded conodonts indicating the Middle *triangularis*-Zone. According to that zone the basal part of the Famennien can be correlated with the uppermost part of the *Manticoceras*-Stufe (Adorf-Stufe) of Germany (post dolð, see ZIEGLER 1971). Hence, widespread usage of Frasnian as being equivalent to *Manticoceras*-Stufe and lower Famennian equivalent to the lowermost part of the *Cheiloceras*-Stufe, must be considered with some hesitation.

A well established rhynchonellid succession of the Frasnian-Famennian transition beds was carefully studied by P. SARTENAER.

His studies include not only the "Barvaux"- and "Matagne-facies" but also the lateral transition-beds from the "Matagne"- into the "Barvaux-facies".

His conclusions (1968–1970) are summarized in the following scheme:

	MATAGNE FACIES	TRANSITION BEDS	BARVAUX FACIES
Famennian	*Pampoecilorhynchus lecomptei*	*Paromoeopygma bellicastellana*	*Pampoec. lecomptei* *P. nux praenux*
Frasnian	*Caryorhynchus tumidus*	*Car. tumidus*	*Ripidiorhynchus*

In this paper the writers describe and discuss the conodont faunas that come from three sections across the Frasnian-Famennian boundary that are respectively typical for the same facies developments.

II. The Frasnian-Famennian boundary in the Matagne-facies

The Section of Senzeilles (fig. 1)
(For basic information see: J. GOSSELET 1877, 1888; P. SARTENAER 1960; J. BOUCKAERT & W. ZIEGLER 1965)
The base of the Famennian at the type section of Senzeille is situated at Km 101,026; there it was defined by GOSSELET (1877) based on the appearence of "*Cyrthia murchisoniana*" in "Schistes contenant de grosses plaques solides", 6 m thick. Four meters above this boundary, P. SARTENAER (1960) discovered the first occurrence of *Pampoecilorhynchus lecomptei*.
The first limestone layer appears at Km 101,045 and contains a conodont fauna of the Middle *triangularis*-Zone (BOUCKAERT & ZIEGLER 1965).
Immediately below the classical boundary 14 m of black shales are exposed. They have yielded no conodonts because of the lack of limestones. *P. lecomptei* has not been found as yet in the facies of this black shale. P. SARTENAER (1968) demonstrates that *Caryorhynchus tumidus* is present at the base of these 14 m of black shales, more precisely at Km 101. It is thus possible that a part of this black shales could represent totally or partially the equivalent of the upper part of the Upper *gigas*-Zone, recognized below (MOURAVIEFF 1970) the Lower *triangularis*-Zone or/and a part of the Middle *triangularis*-Zone.

III. The Frasnian-Famennian boundary in the Matagne-Barvaux transitional facies (fig. 2)

(See P. SARTENAER 1970 for basic information)
The region where the transitional facies occurs was especially studied by P. SARTENAER (1968–1970). He defined the base of the Famennian with the appearence of *Paromoeopygma bellicastellana*, name-bearer of a new rhynchonellid-zone developed in this region "where other rhynchonellid zones are poorly represented" (SARTENAER 1968: 1).
Further geological investigations carried out by the Belgian Geological Survey by means of numerous boreholes and galleries permit the general stratigraphical scheme as follows (see also fig. 2):
The association of Frasnian goniatites with *C. tumidus*, the appearence of *P. bellicastellana* and *Pampoecilorhynchus nux praenux* about 30 m above, and the first recognized occurrence of conodonts belonging to the Middle *triangularis*-Zone in the *P. bellicastellana*-Zone, do not permit to trace an accurate boundary between the Frasnian and the Famennian.

IV. The Frasnian-Famennian boundary in the Barvaux-facies

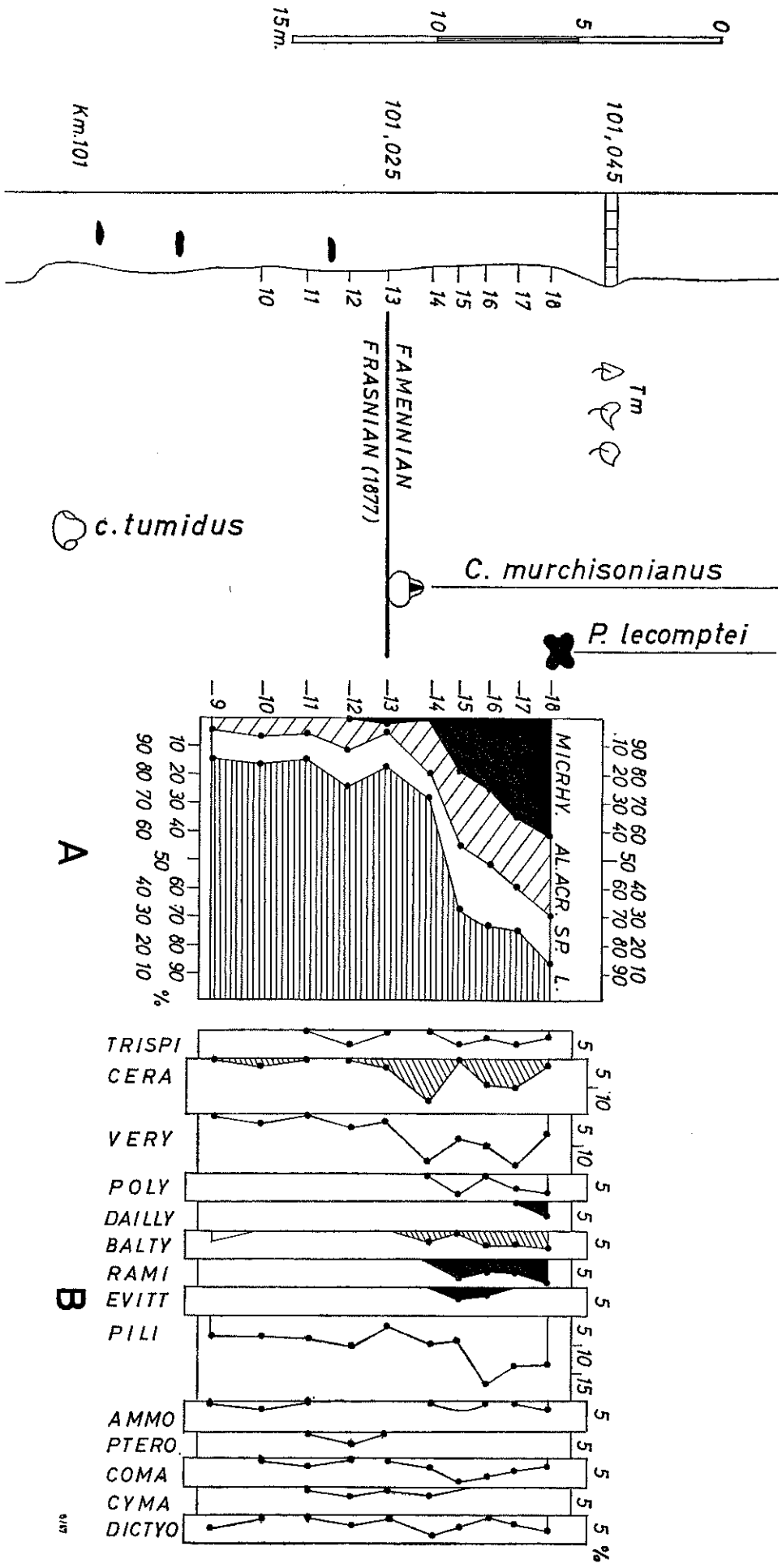
The section of Hony (fig. 3)
(See J. BOUCKAERT & J. THOREZ 1965 for basic information)
At layer 50 and above, *Palmatolepis triangularis* and *Ancyrognathus cryptus* indicate the Middle *triangularis*-Zone (Bed no. 10 of BOUCKAERT & THOREZ 1965). This zone is the first conodont zone to occur above the Famennian/Frasnian-limit in the Senzeille stratotype.
At layer 48t and below, *Ancyrognathus asymmetricus* indicates the Upper *gigas*-Zone (Bed no. 9 of BOUCKAERT & THOREZ 1965).
Between these two layers, bed 48b yielded more than thousand conodonts from 14,2 kg of limestone. The presence of *Palmatolepis triangularis*, *Ancyrognathus cryptus*, and *A.*

Fig. 1: Type section at Senzeilles
Diagrammatic column of section at left. Base of the Famennian placed at km 101,026 by GOSSELET (1877) on the first occurrence of *Caryorhynchus murchisonianus*. First occurrence of *Pampoecilorhynchus lecomptei* is 4 m above the base (SARTENAER, 1960). 14 m black shale follow below the lower boundary of the Famennian. They have yielded neither conodonts nor *C. lecomptei*. The latter species was discovered by SARTENAER (1968) at km 101,000. Tm = Layer with conodonts of the Middle *triangularis*-Zone.
A and B = Palynological evidence:
A. Percentages of major groups of organisms based on a total count of 200 specimens at each level.

MICRHY	= all species of *Micrhystridium* sensu lato	Ch.	= Chitinozoa and Scolecodonts (1 % max.)
AL. ACR	= sum of al acritarcha excluding *Micrhystridium, Leiosphaeridia* and *Lophosphaeridium*.	SP.	= Spores
		L.	= *Leiosphaeridia* + *Lophosphaeridium*.

B. Percentages of a few selected acritarcha taxa, in % of supposed planctonic microfossils (i.e. excluding spores)

TRISPI	= *Verybachium trispinosum* (EISENACK 1938) DEUNFF 1964 sensu lato.	EVITT	= *Evittia* BRITTO 1967
CERA	= *Verybachium ceratioides* STOCKMANS & WILLIERE 1962 sensu lato.	PILI	= *Baltisphaeridium piliferum* STOCKMANS & WILLIERE 1962
VERY	= all *Verybachium* including TRISPI and CERA	AMMO	= *Ammonidium sprucegrovensis* (STAPLIN 1961) LISTER 1970
POLY	= *Polyedryxium* cf. *belgium* STOCKMANS & WILLIERE 1960	PTERO	= *Pterospermopsis*
DAILLY	= *Daillydium quadridactylites* (STOCKMANS & WILLIERE 1962) STOCKMANS & WILLIERE 1969	COMA	= *Comasphaeridium*
		CYMA	= *Cymatiosphaera*
BALTI	= *Baltisphaeridium* cf. *longispinosum* EISENACK 1931	DICTYO	= *Dictyotidium*
RAMI	= *Baltisphaeridium ramispinosum* (STAPLIN 1961) DOWNIE & SARJEANT 1963 sensu lato		



SENZEILLE — SECTION

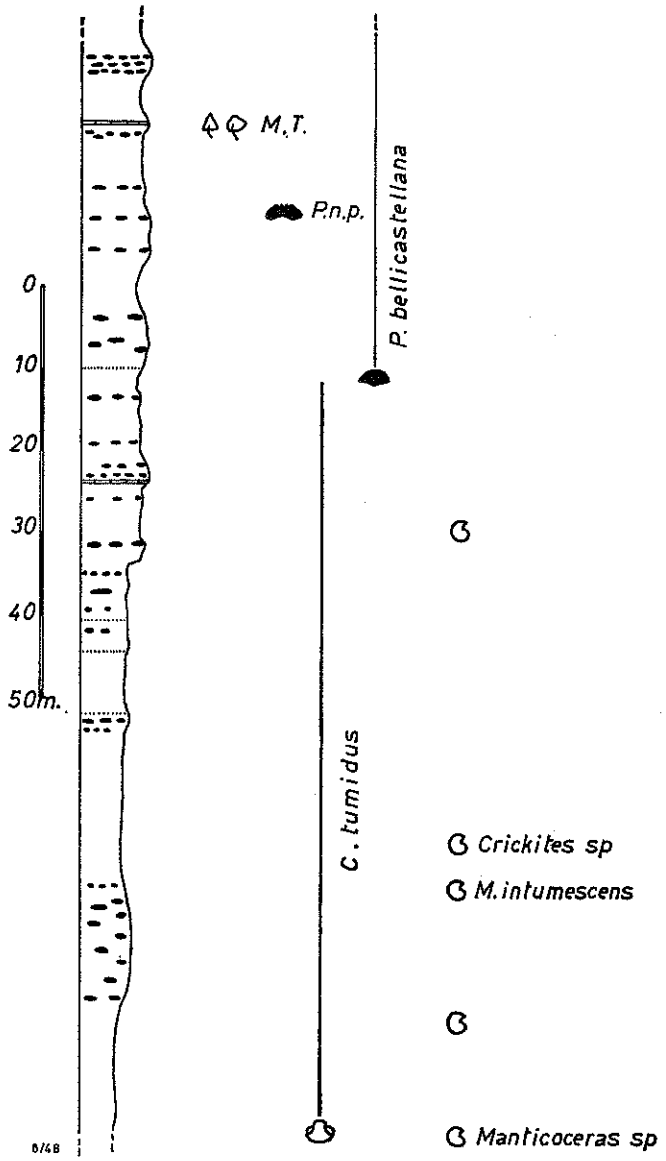


Fig. 2: Frasnian/Famennian boundary in the Matagne-Barvaux transitional facies
Diagrammatic columnar section with range of fossils. Note the association of "Frasnian" goniatites with *Caryorhynchus tumidus* in the lower portion of the section. *Paromoeopygma bellicastellana* and *P. nux praenux* occur about 30 m above. Conodonts of the Middle *triangularis*-Zone (M.T.) occur within the *P. bellicastellana*-Zone.

asymmetricus, allows us to indentify the Lower *triangularis*-Zone for the first time in Belgium.
The Lower *triangularis*-Zone, positively indicated by the fauna of bed 48b, can be extended downward from the base of layer 50 to the base of layer 48b.
Perhaps, it may also be extended to the top of layer 48t where *P. nux praenux* appears. So, it may be considered that the appearence of this brachiopod reflects at the same time a change of environment that coincides with the beginning of a new conodont fauna.
The distinction between the Lower and the Middle *triangularis*-Zone is made by three specimens of *Ancyrognathus cryptus* recovered within 2546 conodonts that means 0,1 % of the conodont association. It is to be noted that *Palmatolepis delicatula* is lacking among the *Palmatolepis* species collected in the Middle *triangularis*-Zone.
On the other hand the change between the Upper *gigas*-Zone and the Lower *triangularis*-Zone is marked by:
1. The total lack of the 3 % of *Ancyrodella curvata* and the 2 % of *Ancyrognathus asymmetricus* recovered below.
2. The replacement of all *Palmatolepis subrecta* by *Palmatolepis triangularis*.
3. The dominant *Polygnathus* fauna changes from a majority of *P. normalis* into the majority of *P. brevilamina*.
4. There is also a change in the *Icriodus*-fauna but a detailed study is necessary before specific identifications can be given.
5. The 1 % of *Spathognathodus gradatus* changes into a different species.

In summary, all the rapidly evolving conodont genera show an important change which affects more than the half of the total conodont population in contrast to the 0.1 % of change between the Lower and the Middle *triangularis*-Zones.
The studies of the brachiopod and conodont faunas allow to draw the following conclusions:
1. The inadequacy of the Frasnian/Famennian contact at Senzeilles for a precise paleontological definition of this limit.
2. The small thickness of rocks in the Lower *triangularis*-Zone.
3. The important change of conodont-population at the base of the Lower *triangularis*-Zone.
4. The appearence of *P. nux praenux* in the Lower *triangularis*-Zone.

According to these conclusions the authors regard the Lower *triangularis*-Zone as Famennian in age. They also strongly suggest to establish a new boundary stratotype for the Frasnian/Famennian limit in the Hony section with the boundary to be placed at the base of layer 48 b (see Fig. 3).

V. Correlation of the Senzeilles and Hony sections using palynological methods

An attempt has been made to correlate this newly proposed Frasnian/Famennian limit at Hony with the shaly part of the classical section of Senzeilles using the quantitative variations of presumed planctonic plant-microfossil assemblages. For that purpose, both sections have been sampled in a rather great detail, and particular focus was put on those portions of shales which underly the limestone beds containing the fauna of the Middle *triangularis*-Zone. The aim was to correlate the limestone beds of the Lower *triangularis*-Zone of Hony with the equivalent part of the section at Senzeilles which is devoid of any limestone beds.
The quantitative data are presented in details on fig. 1 and fig. 3. Most of the samples are extremely rich in well preserved acritarcha (a few thousands specimens on each microscopical slide). Spores are poorly preserved. The systematic position is briefly mentioned in the legend of the fig. 1 and 3. We refer to DRICOT (1971) for a taxonomic discussion of these taxa. Our data are preliminary and a more complete study is planed including various other sections of the same stratigraphical interval.
Nevertheless, we would already now like to emphasize the similarity of the general trends of variations that occur in the acritarcha assemblage from the bottom to the top of both sections especially regarding: 1. the ratio *Micrhystridium/Leiosphaeridia* and *Lophosphaeridium*, 2. the abundance of *Veryhachium ceratioides* and *Baltisphaeridium* cf. *longispinosum* increasing upwards in the section, 3. the ocurrence in the upper part of both sections of the genera *Daillydium*

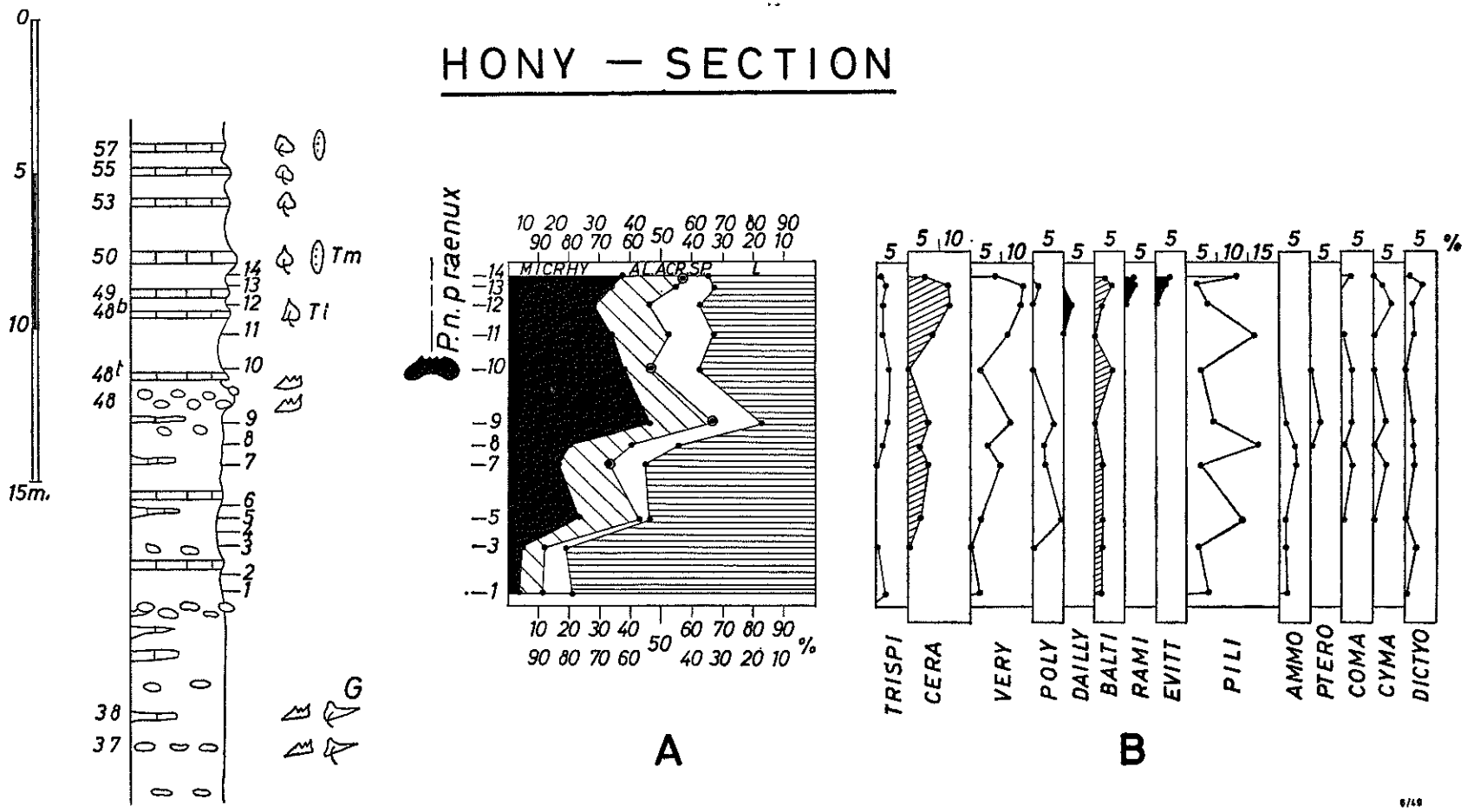


Fig. 3: The section of Hony

Columnar section at left demonstrates the Middle *triangularis*-Zone (Tm) to range from layer 50 upward. The Upper *gigas*-Zone (G) occurs from layer 48 t downward. Between these two layers, bed 48 b contains a huge fauna positively indicative of the Lower *triangularis*-Zone (Ti). The entire extent of this zone is from the base of layer 48 b to the base of layer 50. If it can be extended downward to the top of layer 48 t it coincides with the first occurrence of *Pampoecilorhynchus nux praenux*. A and B = Palynological evidence from a selected sequence of layers 1 to 14 (explanation see caption of Fig. 1).

and *Evittia* and the species *Baltisphaeridium ramispinosum*. We tend to believe that this more or less correlative variation might represent a biostratigraphic feature that is not too much subjected to facies control. We therefore assume that the time equivalent of the limestone beds of the Lower *triangularis*-Zone at Hony has to be searched in that part of the Senzeilles section where the ratio *Micrhystridium/ Leiosphaeridia* and *Lophosphaeridium* is rather high. This means that the newly proposed base of the Famennian at Hony would have to be located not below the classical limit of GOSSELET at Senzeilles, but between this limit and the first occurrence of conodonts of the Middle *triangularis*-Zone.

The petrographical analysis of a few samples containing Acritarcha at Senzeilles has revealed a great homogeneity of the finely recristallised pelitic material. Samples 11 to 13 yield very small quartz-grains, a few framboidal pyrite crystals and are fairly calcitic. These shales (11–13) contain also fragments of vegetal material surrounded by a thin coherent layer of cryptograined kaolinite which does not occur in samples 14 to 16.

All samples (11–16) show a few disarticulated ostracods.

At Hony all samples are also pelitic but sample 1 in addition contains heterogranular quartzite material. This material is better sorted in samples 3 to 5 and is lacking in the successive samples 7 to 14.

A mineral fraction insoluble in the fluoridric acid treatment required for palynological analysis is present in the slides corresponding to samples 1 to 8.

We therefore assume that a change at least in the velocity of the marine currents at the time during which the investigated sediments were deposited is of the same rate and might be related to the quantitative change in the phytoplanctonic association.

Literature

BOUCKAERT, J., ZIEGLER, W. & THOREZ, J. (1965): Conodont stratigraphy of the Famennian stage (Upper Devonian) in Belgium. — Serv. géol. de Belgique, Mém. 5: 1–40, pls. 1–5, 9 tabl., Bruxelles.

BOUCKAERT, J. & THOREZ, J. (1966): Contribution à l'étude du Devonian supérieur dans la région d'Esneux. — Soc. belge Géol. Pal. Hydr. Bull. 74: 1–7, 1 textfig., 1 tabl., Bruxelles.

BOUCKAERT, J., STREEL, M. & THOREZ, J. (1969): Biostratigraphic scale of the Famennian stage (Upper Devonian) in the type localities of Belgium: a preliminary report. — J. Paleont. 43: 727–734, pls. 93–94, 2 textfigs., Tulsa/Okla.

DRICOT, E. M. (1971): Acritarches du Frasnien moyen et supérieur de la Belgique. Systématique et aspects écologiques. — Univ. Cath. Louvain (unpublished dissert.).

GOSSELET, J. (1871): Histoire des Sciences locales. Esquisse géologique du Département du Nord et des contrées voisines. — Bull. sci. du Départ. du Nord, 3e ann., no. 11: 291–301, no. 12: 316–325, Bruxelles.

GOSSELET, J. (1877): Première note sur le Famennien: Quelques documents pour l'étude des Schistes de Famenne. — Ann. Soc. géol. Nord, IV: 303–320, Bruxelles.

GOSSELET, J. (1888): L'Ardenne. — Paris.

MOURAVIEFF, A. N. (1970): Biostratigraphie par Conodontes du Frasnien Moyen et Supérieur de la Belgique. — Univ. Cath. Louvain (unpublished dissert.).

SARTENAER, P. (1957): Esquisse d'une division stratigraphique nouvelle des dépôts du Famennien inférieur du Bassin de Dinant. — Soc. belge Géol. Pal. Hydrol. Bull. 65: 421–446, Bruxelles.

— (1960): Visage "1960" de la "tranchée de Senzeiles". — Soc. belge Géol. Pal. Hydrol. Bull. 68: 430–442, 3 pls., Bruxelles.

— (1968): De la validité de *Caryorhynchus* CRICKMAY, C. H., 1952, genre de brachiopode rhynchonellide, et de sa présence dans le Frasnien supérior d'Europe occidentale. — Bull. Inst. r. Sci. nat. Belg. 44, no. 34, Bruxelles.

— (1968): De l'importance stratigraphique des rhynchonelles Famenniennes situées sous la zone à *Ptychomaletoechia omaliusi* (GOSSELET, J., 1877). Cinquiéme note: *Paromoepygma* n. gen. — Bull. Inst. r. Sci. nat. Belg. 44, no. 42, Bruxelles.

— (1968): Idem. Sixiéme note: *Pampoecilorhynchus* n. gen. — Bull. Inst. r. Sci. nat. Belg. 44, no. 43, Bruxelles.

— (1970): Le contact Frasnien-Famennien dans la région de Houyet-Han. s. Lesse. — Ann. Soc. géol. 92: 345–357, Bruxelles (1969).

ZIEGLER, W. (1971): Conodont Stratigraphy of the European Devonian. — Geol. Soc. Amer. Mem. 127: 227–284, 3 textfigs., 6 tabl., Boulder/Colorado.