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HASSELBACHTAL, THE SECTION BEST DISPLAYING THE DEVONIAN-CARBONIFEROUS BOUNDARY BEDS IN THE RHENISH MASSIF (RHEINISCHES SCHIEFERGEBIRGE)

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(6 figures, 1 plate)

INTRODUCTION

The Hasselbachtal section is located on the northern border of the Rhenish Massif, on the northern flanc of the Remscheid-Altena anticline (fig. 1, 4).

The locality is north of the town Hagen-Hohenlimburg, sheet (1 : 25.000) 4611 Hohenlimburg, R. 07000, H. 94220 ; Kreis Stadt Hagen, Regierungsbezirk Arnsberg, Nordrhein-Westfalen (fig. 2 and 3).

Accessibility : by car 2 kms from the Highway (A 46) entrance " Hohenlimburg" (fig. 3), crossing the northern fringe of Hohenlimburg-Reh, following the " Hasselbachstrasse" beside the little Hasselbach (Hassel brook) until end of the street with parking place ; walk on foot path beside the Hasselbach, in the wood for 600 m. The possibility to approach the locality by car directly exists by a little longer way through the wood.

An application to protect the locality as a Natural Monument (Naturdenkmal) is on the way.

The little Hassel brook is a contributary to the river Lenne. North of Hohenlimburg the brook cuts Carboniferous (Namurian and Dinantian) and Upper Devonian rocks. The general geological framework of the Devonian and Carboniferous rocks is relatively well known in the area. There exists the 2nd edition of the geological map (1 : 25.000) sheet 4611 Hohenlimburg (Krefeld 1972). The 1st edition was published in 1911 and it was in this area that DENCKMANN (1902, 1909) and others described the fundamental lithostratigraphic subdivision of the Dinantian and middle to upper Devonian rocks used for large parts of the Rhenish Massif until these days.

The Devonian-Carboniferous boundary beds are visible at the northern flanc of the Hasselbach valley, immedia-

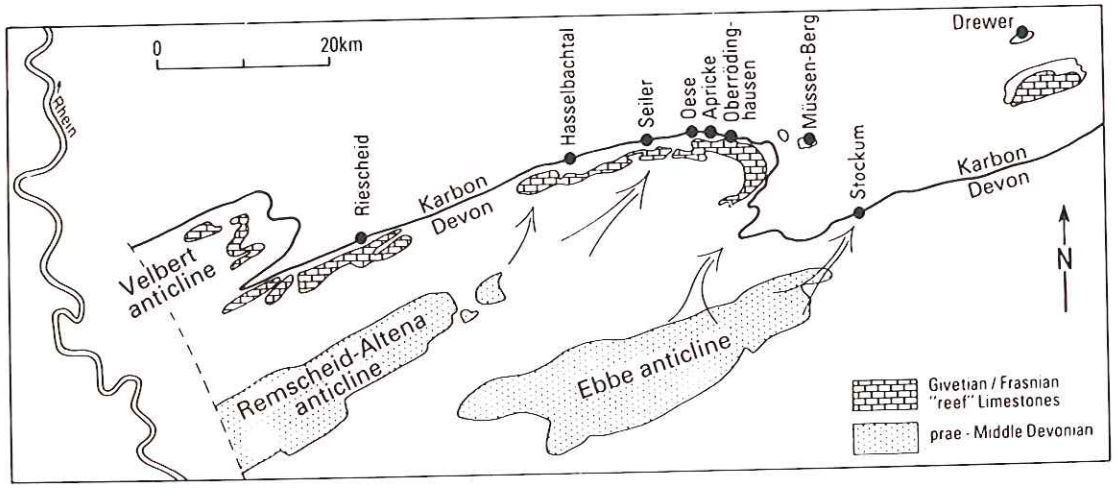


Fig. 1. Geologic sketch map with localities from where Devonian--Carboniferous boundary beds have been or are being described in the text and suggested transport directions of Seiler conglomerate, Hangenberg-Sandstone and Stockum sandstone (cf. PLESSMANN 1962, Abb. 3).

tely west of a foot path crossing (fig. 2). The valley cuts here about 2 m deep into the sediments. The sediments dip regularly with about 40° to the NNW. In the whole area, tectonisation is limited to a soft and regular folding, without schistosity or stronger diagenetic changes resp. higher coalification rank (fig. 4).

West of the path crossing, and north of it, conodonts and ostracods have been described out of Dinantian sediments (GROOS-UFFENORDE & UFFENDORDE 1974). South of it, the proper section starts in the Carboniferous *Siphonodella sandbergi* zone (first conodonts about 50 cm beneath the top of this section, from bed 61) with an alternation of nodular limestones and mudstones, thickness of individual beds varying around 5 cm. About 1,80 m below the youngest measured bed (nr. 49) west and south of the path crossing, more shaly, less calcareous beds of 65 cm thickness (bed 85) form the transition to the underlying mudstones of nearly 5 m thickness. They again overlie nodular limestones of the *Wocklumeria sphaeroides* and *Kamptoclymenia endogona* subzones resp. the Middle and Upper *costatus* zone (fig. 5).

The outcrop has been described by H. SCHMIDT (1924, p. 101). He correlated the upper, calcareous part with the Hangenberg-Kalk (*Gattendorfia*-Kalk, Obere Hangenberg-Schichten) of the Oberrödinghausen railway cut and other sections, the mudstones beneath bed 84 (beds 85 and older) with the Hangenberg-Schiefer (Untere Hangenberg-Schichten). He did not mention cephalopods or trilobites.

GROOS-UFFENORDE & UFFENORDE (1974) published especially conodonts from bed 84 top (their sample 956) and bed 83 (their sample 957).

In 1981, the presence of spores in bed 85, particularly the exact approach of the LN/VI zones boundary attracted the interest of the Working Group on the

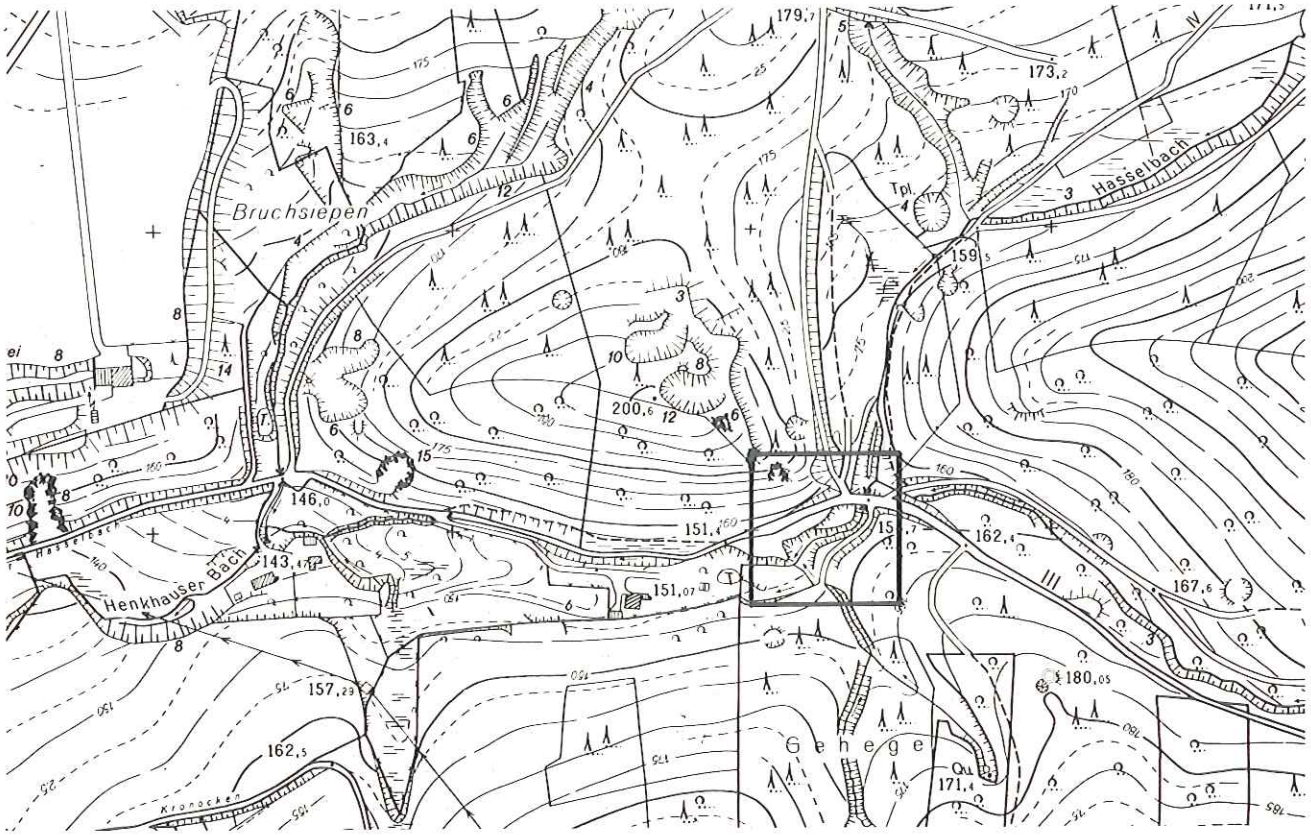
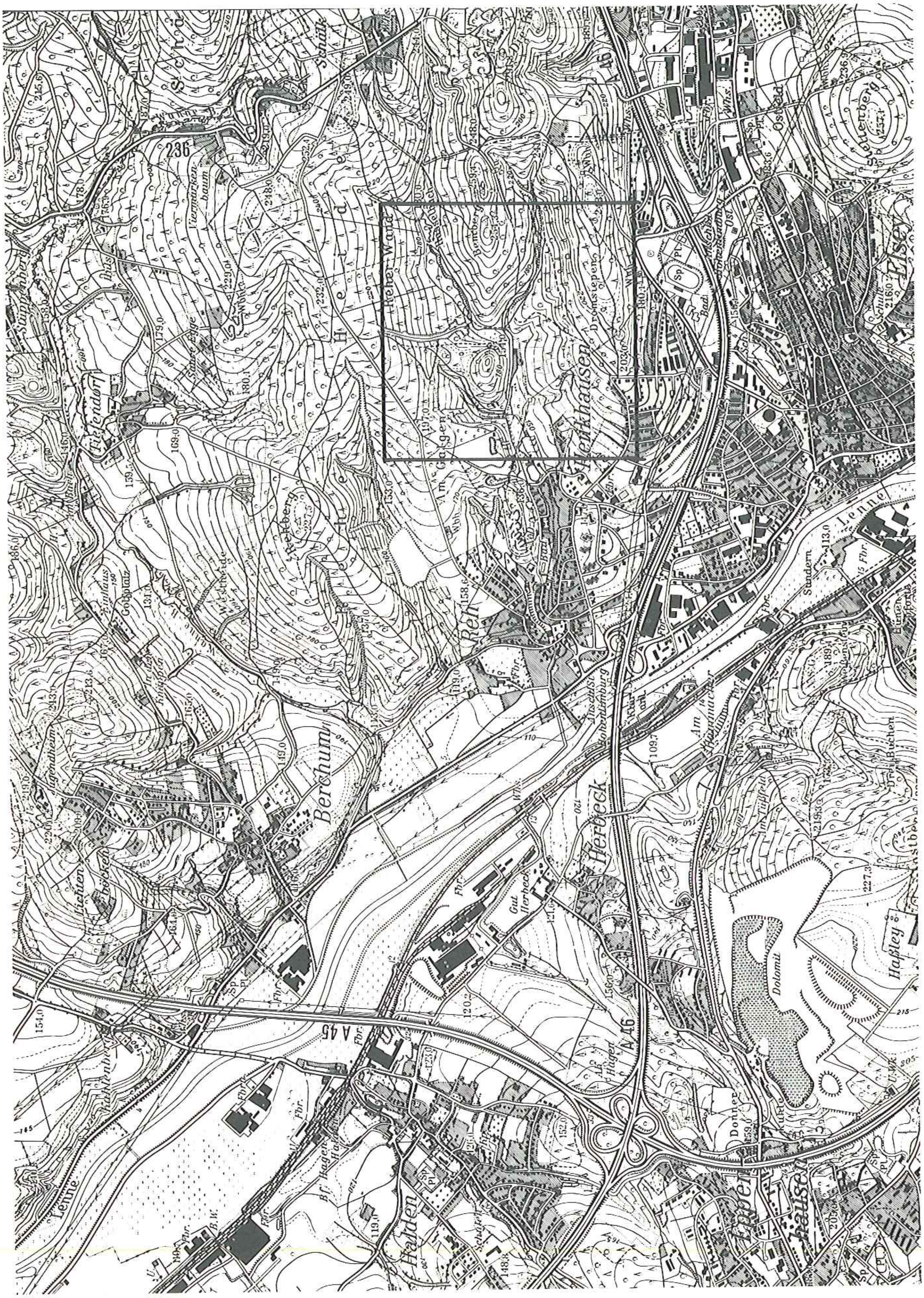


Fig. 2. Locality "Hasselbachtal", in the small quadrangle (from topographische Karte 1 : 5000, sheet Berchum ; hrg. Landesvermessungsamt Nordrhein-Westfalen).

Fig. 3. Locality "Hasselbachtal" at western foot of the Bemberg, near topographic point 154,0 (from topographische Karte 1 : 25000, sheet 4611 Hagen-Hohenlimburg ; hrg. Landesvermessungsamt Nordrhein-Westfalen).


Berchum
Herbeck
Halden
Lenne
Dolomit
A 45
A 46
Elsey
Oege
Henkhausen
Tiefendorf
Hagen
Sundern
236

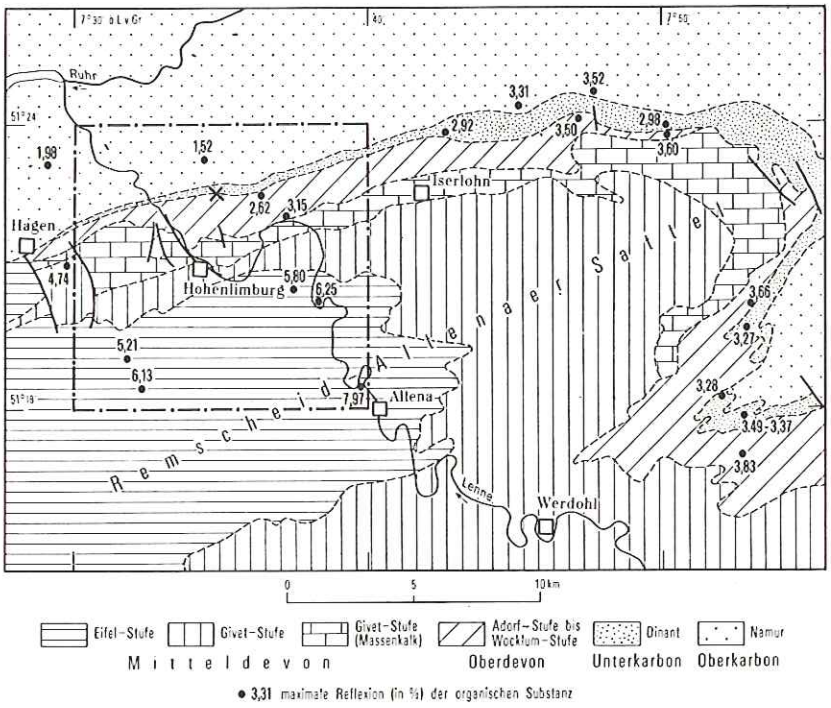


Fig. 4. Coalification rank of organic matter (numbers : maximum reflectance) in rocks of different age on sheet 4611 (Hagen-) Hohenlimburg (in quadrangle) and neighbouring area. Locality Hasselbachtal marked by cross. (WOLF 1972, Abb. 17).

Devonian-Carboniferous boundary. Since then, several details of the section have been studied, but it should be underlined that intense search for megafossils as cephalopods, trilobites, plants and other groups, has not sufficiently been undertaken. Nevertheless, the fauna found seems remarkedly variegated.

The proximity of the Hasselbachtal section to other localities where beds of about the same age are well known (fig. 1, localities mentioned) allow to form a reasonable judgment on the environmental framework and the palaeogeographical situation of that area at that particular time. Therefore, no fundamentally new facts are to be expected near the Hasselbachtal section - although intent research will certainly enrich and refine knowledge.

DESCRIPTION OF THE SECTION

(so far as studied in detail) :

Following from younger to older beds (fig. 5 and photographs) ;

bed 49 5 cm nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP), uncomplete goniatite

bed 50 5 cm mudstone

bed 51 5 cm nodular limestone

bed 52 3 cm mudstone

bed 53 4 cm nodular limestone

bed 54 7 cm mudstone
orthocone cephalopod

bed 55 3 cm nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP).
Eocanites spiratissimus (SCHINDEWOLF) ? (det. BECKER)

bed 56 3 cm mudstone

bed 57 2 cm nodular limestone
Acutimitoceras intermedium (SCHINDEWOLF) (det. BECKER)
orthocone cephalopod

bed 58 4 cm mudstone

bed 59 3 cm nodular limestone

bed 60 1 cm mudstone

bed 61 6 cm nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP), trilobite debris in thin slices (det. KEUPP).
Ligonodina sp. indet.
Polygnathus inornatus cf. *rostratus* RHODES, AUSTIN & DRUCE
- *longiposticus* BRANSON & MEHL
- *purus purus* VOGES

Pseudopolygnathus marginatus (BRANSON & MEHL)
- *multistriatus* MEHL & THOMAS
- *triangulus inaequalis* VOGES

Siphonodella duplicata (BRANSON & MEHL)
- *sulcata* (HUDDLE)

age : *sandbergi* zone, lower part (- *duplicata* zone, upper part) (det. STOPPEL, sample Con 4722)

bed 62 5 cm mudstone

bed 63 3 cm nodular limestone
Polygnathus communis communis BRANSON & MEHL
- *purus purus* VOGES

Protognathodus sp. juv. (cf. *meischneri* ZIEGLER)
Pseudopolygnathus triangulus VOGES subsp. indet.
Siphonodella sulcata (HUDDLE)

age : *sandbergi* zone - *duplicata* zone, upper part (det. STOPPEL sample Con 4688)

bed 64 2 cm mudstone

bed 65 4 cm nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP)
in thin slice : echinoderms
bryozoa
cephalopods
trilobites
ostracods (det. KEUPP)
Ligonodina sp. indet.
Ozarkodina sp. indet.
Polygnathus purus subplanus VOGES
Protognathodus kockeli (BISCHOFF)
Pseudopolygnathus triangulus inaequalis VOGES
Siphonodella cf. *duplicata* (BRANSON & MEHL)

age : *sandbergi* zone - *duplicata* zone, upper part (det. STOPPEL, sample Con 4693).

bed 66 2 cm mudstone

bed 67 4-8 cm nodular limestone
Neoprioniodus sp. indet. (juv.)
Polygnathus communis communis BRANSON & MEHL
- *purus purus* VOGES

Pseudopolygnathus fusiformis BRANSON & MEHL
- cf. *marginatus* (BRANSON & MEHL)
- *triangulus* subsp. indet.

Siphonodella duplicata (BRANSON & MEHL)

age : *sandbergi* zone - *duplicata* zone, upper part (det. STOPPEL sample Con 4693)

bed 68 2 cm mudstone

bed 69 4 cm nodular limestone
Liobole cf. *submonstrans* R. & R. RICHTER (det. BRAUCKMANN)
foraminifera, agglutinated forms (det. STOPPEL)

bed 70 4 cm mudstone, silty-sandy

bed 71 5 cm limestone
± bioturbate bioclastic wackestone (det. KEUPP), trilobites, cephalopods in thin slices (det. KEUPP)
no conodonts (STOPPEL)

bed 72 nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP)
in thin slice, trilobites (det. KEUPP)
Archegonus (Phillibole) cf. *drewerensis* R. & E. RICHTER (det. BRAUCKMANN)
Pseudopolygnathus primus BRANSON & MEHL
(det. STOPPEL, sample Con 4692);

bed 73 mudstone, silty-sandy

bed 74 nodular limestone
Hindeodella subtilis BASSLER
Neoprioniodus sp. indet.
Ozarkodina cf. *delicatula* STAUFFER & PLUMMER
Polygnathus purus VOGES subsp. indet.
Pseudopolygnathus primus BRANSON & MEHL
"*Spathognathodus*" sp. indet.
(det. STOPPEL, sample Con 4685)

bed 75 mudstone

bed 76 nodular limestone
± bioturbate bioclastic wackestone (det. KEUPP)
in thin slices : trilobites (det. KEUPP)
no conodonts (STOPPEL)

bed 77 15 cm nodular limestone bed, imbedded in mudstone
no conodonts (STOPPEL)

bed 78 8 cm nodular limestone
bioclastic packstone (det. KEUPP)
in thin slice : calcisphaeres
ostracods (det. KEUPP)
no conodonts (STOPPEL)

bed 79 1 cm metabentonite (acid tuff, det. GRÜNHAGEN)

bed 80 mudstone, silty-sandy

bed 81 7 cm nodular limestone
± bioturbate bioclastic limestone (det. KEUPP)
Archegonus (Phillibole) cf. *drewerensis* R. & E. RICHTER (det. BRAUCKMANN)
fish teeth
"*Ozarkodina*" sp. indet.
Polygnathus communis communis BRANSON & MEHL
- *purus purus* VOGES
- *purus subplanus* VOGES
- cf. *varcus* STAUFFER *

Protognathodus kockeli (BISCHOFF)

age : *sandbergi* zone - *sulcata* zone (* with a reworked Givetian conodont) (det. STOPPEL, sample Con 4721)

bed 82 8 cm mudstone, silty-sandy

bed 83 17 cm nodular limestone surrounded by mudstone containing spores of VI zone (Hb 83 on fig. 6, det. HIGGS & STREEL)
spiriferid
goniatite indet.
Archegonus (Waribole) abruptirhachis R. & E. RICHTER (det. BRAUCKMANN)
fish bones, *Actinopterygians?* (det. FRIMAN)
fish teeth
Guerichia mariannae mariannae (TCHERNYSHEV)
- - *hemicyclia* (SADYKOV)
- *venustiformis globosa* (SADYKOV)
- sp.

cf. *Posidonia striata* (SADYKOV)
lamellibranchs (det. H. ZAKOWA)

Profil in Hasselbachtal

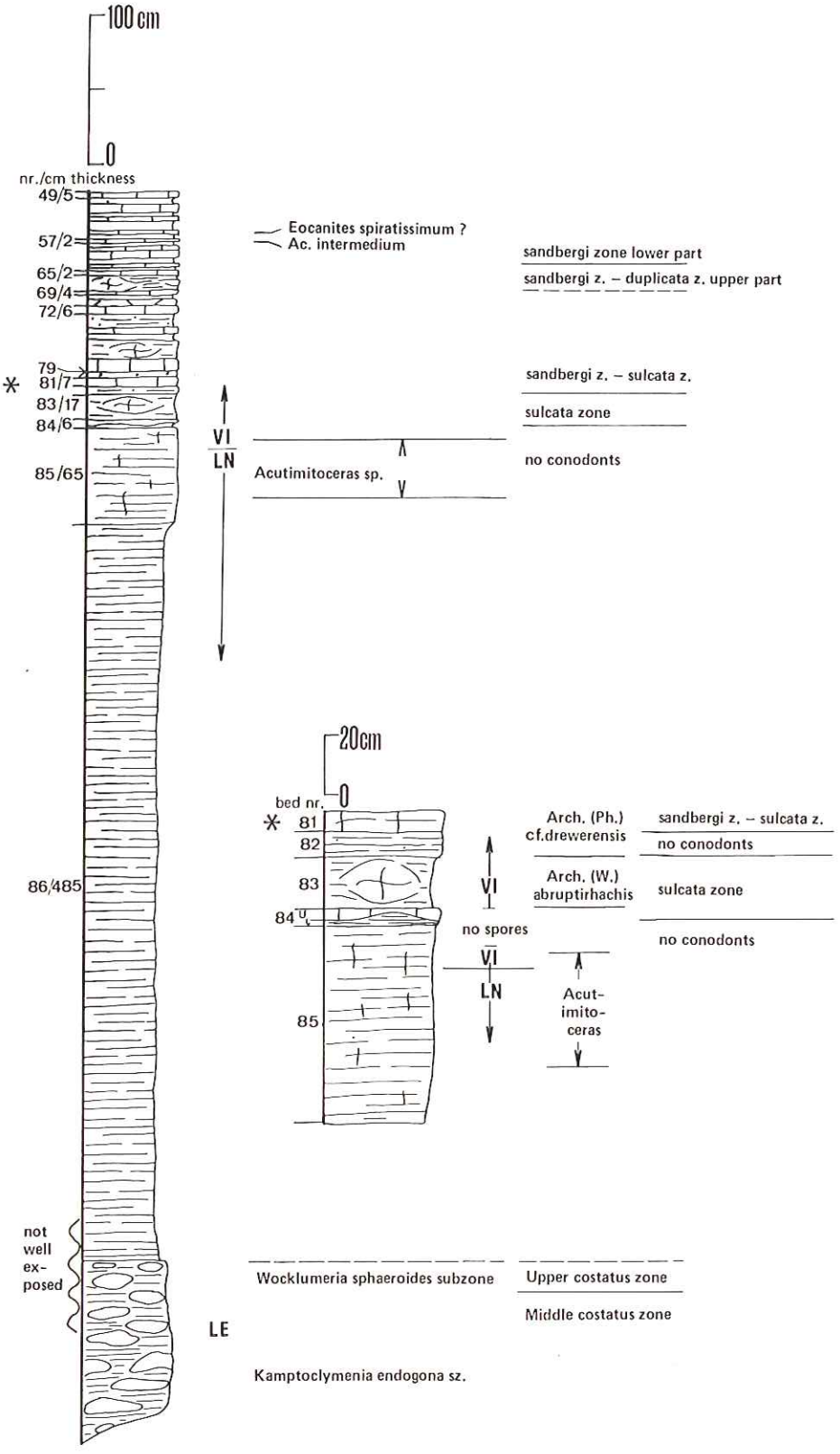


Fig. 5.- Profil in Hasselbachtal

Polygnathus communis communis BRANSON & MEHL
Protognathodus kockeli (BISCHOFF)
- *kuehni* ZIEGLER & LEUTERITZ
- *meischneri* ZIEGLER

form group *Bispathodus stabilis* (BRANSON & MEHL) - *Bispathodus anteposicornis* (SCOTT) - *Bispathodus aculeatus* (BRANSON & MEHL)

age : *sulcata* zone (STOPPEL's sample Con 4720 ; sample 957 of GROOS-UFFENORDE & UFFENORDE 1974, p. 67)

bed 84 3-6 cm, subdivided into :

84 top (or upper part) :

Weakly washed oobiosparite (det. KEUPP). An indistincly graded (fining upwards) turbidite which eroded the underlying bed "84 bottom". Main components of the turbidite are ooides and echinoderme fragments, less frequent are bryozoa and brachiopoda
? Striatochonetes sp. (det. RACHEBOEUF)
Bairdiocypris aff. *rudolphi* (KUMMEROW) (det. BLESS)
Shishaella sp. (det. BLESS)
Bispathodus aculeatus aculeatus (BRANSON & MEHL)
- *costatus* (BRANSON)*
- *stabilis* (BRANSON & MEHL)
- cf. *ultimus* (BISCHOFF)*
- *ziegleri* (RHODES, AUSTIN & DRUCE)*

form group *B. stabilis* (BRANSON & MEHL) – *B. anteposicornis* (SCOTT) – *B. aculeatus* (BRANSON & MEHL)

Lonchodina subsymmetrica ULRICH & BASSLER
Palmatolepis gonioclymeniae K.J. MÜLLER*
- *gracilis gracilis* BRANSON & MEHL*

Polygnathus biconstrictus GEDIX
- *communis communis* BRANSON & MEHL
- *germanus* (ULRICH & BASSLER)
- cf. *nodomarginatus* BRANSON & MEHL
- *symmetricus* BRANSON
- *vogesi* ZIEGLER*

Protognathodus collinsoni ZIEGLER
- *kockeli* (BISCHOFF)
- *kuehni* ZIEGLER & LEUTERITZ

Pseudopolygnathus trigonicus ZIEGLER*
Siphonodella praesulcata SANDBERG
- *sulcata* (HUDDLE)

"Spathognathodus" strigosus (BRANSON & MEHL)
- *supremus* ZIEGLER

age : *sulcata* zone (STOPPEL's samples 4692, 5115, 5230 ; sample 956 of GROOS-UFFENORDE & UFFENORDE 1974, tab. 2), with reworked conodonts (marked *) of the Upper Devonian.

84 bottom (or lower part) :

± bioturbate bioclastic wackestone (det. KEUPP).
no conodonts (STOPPEL)

bed 84-85 0-20 cm below top of bed 84

Guerichia mariannae mariannae (TCHERNYSHEV)
- - *hemicyclia* (SADYKOV)
- *venustiformis* (SADYKOV)
- sp.

lamellibranchs (det. H. ZAKOWA)

bed 85 65 cm mudstone, carbonaceous,
uppermost 7 cm thickness without spores, 7-21 cm below top of bed with abundant spores : boundary BI/LN zones at 14 cm below top of bed 85 (between sample Hb 15-17 and Hb 18-19 on fig. 5, det. HIGGS & STREEL).
Several mega-plant remains.

12 cm below top of bed 85 : *Acutimitoceras* sp.
28 cm below top of bed 85 : gastropods (det. BECKER)
36 cm below top of bed 85 : *Acutimitoceras* cf. *prorsum prorsum* (H. SCHMIDT)
40 cm below top of bed 85 : *Acutimitoceras* cf. *prorsum prorsum* (H. SCHMIDT)
46 cm below top of bed 85 : *Acutimitoceras* cf. *prorsum prorsum* (H. SCHMIDT)
(cephalopods det. D. KORN & T. BECKER)
no conodonts (LANGER, STOPPEL)

0-5 cm below top of bed 85
Guerichia mariannae mariannae (TCHERNYSHEV)
- - *hemicyclia* (SADYKOV) (6,5 cm below bed 83)
- *venustiformis* (SADYKOV)
- cf. *venustiformis* (SADYKOV) (6,5 cm below bed 83)
- sp.

cf. - *venustiformis globosa* (SADYKOV)

uppermost 2 cm
Guerichia mariannae mariannae (TCHERNYSHEV)
- - *hemicyclia* (SADYKOV)
- *venustiformis* (SADYKOV)

30 cm below top of bed 84
Guerichia aff. *mariannae*
- cf. *mariannae hemicyclia* (SADYKOV)
- *venustiformis* (SADYKOV)
- cf. *venustiformis* (SADYKOV)
- sp.

40-50 cm below top of bed 84
Guerichia aff. *mariannae*
- cf. *venustiformis* (SADYKOV)
- cf. *venustiformis globosa* (SADYKOV)
- sp.

lamellibranchs (det. H. ZAKOWA)

bed 86 about 4,85 m thick mudstones (silty), spores of LN zone (Hb 7 and 5 on fig. 6, det. HIGGS & STREEL).

70 cm below top of bed 84
Guerichia aff. *mariannae*
- sp.

75-80 cm below top of bed 84
Guerichia aff. *mariannae* ssp.
- *venustiformis* (SADYKOV)
- sp.

80-90 cm below top of bed 84
Guerichia cf. *venustiformis globosa* (SADYKOV)
- cf. *venusta* (MÜNSTER)

90-100 cm below top of bed 84
Guerichia cf. *venustiformis* (SADYKOV)
- cf. *venusta* (MÜNSTER)

120-140 cm below top of bed 84
Guerichia venustiformis (SADYKOV)
- cf. *venusta* (MÜNSTER)

200-220 cm below top of bed 84
Guerichia cf. *venusta* (MÜNSTER)
- sp.

lamellibranchs (det. H. ZAKOWA)

ZONES	VI						LN				LE
MIOSPORE TAXA	Hb 83	Hb 10	Hb 11-13	Hb 9	Hb 14-15	Hb 15-17	Hb 18-19	Hb 22-23	Hb 7	Hb 5	Hb 1
Aneurospora greggsi				•			•	•			•
Apiculiretusispora verrucosa							•	•			
Archaeozonotriletes minutus				•		•	•				•
Auroraspora asperella								•			
A. hyalina var. *tournensis*							•				
A. macra	•		•	•		•	•	•			
Camptotriletes paprothii	•	•	•	•	•	•	•	•	•		
Convolutispora caliginosa				•							•
C. oppressa				•			•	•	•	•	
C. vermiformis		•		•	•	•	•		•	•	
Convolutispora sp.		•		•		•		•	•		
Corbulispora cancellata			•	•	•	•	•			•	
Corystisporites sp. (*in* Higgs 1975)	•	•	•	•	•	•	•	•			
Crassispora cf. *maculosa*	•										
Cristatisporites colliculus				•	•		•				
C. menendezii									•		
Cyrtospora cristifer	•					•		•			
Densosporites spitsbergensis								•			
Dictyotriletes trivialis		•	•	•	•			•	•		
Diducites mucronatus								•	•	•	•
D. plicabilis				•				•	•	•	
D. poljessicus							•	•	•		
D. versabilis								•	•		
Discernisporites crenulatus									•		
D. micromanifestus			•		•			•			
Emphanisporites rotatus									•		
Endoculeospora gradzinskii							•	•			
Grandispora cornuta											•
G. echinata				•			•	•	•		•
Hymenozonotriletes explanatus				•			•	•	•		•
Knoxisporites literatus	•	•		•		•			•	•	
K. pristinus		•									
Leiotriletes trivialis							•				
Lophozonotriletes excicus					•			•			
L. triangulatus			•	•		•		•		•	•
Lophozonotriletes sp.		•									
Pulvinispora quasilabrata				•				•	•		
P. scolecophora								•	•		
Punctatisporites minutus	•			•			•	•	•	•	
P. planus						•	•	•		•	
Pustulatisporites gibberosus					•						
Pustulatisporites sp. A (Higgs 1975)				•		•	•	•	•	•	
Raistrickia spathulata							•	•			
R. macrura	•		•	•		•	•		•		
R. minor							•	•			
R. variabilis			•	•			•	•	•		
Retispora lepidophyta							•	•	•	•	
Retusotriletes communis		•			•			•		•	
R. crassus				•				•	•		
R. famenensis							•				
R. incohatus	•	•	•	•	•	•	•	•	•	•	
R. minor							•	•			
Rugospora flexuosa						•	•	•		•	
R. granulatispunctata				•							
Secarisporites sp.						•					
Spelaeotriletes crustatus		•		•		•	•	•		•	
S. obtusus							•	•			
Spinozonotriletes uncatus							•		•		
Tumilispora ordinaria								•	•		
Umbonatisporites abstrusus							•		•		
Vallatisporites pusillites				•		•		•	•	•	
V. vallatus				•				•	•		
V. verrucosus				•			•	•	•	•	
Velamisporites magnus								•			
Verrucosisporites nitidus				•	•	•	•	•	•	•	
V. scurrus						•		•			
? Spelaeotriletes cumulus				•				•			

Fig. 6.- Spores content.

The boundary of the mudstones to the underlying nodular limestones is hidden by roots of a large beech tree.

Base of the section : nodular limestones of the *Wocklumeria sphaeroides* and (beneath) *Kamptoclymenia endogona* subzones (det. BECKER & KORN). Have been found :

Imitoceras sp.
Discoclymenia sp.
Cyrtoclymenia sp.
Cymaclymenia sp.
Kosmoclymenia sp.
Gonioclumeniidae
Wocklumeria sphaeroides (RICHTER)
Parawocklumeria paradoxa (WDKD).
orthocone cephalopods

From about the top of the nodular limestones.

Richterina (Richterina) costata (RICHTER)
– – *striatula* (RICHTER)
which caracterise the *hemisphaerica/latior-Interregnum* have been reported (GROOS-UFFENORDE & UFFENORDE 1974, sample 950, Abb. 2 and pp. 70-71).

0-0.20 m beneath top of the nodular limestones :

Bispathodus costatus (E.R. BRANSON)
– *ziegleri* (RHODES, AUSTIN & DRUCE)
Palmatolepis gracilis gracilis BRANSON & MEHL
– – *sigmoidalis* ZIEGLER
Pseudopolygnathus trigonicus ZIEGLER
"Spathognathodus" supremus ZIEGLER
age : upper *costatus* zone (STOPPEL's sample 4916 ; sample 955 of GROOS-UFFENORDE & UFFENORDE 1974, tabl. 2, p. 67)

0.20 - 0.35 m beneath top of the nodular limestones :

Bispathodus costatus (E.R. BRANSON)
– *ziegleri* (RHODES, AUSTIN & DRUCE)
Palmatolepis gonioclymeniae K.J. MÜLLER
– *gracilis sigmoidalis* ZIEGLER
Pseudopolygnathus trigonicus ZIEGLER
"Spathognathodus" supremus ZIEGLER
age : middle *costatus* zone (samples 952, 953, 954 of GROOS-UFFENORDE & UFFENORDE 1974, tabl. 2, p. 67).

From about 0.50 m below the top of the nodular limestone :

spores of LE zone (fig. 5; Hb 1 on fig. 6, det. HIGGS & STREEL).

GENERAL REMARKS

LAMELLIBRANCHS

Professor ZAKOWA comments in a letter (of April) 17, 1984) that *Guerichia mariannae mariannae* and *G. mariannae hemicyclia* seem to characterise Tournaisian deposits in the Holy Cross Mountains (Poland) and Kazakhstan (USSR) ("Tn 1b - - Tn 3"); these forms have been recognized in bed 83 and the upper two respective five cms of bed 85 of the Hasselbachtal section. Bed 85 should be thoroughly searched for *Guerichia*, in order to place exactly the first appearance of *Guerichia mariannae mariannae* and *G. mariannae hemicyclia*. *Guerichia venusta* which seems to be characteristic for Devonian sediments has not been recognized in the material studied.

FOSSIL GROUPS FOUND IN THE SECTION :

spores	gastropods
mega-plants	lamellibranchs
calcisphaeres	cephalopods
foraminifers (agglutinantia)	trilobites
echinoderms	ostracods
bryozoa	conodonts
brachiopods	vertebrates (fishes)

REMARKS ON THE ENVIRONMENT

Microfacies analysis of some limestone beds (49, 55, 61, 65, 71, 72, 76, 78, 81, 84 ; by H. KEUPP, Bochum) indicate an open marine shelf milieu below wave base for the lower (older) part of the "Hangenberg-Kalk" (beds 84 - 85), with the exception of bed 78 where calcisphaeres indicate a restricted environment (in relation to the underlying tuff ?). The upper, younger part of the "Hangenberg-Kalk" (beds 55 -- 49) indicate a growing pauperization of the fauna.

Bed 84 top is the only turbiditic level (KEUPP) : the indistinct gradation and the partly washed pores indicate sedimentation near the source area (proximal situation). Primary sedimentation area of the oobiosparite material may have been a very shallow shelf or shelf hinge area. The ostracod genera found in this bed "are interpreted as guides for a normal marine environment ("open marine"), usually at some distance from the coast" (BLESS).

A first version of this text has been distributed to the members of the IUGS working group on the Devonian-Carboniferous boundary and to the attenders at the Moscow and Madrid meetings.

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HASSELBACHTAL, THE SECTION BEST DISPLAYING THE DEVONIAN-CARBONIFEROUS BOUNDARY BEDS IN THE RHENISH MASSIF (RHEINISCHES SCHIEFERGEBIRGE)

ABSTRACT

The Hasselbachtal section, on the northern border of the Rhenish Massif, displays about 1.80 m of alternating nodular limestones and mudstones with conodont, trilobite and ammonoid faunas and, containing spores, 65 cm of less calcareous beds transitional to the underlying mudstones of nearly 5 m thickness. The oldest *Siphonodella sulcata* occurs, with *S. praesulcata,* in the lowermost limestone bed.

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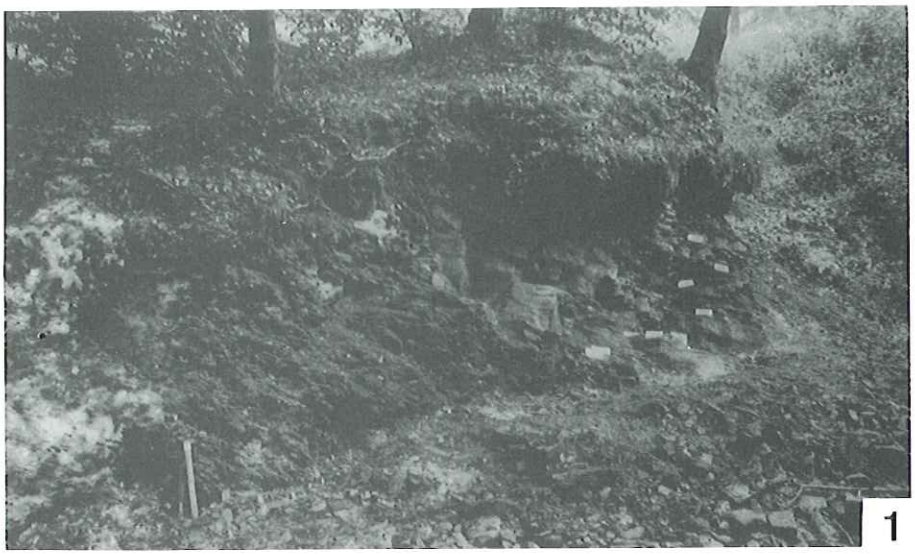
PLATE 1

PROFIL IN HASSELBACHTAL

Fig. 1. The complete profil.
(The hammer indicates the top of the Wocklumer Limestone)

Fig. 2. The upper limy part of the profil.

Fig. 3. Close-up on the boundary beds.



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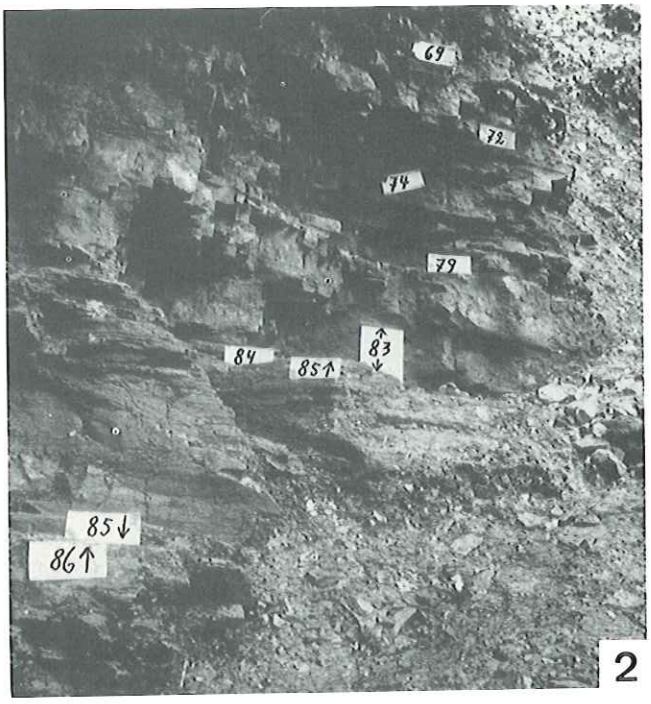

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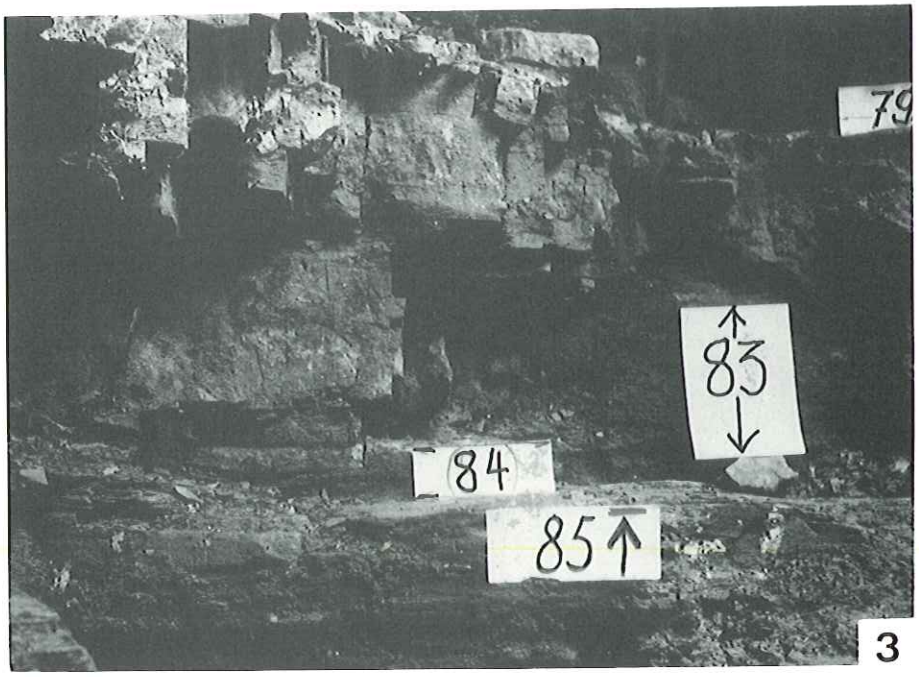

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