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STRATIGRAPHY OF THE UPPER FRASNIAN AND FAMENNIAN DEPOSITS IN THE REGION OF HAMOIR-SUR-OURTHE

(DINANT SYNCLINORIUM, BELGIUM)

par
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(DINANT SYNCLINORIUM, BELGIUM)

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INTRODUCTION

The purpose of this paper is to present brief descriptions useful for the recognition of lithostratigraphic subdivisions and of the conodont and rhynchonellid biozonation, of different outcrops in the Upper Frasnian and Famennian of the Hamoir region in continuation of work already published (Bouckaert and Streel, 1974 ; Dreesen and Dusar, 1974). Detailed descriptions of all outcrops are stored in the Archives of the Belgian Geological Survey under the location numbers also utilised in this text.

A detailed description and stratigraphical subdivision of the Devonian-Carboniferous transition beds was provided by the Tohogne borehole (158W270) which contained a continuous section from "Fa2c" to "Tn2b", recognised with conodonts, foraminifera, spores and acritarchs. These transitional beds developed in a more marine depositional environment as compared to the equivalent beds known northwards in the classical part of the Ourthe valley (Bouckaert et al., 1977 ; Bouckaert and Dusar, 1976 ; Dusar, 1976a ; Vanguestaine et al., 1978).

A geological map with explanatory note of the Hamoir region is presented separately (Dusar, in press). The strata exposed comprise shale, sandstone and carbonate units ranging from Lower Devonian to Lower Carboniferous and belonging to the eastern margin of the Dinant Synclinorium along the Xhoris thrust fault system (fig. 1-2). The subdivision of the neritic-coastal complex at the top of the Devonian proved difficult however without additional biostratigraphic data provided by rhynchonellids and especially conodonts which were extracted in great numbers from calcareous intercalations.

The standard conodont zonation of the Upper Devonian based on pelagic fauna associations was established in Germany on the eastern border of the "Rheinische Schiefergebirge" and in the Harz (Ziegler, 1962-1971). This standard zonation cannot be applied directly in the belgian sedimentary basins where, because of facies differences, the number and frequency distribution of the conodonts are different, even if the time range for each conodont morphospecies remains unchanged. The influence of local facies conditions on the biozonation (e.g. absence or delay in first appearance of some conodont guides) is discussed.

SUMMARY

Brief descriptions are given of relevant outcrops in the Upper Frasnian and Famennian deposits of the Hamoir region (eastern part of the Dinant Synclinorium) which allow a refinement of the stratigraphic subdivision and provide new insights in the tectonic structure of the area and in the facies relationships of the lithostratigraphic units.

The conodont distribution in the Upper Frasnian and the Famennian strata on the eastern border of the Dinant Synclinorium has been correlated with the standard zonation valid for pelagic facies conditions. In the Lower Famennian the conodont zonation is parallellised by the rhynchonellid zonation. The validity of the different zonal correlations and the absence or delay in appearance of some guide forms is evaluated.

SAMENVATTING

Korte beschrijvingen van enkele profielen in de Boven Frasniaan en Famenniaan lagen van het gebied rond Hamoir tonen hun aandeel in de verfijning van de stratigrafische schaal en leiden tot een betere interpretatie van de tektonische struktuur en van de paleogeografie.

Een biozonatie gebaseerd op conodonten en geldig voor de oostrand van het Bekken van Dinant werd onafhankelijk opgebouwd en vergeleken met de standaardzonatie gebaseerd op pelagische diepwatervormen. In het onder- en middendeel van het Famenniaan werd deze zonatie integraal teruggevonden. De ontbrekende of de voor correlatiedoeleinden minder betrouwbare zones werden kritisch besproken. In het Onder Famenniaan blijven de conodontenzonatie en de rhynchonellazonatie vrijwel gelijklopend.

RESUME

L'échelle stratigraphique, l'interprétation de la structure tectonique et les relations faciétiques des dépôts sédimentaires du Frasnien supérieur et du Famennien de la région d'Hamoir ont été améliorées grâce à l'étude de quelques profils-clés. La distribution des conodontes dans le Frasnien supérieur et le Famennien de la bordure orientale du Synclinorium de Dinant

a permis d'établir une zonation régionale, corrélée ensuite avec la zonation-standard établie dans des bassins pélagiques.

Cette zonation est parallellisée par la zonation des rhynchonellides au moins pour le Famennien inférieur. Toutefois, les zones à conodontes reconnues ne permettent pas toujours des corrélations interrégionales sûres. Une explication est proposée pour les différences apparentes dans cette zonation.

STRATIGRAPHIC DESCRIPTIONS

1) THE UPPER FRASNIAN

The shale sequence overlying the last massive Frasnian biostrome shows some remarkable correlations (fig. 3). These deposits are assigned to the *Ancyrognathus triangularis* and Upper *Palmatolepis gigas* conodont-Zones (plate 1).
Some of the sections were already described or mentioned by Coen (1974) : 158E 268 = My 3 ; 158W 143-569 = Sy 9 ; 158W 121 = Sy 6 ; 158W 146 = Sy 8 ; 158E 291 = Comblain 1a Tour 2.
These Upper Frasnian beds overly massive biostromal limestones in the north and partly clayey nodular limestones (Bomal lagoon, Coen 1974) in the south (Vieuxville 158E 268).

A subdivision into three units is recognized everywhere. The lower unit consists of grey-green shales with numerous nodular limestone layers ("F2i"-type) varying widely in thickness (40 to 90 m). Conodont samples indicate the *Ancyrognathus triangularis* - Zone although the lowermost samples overlying the biostromal rocks generally contain a restricted *Polygnathus* fauna. The upper part of the "F2i"-type shales is characterised by the occurrence of *Minatothyris maureri* within a rich brachipod fauna.

A second unit varies in regard to its position north or south of the Xhoris thrust fault. To the south it is up to 30 m thick and consists of a fine limestone marker bed which is often doubled, followed by clayey limestones and marls ("F2k"-type). The limestone marker bed forms the base for isolated "F2j" biohermal mounds. The northern most "F2j" bioherm in the Dinant basin is found in Hamoir at the crossing with the Xhoris road. An *Ancyrognathus asymmetricus* conodont association indicating the Upper *Palmatolepis gigas*-Zone and *Phillipsastraea* colonial corals characterise this sequence. North of the Xhoris thrust fault another facies occurs in the second unit rich in *Phillipsastraea* and consists of nodular limestones forming a third Frasnian biostrome (open-lagoonal equivalent to the F2j-type bioherms towards the south) and increasing in thickness to the north (from 3 m to more than 15 m). The presence of *Ancyrognathus asymmetricus* in 158W 166 also

indicates the Upper *Palmatolepis gigas* - Zone (specimen in possession of A.N. Mouravieff). The Lower *Palmatolepis gigas* - Zone (*P. gigas* without *A. asymmetricus*) has not been recognised thus far in the Dinant sedimentary-tectonic basin. Time-equivalent beds probably are characterised by the persisting *Ancyrognathus triangularis* association. However in the Theux tectonic window the Lower *Palmatolepis gigas* - Zone has been recognised in the Polleur borehole (Dusar and Dreesen, 1976).

A third unit with typical purple colouration of the shales (Barvaux-type) is more regular in facies and thickness (70 m in the south ; nearly 100 m in the north). Conodonts are rare but indicate the Upper *Palmatolepis gigas* - Zone. The sand content increases notably at its top near the Frasnian-Famennian stage boundary (sand influxes in stormlayers).

2) THE FRASNIAN-FAMENNIAN TRANSITION

The Frasnian-Famennian stage limit is drawn at the base of the *Palmatolepis triangularis* conodont - Zone. A new rhynchonellid fauna with *Pampoecilorhynchus lecomptei* and *P. praenux* also appears at this level (figs. 4-6).

a) XHIGNESSE 158W 798

1974 - Bouckaert, J., Coen, M., Coen-Aubert, M. and Dusar, M. in Bouckaert, J. and Streel, M., International Symposium on belgian micropaleontological limits, Namur 1974, Guidebook Excursion I-7.

A reference section situated near Xhignesse, a hamlet of Hamoir on the right bank of the Ourthe. The transition from Upper *gigas* - Zone to Upper *triangularis* - Zone is observed, as well as the intervening rhynchonellid zones. Unfortunately a small (4 m wide) gap in the outcrop masks the point where the stage limit passes between samples 4 and 5. In addition to the columnar section (scale 1:500) published in the Namur Symposium Guidebook, a tectonic situation map is given in fig. 4. This section is only part of a large discontinuous outcrop along the Ourthe, from biostromal F2gh - type limestones in the north to Famennian shales with *Ptychomaletoechia dumonti* (Upper *crepida* - Zone) in the south.

b) NOISEUX 168E 25-26

1974 - Bouckaert, J., Coen, M., Coen-Aubert, M. and Dusar M. in

in Bouckaert, J. and Streel, M., International Symposium on belgian micropaleontological limits, Namur 1974, Guidebook Excursion I-5.

This section represents a more complete reference section, which yielded rich conodont faunas from Upper *gigas* to Middle *crepida* - Zones, and rhynchonellid faunas from *Pampoecilorhynchus praenux* to *Phychomaletoechia dumonti* (Sartenaer, 1972).

The Lower *triangularis* - Zone has not been recovered. *Palmatolepis triangularis* and *P. delicatula* appear together at layer 6, barely half a metre of shale above the preceding sample with a Frasnian microfauna. The lower limit of the Famennian stage coincides here with the base of the Middle *triangularis* - Zone and not with the base of the "Lower *triangularis*" - Zone as in other sections. This is probably due to the higher frequency of the formgenus *Palmatolepis* at these levels which are richer in pelagic conodonts (15 % *Palmatolepis* in the total conodont fauna at Noiseux, 8 % only at Xhignesse). Hence an increased probability of finding specimens of a new pelagic index - species normally rare at the point of its first appearance (Dusar, 1976b).

In addition to the columnar section published in the Namur Symposium Guidebook, a situation map is given in fig. 5.

c) VERLAINE 158W 143 (fig.6)

1974 - Coen, M., Ann. Soc. géol. Belg., 97, 1, 67-103 (out crop Verlaine = Sy 9).

This section located in the turn of a road south of Verlaine, a Tohogne hamlet, and continuing up to the Frasnian biostromes (see fig. 3, 158W 569) was briefly described by Coen. The strata are vertical to slightly overturned passing into a synclinal fold in the middle of the road. On the north side of the road the gently southward-dipping beds belong to the Middle *triangularis* - Zone (with *Pampoecilorhynchus praenux*) and contain *Palmatolepis triangularis, P. quadrantinodosalobata, P. delicatula, P. delicatula clarki, Ancyrognathus sinelaminus*.

The first appearance of *P. triangularis* is in bed 6, also marked by an outburst of *Icriodus* (up to 49 % of the total conodont fauna). The highest bed which can be attributed with certainly to the Frasnian is bed 4. Between beds 6 and 4 there is 7 m of shale with fossiliferous calcpsammitic

beds, the upper half containing *Pampoecilorhynchus praenux* and *P. lecomptei*, which could lower the base of the Famennian to bed 5. This is the only section where Fammennian conodonts do not appear simultaneously with or slightly earlier than Famennian rhynchonellids.
A slight diachronism in the first appearance of these two fossil groups is not excluded, althongh the scarcity of conodonts is more a plausible explanation here.

d) COMBLAIN LA TOUR 158E 281 (fig. 3)

The Frasnian-Famennian transition is also observed in this poorly preserved and partially exposed section showing sleeply overturned purple-coloured shales. The presence of the "Lower *triangularis*" - Zone is marked by the appearance of *Palmatolepis triangularis* and the sudden outburst of *Icriodus*. Near the main road are many sandy limestone nodules and calcpsammitic layers containing *Pampoecilorhynchus praenux* and a Middle *triangularis* conodont association (*Palmatolepis triangularis, P. triangularis - quadrantinodosalobata, P. delicatula delicatula, Ancyrognathus sinelaminus*).

3) THE LOWER FAMENNIAN

P. triangularis and *P. crepida* conodont - Zones (plate 2)

A detailed subdivision of lithologically more uniforme Lower Famennian shales is made possible by the conodont and rhynchonellid biozonations. A correlation scheme between conodont and rhynchonellid zonation, based on numerous sections and small outcrops has been proposed by Dusar (1976b). Continuous sections showing large sequences of Lower Fammennian rocks are rare, except for the Noiseux section (168E 25-26) and the Xhignesse section (158W 798).

- COMBLAIN LA TOUR 158E 283 (fig.7)

Section in or along a small path showing Middle *crepida* shales with *Phychomaletoechia dumonti*.

In the westward turn of the path, similar but older shales are exposed, also with *P. dumonti* and Middle *crepida* - Zone conodont associations (nrs. 158E 284-285).

Thickness of the Middle *crepida* - Zone and the *dumonti* - Zone both at least 45 m here.

153E 283	1	2	3	4	5
con./kg	2	81	5	262	5
P. crepida	x	x		x	
P. tenuipunctata	x	x	x	x	
P. quad. lobata		x	x	x	x
P. termini		x		x	x
P. minuta		x			
P. circularis				x	
A. sinelaminus				x	
P. procerus			x	x	
P. cf. brevilaminus				x	
P. communis		x			
"I." cornutus		x		x	

4) THE LOWER-UPPER FAMMENNIAN TRANSITION

a) OUFFET 158W 60 = 1i (fig. 7)

1974 - Dreesen, R. and Dusar, M., Int. Symp. belg. micropal. limits, Namur 1974, Publ. 13, p.2.

Important outcrop along the road Hamoir-Ocquier near an old mill in the Néblon valley showing the transition from Famenne Shales with *Phychomaletoechia dumonti* (Middle and Upper *crepida* conodont - Zones) to sandy micaceous shales ("Schistes stratoides") of the Esneux Formation with *Basilicorhynchus basilicus gerardimontis* and *Cavatisinurostrum faniae*, situated in the upper (most ?) part of the *crepida* - Zone.

158W 60 = 1i	0	1	2'	3	3'	4	5'	6'	9
P. crepida	x			x	x	x		x	
P. tenuipunctata	x				x				
P. quad. lobata	x		x	x					
P. termini			x	x	x				
P. minuta				x	x	x			
P. glabra prima				x	x		x	x	x
P. subperlobata				x					
P. cf. regularis							x		
P. procerus	x	x				x			
P. lauriformis				x					
P. semicostatus							x		x
P. nodocostatus									x
I. alternatus					x				
I. cornutus									x
	Middle *crepida*			Upper *crepida*					Upper most ? *crepida*

b) HAMOIR 158W 763 (fig. 7,8)

1974 - Bouckaert, J., Coen, M., Coen-Aubert, M. and Dusar, M. in Bouckaert, J. and Streel, M., Int. Symp. belg. micropal. limits, Namur 1974, Guidebook excursion I-8 (Hamoir-Néblon).

1974 - Dreesen, R. and Dusar, M., Int. Symp. belg. micropal. limits, Namur 1974, Publ. 13, p. 3.

This section with its conodont distribution was partially published in the Namur Symposium Guidebook. Some corrections in conodont terminology have since become necessary : *P. quadrantinodosa inflexoidea* should read *P. helmsi* ⁂ *P. quadrantinodosa inflexa* should read *P. cf. inflexa*.

⁂ (this form-species has recently been interpreted by ZIEGLER as a particular Morphotype of the P. glabra lepta group - see catalogue of conodonts)

Add *P. inflexa inflexoidea* for sample 11 (figured broken specimen).
The section is extended downwards; so 3 new conodont bearing levels are included :
"6" : *Polygnathus bouckaerti, P. semicostatus, Palmatolepis rhomboidea, P. glabra prima, "Icriodus" cornutus, Spathognathodus strigosus*
"5" : *Polygnathus semicostatus, Palmatolepis glabra prima*
"4" : *Pelekysgnathus inclinatus*
This section shows some interesting litho- and biostratigraphical features.
The green sandy shale facies on the Esneux Formation is developed from the base of the section upwards.
The basal beds are situated in a probably condensed *crepida - rhomboidea* zonal interval in continuation with bed 9 of the preceding section.
The Upper Famennian starts with the first appearance of *Palmatolepis rhomboidea* (bed "6"), at least 15 m above the installation of the Esneux Formation. This formation contains 2 distinct oolitic ironstone horizons succeeded by an important accumulation of crinoid ossicles. The upper oolitic ironstone level is an excellent marker bed, and has been observed throughout the Dinant, Vesdre and Theux basins (level IIIb) (Dusar & Dreesen 1976 ; Dreesen 1982). This event-stratigraphical marker bed also forms the base of the *marginifera* conodont - Zone in the Hamoir area.
The resulting thickness of the *rhomboidea* - Zone is 20 m only.
The succession of this important oolitic ironstone bed by an irregular accumulation of large crinoid stems is also observed in different sections of the Hamoir area (see fig. 8).

c) HAMOIR 158W 762 (fig. 8)
Outcrop along the southern Néblon valley slope.
The Esneux shales immediately below the oolitic ironstone marker bed are separated from Lower Famennian shales with Middle *crepida* - Zone conodonts, by a satellite-fault of the Xhoris thrust fault.
Conodonts :
762-4 : *Polygnathus semicostatus, "Icriodus" cornutus*
762-3 : *Palmatolepis klapperi, P. glabra prima, P. glabra pectinata, P. glabra lepta, P. stoppeli, P.* cf. *inflexa, P. inflexa inflexoidea, P. inflexa* cf. *inflexoidea, P. minuta minuta, P. minuta*

loba - *P.* sp. *A.* Sandberg and Ziegler 1973, *Polygnathus glaber glaber, P. communis, P. semicostatus, P.* cf. *semicostatus, P.* aff. *procerus* Matya 1972 (= *semicostatus* juvenile ?), *P. nodocostatus, P.* cf. *pennatuloideus, Pelekysgnathus inclinatus.*

d) HAMOIR 158W 56 (fig. 8)

1974 - Dreesen, R. and Dusar, M., Int. Symp.belg. micropal. limits, Namur 1974, Publ. 13 (= Hamoir nord, with conodont fraquency distribution list).

1975 - Streel, M. et al., Int. Symp. belg. micropal. limits, Namur 1974, Publ. 19, p. 5, 21.

Outcrop along the western slope of the Ourthe valley, north of Hamoir with the oolitic ironstone (level IIIb) marker bed containing the first Lower *marginifera* - Zone conodonts. Up to 7 m higher, a 3 m mound-like accumulation of large crinoid stems is reminiscent of the Upper Famennian biohermal crinoid-mound at Baelen (Vesdre tectonic basin). The stratigraphic position is different however, as the biohermal mound in Baelen forms a reef-like lateral equivalent to the Souverain Pré Formation (Dreesen, 1977 ; Dreesen & Flajs, 1984, in press).

Also noteworthy are the different conodont associations observed in random samples from the same oolitic marker bed at the 3 outcrops near the centre of Hamoir (oolitic ironstone level IIIb of Dreesen, 1982) :

763 : dominance of *Palmatolepis rhomboidea*

762 : dominance of *Palmatolepis klapperi*

56 : dominance of *Palmatolepis glabra.*

e) OUFFET 158W 36 (fig. 8)

Outcrop along the road Hamoir-Ocquier, Néblon valley showing the oolitic ironstone marker bed with overlying crinoidal beds and containing Lower *marginifera* - Zone conodonts. (oolitic ironstone level IIIb of Dreesen, 1982)

158W 36	1	4	3	2
con./kg	102	34	145	36
P. rhomboidea	x			
P. minuta minuta	x			
P. minuta loba	x			
P. glabra prima	x	x	x	
P. glabra pectinata	x	x	x	x
P. glabra acuta	x		x	
P. glabra lepta	x			x
P. perlobata	x		x	
P. inflexa inflexoidea	x		x	
P. cf. inflexa			x	
P. cf. inflexa → marginifera			x	
P. inflexa inflexa			x	
P. klapperi			x	
P. subperlobata			x	
S. strigosus	x		x	x
P. glaber glaber	x			
P. semicostatus	x	x		
P. cf. semicostatus	x			x
P. nodocostatus	x		x	
P. cf. pennatuloideus	x			
P. procerus	x		x	
P. lauriformis	x		x	
P. planirostratus			x	
I. alternatus	x	x		
"I". cornutus			x	x

f) COMBLAIN LA TOUR 158 W 855 (fig. 9)

1974 - Dreesen, R. and Dusar, M., Int. Symp. belg. micropal. limits, Namur 1974, Publ. 13 (= Hamoir-Fairon, HF).

Outcrop 350 m NNW of Fairon centre. The outcrop morphology has changed after a recent construction ; hence a more complete tectonic profile has been available showing the transition between the *rhomboidea* and *marginifera* conodont - Zones in the Esneux Formation. Bed 4 marking the first appearance of Palmatolepids characteristic of the *marginifera* - Zone corresponds to the oolitic ironstone marker bed (level III b) in the sections around Hamoir (lag deposits consisting of phosphatic micro-pebbles, conodonts and fish remains, instead of ferruginous ooid). The holotype of *? Polygnathus pseudostrigosus* Dreesen and Dusar*, 1974 was recovered from this bed.

* this particular platform conodont type represents a new shallow-water conodont form genus, defined as *Alternognathus* Ziegler & Sandberg, 1984, in press.)

g1) TOHOGNE 158 W 150 north of Xhoris thrust fault (fig. 7)

Outcrop along the road Hamoir-Tohogne north of the Xhoris Fault. At the turn of the road to the south, Lower Famennian shales with *Ptychomaletoechia dumonti* and *crepida* - Zone conodonts, are separated from the sequence outcropping in 158 W 150 by a major although inconspicions fault belonging to the Xhoris thrust fault system.

Esneux Formation (lower to middle part) with *Basilicorhynchus basilicus gerardimontis* and *Cavatisinurostrum faniae* and conodonts of the Lower *marginifera* - Zone. Above level 1 a 60 cm thick completely weathered nodular horizon may correspond to the oolitic ironstone bed.

Zone / Conodonts	Upper *rhomboidea*					Lower *marginifera*	
Sample HF(185E 855)	0	1	2	00	3	4'	4
Palmatolepis rhomboidea	2	–	–	3	4	–	14
P. glabra prima	1	3	1	3	2	–	4
P. glabra pectinata	5	3	5	2	5	2	8
P. glabra acuta	–	–	–	2	x	–	3
P. glabra lepta	–	–	–	–	x	–	1
P. subperlobata	1	–	–	–	–	–	–
P. klapperi	–	–	1	–	–	–	–
P. cf. helmsi	–	–	–	–	–	–	1
Polygnathus semicostatus	13	10	12	8	59	24	326
P. nodocostatus	1	–	–	1	1	2	6
P. aff. procerus Matya, 1972	2	–	–	3	1	2	11
P. bouckaerti	1	–	1	2	5	2	11
P. communis	1	–	–	1	–	2	–
P. procerus	–	–	1	–	3	–	3
P. planirostratus	–	–	–	1	–	–	10
P. cf. pennatuloideus	–	–	–	–	x	–	2
P. lauriformis	–	–	–	–	x	–	2
A. pseudostrigosus	–	–	–	–	2	–	8
Polyophodonta linguiformis	–	–	–	–	–	2	–
Spathognathodus amplus	1	–	–	–	–	–	3
S. strigosus	–	–	–	2	1	2	4
Icriodus chojnicensis	1	–	–	6	10	4	56
Pelekysgnathus inclinatus	–	–	–	–	3	–	4
ramiform elements	2	3	15	8	52	7	96
Total specimens	33	7	27	64	770	22	911
Weight of samples in kg	1	0,4	0,75	1,35	5,2	0,45	1,6
Number of conodonts/kg	32	18	36	41	148	49	570

Table : Conodont distribution in the Hamoir-Fairon (HF) section 158 W 855)
(number of conodont specimens per kg)

158W 150	5	2	1
con./kg	4	14	40
P. perlobata schindewolfi	x	x	
P. minuta loba		x	
P. glabra prima		x	x
P. glabra pectinata		x	x
P. marginifera marginifera		x	
P. inflexa inflexoidea			x
P. communis	x		x
P. semicostatus		x	x
P. procerus			x
P. glaber glaber			x
"I". chojnicensis			x

g2 TOHOGNE 158 W 150, south of the Xhoris thrust fault (fig. 7)

A new road outcrop on top of 158 W 150 completes the section south of the Xhoris thrust fault. The transition of the Mariembourg shales to the Aye Shales (equivalent of Esneux psammites, Bouckaert, Streel & Thorez, 1968 ; Dreesen & Dusar, 1975) is exposed here. These shales are highly fossiliferous. Noteworthy is a 5 moverlap between the *P. dumonti* zone (characterising the upper Fammenne or Mariembourg Shales) and the *B. basilicus-Evanescirostrum - C. faniae* (characterising the lower part of the Aye - Esneux formation) rhynchonellid faunas immediately below a red-coloured oolitic ironstone bed which contains goniatites (*Cheiloceras*)*. The shale overlying the oolite bed, on top of the road outcrop, is rather sandy, finely laminated and almost barren of megafossils. This oolitic ironstone bed corresponds to the basal part of a split level III b (*uppermost ? rhomboidea*) which can be correlated with the basal part or lower oolitic ironstone lens of Section 158 W 763 (described under 4 b). The upper part of this split oolitic level III b (not exposed here in the new road outcrop)

has been dated as basal *P. marginifera*.
Its lateral equivalents are in sections 4 a (uppermost part of the section) and 4 b (lowermost part of the section) and show the appearance of the *B. basilicus* association in a more sandy shale environment, well separated from the underlying Famenne shales with *P. dumonti*, and directly overlain by barren, finely laminated sandy shales without intervening oolitic marker.
A detailed study of this new outcrop and its relationships with its northern equivalents is actually carried out in the Paleobotany-Palynology Laboratory of the Liège University.
The medium angle thrust fault separating the new outcrop from the underlying outcrop 150 (gl) thus brings into contact beds of slightly different age but of important facies difference.

* Some of the specimens collected within this marker bed (sample TOH - 4) have been determined as *Cheiloceras circumflexum* G. & H. Sandberger by Dr. J. Price (Hull, U.K., written communication, 1982). This goniatite characterizes the top of "Substage" do II a of the German orthozonation.

5) THE UPPER FAMENNIAN

P. rhomboidea, *P. marginifera* and *Sc. velifer* conodont - Zones (plate 3) ; *Sc. velifer* - *B. costatus* "interval - zone " (plate 4).
The Upper Famennian is characterised by a predominance of sandy sediments and a gradual decrease of conodonts in regressive sand-barier and tidal-flatsubtidal environments (Thorez, 1973). The Souverain-Pré Formation which constitutes an important calcareous interruption, was studied in detail by Dreesen (1976b). The Hamoir-Néblon supérieur (HNS) section = 158 W 1 abc which yielded the best conodont faunas has been described in Dreesen & Dusar (1974).

a) HAMOIR 158 W 6ab (fig. 7)

Outcrop along the same road, near the centre of Hamoir, on the north flank of the Hamoir-Houmart syncline. The bed thicknesses were not measured exactly and may be underestimated. Sandy shales of the Esneux Formation (upper part) with a small oolitic ironstone bed and coarse-grained crinoidal limestone layers (Lower *marginifera* - Zone) grade into nodular limestones of the Souverain-Pré Formation, of which the upper 5,5 m are not represented on fig. 5. The Souverain Pré Formation (26 m) is composed of the following units :

- 13,5 m : grey marls with limestone beds (c)
- 8,0 m : clayey limestones, nodular if weathered (b)
- 4,5 m : nodular limestones alternating with shales (a).

The Souverain Pré Formation can be correlated with the well-studied section 158 W 1abc (= Hamoir-Néblon supérieur in Dreesen and Dusar, 1974).

158W 6ab	1	2	3	4	5	6	7	8
con./kg	70	28	406	75	66	24	64	26
Pelekysgnathus sp.	x		x	x				
S. strigosus	x	x	x					
S. amplus			x					x
S. werneri					x			
P. confluens	x							
"I." chojnicensis	x				x	x	x	x
P. semicostatus	x		x	x	x		x	x
P. planirostratus	x							
P. aff. procerus	x		x	x	x			
P. cf. semicostatus	x	x	x	x	x	x	x	x
P. nodocostatus	x		x		x			
P. bouckaerti	x							
A. pseudostrigosus	x							
P. laurifromis			x		x			
P. communis			x					
P. cf. pennatuloideus			x		x			
P. triphyllatus			x	x				
P. cf. perplexus			x					
P. rhomboidea	x	x	x	x		x		
P. glabra prima		x	x					x
P. glabra pectinata	x		x					
P. klapperi	x							
P. helmsi			x					
P. minuta minuta			x					
P. perlobata	x		x					
P. inflexa inflexoidea			x		x			
P. stoppeli					x			
P. quadrantinodosa m. type 1					x			
P. marginifera granulosa							x	
P. distorta								x

b) OUFFET 158 W 4 (fig. 11)

Section along the road Hamoir-Ocquier in the Néblon valley. Souverain-Pré Formation (thickness 31 m !) and basal beds of the Comblain-la-Tour Formation.

Compared to the reference section of Hamoir-Néblon supérieur (Dreesen and Dusar, 1974) this section shows an increase in sand content (also more foraminifera), although a subdivision into a lower nodular limestone unit and an upper sandy-shaly unit with isolated limestone layers persists. As in the HNS section (158 W 1abc) *S. velifer* appears in the upper unit.

158W 4	1	2	2	4	5	6	7	8	9	10	11
con./kg	30	20	7	38	14	2	6	7	11	125	42
I. chojnicensis	x		x	x	x						
P. communis	x	x	x								
P. semicostatus	x	x	x	x	x		x	x	x	x	
P. procerus	x	x		x	x	x	x	x			
P. aff. procerus Matya				x							
P. nodocostatus				x	x				x	x	
P. cf. pennatuloideus				x					x		
P. lauriformis				x							
A. pseudostrigosus				x							
P. perplexus									x		
P. glaber bilobatus										x	
P. cf. nodoundatus										x	
S. strigosus		x		x	x				x		
S. amplus										x	
P. glabra pectinata				x							
P. marginifera marginifera				x							
P. stoppeli - marginifera					x						
P. distorta											x
S. velifer									x		
S. cf. compressa	x										
S. gosseleti				x				x			
S. sp.									x		
S. aff. donica								x			
Quasiendothyra or Tournayella								x			

c) TOHOGNE 158 W 2 (fig. 12)

1899 - Destinez, P., Ann. Soc. géol. Belg., 26, B LVI-LVII.

1900 - Destinez, P., Ann. Soc. géol. Belg., 27, B CLVI-CLVIII.

1941 - Ubaghs, G., Bull. Mus. roy. Hist. Nat., 17, 44.

Important road outcrop along the road Tohogne-Ocquier. The Souverain-Pré Formation (thickness 30 m) is exposed. The subdivision of this formation is recognised : the lower unit consists of nodular limestones in a sandy-calcareous matrix ; the upper unit consists of nodular limestones in a shale matrix alternating with micaceous sandy shales.

The Souverain-Pré Formation is overlain by the Comblain-la-Tour Formation, which can also be subdivided into two units : a typical lower unit (thickness 35 m) consisting of a homogenous rhythmic micaceous sandy shale sequence, and an upper unit (at least 50 m in this section) consisting of well-bedded fossiliferous micaceous sandstones with numerous nodular limestone beds sometimes reminiscent of the Souverain-Pré Formation.

d) HAMOIR 158 W 1e (fig. 12)

Outcrop in the eastern (or left-side) slope of the Néblon valley, along the road Hamoir-Ocquier, exposing beds of the Comblain-la-Tour Formation. The subdivisions recognised in the prerious section can be correlated to this outcrop.

Conodont samples in micaceous organoclastic limestone lenses indicate the Lower *velifer* - Zone although the guide was not recovered.

1e-1 : *Spathognathodus strigosus* (6 con./kg)

1e-2 : *S. strigosus*, *"Icriodus" pectinatus*, *Polygnathus semicostatus*, *P.* cf. *semicostatus*, *Palmatolepis distorta* (64 con./kg)

1e-3 : *S. strigosus*, *P. semicostatus*, *P.* cf. *semicostatus*, *Palmatolepis perlobata schindewolfi* (40 con./kg).

e) TOHOGNE 158 W 152 (fig.12)

A long but badly exposed section in the Nanchnioule valley along the road Verlaine-Houmart, starting at the transition from the lower shaly to the upper sandy-calcareous part of the Comblain-la-Tour Formation. A small fault in a depression east of the outcrop, is probably responsible for the disappearance of the Souverain-Pré Formation. The base of the

Montfort Formation is obscure, probably passing between samples 7 and 8 (large loadcasts = "ball-and-pillow" structure or "pseudonodules").
The exploitable sandstone beds are already much reduced in thickness. The outcrop ends at the contact with the Strunian depression immediately south of Houmart and is so separated from nr. 158 W 153 (Fa2d-Tn1a)-(Dusar, 1976a).
The upper limit of the Montfort Formation which remains within the same rather monotone facies type, is probably situated near the western termination of the outcrop (thickness Montfort Formation ± 150 m).
See also tectonic profile on fig. 12.
All conodont samples are assigned to the *velifer* - Zone. A further subdivision is not possible because of the presence of shallow-water conodont biofacies.

158W 152	1	3	4	5	6	7	8
con./kg	3	110	62	61	4	32	140
Pelekysgnathus inclinatus		x		x			x
"I." pectinatus		x	x			x	x
S. strigosus		x	x	x	x	x	x
P. semicostatus		x	x	x		x	x
P. cf. semicostatus				x		x	x
P. nodocostatus			x				
P. diversus						x	
P. communis							x
P. perlobata		x					
P. distorta			x				
P. marginifera marginifera			x				
S. velifer							x

f) TOHOGNE 158 W 53 (fig. 13)

Quarry near La Hesse.

In the access road the upper part of the Comblain-la-Tour Formation is exposed, showing alternating sandstone beds, nodular beds with brachiopod

lumachelles or dispersed globular brachiopods and some shaly intercalations containing *Streptorhynchus consimilis* and pelecypods. The quarried Montfort Formation is characterised by rather impressive loadcast-structures (reaching a diametre of more than 1 m). In the upper part massive quartzitic sandstones alternate with thin-bedded micaceous sandstones and sandy shales.

158 W 53	2	4	5	7	8	10	11
con./kg	29	25	5	180	7	0	190
Pelekysgnathus inclinatus	x			x			
S. strigosus	x			x			x
S. amplus		x					
S. stabilis				x			
P. semicostatus	x	x	x	x	x		x
P. cf. semicostatus	x		x	x	x		
P. cf. perplexus	x			x			x
P. nodocostatus				x			
P. communis				x			x
P. planirostratus							x
S. velifer	x			x			x
"I". pectinatus				x			
"I". costatus M1							x

g) HAMOIR 158 W 758 (fig. 13)

Section on the northern slope (left side) of the Néblon valley along the road Hamoir-Ocquier. The transition between the Comblain-la-Tour and Montfort Formations is exposed.

The basal beds of the Montfort Formation are characterised by the occurrence of very large loadcast - or ball-and-pillow - structures (1 m high and 4 m long !). Three such loadcast horizons were observed in a 7 m interval. Coarse-grained, bioclastic (crinoidal) limestone lenses are often situated on top of the loadcast-structures (representing lag-deposits probably).

Conodonts recovered :

"Icriodus" costatus M1, Pandorinellina cf. insita, Palmatolepis margini-

fera marginifera, P. perlobata schindewolfi, Polygnathus semicostatus, Pelekysgnathus inclinatus (78 con./kg) of the *S. velifer* - Zone.
To the east of this section lies an abandoned quarry in well-bedded Montfort sandstones (nr. 158 W 757, fig.13).
The succeeding beds on the south-side of the Néblon valley are found in a large abandoned quarry where the upper levels only are still visible (nr. 158 W 41). The total thickness of the lower exploitable part of the Montfort Sandstones in the eastern part of the Hamoir syncline is estimated at 60 m.

h) HAMOIR 158 W 44 (fig. 13)

Section in the western Ourthe valley slope, along the road Hamoir-Tohogne (as are sections 596 and 149), in continuity with 158 W 6ab (Esneux-Souverain Pré Formations).
The Comblain-la-Tour-Montfort transition beds are exposed. The Comblain-la-Tour beds are discontinously exposed on the valley slope between nrs. 6ab and 44. The Montfort beds generally consist of well-bedded often quartzitic sandstones.
Massive loadcast-structures are characteristic for the Montfort Formation ; their first appearance marks the base of this formation in the area studied. No other striking features distinguish this formation from the upper part of the Comblain-la-Tour Formation, since changes are gradual and the depositional environment remains subtidal to open marine (Thorez, 1973). All conodonts belong to the *S. velifer* - Zone. A further subdivision is impossible because of the presence of shallow-water conodont biofacies.

158 W 44	1	2	3
con./kg	200	-	-
I. costatus M1	x	x	
Pandorinella cf.insita	x	x	x
S. amplus			x
A. distorta	x		
P. subserratus	x		
S. velifer		x	

P. semicostatus	x	x	x
P. glaber bilobatus	x		
	x		
A. pseudostrigosus	x		
P. nodoundatus	x		
P. planirostratus		x	x
P. communis		x	x
P. perplexus			x
Pelekysgnathus inclinatus			x

i) TOHOGNE 158 W 596 (fig. 13)

South of 158 W 44 corresponding beds outcrop again due to a turn in the road, which has a direction nearly parallel to the stratification. Montfort sandstones with pseudonodule - or ball-and-pillow - structures reappear. The conodonts belong to the *S. velifer* - Zone. Same remarks as for the previous section.

158W 596	1 + 2	3
con./kg	180	91
"I" costatus M1	x	x
Pelekysgnathus inclinatus	x	
Pand. of insita	x	x
S. amplus	x	
P. distorta	x	
P. perlobata	x	
P. gracilis	x	x
P. helmsi		x
S. velifer	x	x
A. subserratus	x	
P. semicostatus	x	x
P. communis	x	x
P. nodoundatus	x	
P. planirostratus		x

j) TOHOGNE 158 W 149 (fig. 13)

Abandoned quarry in the western Ourthe valley slope in between sections 596 and 44. At the base of the quarry near the road, "ball-and-pillow-" or "pseudonodules" - structures are observed in the 22 m thick lower part of the Montfort Formation.

Above this lower unit sandstones and psammites with many fine sedimentary structures are exposed for 40 m. Limestone beds -even impure - are rare. At the top of the outcrop a bioclastic limestone bed yielded a shallow-water conodont fauna characteristic of the Montfort Formation as a whole : *"Icriodus" costatus M1, Polygnatus communis, Pandorinellina cf. insita* (see plate 4).

k) OUFFET 158 W 492 (fig.13)

Quarry in the Néblon valley along the road Hamoir-Ocquier. Montfort sandstones with many sedimentary structures and even some reddish beds are exposed over 31 m. Because of its structural position these sandstones bear more similarities to the quarried beds at Blockai (158 W 55) or even to the Comblain-la-Tour outcrop (Thorez,1973). No typical loadcasts were found ; they seem to be confined to the basal part of the Montfort Formation. Important loadcast-structures reappear sporadically in the sandy basal part of the Strunian transgressive sequence (Fa2c-Fa2d) as at 158 W 152.

Poor conodont-bearing sample with *Scaphignathus velifer, Polygnathus perplexus* and *P. communis* (12 con./kg).

EVALUATION OF THE CONODONT BIOZONATION OF THE UPPER FRASNIAN AND FAMENNIAN.

1) THE UPPER FRASNIAN.

Conodont guides are illustrated on plate 1.

The conodont biostratigraphy of the Frasnian deposits on the eastern border of the Dinant Synclinorium has been studied in detail by Coen (1973-1974, Bouckaert and Streel, 1974, in Streel et al., 1974).

In the Hamoir region the "F2dh" Middle Frasnian biostromes form a conodont-barren wedge between the *Ancyrodella rotundiloba* - Zone in the "F2a" shales or "Schistes de base" (Coen, 1973) - (Blëron, 158 E 315) and the *Ancyrognathus triangularis* - Zone, commonly recognized in the "F2i" shales.

The lower limit of this *A. triangularis* - Zone coincides with a facies change from biostromal limestone to nodular shale. The marly coral-rich transition beds between the underlying "F2h" and the overlying "F2i" contain a shallow-water conodont fauna characterised by Polygnathids of the *webbi*- group (Xhignesse, 158 W 810). The limit between the *Ancyrognathus triangularis* - Zone s.l. and the Upper *Palmatolepis gigas* - Zone which is characterised by the joint occurrence of *Palmatolepis gigas* and *Angyrognathus asymmetricus*, is found in the "F2k" limestones substratum of the red-coloured "F2j" biohermal mounds south of the Xhoris Fault (*A. asymmetricus* in Sy, 158 W 121) and in the equivalent biostromal horizon north of the Xhoris Fault (*A. asymmetricus* in Rënale, 158 W 166). Correlations remain uncertain however because of the scarcity of pelagic conodont guides, particularly of Palmatolepids.

The Lower *Palmatolepis gigas* - Zone, characterised by the joint occurrence of *Palmatolepis gigas* and *Ancyrognathus triangularis*, before the first appearance of *A. asymmetricus* has yet never been recorded in the Dinant Synclinorium. Beds deposited during the time interval of this zone therefore are most probably incorporated in the upper part of the *Ancyrognathus triangularis* - Zone. Nevertheless, the Lower *Palmatolepis gigas* - Zone has been recognised in the tectonic "Theux Window" in a more condensed shaly succession, reminiscent of the more basinal facies developed more eastwards in Germany (Dusar and Dreesen, 1976).

2) THE FRASNIAN-FAMENNIAN STAGE LIMIT.

The boundary between the Frasnian and Famennian stages has been drawn at the base of the *Palmatolepis triangularis* - Zone in accordance with the Hony reference section (Bouckaert et al., 1972 ; Streel et al., 1974). The base of this zone is very clear-cut in many sections on the eastern border of the Dinant Synclinorium and equally so in the "Theux Window" (Bouckaert and Streel, 1974 ; Coen, 1973 ; Dusar and Dreesen, 1976).
A faunal break clearly appears at the limit between the Frasnian *Palmatolepis gigas* - Zone and the Famennian *P. triangularis* Zone. None of the Frasnian conodont guides, numerous up to the top bed of the Frasnian, persists into the Famennian. Furthermore the frequency distribution of the different conodont formgenera is reversed : *Icriodus* which is indicative for an euphotic marine environment increases spectaculary in the basal beds of the Famennian (Dusar, 1976 b).
The uppermost *Palmatolepis gigas* - Zone established in the german hercynian basins and characterised by the occurrence of *Palmatolepis linguiformis* associated with *P. gigas* before the first appearance of *P. triangularis* has never been recorded in the belgian sedimentary basins. Two possible explanations herefore are proposed : either this zone is incorporated in the underlying Upper *Palmatolepis gigas* - Zone because the guide *Palmatolepis linguiformis* is lacking as a result of an unfavourable non-pelagic facies, or the zone is missing due to a sedimentary gap or condensation at the end of the Frasnian stage in the belgian basins.
The Lower *Palmatolepis triangularis* Zone characterised by the occurrence of *P. triangularis* before the first appearance of *P. delicatula* has been defined in most belgian sections. The sediments assigned to this zone are insignificant in thickness and do not exceed 5 meters (Bouckaert et al., 1972, Bouckaert and Streel, 1974, Dusar and Dreesen, 1976, Streel et al., 1974). The Lower *P. triangularis* - Zone as defined in these sections, probably should be assigned to the lower part of the Middle *P. triangularis* - Zone, characterised by the association *P. triangularis* - *P. delicatula*, elsewhere.
In the Noiseux section (168E 25-26) the Middle *P. triangularis* - Zone immediately succeeds the Upper *P. gigas* - Zone (not taking into account a 1 m - sequence of shale, between two successive conodont sample beds). Palmatolepids wich represent the guides for the pelagic standard biozonation normally

constitute less than 10 % of the total conodont population at the base of the Fammennian, but in Noiseux they reach 15 %, which increases the chances of finding the rare early specimens of a new form-species (Dusar, 1976b).
The Lower *P. triangularis* - Zone as established in Germany (first appearance of *P. triangularis* still associated with *P. gigas*) is unknown in Belgium, probably for reasons similar to those already invoked to explain the absence of the Uppermost *P. gigas* - Zone.
Noteworthy is the fact that the faunal break at the Frasnian-Famennian stage limit in the belgian sedimentary basins is not only observed in the conodont succession but in other fossil groups as well (brachiopods, corals, tentaculites) and is parallellised by a reduction in the sedimentation rate leading to a reduction in thickness of the sedimentary strata and to a temporary increase of sandy intercalations in the otherwise homogenous shale deposits (Dusar, 1976b).

3) THE LOWER FAMENNIAN ("Fa1").

Conodont guides are illustrated on plate 2.
The Lower Famennian coincides biostratigraphically with the *Palmatolepis triangularis* and *P. crepida* conodont Zones. The base coincides with the Frasnian-Famennian stage limit at the first appearance of *P. triangularis* ; the top coincides with the first appearance of *P. rhomboidea*, guide for the *P. rhomboidea* - Zone (Bouckaert, et al.,1968). As an alternative, we can use the first appearance of *P. klapperi* instead of *P. rhomboidea* for defining the base of the *P. rhomboidea* - Zone. In the Hamoir region the Fa1/ Fa2 biostratigraphic limit is somewhat preceeded by the Famenne Shales - Esneux micaceous shales lithostratigraphic limit. The latter limit is parallellised by the limit between the *Phychomaletoechia dumonti* and *Basilicorhynchus basilicus gerardimontis* rhynchonellid zones (Sartenaer, 1972).
The *P. crepida* - *P. rhomboidea* and *P. dumonti* - *B. basilicus gerardimontis* - Zonal boundaries are apparently diachronous : the base of the *B. basilicus gerardimontis* rises from north to south in comparison with the conodont zonation (Dusar, 1976b).
North of the Xhoris thrust fault in Hamoir (Néblon 158W 60, 763) the basal part of the Esneux Formation is characterised by a conodont-poor "interval-zone" as *Palmatolepis crepida* disappears before the first appearance

lien of *P. rhomboidea*. South of the Xhoris thrust fault in Tohogne as well as in the Haversin area (Aye, Tige de Hogne) where suitable facies conditions (more open marine) for conodonts locally persist possibly because of a delay in the influx of micaceous sands, *P. crepida* and *P. rhomboidea* coexist in the basal part of the *P. rhomboidea* - Zone (Dreesen and Dusar, 1975).*

4) THE LOWER PART OF THE UPPER FAMENNIAN ("Fa2a").

Conodont guides are illustrated on plate 3.
The Lower part of the Upper Famennian or "Fa2a" coincides bio-stratigraphically with the *P. rhomboidea* and *P. marginifera* conodont - Zones. The base coincides with the first appearance of *P. rhomboidea* ; the top coincides with the first appearance of *Scaphignathus velifer*. Lithostratigraphically the "Fa2a" encompasses the major part of the Esneux and Souverain-Pré Formations.
A subdivision of the *Palmatolepis rhomboidea* - Zone based on the occurrence of *P. poolei* as proposed by Sandberg and Ziegler (1973) is not very useful although this form-species has been recorded from Haversin (Dreesen and Dusar, 1975). The Upper *P. rhomboidea* - Zone probably covers a relatively short time span since the sediments deposited during the range of this zone reach a thickness of only 20 m in Hamoir. In Hamoir the earliest forms of the *P. quadrantinodosa* - Stock and hence the base of the *P. marginifera* - Zone have been recorded from an oolitic ironstone marker bed (level III b) rich in conodonts which is known from the entire eastern border or the Dinant Synclinorium, the Vesdre Massif and the "Theux Window".
The Hamoir-Nord section (158 W 56) constitutes a reference-section for the limit between the *P. rhomboidea* and *P. marginifera* - Zones (Dreesen and Dusar, 1974, Streel et al., 1974)

These faunas have been isolated from either ferruginuous ooid-bearing coquinas or red-stained encrinites, which represent a distal facies of valitic ironstone level III a (Dreesen, 1982). The conodont faunas indicate clearly a paleontological condensation, encompassing the uppermost *P. aepida* and Lower *P. rhomboidea*- Zones.

The association of all form-species and transitional forms of the *quadrantinodosa* - Stock as a whole characterises the Lower *P. marginifera* - Zone (Dreesen, 1076a, Sandberg and Ziegler, 1973). *P. cf. helmsi* (= a particular morphotype of Pylatma lepta) is proposed as an alternative or additional guide (Dreesen and Dusar, 1974, Streel et al., 1974). *P. rhomboidea* persists and the association *P. rhomboidea - P. marginifera* also characterises the Lower *P. marginifera* - Zone since the disappearance of *P. rhomboidea* is simultaneous with the disappearance of several members of the *quadrantinodosa* - Stock. This disappearance coincides everywhere with the base of the Souverain-Pré nodular limestone facies, apparently less-favourable for conodonts (as a more protected subtidal environment). The limit between the Lower and Upper *P. marginifera* conodont - Zones is based on these disappearances which are clearly facies-related in the belgian sedimentary basins and thus unacceptable for the international correlation pruposes. The Upper *P. marginifera* - Zone in fact constitutes an "intra-zone" between the more profuse Lower *P. marginifera* and Lower *Scaphignathus velifer* - Zones. *Palmatolepis rugosa grossi* and *P. rugosa ampla* only appear together with *Scaphignathus velifer* (158 W 1abc) because of the unfavourable facies in the underlying nodular limestone beds of the Souverain Pré-formation.
Differences in first appearances of Palmatolepis index species, with respect to the German standard (pelagic) conodont zonation, are now explained by differences in conodont biofacies (Dreesen & Thorez, 1980) and by paleontological condensations at the transition of two succeeding lithostratigraphie units (Dreesen 1982)

5) THE UPPER PART OF THE UPPER FAMENNIAN ("Fa2b-Fa2c").

Conodont guides are illustrated on plate 3.
The upper part of the Upper Famennian or the "Fa2b-Fa2c" extends from the first appearance of *Scaphignathus velifer*, guide of the *S. velifer* - Zone which is recorded from marly layers near the top of the Souverain Pré Formation in Hamoir (158W 1abc) - (Dreesen and Dusar, 1974 ; Streel et al., 1974) into the base of the *Spelaeotriletes lepidophytus* - sporozone which defines the base of the "Fa2d" and is recorded from the basal beds of the "Strunian" in the Tohogne borehole (158W 270) - (Bouckaert, 1977 ; Bouckaert et al, 1968). Besides the top beds of the Souverain-Pré Formation and the

basal beds of the "Strunian", the "Fa2b-Fa2c" encompasses the "Condroz Psammites" composed of the Comblain-la-Tour and Montfort Formations in the Hamoir region (Thorez, 1973).

The base of the *Scaphignathus velifer* - Zone was preferred as a base for the "Fa2b" above the limit between the Lower and the Middle *gracilis - minutus* miospore association as proposed by Bouckaert et al in 1968 : the time lag between both limits is probably very small and the conodont biozonation is more widely used.

The first appearance of *Spathognathodus bohlenanus* recorded from Haversin (Dreesen and Dusar, 1975) does not provide a useful tool for subdividing the Lower and Middle *Scaphignathus velifer* - Zones. No conodonts indicating the Upper *S. velifer* - Zone or the *Polygnathus styriacus* - Zone have been recorded drom the belgian sedimentary basins, because of the prevailing shallow-water conodont biofacies.

A restricted conodont association without any guide forms, composed of *Polygnathus semicostatus - Pandorinellina cf insita - "Icriodus" costatus* M 1 - *Pelekysgnathus inclinatus* (plate 4) generally characterises the Montfort beds, where regressive facies conditions led to a replacement of conodonts by miospores as the most precious element for biostratigraphic subdivisions.

6) THE "STRUNIAN" AND THE FAMENNIAN-TOURNAISIAN STAGE LIMIT ("Fa2d-Tn1a").

The Famennian-Tournaisian stage limit, has been fixed on top of the oolite bed at the base of the Hastière Limestone ("Tn1b"). The underlying "Strunian" thus is incorporated in the Devonian.

The "Fa2c"-"Fa2d" limit has been defined as the limit between the *versabilis-uncatus* (VU) and *pusillites-lepidophytus* (PL) sporozones. This limit is somewhat preceeded by the base of the *Bispathodus costatus* conodont - Zone.

The "Fa2d"-"Tn1a" limit is based on the first appearance of the foraminifer *Quasiendothyra kobeitusana* (Bouckaert et al, 1968).

The Tohogne borehole (158W 270) serves as a base for the stratigraphic subdivision of these strata in the Hamoir region.

All bio- and lithostratigraphic limits established in the Ourthe region have been recognised here (Bouckaert et al, 1977, Bouckaert and Dusar, 1976, Dusar, 1976a).

The "Strunian" transgression starts in the uppermost part of the "Fa2c", 15m below the base of the "Fa2d" in Houmart (158W 694) with a compact sandstone bed gradually increasing in thickness towards the north e.g. (Blockai, 158W 7) and which is overlying the partially red-coloured top beds of the Montfort Formation. Conodonts assigned to the *Bispathodus costatus* - Zone occur from the base of the transgressive sequence onwards.
The lower limit of the *B. costatus* - Zone is thus clearly facies-controlled as has already been described for other zones and subzones.
Polygnathus streeli is typical for the lower part of the "Strunian" and especially flourished where a sandy facies predominated (158W 884)-(Dreesen et al, 1976 ; Dusar, 1976a).
A conodont biozonation within the "Strunian" is not yet feasible ; further work on interbasinal correlations is required.
The basal beds of the Hastière Limestone ("Tn1b") consist of a conodont-bearing oosparitic limestone characterised by a *Pseudopolygnathus graulichi* - *Protognathodus meischneri* - *Pelekysgnathus inclinatus* conodont association possibly reworked from the underlying Etroeungt Limestone ("Tn1aγ") (Bouckaert and Dusar, 1976), and representing a shallow-water conodont biofacies.
This process of penecontemporaneous erosion or non-deposition in a high-energy marine environment interrupts the Strunian transgression at the Devonian - Carboniferous transition, on a basinal scale at least.

REFERENCES.

Bouckaert, J. ; Conil, R. ; Dusar, M. and Streel, M., 1977 - Stratigraphic interpretation of the Tohogne borehole (Province of Luxembourg). Devonian - Carboniferous transition. *Ann. Soc. géol. Belg., 100, 87-101.*

Bouckaert, J. and Dusar, M., 1976 - Description géologique du sondage de Tohogne. *Serv. géol. Belg., Prof. Paper 7.*

Bouckaert, J. ; Mouravieff, A. ; Streel, M. ; Thorez, J. and Ziegler, W., 1972 - The Frasnian-Famennian boudary in Belgium. *Geol. et Palaeont., 6, 87-92.*

Bouckaert, J. and Streel, M., 1974 - International Symposium on belgian micropaleontological limits, Namur. Guidebook.

Bouckaert, J. ; Streel, M. and Thorez, J., 1968 - Schéma biostratigraphique et coupes de référence du Famennien belge. *Ann. Soc. géol. Belg., 91, 317-336.*

Coen, M., 1073 - Facies, Conodontes et stratigraphie du Frasnien de l'est de la Belgique, pour servir à une révision de l'étage. *Ann. Soc. géol. Belg., 95, 239-253.*

Coen, M., 1974 - Le Frasnien de la bordure orientale du Bassin de Dinant. *Ann. Soc. géol. Belg., 97, 67-103.*

Destinez, P., 1899 - Découverte de *Protaster* dans l'assise d'Esneux (Falc), à Tohogne. *Ann. Soc. géol. Belg., 26, 56-58.*

Destinez, P., 1900 - Quelques fossiles nouveaux du Famennien, rencontrés dans les assises (Fa2a), (Fa2c) et (Falb) à la Hesse (Tohogne), au bois de Mont (Clavier) et à Clémodeau (Villers le Temple). *Ann. Soc. géol. Belg., 27, 156-161.*

Dreesen, R., 1976a - Interspecific morphological relations within the *"Quadrantinodosa* - Stock" (Branson & Mehl, 1934)-(*marginifera* - Zone, Upper Devonian). *Ann. Soc. géol. Belg., 99, 511-529.*

Dreesen, R., 1976b - Bijdrage tot de biostratigrafische kennis van het Famenniaan : de Souverain Pré Formatie in het Bekken van Dinant en het Vesdermassief. *K.U.Leuven, unpublished.*

Dreesen, R., 1977 - La Formation de Souverain Pré, réconstruction paléogéographique dans le Massif de la Vesdre. *Meded. Rijks Geol. Dienst, N. Serie 28, 29-32.*

Dreesen, R., and Dusar, M., 1974 - Refinement of conodont biozonation in the Famenne type area. *International Symposium on belgian micropaleontological limits, Namur, Publ. 13.*

Dreesen, R. and Dusar, M., 1975 - Description et interprétation de coupes situées dans la région d'Haversin. *Serv. géol. Belg., Prof. Paper 3.*

Dreesen, R. ; Dusar, M. and Groessens, E., 1976 - Biostratigraphy of the Yves - Gomezée road section (Uppermost Famennian). *Serv. géol. Belg., Prof. Paper 6.*

Dreesen, R. and Houlleberghs, E., 1980 - Evolutionary trends of the Famannian icriodids in the Dinant and Vesdre Basins. *Ann. Soc. géol. Belg., 103, 111-141.*

Dreesen, R. and Thorez, J., 1980 - Sedimentary environments, conodont biofacies and paleoecology of the Belgian Famennian (Upper Devonian) An approach. *Ann. Soc. géol. Belg., 103, 97-110.*

Dreesen, R., 1982 - Storm-generated valitic ironstones and associated redbeds in the Famennian (Falb - Fa2a, "Nehden Stufe" equivalent) of the Dinant and Vesdre Synclinoria (Upper Devonian, Belgium) A case study. *Ann. Soc. géol. Belg., 105, 105-129.*

Dreesen, R. and Flays, G. (1984, in press) - The "Baelen Marble", a sponge-algal-crinoidal carbonate build-up in the Uppermost Devonian (Famennian) of the Ardennes (Belgium). Facies, 1984.

Dusar, M., 1976a - Devonian - Carboniferous transition beds in the region of Hamoir sur Ourthe. *Ann. Soc. géol. Belg., 99, 531-542.*

Dusar, M., 1976b - The Lower Famennian at the southeastern border of the Dinant Basin. *Ann. Soc. géol. Belg., 99, 565-570.*

Dusar, M. and Dreesen, R., 1976 - Etude biostratigraphique du Famennian inférieur dans les environs de Theux. *Ann. Soc. géol. Belg., 99, 543-564.*

Sandberg, C. and Ziegler, W., 1973 - Refinement of standard Upper Devonian conodont zonation based on sections in Nevada and West Germany. *Geol. et Palaeont., 7, 97-122.*

Sandberg, C.A. and Dreesen, R., 1983 - Alternative Late Devonian zonation for shallow-water conodont biofacies. *Geol. Soc. Am. Abstr. w. Progr., 220, n° 26942.*

Sartenaer, P., 1972 - De l'importance stratigraphique des rhynchonellides famenniens situés au-dessus de la Zone à *Ptychomaletoechia dumonti* (Gosselet, J., 1877). Première note : *Cavatisinurostrum* n.gen. *Bull. Inst. roy. Sc. Nat., Sc. Terre, 48, 2, 1-31.*

Streel, M. ; Bless, M. ; Bouckaert, J. ; Coen, M. ; Coen-Aubert, M. ; Conil, R. ; Dreesen, R. ; Dusar, M. : Mouravieff, N. and Thorez, J., 1974 - Chief micropaleontological limits in the Belgian Upper Devonian. *International Symposium on belgian micropaleontological limits, Namur, Publ. 19.*

Thorez, J., 1973 - "Chromatographie" sédimentologique et stratigraphique (biostratigraphie et lithostratigraphie) du Famennien supérieur dans la partie orientale du Synclinorium de Dinant (vallées de l'Ourthe, du Houyoux et du Bocq). Session extraordinaire 1973, Livret-guide d'excursion. *Soc. géol. Belg., Soc. belge Géol.*

Ubaghs, G., 1941 - Description de quelques Ophiures du Famennien de la Belgique. *Bull. Mus. roy. Hist. Nat., 17,44, 1-31.*

Vanguestaine, M. ; Declairfayt, T. ; Roubart, A. and Smeesters, A., 1983 - Zonation par acritarches du Frasnien supérieur. Famennien inférieur dans les Bassins de Dinant, Namur, Herve et Campine (Dévonien supérieur de Belgique). *Ann. Soc. géol. Belg., 106, 121-171.*

Ziegler, W., 1962 - Taxionomie und Phylogenie oberdevonischer Conodonten und ihre stratigraphische Bedeutung. *Abhandl. hess. L. Amt. Bodenf., 38, 1-166.*

Ziegler, W., 1971 - Conodont stratigraphy of the European Devonian. *Geol. Soc. Am., Mem. 127, 227-284.*

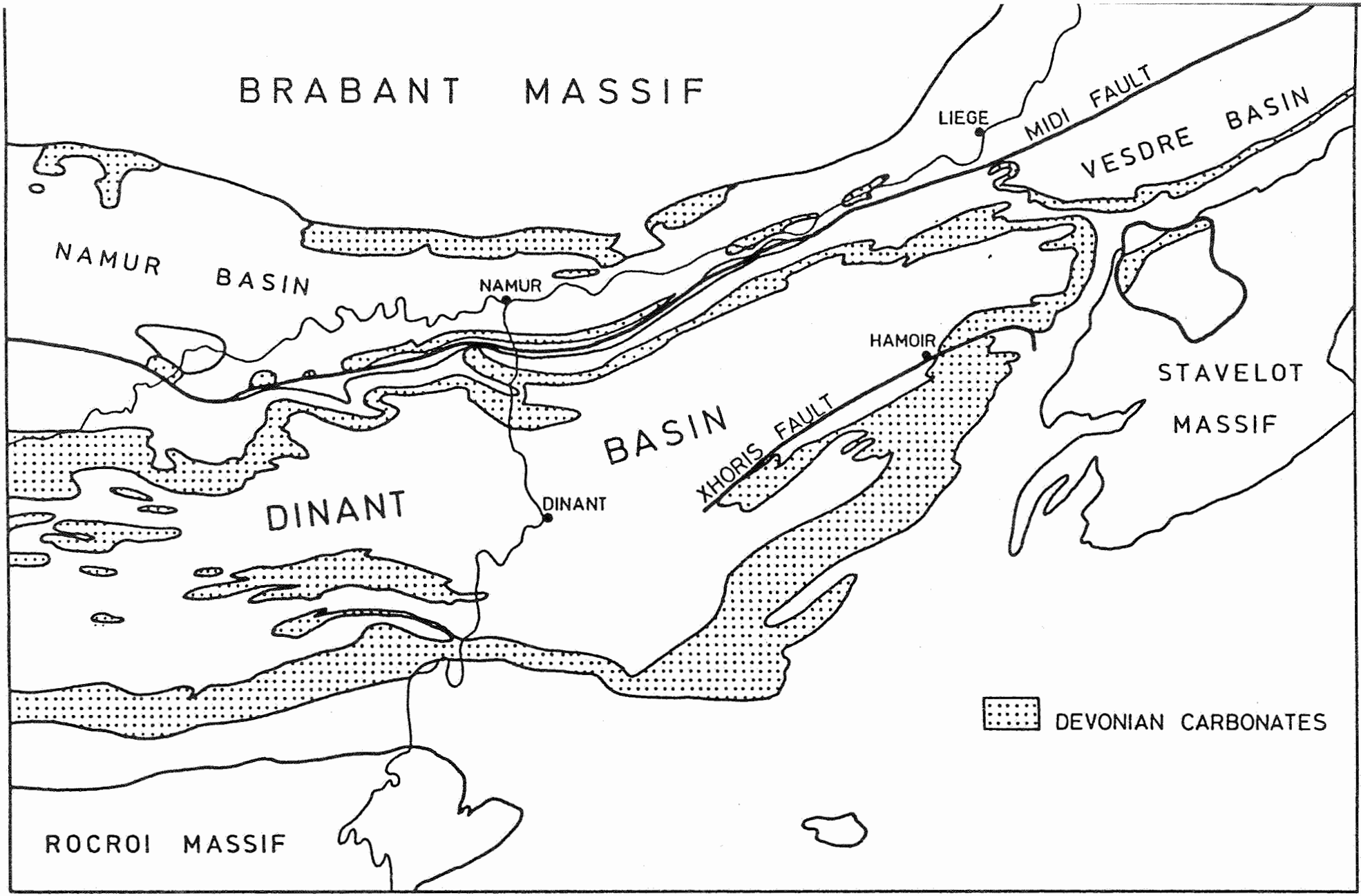


Fig. 1 Geographic setting of the Hamoir area.

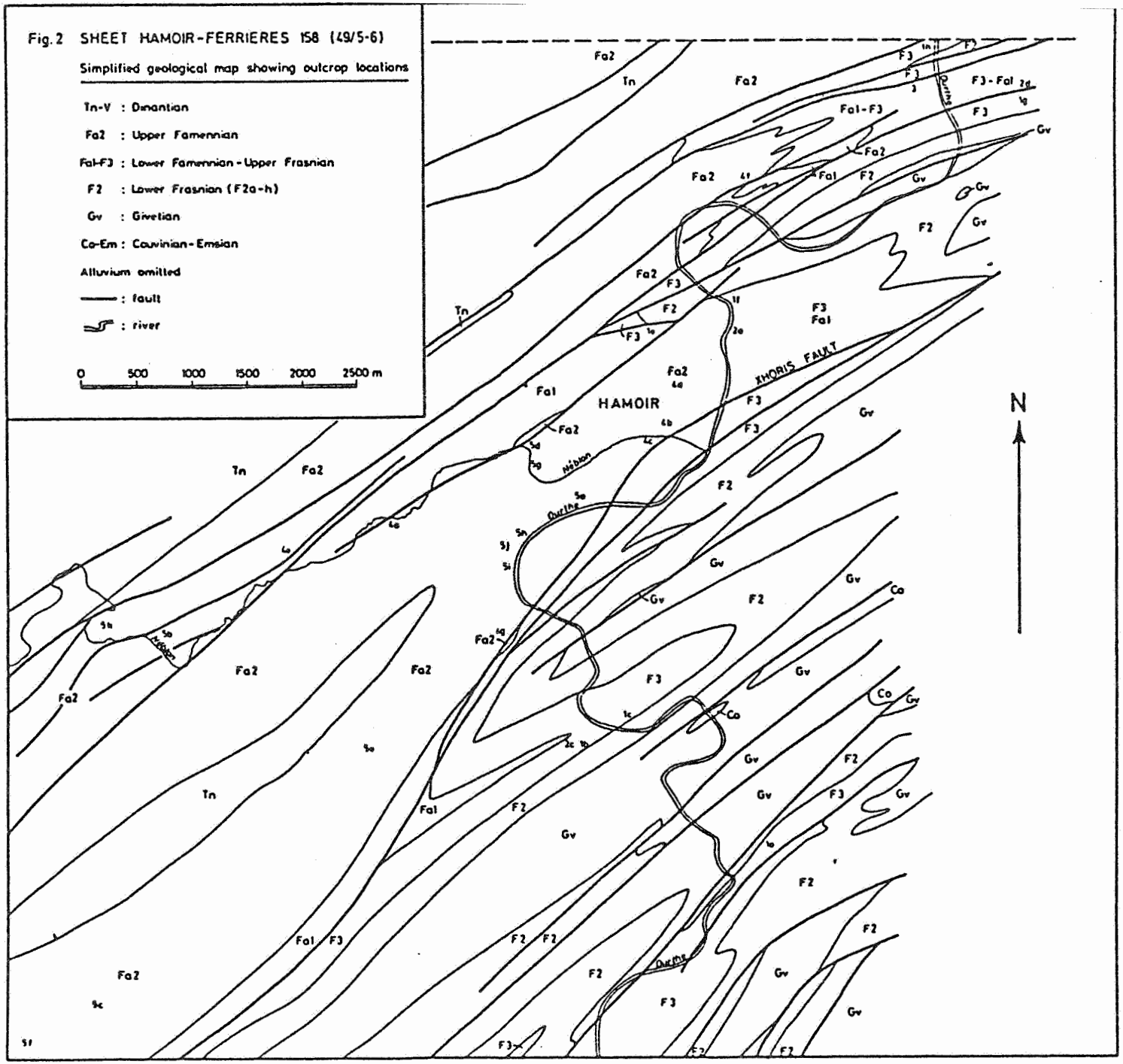


Fig. 2 SHEET HAMOIR-FERRIERES 158 (49/5-6)
Simplified geological map showing outcrop locations
Tn-V : Dinantian
Fa2 : Upper Famennian
Fal-F3 : Lower Famennian - Upper Frasnian
F2 : Lower Frasnian (F2a-h)
Gv : Givetian
Co-Em : Couvinian - Emsian
Alluvium omitted
: fault
: river
0 500 1000 1500 2000 2500 m
HAMOIR
XHORIS FAULT
N

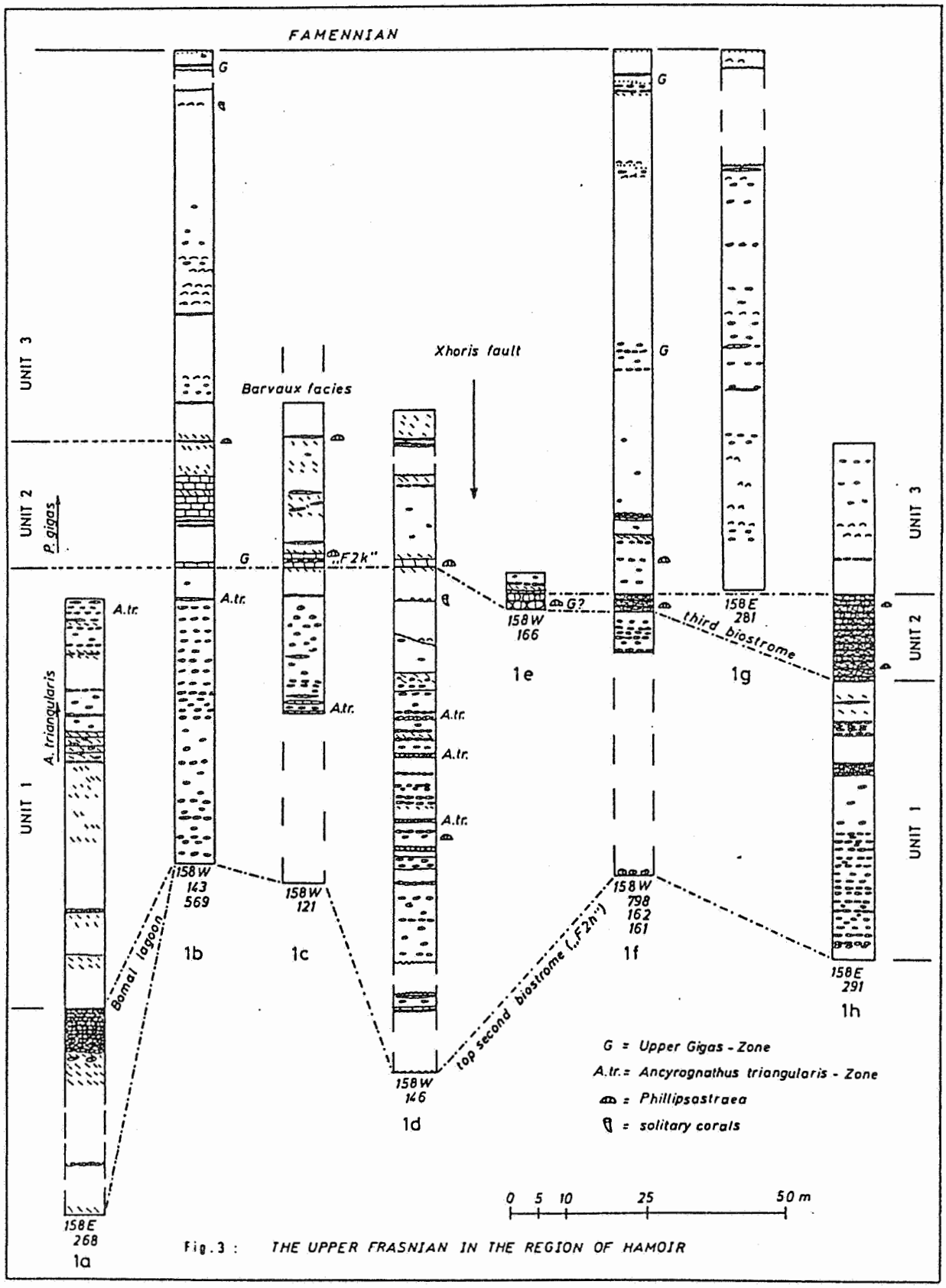


Fig.3 : THE UPPER FRASNIAN IN THE REGION OF HAMOIR

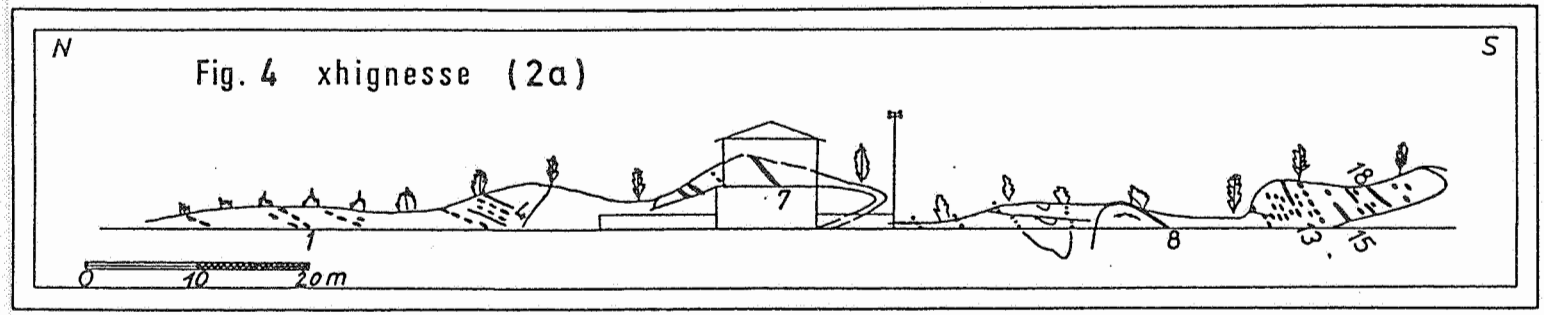


Fig. 4 xhignesse (2a)

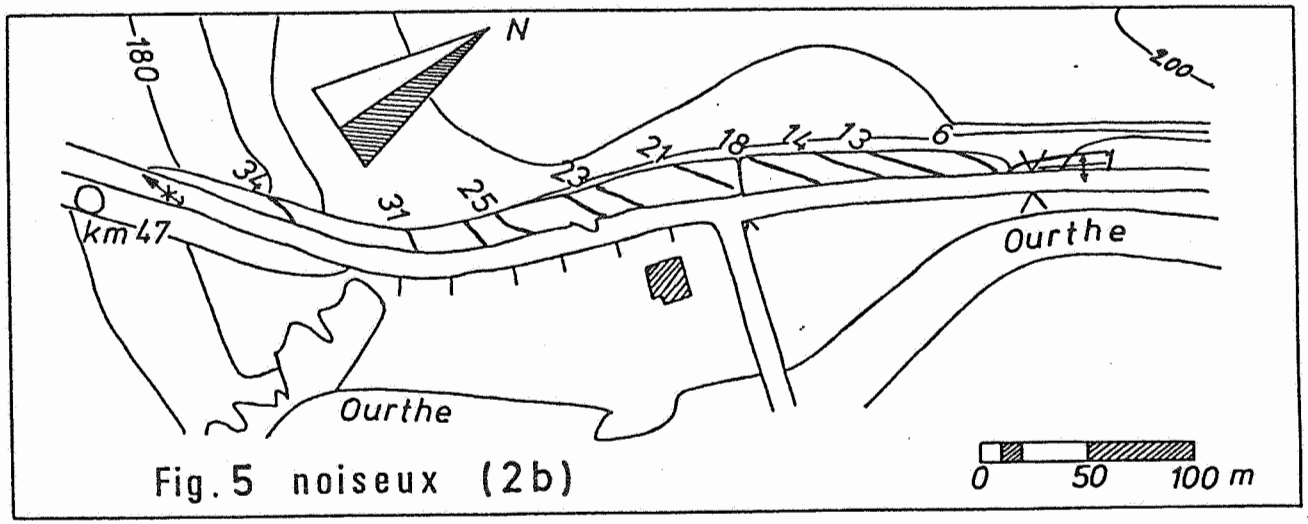
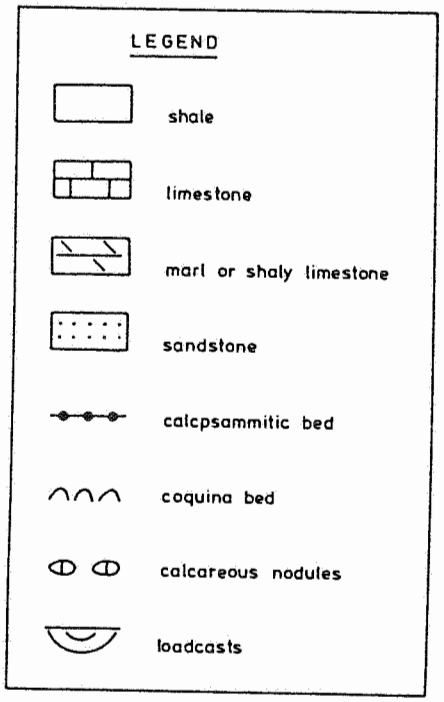


Fig. 5 noiseux (2b)



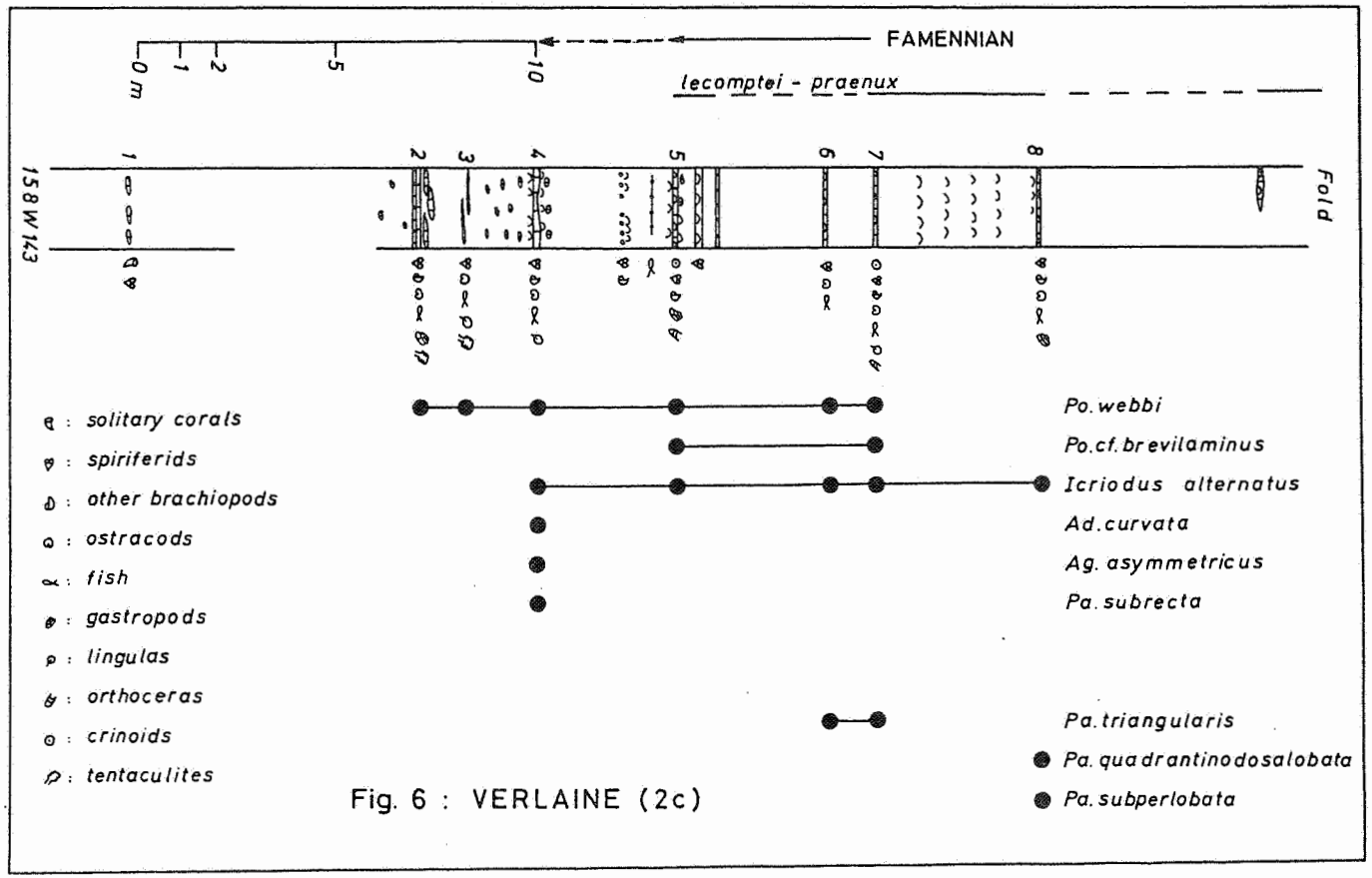


Fig. 6 : VERLAINE (2c)

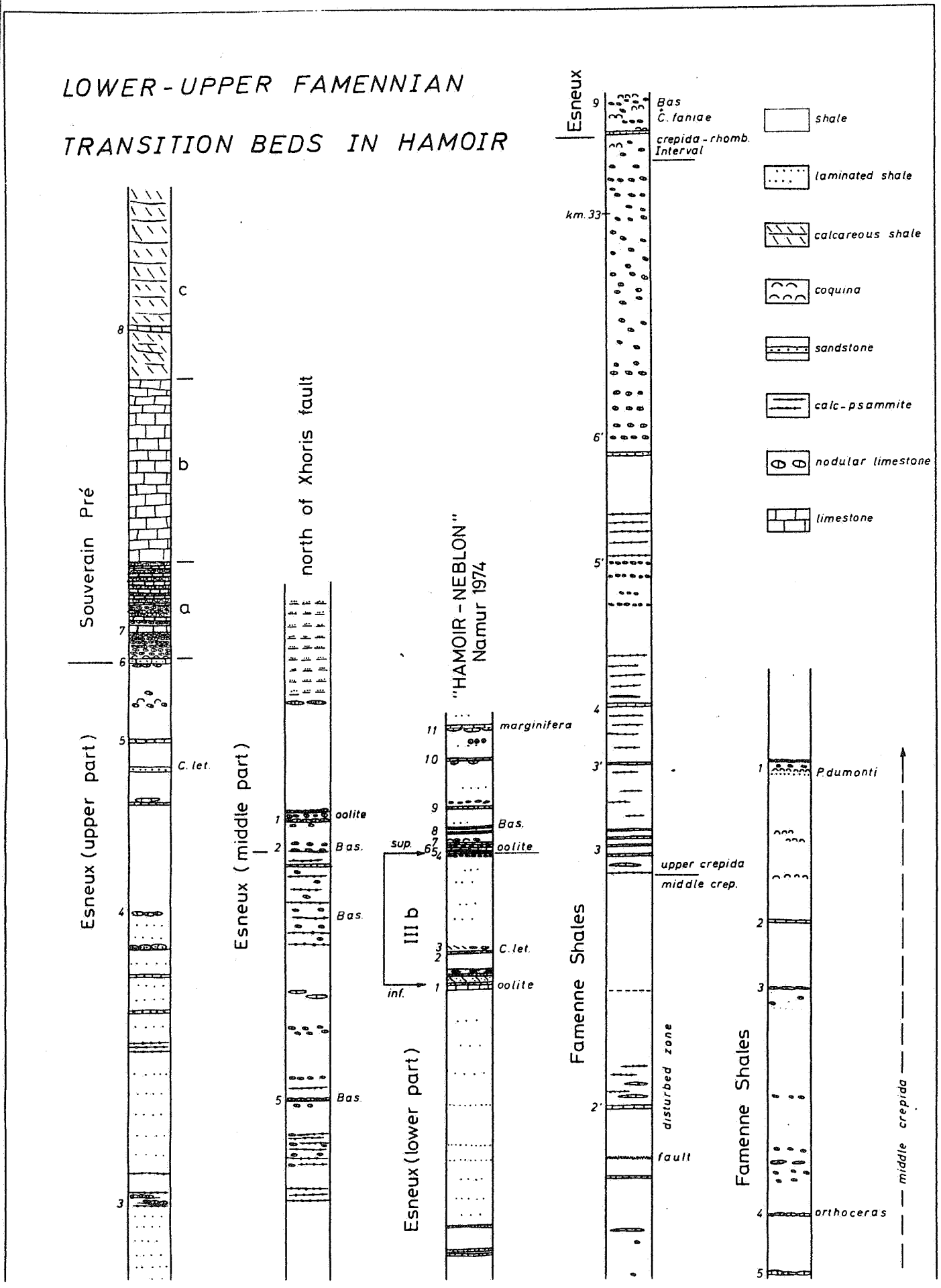

LOWER-UPPER FAMENNIAN
TRANSITION BEDS IN HAMOIR
Souverain Pré
Esneux (upper part)
c
b
a
C. let.
north of Xhoris fault
Esneux (middle part)
oolite
Bas.
Bas.
Bas.
"HAMOIR-NEBLON"
Namur 1974
marginifera
Bas.
oolite
C. let.
oolite
sup.
III b
inf.
Esneux (lower part)
Esneux
Bas
C. faniae
crepida-rhomb.
Interval
km. 33
upper crepida
middle crep.
disturbed zone
fault
Famenne Shales
shale
laminated shale
calcareous shale
coquina
sandstone
calc-psammite
nodular limestone
limestone
P. dumonti
orthoceras
Famenne Shales
middle crepida

Fig. 7a

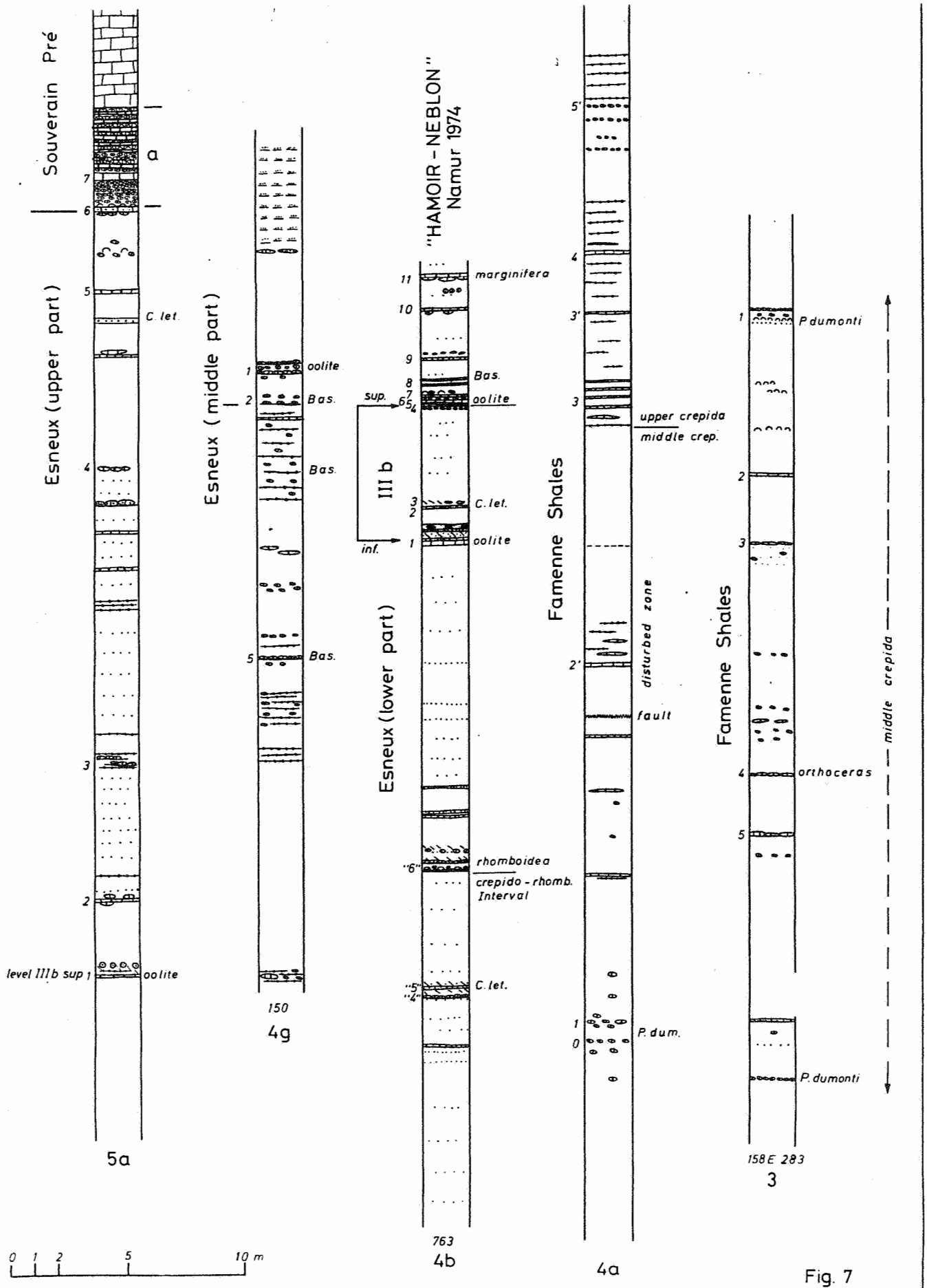

Souverain Pré
a
Esneux (upper part)
C. let.
level III b sup
oolite
5a
Esneux (middle part)
oolite
Bas.
Bas.
Bas.
150
4g
"HAMOIR - NEBLON"
Namur 1974
marginifera
Bas.
oolite
sup.
III b
inf.
C. let.
oolite
Esneux (lower part)
rhomboidea
crepido - rhomb.
Interval
C. let.
763
4b
Famenne Shales
upper crepida
middle crep.
disturbed zone
fault
P. dum.
4a
Famenne Shales
P. dumonti
orthoceras
P. dumonti
middle crepida
158 E 283
3
0 1 2 5 10 m

Fig. 7

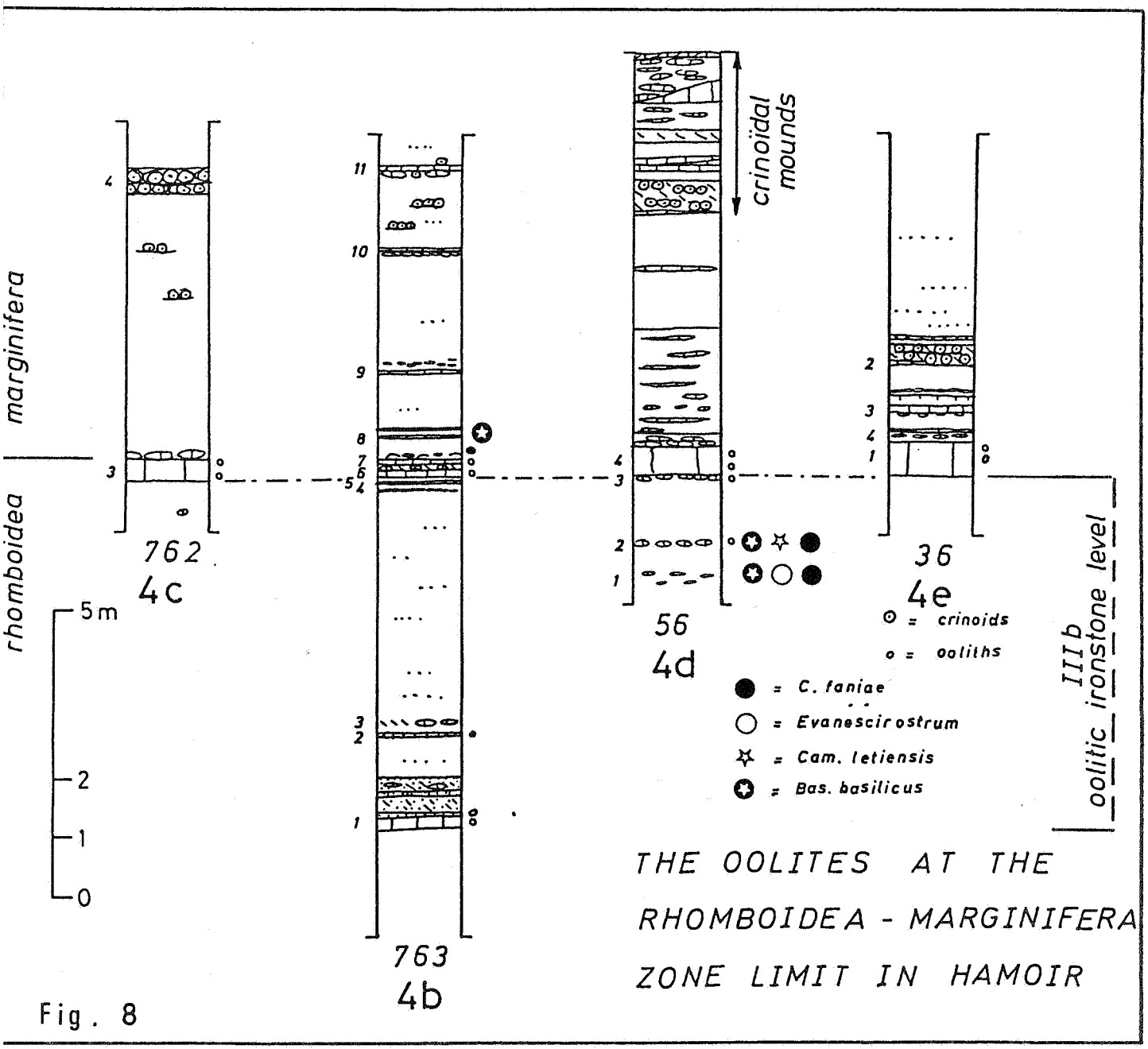

marginifera
rhomboidea
762
4c
763
4b
56
4d
36
4e
crinoidal mounds
5m
2
1
0
= crinoids
= ooliths
= C. faniae
= Evanescirostrum
= Cam. letiensis
= Bas. basilicus
III b
oolitic ironstone level
THE OOLITES AT THE
RHOMBOIDEA - MARGINIFERA
ZONE LIMIT IN HAMOIR

Fig. 8

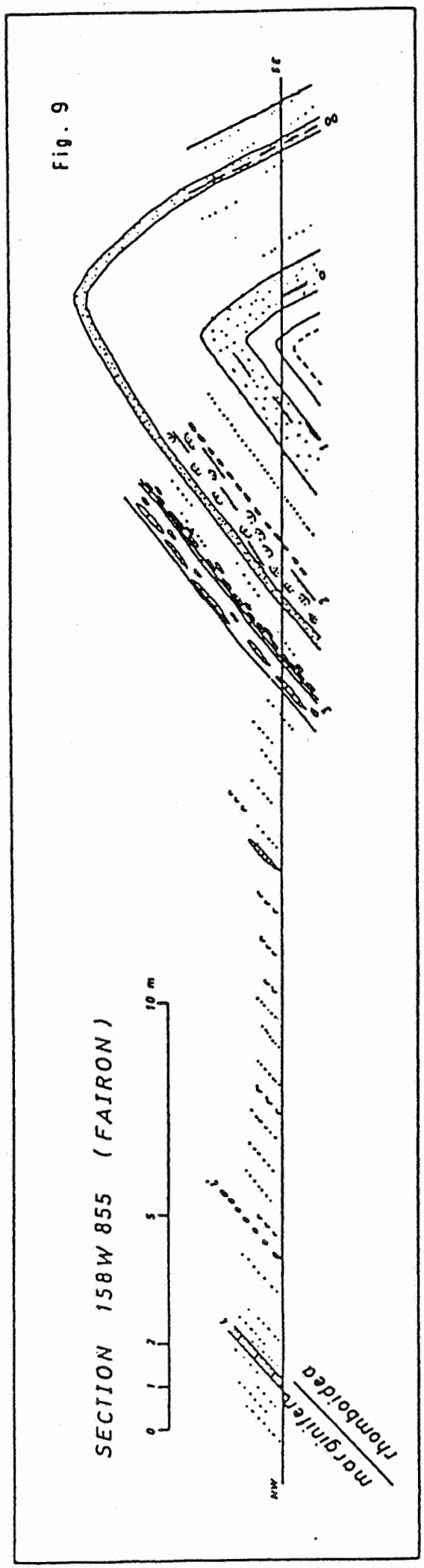


Fig. 9
SECTION 158W 855 (FAIRON)
0
1
2
5
10 m
marginifera
rhomboidea
NW
SE

HAMOIR – TOHOGNE 158 W 150

south of Xhoris thrust fault

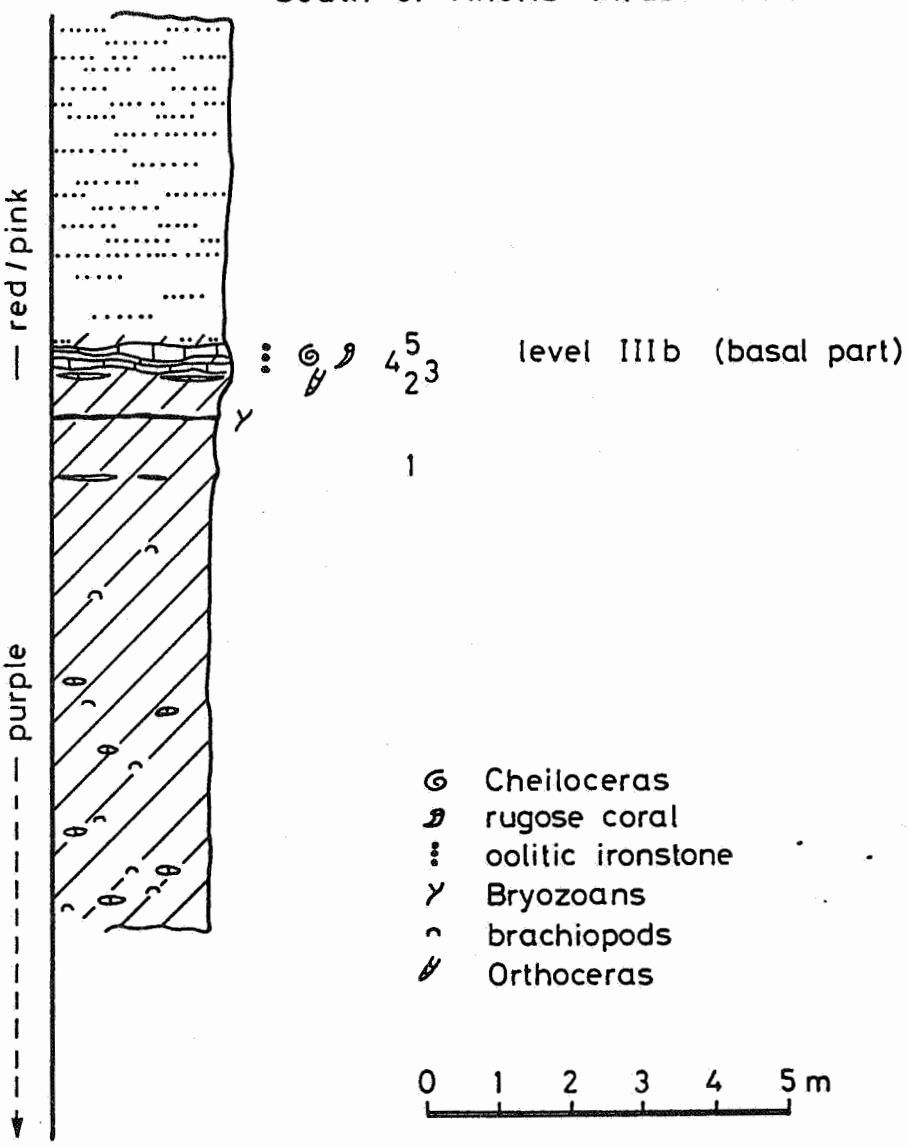


Fig 10

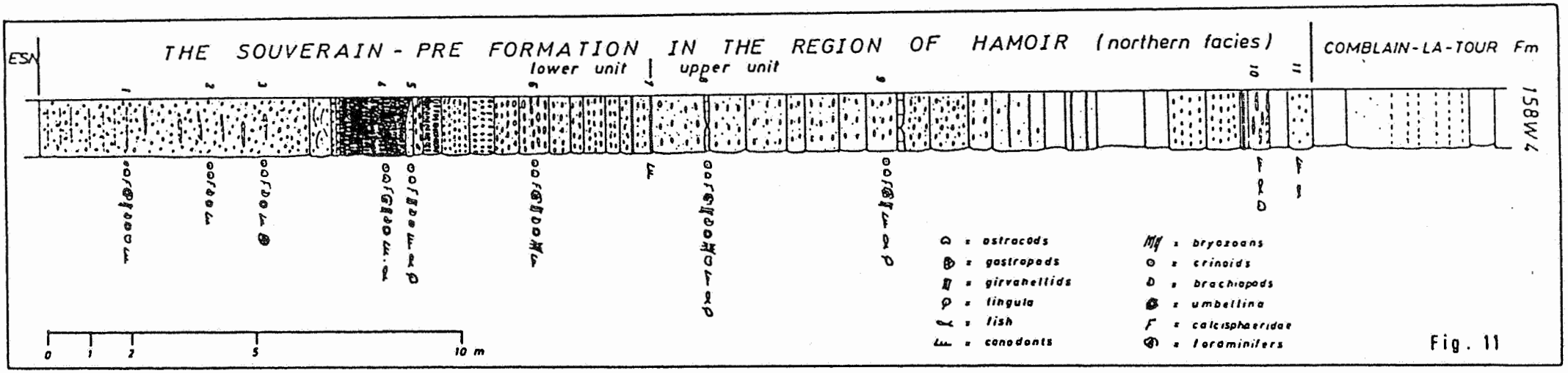

THE SOUVERAIN - PRE FORMATION IN THE REGION OF HAMOIR (northern facies)
ESN
lower unit
upper unit
COMBLAIN-LA-TOUR Fm
158W4
o = ostracods
gastropods
girvanellids
lingula
fish
conodonts
bryozoans
crinoids
brachiopods
umbellina
calcisphaeridae
foraminifers
0 1 2 5 10 m

Fig. 11

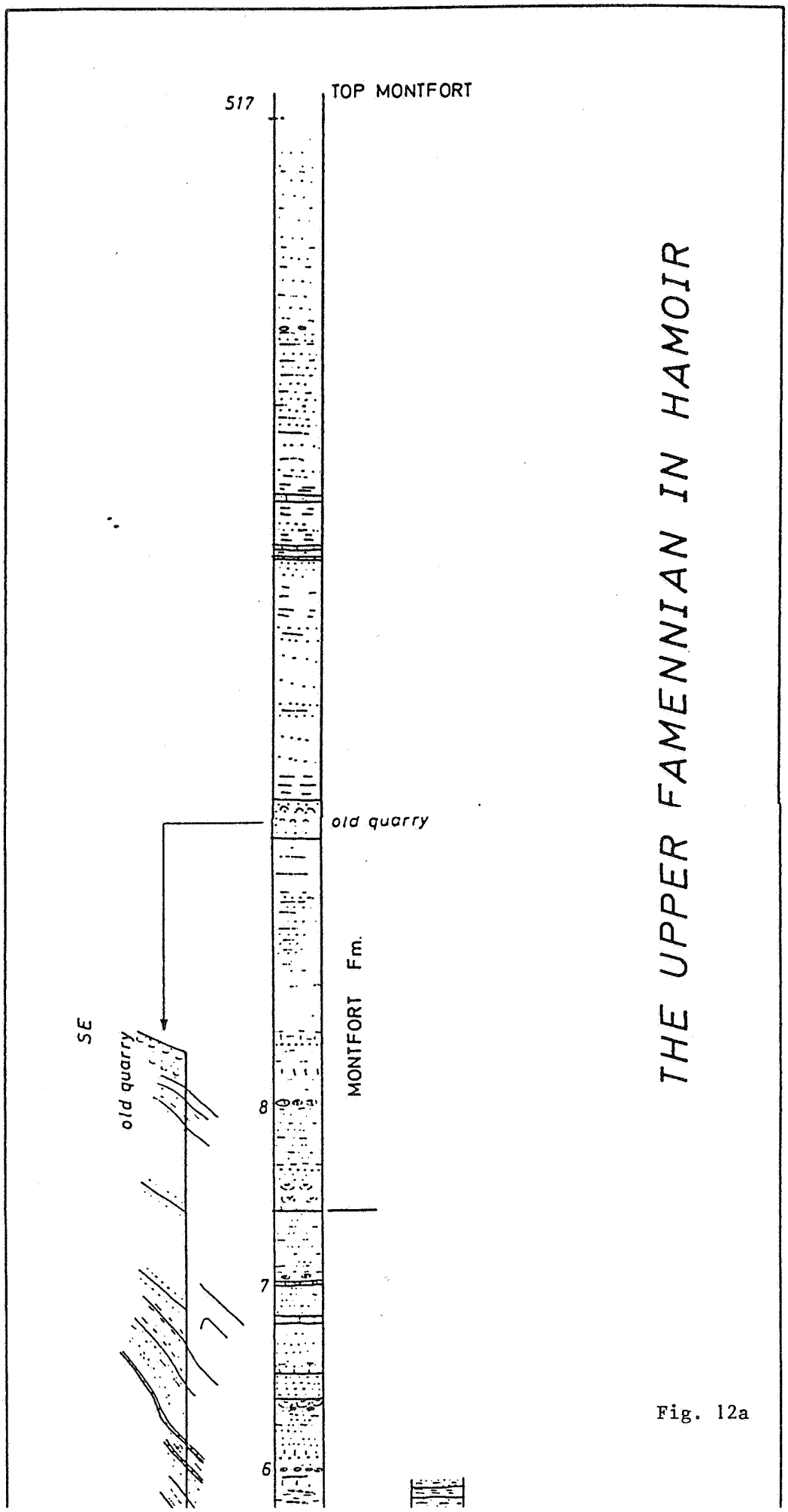

THE UPPER FAMENNIAN IN HAMOIR
517
TOP MONTFORT
old quarry
MONTFORT Fm.
8
7
6
SE
old quarry

Fig. 12a

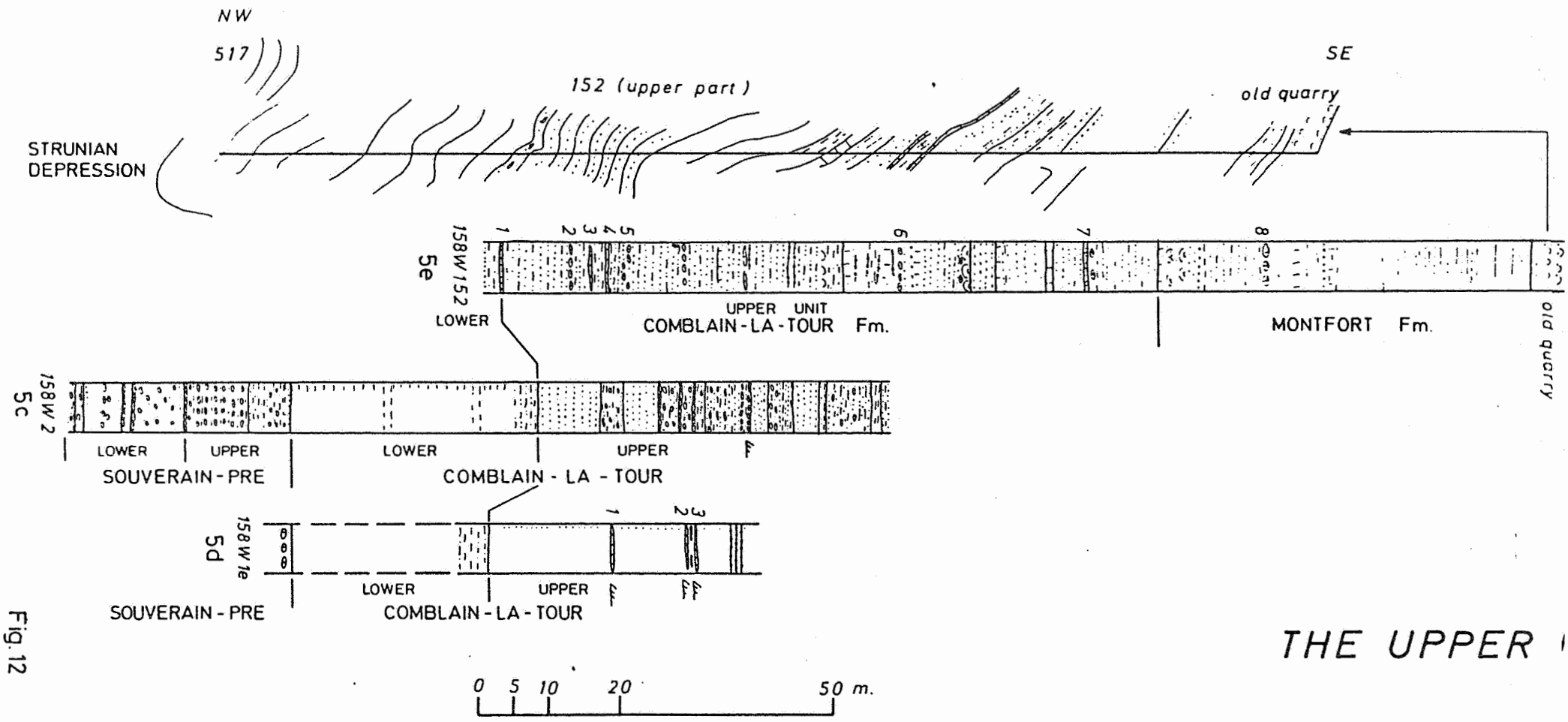


Fig. 12

THE UPPER

THE UPPER FAMENNIAN (lower part of the MONTFORT Formation)
IN THE REGION OF HAMOIR (sh. 158 W, Hamoir)

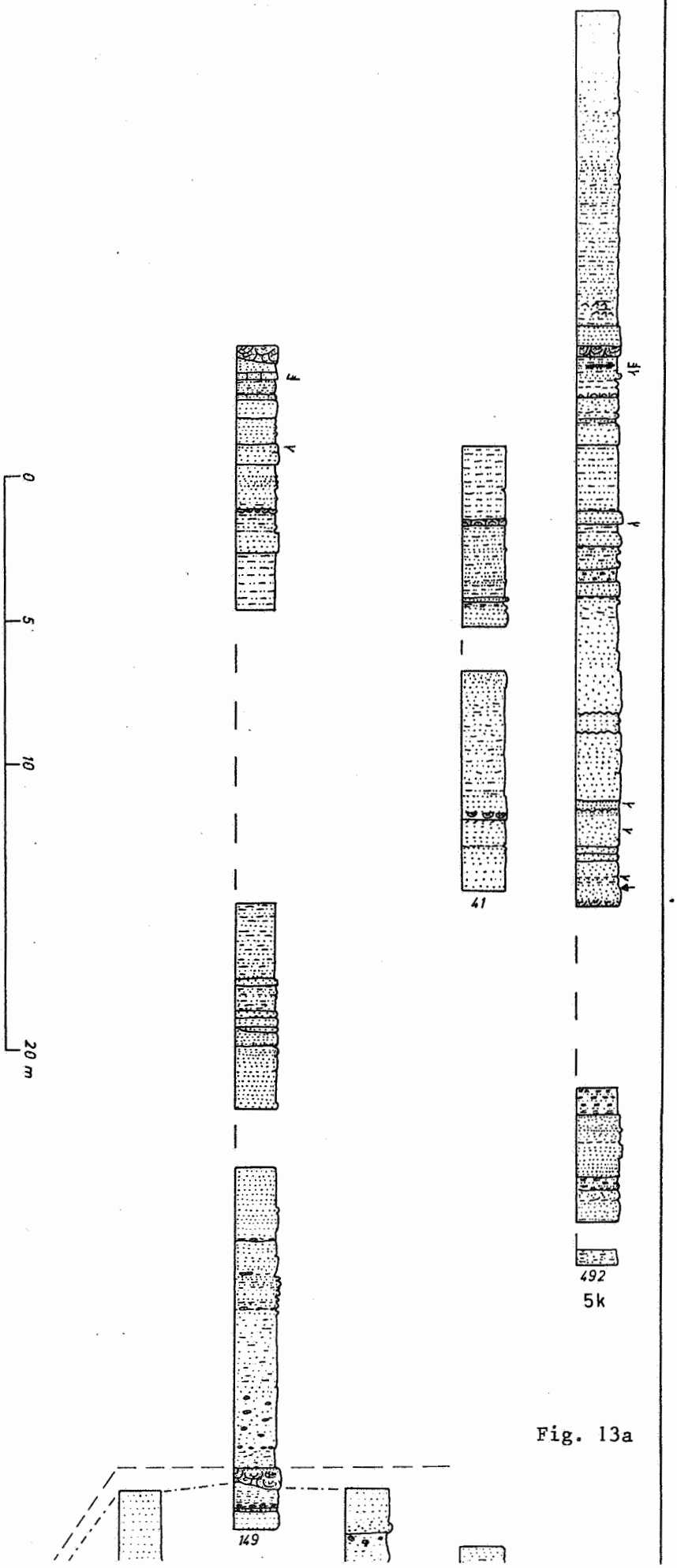


Fig. 13a

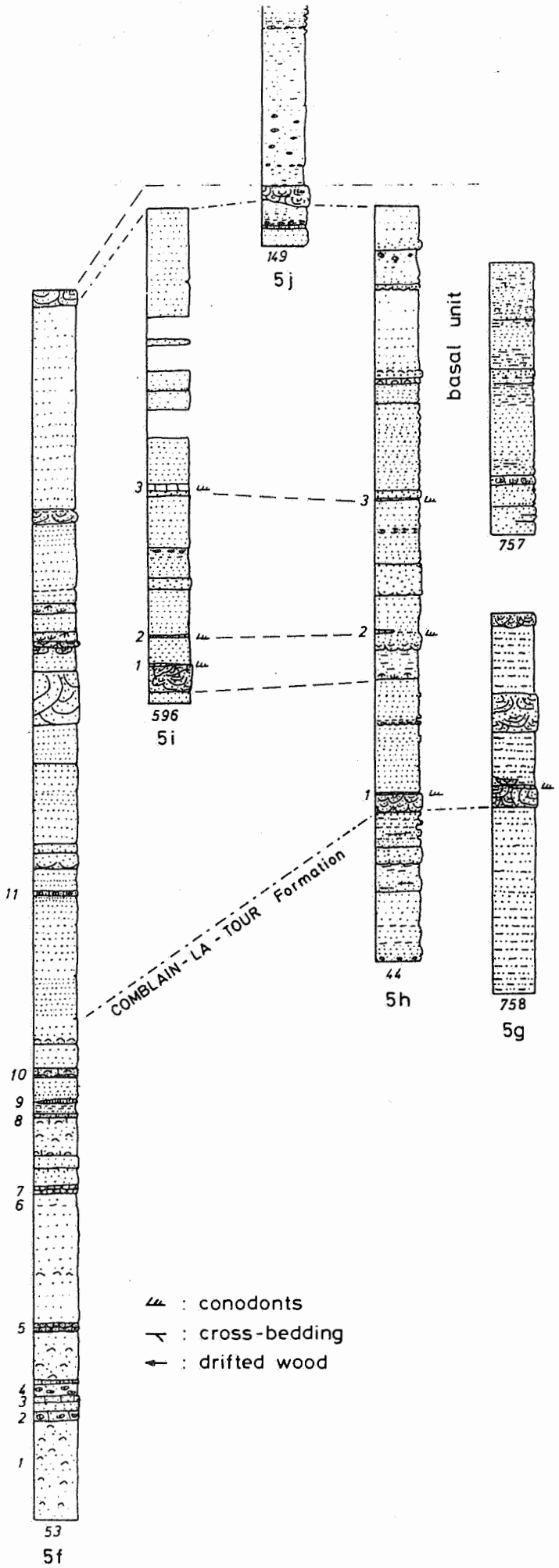

149
5j
basal unit
757
3
2
1
596
5i
44
5h
758
5g
11
10
9
8
7
6
5
4
3
2
1
53
5f
COMBLAIN-LA-TOUR Formation
: conodonts
: cross-bedding
: drifted wood

Fig. 13

PLATE 1

Ancyrodella curvata Branson & Mehl, 1934
Fig. 1 : 168E 25-26 (1-5-4) ; Liège, 100x

Palmatolepis subrecta Miller & Youngquist, 1947
Fig. 2 : 168E 25-26 (1-5-4) ; LSEM 430/24 ; 100x

Ancyrognathus asymmetricus Ulrich & Bassler, 1926
Fig. 3 : 168E 25-26 (1-5-1) ; LSEM 426/7 ; 120x

Palmatolepis gigas Miller & Youngquist, 1947
Fig. 4 : 168E 25-26 (1-5-5) ; Liège ; 50x

Ancyrognathus triangularis Youngquist, 1947
Fig. 5 : 158W 120 ; LSEM 464/9 ; 83x

PLANCHE 1

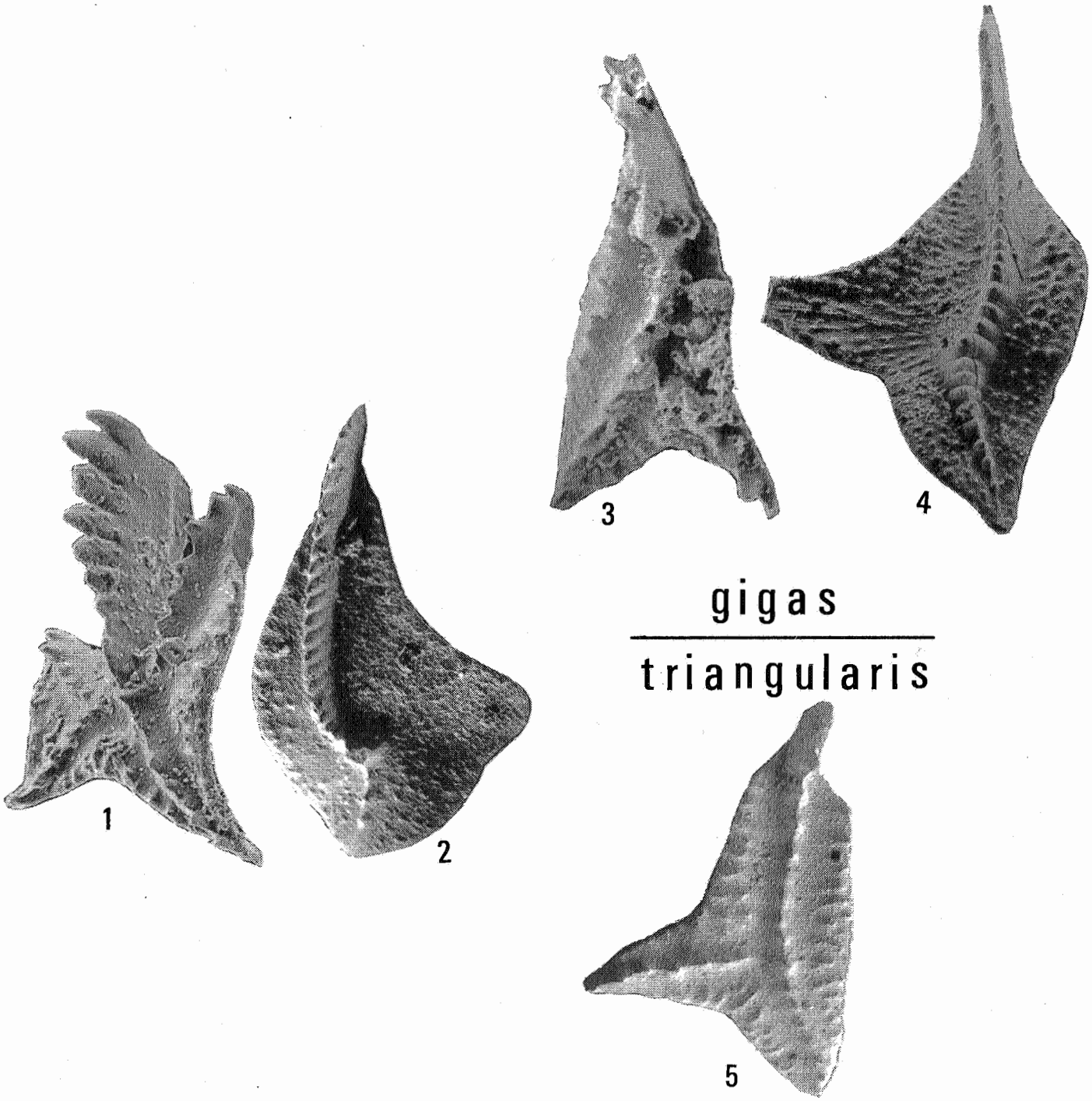


PLATE 2

Palmatolepis crepida Sannemann, 1955
Fig. 1 : 158W 1g ; LSEM 423/11 ; 120x

Palmatolepis glabra prima Ziegler & Huddle, 1969
Fig. 2 : 158E 3 ; LSEM 461/22 ; 55x

Palmatolepis termini Sannemann, 1955
Fig. 3 : 158E 286 ; LSEM 462/5 ; 120x

Palmatolepis tenuipunctata Sannemann, 1955
Fig. 4 : Aye 3-2 (Dreesen & Dusar, 1975) ; Liège ; 100x

Palmatolepis triangularis Sannemann, 1955 *P. subperlobata* Branson & Mehl, 1934
Fig. 5 : 168E 25-26 (1-5-24) ; Liège ; 100x

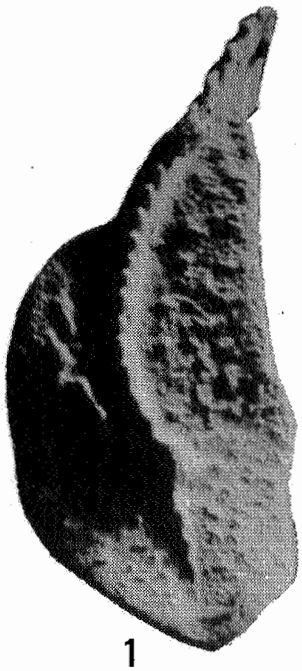
Palmatolepis quadrantinodosalobata Sannemann, 1955
Fig. 6 : Aye 3-2 (Dreesen & Dusar, 1975) ; Liège ; 100x

Palmatolepis triangularis Sannemann, 1955
Fig. 7 : 158W 798 (1-7-13) ; Liège ; 100x

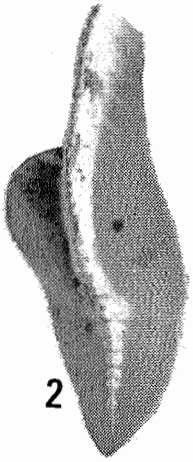
Palmatolepis delicatula clarki Ziegler, 1962
Fig. 8 : 158W 798 (1-7-13) ; Liège ; 100x

Palmatolepis delicatula delicatula Branson & Mehl, 1934
Fig. 9 : 158E 282-4 ; LSEM 434/28 ; 122x

PLANCHE 2



1



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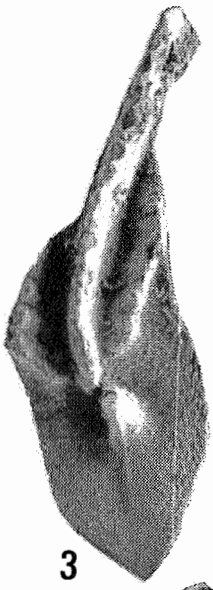
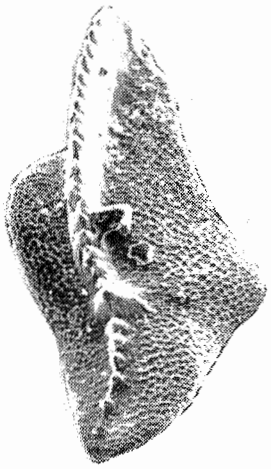


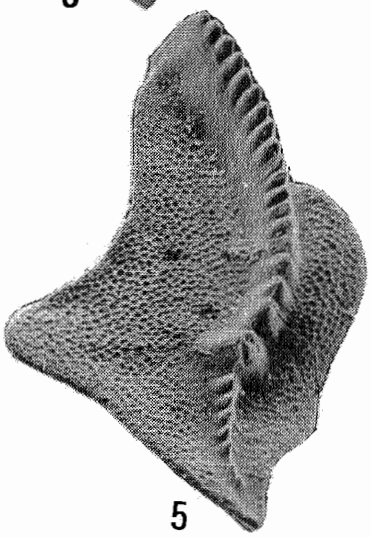
3



4

crepida

triangularis



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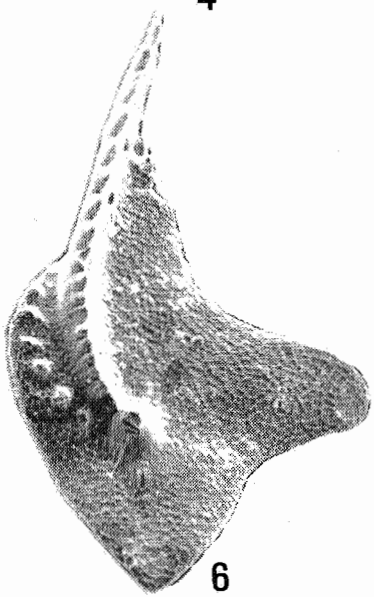

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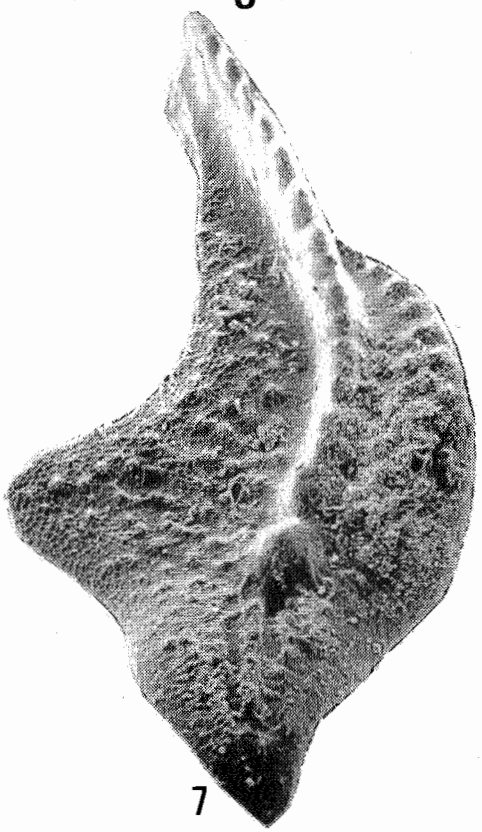

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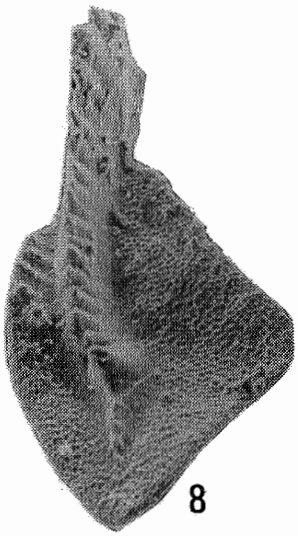

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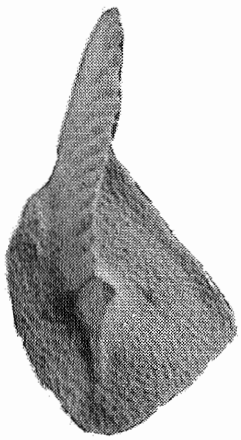

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PLATE 3

Scaphignathus velifer Helms, 1959
Fig. 1 : 158W 1abc (HNS 26) ; Liège ; 43x ; C 1168

Palmatolepis marginifera marginifera Helms, 1959
Fig. 2 : 158W 1abc (HNS 3) ; 38x ; C 1071

Palmatolepis rhomboidea Sannemann, 1955
Fig. 3 : Haversin 35 (Dreesen & Dusar, 1975) ; Liège ; 100x

Palmatolepis rugosa grossi Ziegler, 1960
Fig. 4 : 158W 1abc (HNS 26) ; 45x ; C 1084

Palmatolepis rugosa ampla Müller, 1956
Fig. 5 : 158W 1abc (HNS 26) ; 42x ; C 1090

Palmatolepis marginifera curvata Dreesen, 1976
Fig. 6 : 158W 1abc (HNS 26) ; 45x ; C 1068 (LSEM 415/10)

Palmatolepis cf. *inflexa* Müller, 1956
Fig. 7 : 158W 1abc (HNS 2) ; 85x ; C 1190

Palmatolepis quadrantinodosa
Branson & Mehl ; 1934 morphotype 1
Dreesen & Dusar, 1974
Fig. 8 : Trooz 1 (Dreesen & Dusar, 1974) ; 40x ; C 1053

Palmatolepis inflexa inflexoidea Ziegler, 1962
Fig. 9 : 158W 1abc (HNS 13) ; 45x ; C 1060 (LSEM 414/15)

Palmatolepis cf. *helmsi* Ziegler, 1962
Fig. 10 : Haversin 52 (Dreesen & Dusar, 1975) ; 42x ; C 1085

Palmatolepis marginifera Helms, 1959 — *P. quadrantinodosa* morphotype 1
Fig. 11 : 158W 56 (HN4) ; 47x ; C 1073

Palmatolepis poolei Sandberg & Ziegler, 1973
Fig. 12 : Haversin 46 (Dreesen & Dusar, 1975) ; 115x ; LSEM 461/14

PLANCHE 3

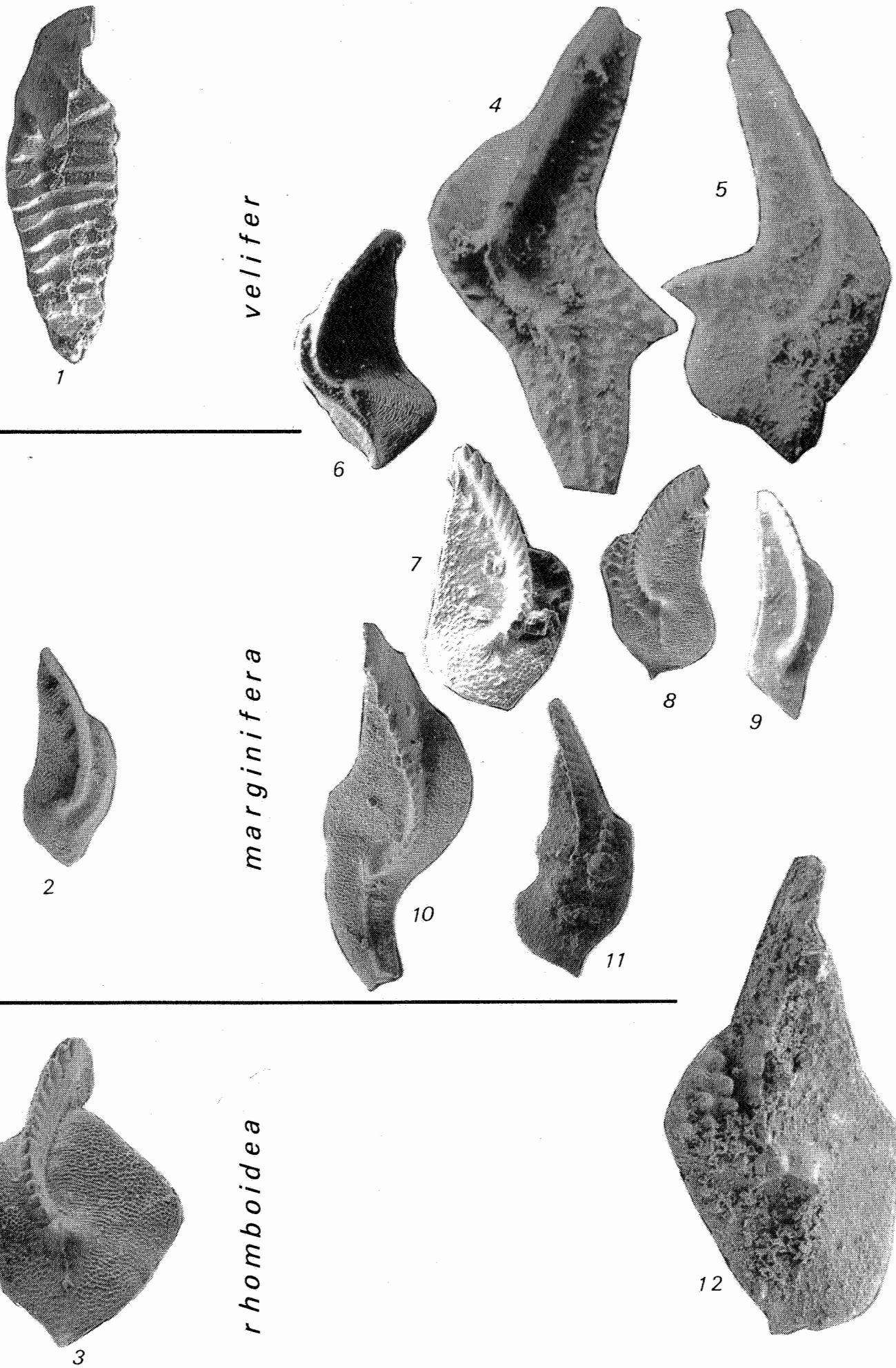

PLATE 4

Polygnathus semicostatus Branson & Mehl, 1934
Fig; 1 : 158W 152-8 ; LSEM 463/27 ; 54x
Fig. 2 : 158W 152-8 ; LSEM 463/30 ; 50x
Fig. 3 : 158W 152-8 ; LSEM 463/26 ; 52x

Pandorinellina cf insita
Fig. 4 : 158W 2-9 ; LSEM 448/18 ; 46x

Polygnathus communis Branson & Mehl, 1934
Fif. 5 : 158W 152-8 ; LSEM 464/3 ; 95x

Pelekysgnathus inclinatus
Fig. 6 : 158W 152-8 ; LSEM 463/28 ; 104x

"Icriodus" pectinatus Dreesen & Houlleberghs, 1980
Fig. 7 : 158W 44 ; LSEM 463/11 ; 90x

"Icriodus" costatus Thomas, 1949 Morphotype 1 Sandberg & Dreesen, 1984
Fig. 8 : 158W 149 ; LSEM 463/20 ; 95x

PLANCHE 4

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