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AN INTRODUCTION TO A FIELD TRIP TO THE LATE DEVONIAN OUTCROPS IN THE NORTHERN RHEINISCHES SCHIEFERGEBIRGE (FEDERAL REPUBLIC OF GERMANY)

by

Eva PAPROTH [1]

(7 figures and 4 tables)

ABSTRACT. - Nehdenian (early Famennian) to late Wocklumerian (latest Famennian or Strunian) sedimentation of the northern Rheinisches Schiefergebirge is reviewed and examplified by a few typical localities.

RESUME. - La sédimentation du Nehdenien (Famennien ancien) au Wocklumerien tardif (Famennien le plus récent ou Strunien) du nord du Massif schisteux rhénan est revue et illustrée par quelques localités types.

In the northern Rheinisches Schiefergebirge (fig. 1) the Famennian rocks occur usually on top of Givetian-Frasnian limestone complexes, and sometimes on top of Givetian-Frasnian siliciclastics.

In the Givetian-Frasnian, the widespread marine transgressional trend is characterized by widely extended, rather pure carbonate rocks (generally more than 95 % $CaCO_3$) with a considerable thickness (locally more than 1000 m). The contemporaneous siliciclastic sediments are concentrated in relatively small and quickly subsiding troughs which were fed by local source areas. In the upper Frasnian, near the Frasnian-Famennian boundary, the widespread black Kellwasser horizons (shales and limestones) mark a paleogeographic change.

1. Geologisches Landesamt Nordrhein-Westfalen, De Greiff-Str. 195 - D-4150 Krefeld (F.R.G.).

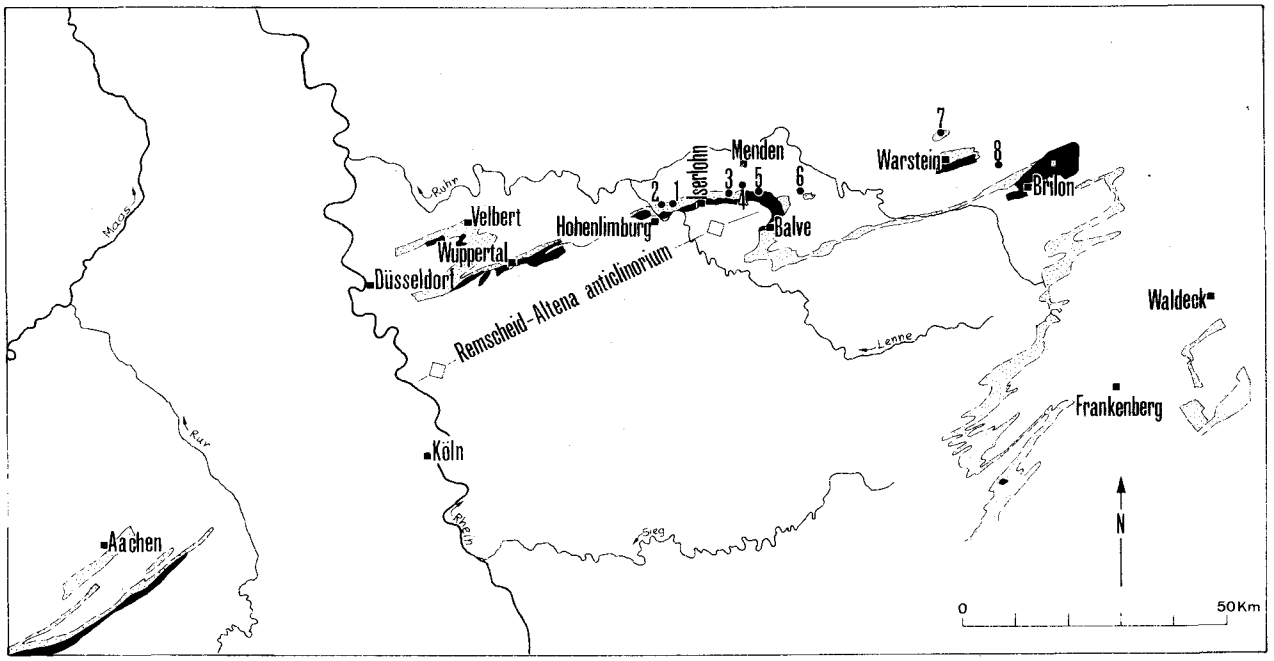

Figure 1. - Stops 1 to 8 of a field trip to the northern Rheinisches Schiefergebirge between Hagen-Hohenlimburg and Brilon. grey : Frasnian and Famennian siliciclastics; black : Givetian and Frasnian "massive limestone" (Massenkalk).

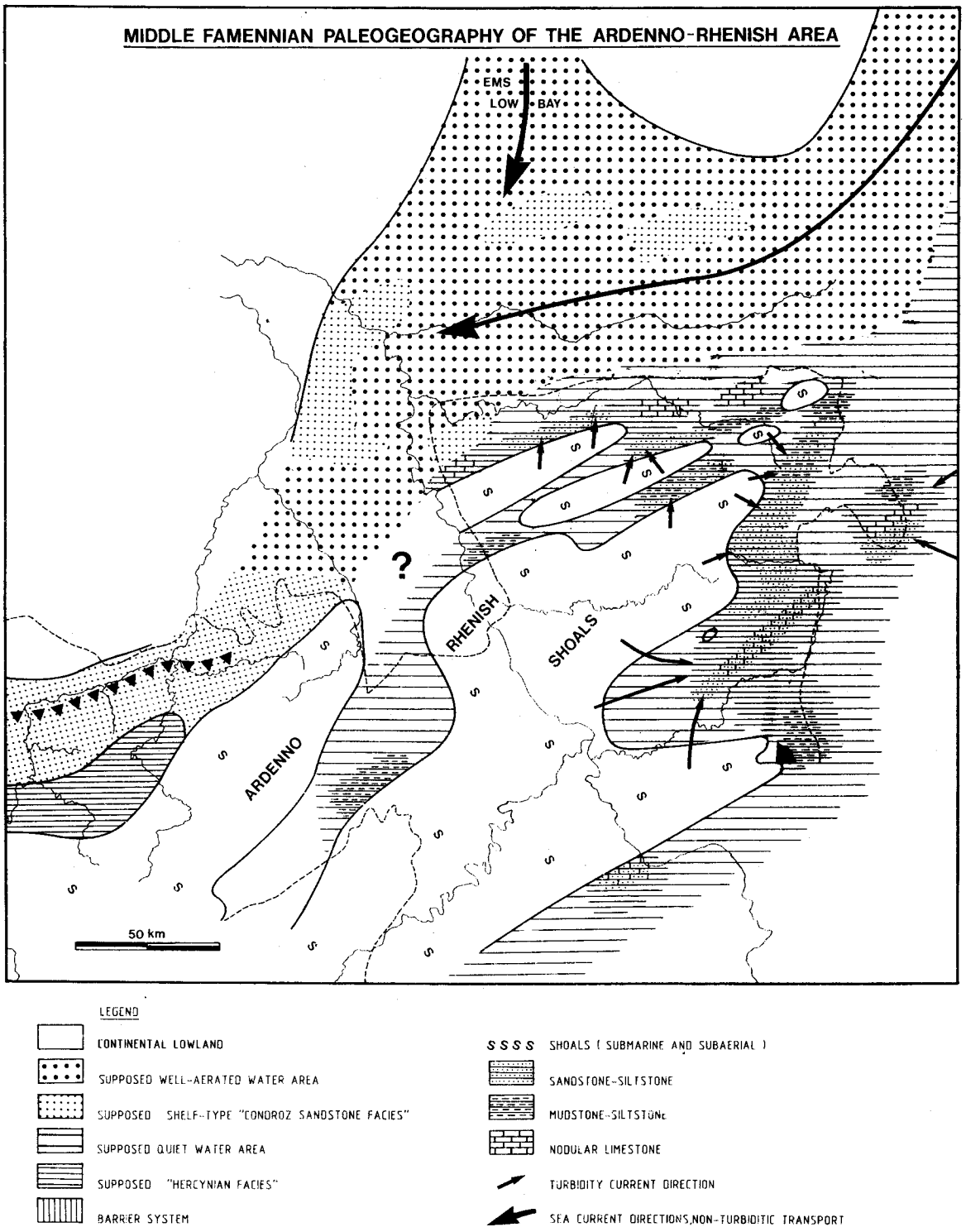

Figure 2. - Paleogeographic sketch map of east Belgium and west Germany during the middle Famennian. (Paproth, Dreesen & Thorez, 1986, fig. 2)

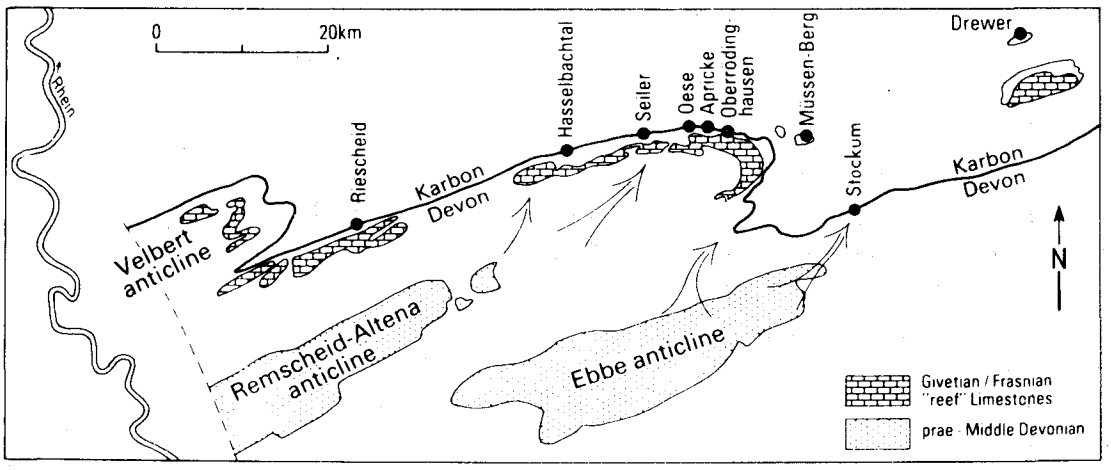

Figure 3. - Paleogeographic sketch map of the northern Rheinisches Schiefergebirge during the Wocklumerian, with suggested transport directions of siliciclastic influx (Becker *et al.*, 1984, Fig. 1).

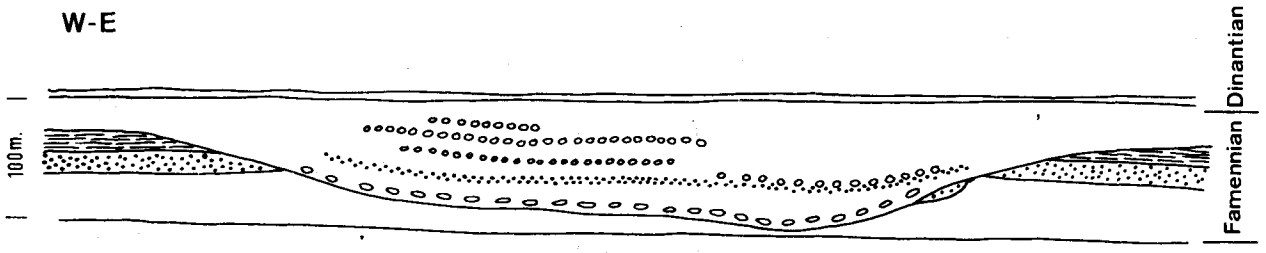

Figure 4. - The channel of the Seiler Conglomerate at Iserlohn; cross section (after levelling the base of the Kulm = base of the Liegende Alaunschiefer). After H. Schmidt, 1936, Abb. 1.

In contrast to the Frasnian which was characterized in many parts by little erosional energy (carbonate complexes !), the Famennian (fig. 2) is marked by generally active morphological energies. The Famennian rocks that now form part of the Rheinisches Schiefergebirge testify that pre-Famennian (mainly Devonian) rocks in the inner parts of the same tectogen became already eroded (fig. 3). Whether this erosion is mainly due to an early tectonic uplift or to a general lowering of the sea level is difficult to decide. It is supposed that these two processes interacted.

In the **early Famennian** (tables 1 and 3), the material of the **Nehden**-Schiefer (mudstones) and particularly of the overlying Nehden-Plattensandstein (flaggy sandstone; Kühn-Velten, 1966, 1968) is supposed to have been delivered from the rising hinterland where pre-Famennian (mainly early and middle Devonian) rocks were eroded (Dvořák, 1985).

At the northern flank of the Remscheid-Altena Anticlinorium between Letmathe (in the West; near Stop 1) and Hemer (in the East; near Stop 3) the Nehden Plattensandstein has a channel or fan-like appearance : the maximum thickness of about 60 m in the area North of Iserlohn and Letmathe wedges from there westwards and eastwards and disappears from this region more or less West of the river Lenne and North-East of Hemer (near Stop 3; fig. 7). North of Iserlohn, at Seiler, the fan-like structure is replaced over a West-East directed extension of about 4 km by the late Famennian "Seiler Konglomerat" truncating earlier Famennian sediments, including the Nehden sandstone (fig. 4; table 4).

The **middle Famennian Hemberg Formation** is usually marked by fine-grained, red (and greenish) coloured mudstones with layers of small carbonate nodules called "Kramenzelkalk". Near the top of the Hemberg Formation, two decimetric beds of *annulata* Schwartzschiefer (named after the clymenid *Platyclymenia annulata*) are reported from about Letmathe to Oberrödinghausen (fig. 5); however, these are replaced f.i. at Apricke by silty mudstones. H. Schmidt (1924, p. 110) determined from the twin beds (separated by 1 m thick mudstones) of *annulata*-Schwarzschiefer in Oberrödinghausen *Phacops granulatus* Mstr. *Platyclymenia intracostata* Fr., *P. annulata* Mstr., *P. subnautilina* Sdbg., *? Sporadoceras spirale* Wdk., Unidentified goniatites, *Loxopteria dispar* Sdbg., *Posidonia venusta* Mstr., *Praecardium* n. sp., *Tiariconcha rugosa* Kays., *Chaenocardiola* n. sp.

Table 1. - Stratigraphic subdivisions of the late Devonian and early Dinantian.

INTERNATIONAL CHRONOSTRATIGRAPHIC UNITS		GERMAN STAGES	GUIDE FOSSILS		
			Spores	Cephalopods	Conodonts
CARBONIFEROUS EARLY DINANT.	Middle Tournaisian	Erdbachian	HD	?	Siphonodella crenulata
	Lower Tournaisian	Balvian	VI	Gattendorfia crassa	Siphonodella sandbergi
					Siphonodella duplicata
				Gattendorfia subinvoluta	Siphonodella sulcata
DEVONIAN LATE DEVONIAN	Famennian	Wocklumerian	LN LE LL	Wocklumeria	Siphonodella praesulcata
		Dasbergian		Clymenia	Palmatolepis expansa
		Hembergian		Platyclymenia	Palmatolepis postera
					Palmatolepis trachytera
					Palmatolepis marginifera
		Nehdenian		Cheiloceras	Palmatolepis rhomboidea
					Palmatolepis crepida
		Adorfian		Crickites holzapfeli	Palmatolepis triangularis
	Frasnian (pars)				Palmatolepis gigas
				Manticoceras cordatum	Ancyrognathus triangularis

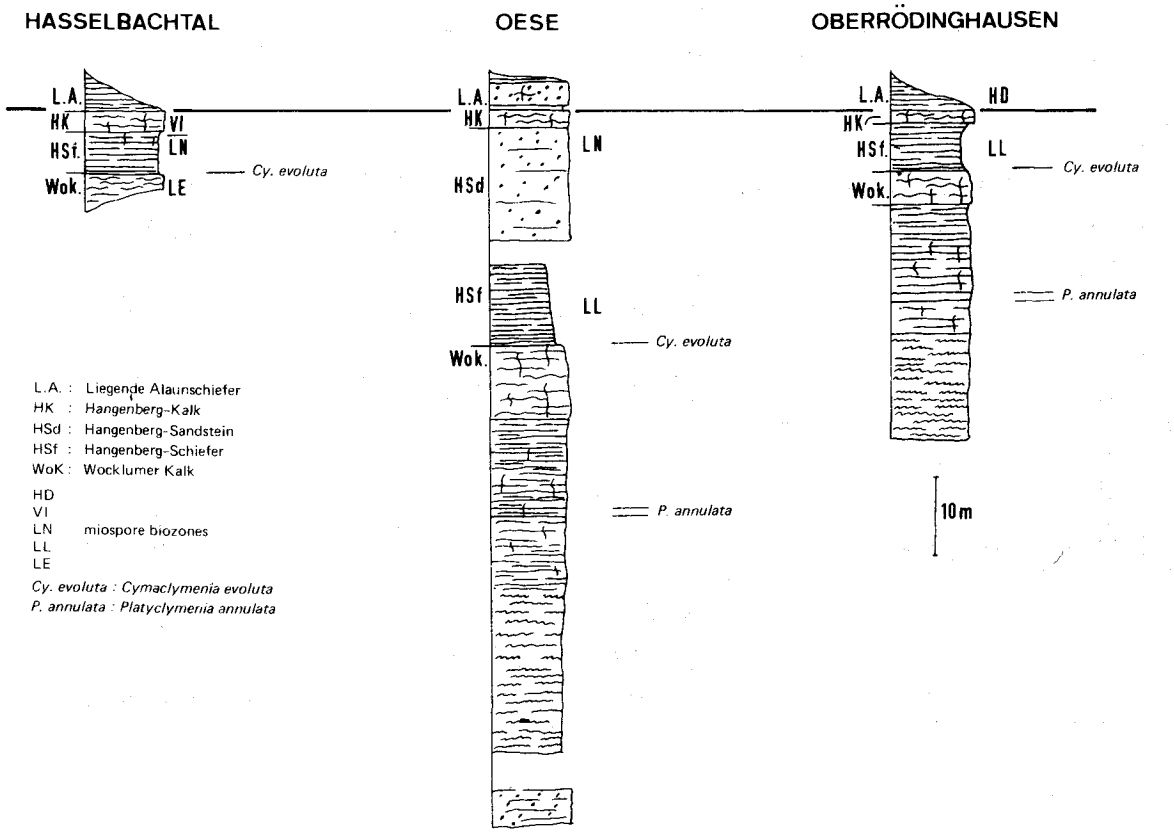

Figure 5. - Upper Famennian–Lower Tournaisian sections of Hasselbachtal (Stop 2), Oese (Stop 4) and Oberrödinghausen (Stop 5).

The **late Famennian Dasberg** and **Wocklum Formations** are characterized by particular facies patterns. In the Dasbergian, nodular limestones prevail at the northern flank of the Remscheid-Altena Anticline. More southerly regions, including the Lüdenscheid Syncline South of the Remscheid-Altena Anticline, contrast by their more siliciclastic sediments, particularly the locally occurring "Pönsandstein" (Pön sandstone), derived from local source areas in the Rhenish Shoals region.

The top of the **early Wocklumerian** (fig. 5), widespread Wocklumer Kalk, a fossiliferous nodular limestone with intercalated shales, seems of the same age everywhere at the northern flank of the Remscheid-Altena Anticlinorium between Hohenlimburg and Oberrödinghausen (Higgs & Streel, 1984) : it is overlain by decimetric black shales with *Cymyclymenia evoluta*. This fossil is recorded also from the French-Belgian late Famennian.

The **late Wocklumerian** (Table 2) is characterized

- at the northern flank of the Remscheid-Altena Anticlinorium from about Iserlohn to Oberrödinghausen, and
- at the northern flank of the Ebbe Anticlinorium near Stockum,

by the intercalation of relatively large lenses of erosional detritus that had been derived from nearby

Table 2. - Correlation between spore and conodont zonations at the Devonian–Carboniferous boundary. (Higgs & Streel, 1984, fig. 10).

SPORE ZONATION	CONODONTS ZONES	CONODONTS BIOFACIES
HIBERNICUS - DISTINCTUS		
? HD	Low CRENULATA	
	SANDBERGI	
VERRUCOSUS - INCOHATUS	Upp DUPLICATA	
VI	Low DUPLICATA	Upper PROTOGNATHODUS with Pr. kuehni
	SULCATA	
	PRAESULCATA upper	Low PROTOGNATHODUS with Pr. kockeli
LEPIDOPHYTA - NITIDUS LN	middle	
LEPIDOPHYTA - EXPLANATUS LE	mid - upp COSTATUS lower	
LEPIDOPHYTA - LITERATUS LL		

Table 3. - Conodont and cephalopod zones of the (upper) Famennian and (lower) Dinantian. (conodont zones (a) see Sandberg *et al.*, 1978; (b) Ziegler & Sandberg, 1984).

	Stufen	CEPHALOPOD ZONES	CONODONT ZONES (a)	(b)
DINANTIAN (pars)	Gattendorfia	?	lower crenulata	lower crenulata
		patens	triangulus triangulus	sandbergi
		westfalicus	triangulus inaequalis	upper duplicata
		dorsoplanus		lower duplicata
		acutum	kockeli-dentilineatus	sulcata
		prorsum	upper Protognathodus	
FAMENNIAN (pars)			lower Protognathodus	upper praesulcata
	Wocklumeria	upper paradoxa	upper costatus	middle praesulcata
		lower paradoxa		lower praesulcata
		upper subarmata	middle costatus	upper expansa
		lower subarmata		
	Clymenia	piriformis	lower costatus	middle expansa
		ornata		
		acuticostata	upper styriacus	lower expansa
		serpentina		
	Prolobites	annulata	middle styriacus	upper postera
			lower styriacus	lower postera
		delphinus	upper velifer	upper trachytera
			middle velifer	lower trachytera
		sandbergeri	lower velifer	uppermost marginifera
	Ch		upper marginifera	upper marginifera

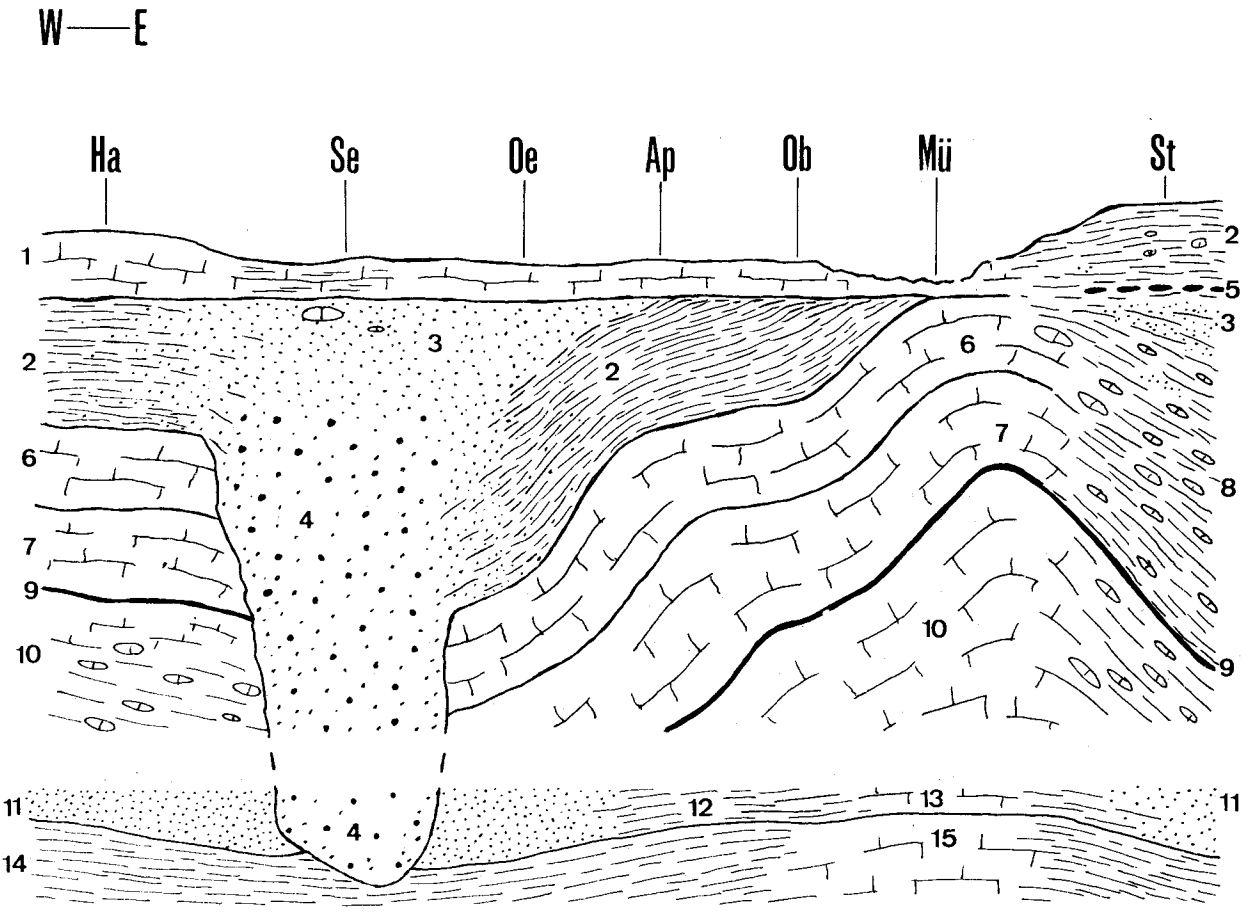

Figure 6. - Rough Diagram (no scale!) of upper Famennian and lower Tournaisian environments between Hasselbachtal and Stockum (after Higgs & Streel, 1984; Fig. 11 and H. Schmidt, 1936, Abb. 1); localities see Fig. 3.
1: Hangenberg limestone (Hangenberg-Kalk); 2: Hangenberg shale (Hangenberg-Schiefer); 3: Hangenberg sandstone (Hangenberg-Sandstein); 4: Seiler Conglomerate; 5: Stockum *Imitoceras* limestone lenses (Korn, 1984); 6: Wocklum limestone; 7: Dasberg limestone; 8: Wocklum and Dasberg shales with nodular limestone (Kalkknollenschiefer); 9: *annulata* black bed (Schwarzschiefer); 10: Hemberg limestone; 11: Nehden sandstone; 12: Nehden shale; 13: Nehden limestone; 14: Adorf shale (Schiefer); 15: Adorf limestone.

source areas to the South (Keupp & Kompa, 1984). The up to 95 m thick Seiler Konglomerat fills a channel which may have had an about North-South extension; a West/East cross section (?) is known from the North of Iserlohn to the Hemer area over a distance of about 4 km (Fig. 4; H. Schmidt, 1936; Heinke, 1978).

Unfortunately, outcrops of the Seiler conglomerate do not exist. It had been studied in detail in some trenches which had to be filled soon after (Koch *et al.*, 1970) : mica-bearing, partly carbonate sandstones, siltstones and mudstones predominate. Intercalated are several conglomeratic layers with quartz grains (rarely up to 3 cm diameter), limestone pebbles and carbonate ooids. The origin of the Seiler conglomerate has been delivered is discussed since long. A nearby source area in southerly direction seems to be most probable : central parts of the present Remscheid-Altena Anticlinorium may have formed highs from where eroded material of older rocks was derived, finding its way through the discontinuous belt of shoals formed by Givetian-Frasnian reef masses along the northern flank of the high (Fig. 7).

Laterally, finer-grained material of the "Seiler conglomerate" and presumably in immediate contact with it is the "Hangenberg-Sandstein" (Higgs & Streel, 1984; Keupp & Kompa, 1984; Fig. 6). The Hangenberg-Sandstein is proved to have been deposited in a short time interval (Stop 4 Oese). The coarser-grained material of this intercalation could not reach higher levels of the shoals (Stops 5 Oberrödinghausen and 6 Effenberg).

Another sandy intercalation of similar petrology, sedimentology and presumably origin, but at least in parts slightly younger, is formed by the Stockum sandstone or conglomerate (Fig. 6; Keupp & Kompa, 1984).

In the Warstein, Belecke and Scharfenberg areas, Middle Devonian to Dinantian sediments are exposed in anticlinal structures. Oldest exposed rocks are Givetian-Frasnian "Massenkalk" (massive limestone) which formed shoals during the Famennian and the

Table 4. - Late Devonian and early Dinantian lithostratigraphic units in the Rheinisches Schiefergebirge.

CHRONOSTRATIGRAPHIC UNITS			LITHOSTRATIGRAPHIC UNITS	
			Rheinisches Schiefergebirge	N. Remscheid-Altena anticlinorium only
DINANTIAN (pars) / TOURNAISIAN (pars)		Erdbachian (Pericyclus-Stufe)	Liegende Alaunschiefer	
		Balvian (Gattendorfia-Stufe)	Obere Hangenberg-Schichten	Hangenberg-Kalk
DEVONIAN	FAMENNIAN	Wocklumerian (Wocklumeria-Kallo-clymenia-Stufe)	Untere Hangenberg-Schichten	Hangenberg-Schiefer Hangenberg-Sandstein Seiler Konglomerat
			Wocklumer Schichten	Wocklumer Kalk
		Dasbergian (Clymenia-Stufe)	Dasberg-Schichten	
		Hembergian (Platyclymenia-Stufe)	Hemberg-Schichten	annulata Schw. Sfr. Kramenzelkalke
				red Cypridina shales
		Nehdenian (Cheiloceras-Stufe)	Nehdener Schichten	Plattensandstein-H. Tonschiefer-Horiz.
UPPER	FRASNIAN	Adorfian (Manticoceras Stufe)	Adorfer Schichten	Mergel- und Ton-schiefer, Kellwasser h. Ostricher Kalk Bänderschiefer Massenkalk (pars)

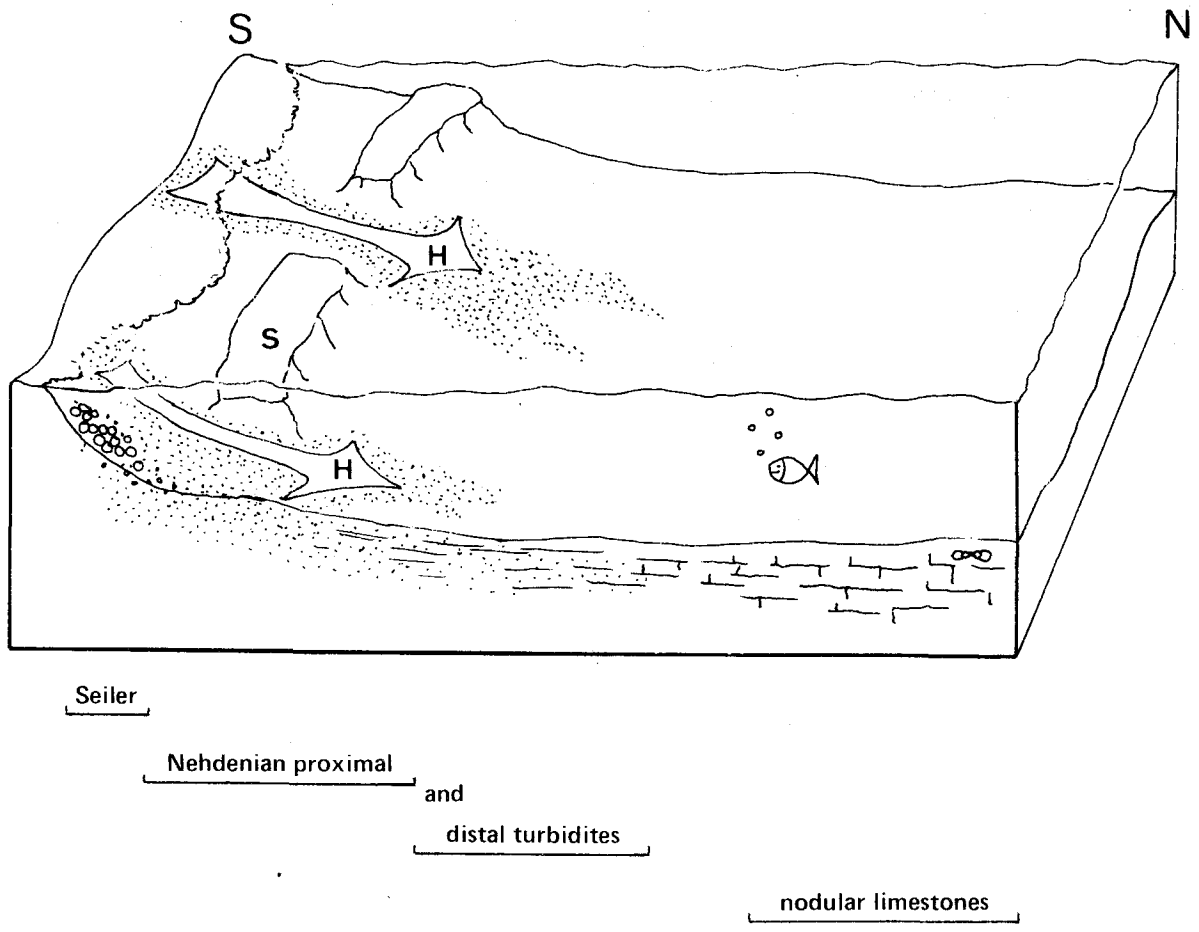

Figure 7. - Facies distribution in the youngest Devonian near the present northern border of the Rheinisches Schiefergebirge (R. Kompa & D. Korn) — H : Hangenberg-Sandstein; S: shoal, gormed by dead Givetian-Frasnian reef complexes.

Dinantian. Only in the uppermost Dinantian and lowermost Namurian (*Silesian*) these became included in the uniform depositional area that was covered by thick sheets of sands.

If a "global event" caused some widespread peculiarities near the Devonian-Carboniferous boundary, the black shales with *Cymaclymenia evoluta* may be one of its more direct consequences (Higgs & Streel, 1984), followed in this part of the Rheinisches Schiefergebirge by a temporary revival of the morphological (erosional) energies and by the catastrophic influx of the Seiler Conglomerate/Hangenberg-Sandstein material and the Stockum sands in an area where the normal (widespread) sediments consist of fine-grained quiet-water deposits : the Hangenberg-Schiefer.

REFERENCES

BECKER, T., BLESS, M.J.M., BRAUCKMANN, C., FRIMAN, L., HIGGS, K., KEUPP, H., KORN, D., LANGER, W., PAPROTH, E., RACHEBOEUF, P., STOPPEL, D., STREEL, M. & ZAKOWA, K., 1984. Hasselbachtal, the section best displaying the Devonian-Carboniferous boundary beds in the Rhenish Massif (*Rheinisches Schiefergebirge*). Cour. Forsch.-Inst. Senckenberg, Frankfurt a. Main, 67 : 181-191.

BECKER, R.T., 1985. Devonische Ammonoideen aus dem Raum Hohen Limburg - Letmathe (Geologisches Blatt 4611 Hohen Limburg). Dortmunder *Beitr. Landeskde*, naturwiss. Mitt., 19 : 19-34.

DVOŘÁK, J., 1985. The red shales of the Upper Devonian in the Rhenish Slate Mountains. N. Jb. Geol. Paläontol. Mh. 1985, Stuttgart, H. 6 : 329-339.

HEINKE, H.-J., 1978. Stratigraphische und fazielle Untersuchungen im Devon und Unterkarbon am Nordrand des Remscheid-Altenaer Sattels zwischen Iserlohn und dem Hönnetal. (Mbl. 4612 Iserlohn, Mbl. 4512 Menden und Mbl. 4613 Balve). Diplom-Arbeit Marburg/Lahn. Not published.

HIGGS, K. & STREEL, M., 1984. Spore stratigraphy at the Devonian-Carboniferous boundary in the northern "Rheinisches Schiefergebirge", Germany. Cour. Forsch.-Inst. Senckenberg, Frankfurt a. Main, 67 : 157-180.

KEUPP, H. & KOMPA, R., 1984. Mikrofazielle und sedimentologische Untersuchungen an Devon/Karbon Profilen am Nordrand des rechtsrheinischen Schiefergebirges. Cour. Forsch.-Inst. Senckenberg, Frankfurt a. Main, 67 : 139-142.

KÜHN-VELTEN, H., 1966. Subaquatische Rutschungen im höheren Oberdevon des Sauerlandes. Geol. Rundschau, Stuttgart, 44 : 3-25.

KÜHN-VELTEN, H., 1968. Struktur, Orientierung und Richtung in sandigem Oberdevonsediment (Plattensandstein der Nehden-Stufe) des nördlichen Sauerlandes. Fortschr. Geol. Rheinld. Westfalen, Krefeld, 16 : 239-268.

PAPROTH, E., DREESEN, R. & THOREZ, J., 1986. Famennian paleogeography and event stratigraphy of Northwestern Europe. *In* Late Devonian events around the Old Red Continent, M.J.M. Bless & M. Streel (eds), Ann. Soc. géol. Belg., 109 : 175-186.

SANDBERG, C.A., ZIEGLER, W., LEUTERITZ, K. & BRILL, S.M., 1978. Phylogeny, speciation and zonation of *Siphonodella* (conodonta, Upper Devonian and Lower Carboniferous). Newsletters on Stratigraphy, 7 (2) : 102-120.

SCHMIDT, H., 1924. Zwei Cephalopodenfaunen an der Devon/Karbongrenze im Sauerland. Jb. preuss. geol. Landesanst. f. 1923, Berlin, 44 : 98-171.

SCHMIDT, H., 1936. Faltungskerne im ostrheinischen Schiefergebirge. Z. dtsch. geol. Ges., Berlin, 88 : 680-686.

ZIEGLER, W. & SANDBERG, C.A., 1984. *Palmatolepis*-based revision of upper part of standard Late Devonian conodont zonation. *In* D.L., ed., Conodont biofacies and provincialism. Geological Society of America, Special paper 196 : 179-194.