Sbor. geol. věd	Paleontologie 30	Pages 61–84	3 figs.	3 tabs.	12 pls.	Praha 1989 ISSN 0036-5297

Fauna from the limestones at the Frasnian/Famennian boundary at Mokrá (Devonian, Moravia, Czechoslovakia)

Fauna z vápenců při hranici frasn/famen v Mokré (devon, Morava, Československo)

JINDŘICH HLADIL[1] - JIŘÍ KALVODA[2] - OLGA FRIÁKOVÁ[3] - ARNOŠT GALLE[4] - ZUZANA KREJČÍ[5]

Received October 6, 1986

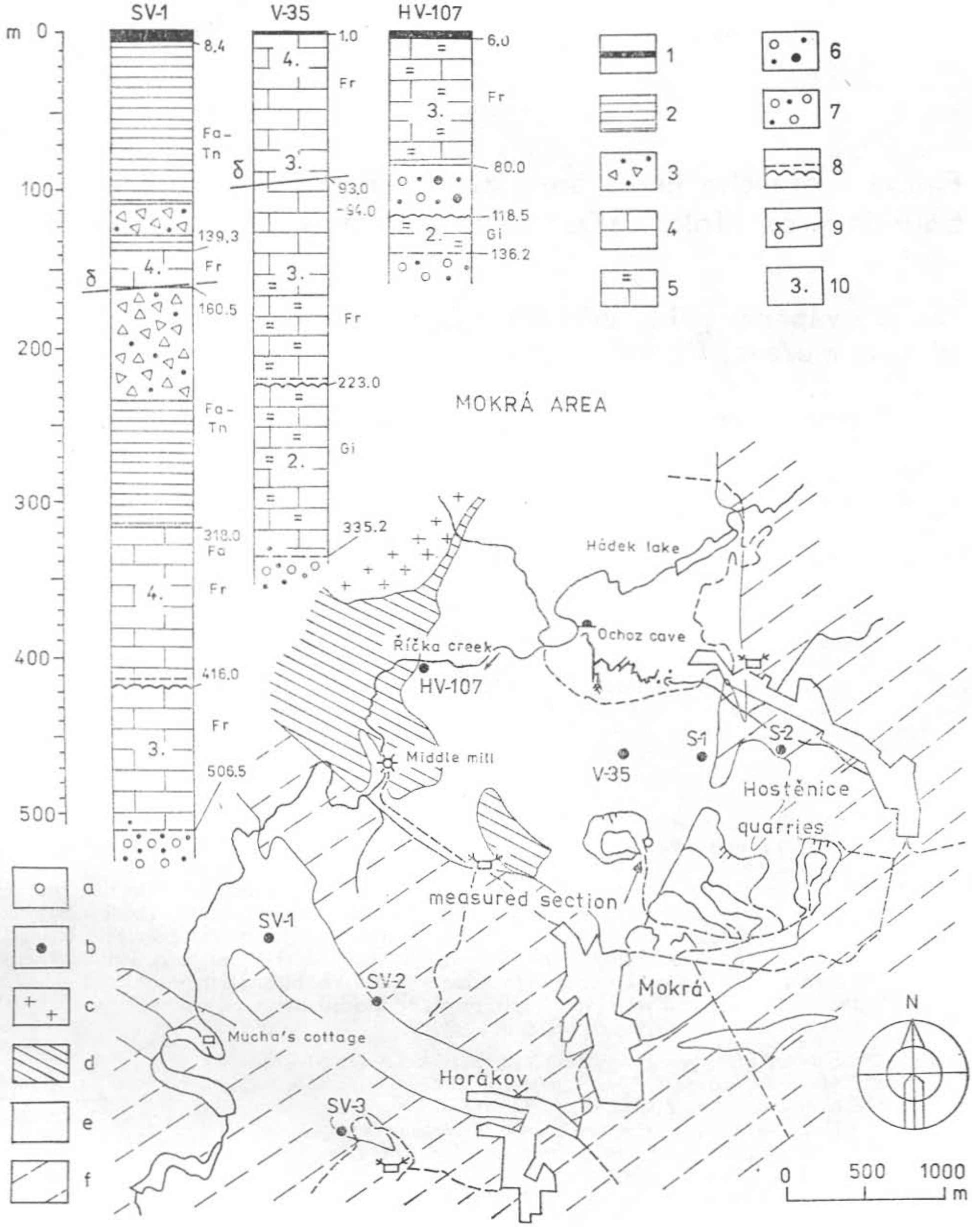
HLADIL J. - KALVODA J. - FRIÁKOVÁ O. - GALLE A. - KREJČÍ Z. (1989): Fauna from the limestones at the Frasnian/Famennian boundary at Mokrá (Devonian, Moravia, Czechoslovakia). — Sbor. geol. Věd, Paleont., 30, 61–84. Praha.

Abstract: The reef-building fauna of the Mokrá section extincted in the upper part of the conodont Palmatolepis crepida Zone. Into the lower Famennian, penetrated namely less diversified euryfacies species. The decrease in the diversity is being associated with the Kellwasser eustatic and climatic events proved today, from a general viewpoint, from the mid-levels of the Palmatolepis gigas Zone up to its top (WALLISER 1985, 1986) and supposed up to the mid-levels of the Palmatolepis triangularis Zone (the so-called Crickites Event — KALVODA 1986). In the section, the Frasnian/Famennian boundary is restricted to the gap between the intervals I and II. Under the gap, occur *Scoliopora kaisini* (LECOMPTE) and the foraminifers *Nanicella* ap. — species found so far in Moravia exclusively up to the upper limit of the conodont Palmatolepis gigas Zone, while above the gap lower Famennian *Labechia cumularis* YAVORSKI and *Syringopora volkensis* TSCHERNYSCHEV appear already. The gap very likely involves the current critical interval of the Fransian/Famennian boundary corresponding to the lower third of the Palmatolepis triangularis Zone. By contrast, the prominent lithologic change between the Macocha and Líšeň Formations (above int. IV) and extinction of sessile benthos (by 3 to 5 cm lower in the section) do not lack a biostratigraphic record — both the underlying and overlying levels provide autochthonous conodonts of the upper part of the Palmatolepis crepida Zone.

[1] *Ústřední ústav geologický, Malostranské nám. 19, 118 21 Praha 1*
[2] *Moravské naftové doly, k. p., Úprkova 5, 695 00 Hodonín*
[3] *Geofyzika, n. p., Poděbradova 102, 612 00 Brno*
[4] *Ústav geologie a geotechniky ČSAV, V Holešovičkách 41, 182 09 Praha 8*
[5] *Ústřední ústav geologický, Leitnerova 22, 602 00 Brno*

Introduction

The section measured stretches in the entrance part of the Western Quarry at Mokrá (comp. fig. 1). It lies at the transition of the Macocha Formation (composed mainly of carbonate buildups) into the overlying post-reef facies of variegated carbonate sequences which refer to the Líšeň Formation. Geologically, the section



1. Sketch map of topography and geology in the environs of the Mokrá Quarries. Location of more significant boreholes is plotted, boreholes mentioned in the paper are schematized
a — measured section, *b* — location of the borehole, *c* — Brno Massif granodiorite, *d* — undistinguished Devonian siliciclastic rocks (the basal clastic formation), *e* — undistinguished Devonian and lower Carboniferous carbonate sediments (Macocha and Líšeň Formations), *f* — Lower Carboniferous sediments of the Culm Facies, undistinguished (Březina Shales, Rozstání and Myslejovice Formations)

is situated in the southern closure of the Moravian Karst in general described by DVOŘÁK (1961) and DVOŘÁK et al. (1987).

The first evaluation of the section situated at the transition of both mentioned formations was given in FRIÁKOVÁ et al. (1985). Then followed a new description of its rugose and tabulate corals (HLADIL 1987, GALLE 1987), microfacies of the individual layers and relations to the surrounding deposition. The data on the section, therefore, had to be newly summarized. The paper was prepared within the framework of the IGCP Project No. 216 "Global Biological Events".

The authors are indebted for useful advice to J. Crha and V. Kudělásek from the Geological Exploration, n. e. and to all the authors referred to in this paper.

General characteristics of the sequence

The Macocha Formation (built preferably of Devonian carbonate buildups) in the space of the Mokrá Quarries started to form later than elsewhere in the Moravian Karst. The Macocha Formation as a stratigraphic unit was defined by ZUKALOVÁ - CHLUPÁČ (1982). It involves dark heavy-bedded limestones of the lagoonal facies — the Lažánky Limestones — and the light-coloured, comparatively massive Vilémovice Limestones.

The earliest evidenced layers of the Macocha Formation carbonate deposits were drilled by boreholes HV-107 located 1.8 km NW of the measured section in the Mokrá Western Quarry (comp. fig. 1) and V-35 roughly 600 m to the NNW of the section (comp. fig. 1). They are Givetian in age and refer to the 2nd megacycle rocks (HLADIL 1986). According to the borehole HV-107, the upper part of the 2nd megacycle is eroded down to the middle or lower Givetian banks with *Amphipora ramosa* (PHILLIPS) and above the eroded surface there is a layer of polymict siliciclastic sediments. Silicified fragments of biohermal limestones of the upper part of the 2nd megacycle [with *Caliapora battersbyi* (MILNE EDWARDS et HAIME)] redeposited even to the 3rd megacycle lower Frasnian limestones in the Old Mokrá Quarry, approx. 600 m to the S of the measured section (comp. fig. 1). The erosion events within the upper part of the Macocha Formation are evidenced also by silicified fragments of the 3rd megacycle limestones (with *Actinostroma crasse-*

←

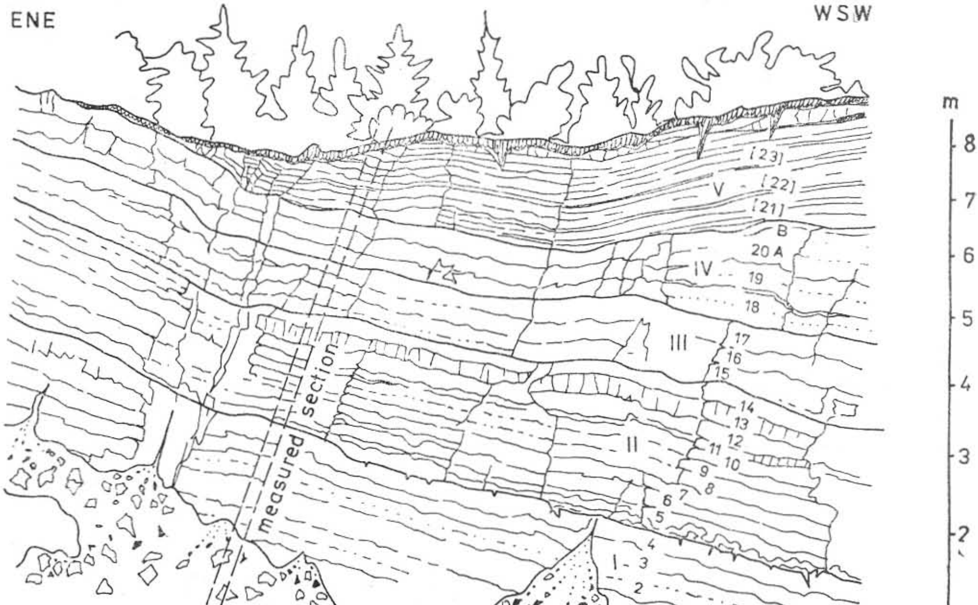
1 — Quaternary deposits and reworked Tertiary residua, *2* — bank facies of micrite and detrital limestones of the Líšeň Formation (Famennian—Tournaisian), *3* — breccia facies of the Líšeň Formation (Famennian—Tournaisian), *4* — light boundstones of the Macocha Formation = Vilémovice Limestone (Frasnian—Famennian) and associated layers, *5* — dark boundstones, packstones, and associated layers = Lažánky Limestone (Givetian—Frasnian), *6* — polymict sandstones and conglomerates of Devonian age, *7* — Devonian quartz sandstones and conglomerates, *8* — levels of nondeposition and erosion, *9* — thrust dislocations (roughly from S to N), *10* — number of the microfacially limitable cycle in the Macocha Formation *pilatum* LECOMPTE), which occur in the 4th megacycle rocks with *Nanicella*? sp. and *Multiseptida* sp., E of a grinder, some 750 m to the SE of the measured section.

An interesting borehole was situated 2.5 km WSW of the measured section (SV-1 Horákov drilled by the Geological Exploration, n. e.) and reached more than 500 m in depth. It revealed that the beds strike subhorizontally but the Macocha and Líšeň Formations tectonically repeat (see the sketch on fig. 1). The lower of the both drilled Macocha Formation sequences is 188.5 m thick (318.0 – 506.5 m). According to the stromatoporoid fauna, the onset of the limestone deposition is confined to the middle Frasnian levels. At the base the limestones contain a sandy admixture, biohermal levels are separated by micritic limestones with cryptalgal structures and gastropods. The boundary between the 3rd and 4th megacycle rocks is situated at the depth of 416.0 m where, after some claystone interbeds, deposit darker limestones (colour N3 to N4 on Munsell colour system). The uppermost parts of the Macocha Formation are of biosparite limestones comprising frequent micritized grains and fragments of *Amphipora tschussovensis* YAVORSKI and *Am. moravica* ZUKALOVÁ. E. Možíšová (Geological Exploration, n. e., Brno branch; personal communication 1986) reports the conodont fauna of the Palmatolepis crepida Zone at a 318.0 m depth. The immediately overlying layers are built of intrasparites comprising coated grains free from sessile benthos. They are light-coloured, devoid of any clay admixture, comparatively massive, and in places contain thick-walled shells of unidentified pelecypods up to 8 cm in diameter. The limestones provide the conodont fauna of the Zones Palmatolepis marginifera (depth 313.0 m) to Palmatolepis postera postera (depth 311.0 m) – E. Možíšová. From the biofacies viewpoint, of this lower Macocha Formation sequence (borehole SV-1 Horákov) the assemblage of a flat, gently inclined ramp is the most typical (*Scoliopora denticulata rachitiforma* HLADIL, *Amphipora tschussovensis* YAVORSKI, foraminifer *Multiseptida* sp., in regression levels the algae *Moravamminidae* indet. and *Umbelaceae* indet.).

The upper sequence of the Macocha Formation drilled by the SV-1 borehole (depth 139.3 to 160.5 m) has a different character. The sequence belongs to the upper levels of the formation, to the 4th megacycle. Rudstones and floatstones with stachyods are more frequent here. The coral fauna of the Frechastraea pentagona – Temnophyllum Zone [*Marisastrum* sp. – depth 142.6 m, *Frechastraea pentagona* (GOLDFUSS) – depth 143.7 m, *Piceaphyllum* sp. – depth 153.9 m] was proved. The conodont fauna detected in the uppermost part of the sequence, at a 140.0 m depth, indicates the Frasnian/Famennian boundary levels (E. Možíšová – personal communication). The limestones contain ubiquitous algae *Renalcis* sp. and they have the character of reef banks.

The upper part of the Macocha Formation (the 4th megacycle) is exposed immediately in the space of the Mokrá Quarries, whereas exposures of the earlier, 3rd megacycle layers are restricted only to the southern part of the Central Quarry and the Old Quarry near Mokrá (about 600 m s. of the measured section). Limestones of the 4th megacycle contain fauna typical of ramps and buildups delimited by non-reef shoals — *Scoliopora denticulata rachitiforma* HLADIL, *Amphipora tschussovensis* YAVORSKI and *Multiseptida* sp. In the space of the quarries, the proximal part of the buildups spatially close to the basin facies is exposed. This is evidenced by a sporadic occurrence of radiolarians in the section (fig. 3). The sequence of strata at the transition of the Macocha Formation into the overlying Líšeň Formation is roughly comparable in different sections within the Mokrá Quarries, unless it is disrupted by disharmonic polyphase deformation. The NNE-SSW stretching elevation exposed in the western face of the Central Quarry is the only exception. Part of the lower Famennian layers of the Macocha Formation is remarkably reduced in this space where Neptunian dykes have developed filled with internal sediment and biosparite layers containing large cross-cuts of *Cribroshaeroides* sp. and fragments of *Amphipora tschussovensis* YAVORSKI.

The section measured is situated in tectonically undisturbed space, at the Western Quarry entrance (comp. figs. 1, 2). Here, the beds dip SE at about 20°. In the uppermost part of the Macocha Formation, cycles attaining a metre order thickness mark the section face. The darker layers scale N3 to N4 on Munsell colour system, the lighter N5. With respect to the cycles, intervals I—IV were established. Interval I involves beds 1—4, interval II — 5—14, interval III — 15—17, and int. IV — 18—20 (comp. figs. 2, 3).



2. Scheme of the measured exposure, state — November 1984, Mokrá — Western Quarry

At the upper limit of interval I and less intensively in intervals II and III, refilled vugs and fissures have developed, whereas in the uppermost part of interval IV they do not appear any more. Here, the sessile benthos disappears inside the bed 20, between the thicker, lower part 20A and the upper one 20B. The lower part of the bed is composed of biosparite with stromatoporoid coenostea "in situ" or broken and transported. The upper part of the bed is formed of fine biosparite with admixed micrite, abundant conodonts, unidentified crushed phosphatic skeletons (fish carapaces ?) and columnals of small crinoids. The suture between the both layers observable on the polished section is horizontal, without erosion structures, modified only with a 2 mm amplitude stylolite, and the supposed dissolution loss of the carbonate material is 3—5 mm. Both parts of the bed 20 contain conodonts of the upper part of the Palmatolepis crepida Zone. The lower one comprises minute elements produced by conodontoforids under less favourable conditions, while the upper contains bigger, excellently created elements. The conodont fauna is given in tabs. 1 and 2. Lithologic and biotic indications point to an abrupt change of the environment that led to the extinction of sessile benthos.

The interval V refers already to the Líšeň Formation. It starts with the deposition of laminite with alternating micrite and biosparite laminae, in places cross--bedded. The above biointrasparite layer contains sporadic clayey and micrite admixtures, frequent cephalopod shells (often straight, conical, partly of Bactrites type), and numerous crinoid columnals. The rest of the interval consists of thinner layers showing fine horizontal bedding where clayey, fossiliferous micritic limestone prevails, often having a nodular structure.

Similarly also interval VI begins with a thin laminite layer and continues with a layer of biosparite and in the higher-situated parts with nodular micritic limestones.

A conspicuous gap accompanied by erosion is located above interval VI. Shallow erosion depressions are filled with irregular layers of encrinite (interval VII). Interval VI includes the fauna of the uppermost part of the conodont Palmatolepis crepida Zone, at the base of interval VII dominate conodonts of the Palmatolepis marginifera Zone and foraminifers of the Septatournayella rauserae — Septabrunsiina Zone. Conodonts of the Palmatolepis rhomboidea Zone do not occur (comp. tab. 2, fig. 3).

With the advancing exploitation of the Western Quarry, the beds 16, 19, and 20 contained more clay minerals. The rising amount of the clay material showed still more tiny, bulbous, joint coenostea of *Habrostroma* cf. *incrustans* (HALL et WHIFIELD).

Microfacies characteristics of the Macocha Formation layers in the measured section (Western Quarry, Mokrá)

The microfacies characteristics of the layers results from the evaluation of a set of thin sections, etched fragments, and insoluble residua after dissoving in acetic acid.

The layers of the measured section are numbered from zero either way, described from the base to the top:

—3: laminated micrite with laminae of finely crystalline limestone, colouring up to N6. Originally most probably algal laminae. The sediment contains small complete ostracod shells. Thickness 15 cm.

—2: laminated linestone built of alternated biosparite laminae, with fragments of Amphipora stems and ostracods, and laminae of originally clastic micrite. The laminae often wedge out laterally. Thickness 23 cm.

—1: Biomicritic limestone with *Amphipora moravica* ZUKALOVÁ and *Am. hanimedi* YAVORSKI. There occur irregularly swelled layers of fossiliferous micrite with algae *Issinella sp.*

0: Biomicritic limestone with transitions into biointramicrite with fine horizontal bedding. At the base, there is a thin biosparite layer, in the upward direction micrite prevails. Thalli of the algae *Issinella* sp., *Moravamminidae* indet. are involved. In the uppermost part, the rock passes into biosparite with scattered *Multiseptida* sp. and *Nanicella* sp.

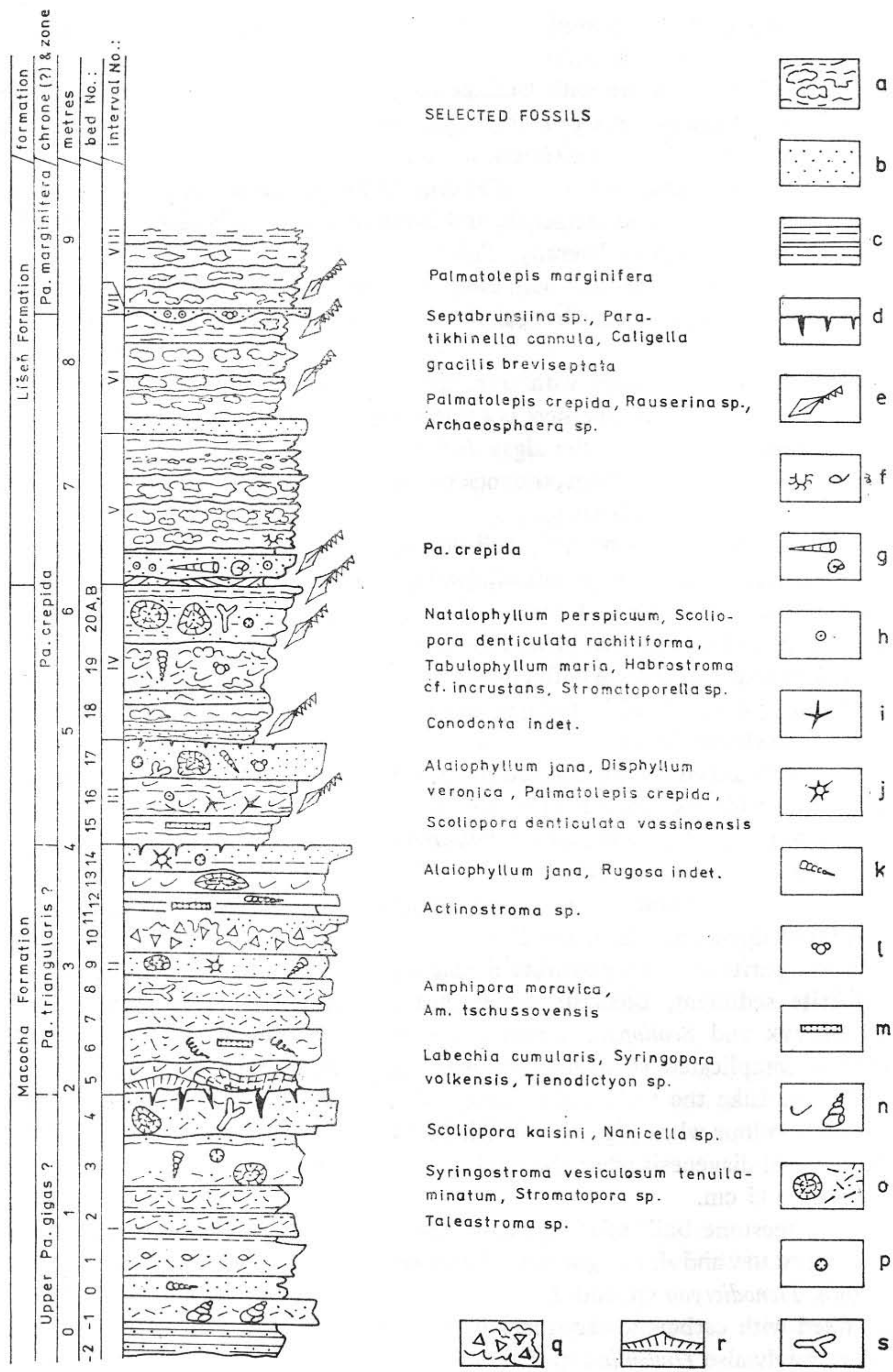
1: Biomicritic limestone with well-developed horizontal bedding. Some layers possess even 2 cm long fragments of *Amphipora moravica* ZUKALOVÁ, other contain finely crushed Amphipora tissues and brachiopods with their spines. Ostracods and sponge spicules are common. Thickness 32 cm.

2: Biomicritic limestone with *Amphipora moravica* ZUKALOVÁ and *Am. hanimedi* YAVORSKI is interlain with wedging out laminae comprising crushed Amphipora tissues. Thickness 40 cm.

3: Inhomogeneous bank formed namely of biosparite with larger fragments of stromatoporoids and corals floating within. Certain parts are bound with algae and stromatoporoids. The presence of *Taleastroma* sp., *Syringostroma vesiculosum tenuilaminatum* ZUKALOVÁ and other species has been ascertained (see table 1). The insoluble residue shows an increased amount of isometric quartz grains, up to 0.5 mm in diameter. Thickness 45 cm.

4: Biosparite and biosparrudite limestone, in places with pocket-like fillings of a micrite sediment. Bioclasts are intensively micritized. *Stachyodes lagowiensis* GOGOLCZYK and *Scoliopora kaisini* (LECOMPTE) are present. In places, we can observe complicated stromatactises with originally fibrous rims encircling the stachyods. Like the vadose silt fillings of the intercoral spaces, they acquire a brownish colour when pigmented with Fe-oxides. The colouring may result from the subaeral diagenesis when the bank surface emerges before the next deposition. Thickness 35 cm.

5: Framestone built of complicated sheets of the corals *Syringopora volkensis* TCHERNYSCHEV and *Aulostegites* sp. The sheets are built in part also by the stromatoporoids *Tienodictyon* sp. and *Labechia cumularis* Yavorski. The intercoral spaces are filled with carbonate claystones or micritic limestones with *Moravamminidae* indet., rarely also *Umbellina* sp. Depressions at the top of the framestone layer are


formation
chrone (?) & zone
metres
bed No.:
interval No.:
Macocha Formation
Líšeň Formation
Upper Pa. gigas ?
Pa. triangularis ?
Pa. crepida
Pa. marginifera
SELECTED FOSSILS
Palmatolepis marginifera
Septabrunsiina sp., Paratikhinella cannula, Caligella gracilis breviseptata
Palmatolepis crepida, Rauserina sp., Archaeosphaera sp.
Pa. crepida
Natalophyllum perspicuum, Scoliopora denticulata rachitiforma, Tabulophyllum maria, Habrostroma cf. incrustans, Stromatoporella sp.
Conodonta indet.
Alaiophyllum jana, Disphyllum veronica, Palmatolepis crepida, Scoliopora denticulata vassinoensis
Alaiophyllum jana, Rugosa indet.
Actinostroma sp.
Amphipora moravica, Am. tschussovensis
Labechia cumularis, Syringopora volkensis, Tienodictyon sp.
Scoliopora kaisini, Nanicella sp.
Syringostroma vesiculosum tenuilaminatum, Stromatopora sp.
Taleastroma sp.

often filled with coquina of thin-walled smooth brachiopods (unidentified broken valves). Thickness 5—35 cm.

6: Biomicritic limestone with Moravamminidae indet. and Amphipora fragments. The sediment was homogenized by bioturbation, somewhere only partially. Thickness 22 cm.

7: Biomicritic limestones densely packed with Amphipora fragments. The stems are slim, variously abraded. Nearly a half of the volume dissolves during the compaction, the insoluble residue contains ample dolomitic crusts of a brownish colour caused by the Fe-pigment. Thickness 17 cm.

8: At the base biomicritic limestone with pyrite crystals prevails, upward sparite becomes more frequent. Stachyods, Amphipora stems dominate together with the first occurrence of *Scoliopora denticulata rachitiforma* HLADIL in the section. Thickness 27 cm.

9: Biosparrudite (rudstone) with rare, irregularly shaped *Actinostroma* sp. and *Syringostroma vesiculosum* LECOMPTE. Beside *Multiseptida* sp., there are partly dissolved radiolarians and sponge spicules. Thickness 16 cm.

10: Inhomogeneous layer with intraclasts of darker micritic limestones and plasticlasts of biosparite with well-sorted grains. The layer is breccia-like, which is supported diagenetically by a partial dissolution of carbonate in the matrix. The matrix includes calcispheres. Thickness 30 cm.

11: Laminated, namely biomicritic limestone with *Moravamminidae* indet. Biosparite laminae are sporadic. On the sutures concentrates an insoluble brown residue. Thickness 8 cm.

12: Biosparite limestone packed with finely crushed gastropods, brachiopods, and calcispheres, in places with crushed Amphipora stems. Bioclasts are often micritized. Of foraminifers, *Multiseptida* sp. and *Vicinesphaera* sp. are represented. Thickness 8—17 cm.

13: Biosparite limestone, in places with micrite-rich layers. Coenostea of *Actinostroma* sp. and *Labechia cumularis* YAVORSKI were detected, locally some brachiopod debris has accumulated. The rock has been more severely compacted than the early and tightly cemented stromatoporoid coenostea. Thickness 18 cm.

14: Biosparite limestone with biomicritic lenses. We can observe the rugose

---

←

3. Stratigraphic column of the measured section in the Western Quarry at Mokrá
a — clayey micritic limestones, often nodularly structured, *b* — layers with prevailing grainstone, *c* — laminated layers, *d* — buried hardground with cracks and vugs, *e* — presence of conodonts, *f* — presence of ostracods (thin but sculptured valves and closed thick-walled smooth shells), *g* — cephalopods (straight and involuted shells), *h* — crinoid ossicles, *i* — sponge spicules, *j* — partly dissolved radiolarian skeletons, *k* — foraminifers *Multiseptida* sp., *l* — foraminifers *Tournayellidae* indet., *m* — algae *Moravamminidae* indet., *n* — brachiopods and gastropods, *o* — branched and massive coenostea of stromatoporoids, *p* — Rugosa, *q* — breccia layers, *r* — tabulate sheets, *s* — branches of tabulate corals

coral *Alaiophyllum jana* GALLE, fragments of *Rugosa* indet., *Amphipora* div. sp., calcispheres, and in part dissolved radiolarians. Thickness 20 cm.

15: Thinly horizontally bedded biomicrite and fossiliferous micritic limestones with *Moravamminidae* indet., occasionally with primitive foraminifers hardly distinguishable from the matrix due to a considerable micritization. Thickness 21 cm.

16: Inhomogeneous, mostly biomicritic layers with accumulated Amphipora and brachiopods. The insoluble residue comprises sponge spicules and conodonts. Either the spicules or the conodonts always predominate. Crinoid ossicles can be noticed. Thickness 29 cm.

17: Biosparite limestone with varied coral and stromatoporoid fauna. Branches of *Natalophyllum perspicuum* HLADIL encrusted with stromatoporoids are prominent. Of foraminifers, *Mustiseptida* sp. and *Tournayellidae* indet. are more frequent. Zonal alterations of carbonate near the upper surface of the layer evidence the former exposure of the surface as hardground. Thickness 27 cm.

18: Biomicritic limestone with spread bioclasts. At the base there are laminae of biosparite with micritized or coated grains. *Amphipora moravica* ZUKALOVÁ and *Am. tschussovensis* YAVORSKI dominate in the upper part of the layer. Notable is the find of unidentified conodont fragments and cross-sections of oogonia of charophytes *Umbellina* sp. Thickness 42 cm.

19: Biosparite limestone with lenses and plasticlasts of micritic limestone. The foraminifers *Multiseptida* sp. and *Tournayellidae* indet. are present. The coral *Scoliopora denticulata vassinoensis* DUBATOLOV is ubiquitous here and observable throughout the layers 16—20. With the locally increased amount of micrite rises the occurrence of *Archaesphaera* sp. and *Cribrosphaeroides* sp. Thickness 40 cm.

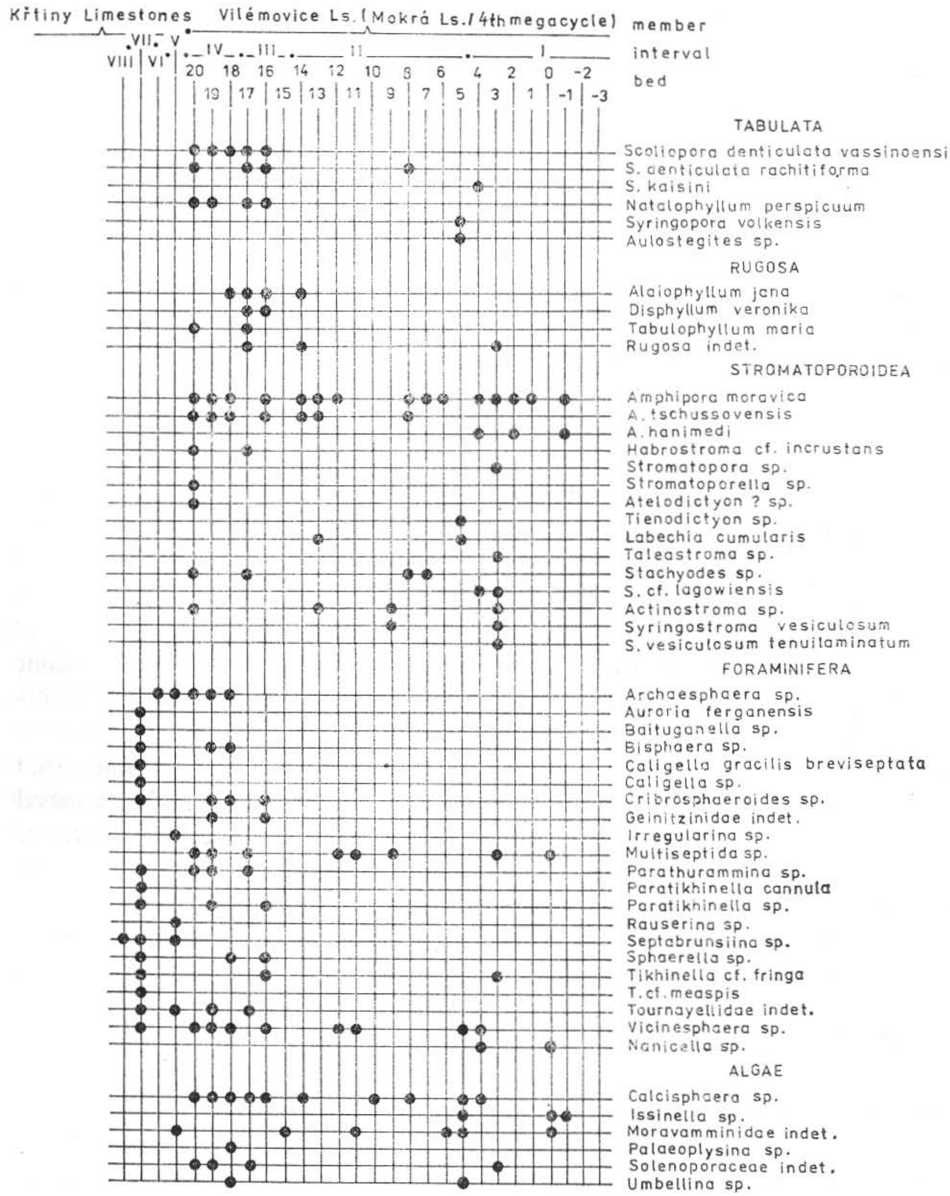
20A: Biosparite limestone with frequent, ball-shaped and encrusting coenostea of *Habrostroma* cf. *incrustans* (HALL et WHITFIELD), *Actinostroma* sp., and *Stromatoporella* sp. and other species — comp. tab. 1. Most of the coenostea are in situ and the overturned ones are often coated with algae. Broken stachyods bear signs of local transport. The insoluble residue contains a larger amount of pyrite framboids; sulphides and organic matter are often free from oxidization. This part of the layer is 38 cm thick.

20B: Fine-grained biosparite with admixtured micrite and clay. Conodonts and a phosphatic crushed mass of more robust unidentified skeletons (plates of Placodermi?) are widespread. There were found tiny crinoid ossicles. Fine debris of altered Amphipora tissues appears already as part of intraclasts together with the original surrounding cement or sediment. This part of the layer is 3—5 cm thick.

If the above microfacies are considered from the viewpoint of WILSON's (1975) classification of standard microfacies, changing of the two associations may be stated: microfacies with ubiquitous micrite and reef-building or accompanying organisms (SMF 7, 8, 9) on the one hand, and well-washed coarse-grained sediments (SMF 11, 12, 18) on the other. The environment is interpreted as a shallow

Table 1

Fossils in beds of int. I–VIII, Western Quarry, Mokrá section, in a wider time span near the Frasnian/Famennian boundary



ramp, more or less exposed to the basin, although extensive micritization and in the lower part of the section even episodic levels with subaeral carbonate diagenesis are observed. Significant is the occurrence of conodonts, sponges, radiolarians, and oogonia of charophytes, especially in the upper part of the section (comp. fig. 3, tabs. 1, 2). The conodonts and radiolarians point to the connection with the basinal sedimentary space, the oogonia rather to a connection with near-shore freshened spaces.

Comparison of the Mokrá section with boreholes HV-105 Křtiny and V-204 Lesní lom

In the borehole HV-105 Křtiny (Dvořák et al. 1984) O. Friáková confirmed the conodont Palmatolepis crepida Zone from the depth of 145.1 to 152.3 m. Biosparite, biopelsparite, and biointrasparrudite limestones in the lower part of this depth range have a reefal character and are bound with plates of stachyods and algae (stachyods in coating adaptation). The formerly problematic coral (depth 152.3 m) could be identified now according to the Mokrá fauna as *Natalophyllum perspicuum* Hladil. At the depth of 149.8 m *Stachyodes* sp. were detected (thin-section collection of V. Skoček). Dvořák et al. (1984) give the following thicknesses of carbonate deposits of the individual conodont zones (downward): Palmatolepis crepida — 8 m, Palmatolepis triangularis — 10 m, Palmatolepis gigas — 12 m. The limestones have developed in the reef cap facies along a more steeply modelled frontal margin of buildups and, therefore, higher thicknesses than on the flat ramp or shoal margin of the Mokrá buildups may be expected.

Similarly, in the borehole V-204 Lesní lom O. Friáková evidenced the conodont fauna of the Palmatolepis crepida Zone coming from the depth of 75.1 m. Thin-sections of the rock derived from depths around 73.5 m (E. Možíšová's collection) point to the presence of biointrasparrudite limestones with coated and micritized grains, algal laminae, with redeposited, diagenetically cemented nodules, crushed brachiopods, and stromatoporoid coenostea. The uppermost, micrite-rich part of the sequence contains cephalopod shells. The upper limit lying at a 73.1 m depth seems analogous to the base of interval V of the Mokrá section. In rocks similar to those encountered in the borehole V-204 at depths about 73.5 m *Natalophyllum perspicuum* Hladil was discovered in the exposure at Lesní lom. The rocks, therefore, may be considered analogous to those of int. IV in the measured section at Mokrá.

Contrary to that, in the time-equivalent sequence of the Jedovnice section (evaluation carried out by Z. Krejčí and J. Dvořák) occur fossiliferous micrites with admixed clay, very finely dispersed detritus, conodonts, thin-walled but markedly sculptured ostracods, and partly dissolved radiolarians. At the base of the interval referring to the Palmatolepis crepida Zone stromatolithic structures appear. The limestones are mostly nodular and there do not occur any fragments of reef-building organisms, if only redeposited.

Location of the Frasnian/Famennian boundary in the Mokrá section

The Mokrá section did not provide any conodont assemblages earlier than those of the Palmatolepis crepida Zone. Accordingly, namely the tabulates, rugose corals, and stromatoporoids were employed for zoning. The zoning resulted from correlation with the conodont fauna in the borehole HV-105 Křtiny, in the south-eastern slopes of the Bohemian Massif under the Carpathian nappes, as well as in the exposures of Hády Hill and the hillock near Bedřichovice (comp. GALLE 1985, HLADIL 1983). Also the indications of the foraminiferal fauna and ecostratigraphic phenomena were taken into consideration.

In the upper part of int. I of the Mokrá section there were ascertained the last occurrences of *Scoliopora kaisini* (LECOMPTE), *Syringostroma vesiculosum tenuilaminatum* ZUKALOVÁ, *Clathrocoilona brunnensis* ZUKALOVÁ, and in fragments also the foraminifers *Nanicella* sp. According to correlations known in Moravia, the occurrences are significant of the uppermost Frasnian (comp. ZUKALOVÁ 1971, 1981). The fauna is typical of the Zones Frechastraea pentagona or Crassialveolites domrachevi, although index species as reefal, stenofacies taxa have neither been found at Mokrá (comp. HLADIL 1983). At the locality Šumbera at Hády near Brno, Rozcestí Křtiny, and in the borehole Jablůnka-1 in northern Moravia, 6 km NNW of Vsetín, the levels were correlated with the conodont Palmatolepis gigas Zone (HLADIL 1983, 1986, ZUKALOVÁ - FRIÁKOVÁ 1987).

Above the interval I there is a prominent gap. For a longer period the deposits of the interval had a hardground surface which also emerged (fills of vadose silt). It is covered with complicatedly concreting coral and stromatoporoid sheets (up to 400×35 cm in size) of *Labechia cumularis* YAVORSKI, *Syringopora volkensis* TCHERNYSCHEV (both considered Famennian — Vaigach Island in the n. continuation of the Ural Mountains), and other species.

Changes in function morphology (in the case of stromatoporoids a preference of vesiculose and laminar tissues, suppression of vertical elements, in the case of tabulates suppression of massive coralla) have a general character of the transition into the Famennian. However, the age of holotypes of both the above-mentioned species cannot be specified, for the identification of the samples' origin is uncertain (comp. YAVORSKI 1957). Some species at the base of int. II exhibit features common with the upper Frasnian faunas (*Tienodictyon* sp., *Syringostroma vesiculosum* LECOMPTE), but their skeletons are lighter and the vertical elements slightly reduced. *Nanicella* sp. does not occur here any more. Int. II is supposingly of the same age as the conodont Palmatolepis triangularis Zone or even the boundary of the Pa. triangularis and Pa. crepida. It was inferred from the "upward" and "downward" faunal limitation and a similarity to lithological and ecological sequences in other sections of the Moravian Karst where the conodonts do occur (boreholes V-204 and HV-105).

The layers of the interval III already contain both the conodonts and the corals (*Disphyllum veronika* GALLE) typical of the Palmatolepis crepida Zone.

In the section the Fransian/Famennian boundary is hypothetically placed into the gap between intervals I and II. The fauna below the gap corresponds to the upper part of the Palmatolepis gigas Zone, moreover, the indications of a longer gap between the both intervals also speak in favour of such a location. However, we cannot fully exclude a less probable position of the boundary in the lower part of int. II. The boundary itself is considered in the sense of the Lower/Middle Palmatolepis triangularis Zone. The facies is being correlated with transgressive--regressive eustatic pulsations (tab. 3). The transgressive pulsation in the uppermost part of the Palmatolepis gigas Zone is generally known (comp. WALLISER 1985) and the linked up regressive pulsation should be well recorded in reef shoals — the gap between the intervals I and II is being associated with this regressive pulsation (comp. tab. 3).

Discussion on manifestations of the Kellwasser Event

Evolution crises of the reef-building communities in Moravia occur with a higher frequency from mid-levels of the Frasnian (comp. DVOŘÁK - FRIÁKOVÁ 1978, Hranice environs), nevertheless, the most notable crises are associated with the Kellwasser series of events (HLADIL et al. 1986). They are linked up with a decrease in the diversity of coral and stromatoporoid communities (according to Shannon--Weaver's index the value lowers from about 2.5 to roughly 0.5). Massive and intensively skeletonized colonies are considerably reduced and gradually displaced by branched and slightly skeletonized colonies. The population number strikingly lowers.

According to the present ideas (Conference on Global Bioevents in Göttingen 1986; WALLISER 1986, WILDE-BERRY 1986, HLADIL et al. 1986), three significant levels of black basin horizons (the uppermost part of the lower part of the Palmatolepis gigas Zone, the uppermost part of the Palmatolepis gigas Zone, and mid-levels of the conodont Palmatolepis triangularis Zone) indicate pulsation maxima of the uplift of anoxic waters together with the general eustatic uplift of the sea level. The uplift maxima are reflected also in carbonate platforms which display comparatively thick reef banks (not dark-coloured sediments as it is in the case of lower-situated bottoms in adjoining areas).

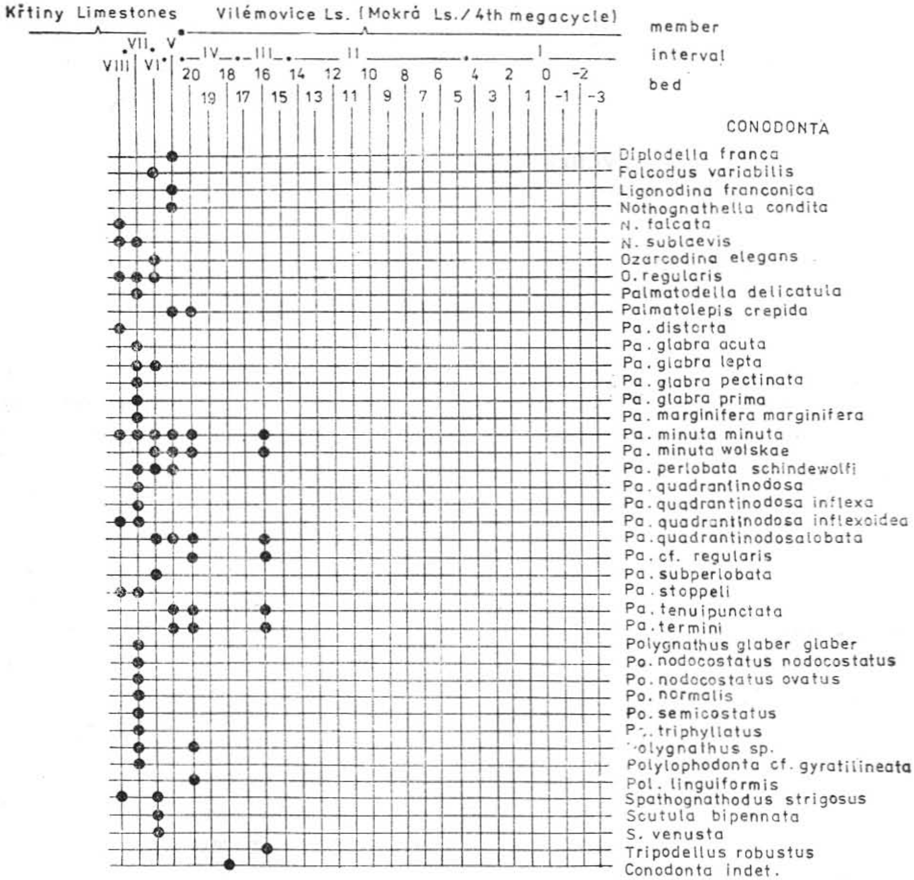
In the basin the eustatic minima between the three levels meant the return of oxidized waters down to the bottom, while on the carbonate platforms could form partly closed shallow lagoons with interrupted fillings of black lagoonal sediments. Thus, on condition that this idea is right, black horizons in the basin sequences on the one hand alternated with black shallow-water horizons on the other.

Of the section measured rather the upper parts of int. I may be correlated with the transgressive event from the uppermost part of the conodont Palmatolepis gigas Zone. The transgressive event in the mid-level of the Palmatolepis triangularis Zone is most probably connected with the deposition of beds 8—10 in the interval II.

Surprising is the survival of the reef-building fauna of the measured section even after the Kellwasser Event, although less diversified and with changes in preferred function morphology. Total extinction of the Mokrá section reef-building fauna falls into the upper part of the conodont Palmatolepis crepida Zone. The reason of this locally ascertained extinction most probably consists in changes in the flow configuration and sea water chemistry. The upper part of the conodont Palmato-

Table 2

Conodont fauna in beds and intervals of the measured section



Under the bed No. 16 and the Palmatolepis crepida Zone no conodonts have been ascertained lepis crepida Zone is devoid of any more apparent break in the biostratigraphical record resulting from the emergence during the regression, for Euramerica supposed on this time level (JOHNSON et al. 1985). However, the problem can be regarded also in a hitherto insufficient biostratigraphical correlation – in the upper part of the Palmatolepis crepida Zone more T-R pulses may be masked.

The reef-building fauna was influenced not only by more pronounced eustatic pulses or pulses in the movement of anoxic waters, but also by other significant factors, such as the restriction of shelves from tectonic reasons (DVOŘÁK et al. 1986) and the increased humidity of the climate (KALVODA 1986, HLADIL et al. 1986).

The increasing humidity is obvious from the rising number of continental outwashes into the sedimentary sequences, from a higher occurrence of charophytes' oogonia, and other indications. The eustatic pulsations thus probably evoked crises of the reef-building assemblages which had already been under a stress from palaeogeographical and climatic reasons. Furthermore, we cannot exclude ecological crises the reasons of which can hardly be deciphered due to a fossil state, and that need not be immediately linked up with physico-chemical parameters of the environment.

Notes on the individual faunal groups of the Mokrá section

The individual groups of fauna were described by FRIÁKOVÁ et al. 1985. Especially the study of the stromatoporoids was completed (the total species spectrum, however, is even wider).

Within the interval I typically occur *Amphipora moravica* ZUKALOVÁ together with *Am. hanimedi* YAVORSKI, furthermore *Syringostroma vesiculosum tenuilaminatum* ZUKALOVÁ, *Taleastroma* sp., *Stachyodes* cf. *lagowiensis* GOGOLCZYK, *Actinostroma* sp., *Stromatopora* sp.; *Clathrocoilona brunensis* ZUKALOVÁ is supposed.

Interval II comprises the following stromatoporoids: *Tienodictyon* sp., *Labechia cumularis* YAVORSKI, *Syringostroma vesiculosum* LECOMPTE, *Actinostroma* sp., and *Amphipora moravica* ZUKALOVÁ together with *Amphipora tschussovensis* YAVORSKI.

Intervals III and IV contain stromatoporoids *Habrostroma* cf. *incrustans* (HALL et WHITFIELD), *Labechia cumularis* YAVORSKI, *Actinostroma* sp., *Stachyodes* sp., *Atelodictyon*? sp., and *Stromatoporella* sp.

Near the supposed Frasnian/Famennian boundary between the intervals I and II there was a shift favouring the labechiids and stromatoporoids with lighter skeletons, but the process was gradual, starting as early as in the Upper Frasnian (ZUKALOVÁ 1971; V. Zukalová – personal communication, 1986). As regards the measured section at Mokrá, it should be added that the process went on after the Frasnian/Famennian boundary period.

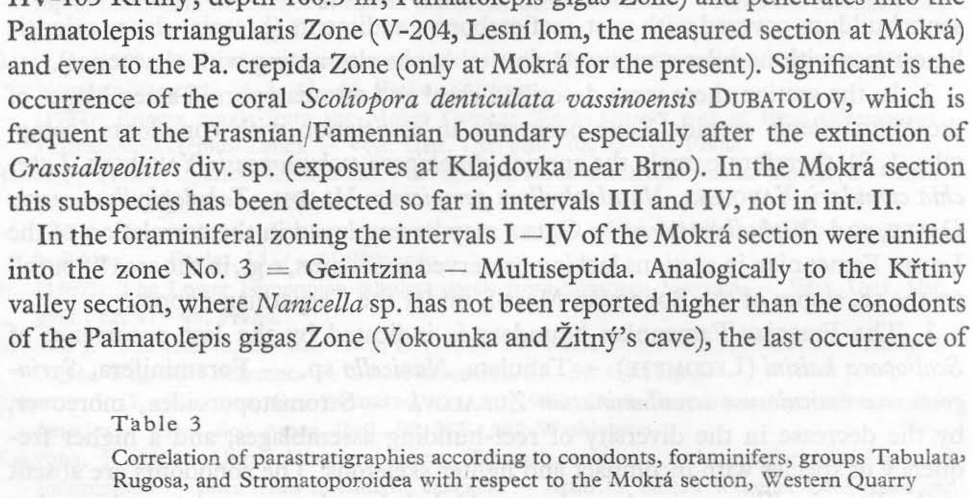
From the viewpoint of the rugose corals, intervals III and IV are best characterized by the presence of *Tabulophyllum maria* GALLE and *Disphyllum veronika* GALLE. *Alaiophyllum jana* GALLE occurs in int. II and prospectively also in int. I, for A. Galle revealed conspecific occurrences also at the locality Šumbera, in layers levelling the conodont Palmatolepis gigas Zone.

In the case of the tabulate corals the situation is similar: *Natalophyllum perspicuum* has been ascertained only in the deposits of the Palmatolepis crepida Zone (Western Quarry at Mokrá, borehole Křtiny HV-105, Lesní lom), whereas *Scoliopora denticulata rachitiforma* HLADIL appears in the upper Frasnian (borehole HV-105 Křtiny; depth 166.5 m; Palmatolepis gigas Zone) and penetrates into the Palmatolepis triangularis Zone (V-204, Lesní lom, the measured section at Mokrá) and even to the Pa. crepida Zone (only at Mokrá for the present). Significant is the occurrence of the coral *Scoliopora denticulata vassinoensis* DUBATOLOV, which is frequent at the Frasnian/Famennian boundary especially after the extinction of *Crassialveolites* div. sp. (exposures at Klajdovka near Brno). In the Mokrá section this subspecies has been detected so far in intervals III and IV, not in int. II.

In the foraminiferal zoning the intervals I – IV of the Mokrá section were unified into the zone No. 3 = Geinitzina — Multiseptida. Analogically to the Křtiny valley section, where *Nanicella* sp. has not been reported higher than the conodonts of the Palmatolepis gigas Zone (Vokounka and Žitný's cave), the last occurrence of

Table 3

Correlation of parastratigraphies according to conodonts, foraminifers, groups Tabulata, Rugosa, and Stromatoporoidea with respect to the Mokrá section, Western Quarry



Zones in the section hitherto unestablished are given in inclined shading; not described so far intervals, neither at Mokrá, nor in whole Moravia are given in dashed line. The curve indicates supposed eustatic fluctuations in the time of the Kellwasser Event (or a series of events)

Nanicella sp. in the Mokrá section is being assigned to the upper limit of the Palmatolepis gigas Zone.

Conclusions

1. The upper limit of the Macocha Formation (ZUKALOVÁ - CHLUPÁČ 1982, for more details see HLADIL in CHLUPÁČ et al. 1986) in the Mokrá section is dated to the upper part of the conodont Palmatolepis crepida Zone. Geologically it represents buildups covered with post-reef carbonate sediments (breccia, clayey micritic limestones with nodular structures, detrital banks alternating with claystones).

2. In the section there were described coral and stromatoporoid assemblages of the Palmatolepis crepida Zone occurring in association with conodonts (comp. tabs. 1, 2), therefore namely the species *Amphipora tschussovensis* YAVORSKI, *Labechia cumularis* YAVORSKI, *Natalophyllum perspicuum* HLADIL, *Tabulophyllum maria* GALLE, and *Disphyllum veronika* GALLE may be employed in the correlation of the Lower Famennian in sections lacking preserved conodonts, e.g., in the area "South" on the se. slopes of the Bohemian Massif, under the Carpathian nappes.

3. The Frasnian/Famennian boundary is indicated by the last occurrence of *Scoliopora kaisini* (LECOMPTE) — Tabulata, *Nanicella* sp. — Foraminifera, *Syringostroma vesiculosum tenuilaminatum* ZUKALOVÁ — Stromatoporoidea, moreover, by the decrease in the diversity of reef-building assemblages, and a higher frequency of species with incompact and lighter skeletons. The conodonts are absent at the Frasnian/Famennian boundary at Mokrá, but they were detected in other sections suitable for correlation (HV-105, Křtiny Rozcestí, or V-204 Lesní lom).

K tisku doporučil I. Chlupáč
Přeložila G. Buberlová

Remark: The Subcommission on Devonian Stratigraphy (Calgary, August 22, 1987) established the Frasnian/Famennian boundary at the base of the conodont Palmatolepis triangularis Zone. This implies a more precise interpretation of the Mokrá section boundary — between the intervals I and II.

References

CHLUPÁČ, I. - HLADIL, J. - LUKEŠ, P. (1986): Barrandian — Moravian Karst 1986. Guidebook of the field conference of the Subcommission on Devonian Stratigraphy of the International Commission on Stratigraphy. — Ústř. úst. geol. Praha.

DVOŘÁK, J. (ed.) (1961): Zpráva o výzkumném úkole č. 10 Základní výzkum moravského paleozoika, část I. Závěrečná zpráva o základním výzkumu devonu a spodního karbonu Moravského krasu. — MS Geofond. Praha.

DVOŘÁK, J. - FRIÁKOVÁ, O. (1978): Stratigrafie paleozoika v okolí Hranic na Moravě. — Výzk. Práce Ústř. Úst. geol., 18, *7—50*. Praha.

DVOŘÁK, J. - FRIÁKOVÁ, O. - GALLE, A. - HLADIL, J. - SKOČEK, V. (1984): Correlation of the reef and basin facies of the Frasnian age in the Křtiny HV 105 borehole in the Moravian Karst. — Sbor. geol. Věd, Geol., 39, *73–103*. Praha.

DVOŘÁK, J. - FRIÁKOVÁ, O. - HLADIL, J. - KALVODA, J. - KUKAL, Z. (1987): Geology of the Paleozoic rocks in the vicinity of the Mokrá Cement Factory quarries (Moravian Karst). — Sbor. geol. Věd, Geol., 42, *41–88*. Praha.

DVOŘÁK, J. - FRIÁKOVÁ, O. - HLADIL, J. - KALVODA, J. - KUKAL, Z. - BLESS, M. J. M. (1986): A field trip to the Famennian of the Moravian Karst (ČSSR). — Ann. Soc. géol. Belg., 109, *267–273*. Bruxelles.

FRIÁKOVÁ, O. - GALLE, A. - HLADIL, J. - KALVODA, J. (1985): A Lower Famennian fauna from the top of the reefoid limestones at Mokrá (Moravia, Czechoslovakia). — Newslett. Stratigr., 15., 1, *43–56*. Berlin, Stuttgart.

GALLE, A. (1985): Biostratigraphy and rugose corals of the Moravian Devonian (Czechoslovakia). — Newslett. Stratigr., 14, 1, *48–68*. Berlin, Stuttgart.

— (1987): Rugose corals from the Mokrá Cement Works Quarry east of Brno (Famennian, Palmatolepis crepida Zone). — Věst. Ústř. Úst. geol., 62, *35–40*. Praha.

HLADIL, J. (1983): Cyklická sedimentace v devonských karbonátech macošského souvrství. — Zem. Plyn Nafta, 28, 1, *1–14*. Hodonín.

— (1986): Trends in the development and cyclic pattern of the Middle and Upper Devonian buildups. — Facies, 15, *1–34*. Erlangen.

— (1987): The Lower Famennian tabulate corals from Southern Moravia. — Věst. Ústř. Úst. geol., *62*, *41–46*, Praha.

HLADIL, J. - KESSLEROVÁ, Z. - FRIÁKOVÁ, O. (1986): The Kellwasser Event in Moravia. — Abstr. 5. Alfred Wegener Conference on Global Bioevents, *51–54*. Göttingen.

JOHNSON, J. G. - KLAPPER, G. - SANDBERG, CH. A. (1985): Devonian eustatic fluctuation in Euamerica. — Geol. Soc. Amer. Bull., 96, *567–587*. Washington.

KALVODA, J. (1986): Upper Frasnian—Lower Tournaisian events and evolution of calcareous foraminifera — close links to climatic changes. — Abstr. 5. Alfred Wegener Conference on Global Bioevents, *68–76*. Göttingen.

WALLISER, O. H. (1985): Natural boundaries and commission boundaries in the Devonian. — Cour. Forsch. Inst. Senckenberg, 75, *401–408*. Frankfurt a. M.

— (1986): Excursion guide of the 5th Alfred Wegener Conference Göttingen. — Steinbruch Schmidt, *11–18*. Göttingen.

WILDE, P. - BERRY, W. B. N. (1986): The role of oceanographic factors in the generation of global bioevents. — Abstr. 5. Alfred Wegener Conference, *148–155*. Göttingen.

WILSON, J. L. (1975): Carbonate facies in geologic history. — Springer Verl. Berlin, Heidelberg, New York.

YAVORSKY, V. I. (1957): Stromatoporoidea Sovetskogo Soyuza, 2. — Trudy Vsesoyuz. Nauch.-Issled. Inst. Geol. (VSEGEI), 18, *3–168*. Moskva.

ZUKALOVÁ, V. (1971): Stromatoporoidea from the Middle and Upper Devonian of the Moravian Karst. — Rozpr. Ústř. Úst. geol., 37, *5–143*. Praha.

— (1981): Přehled mikrofosilií v givetských a frasnských rifových vápencích na Moravě. — Zem. Plyn Nafta, 26, 4, *561–569*, *793–821*. Hodonín.

ZUKALOVÁ, V. - CHLUPÁČ, I. (1982): Stratigrafická klasifikace nemetamorfovaného devonu moravskoslezské oblasti. — Čas. Mineral. Geol., 27, 3, *225–241*. Praha.

ZUKALOVÁ, V. - FRIÁKOVÁ, O. (1987): Biostratigraphy of the Devonian carbonates in the region south of Ostrava (Moravia). — Čas. Morav. Muz., Vědy přír. (Acta Mus. Moraviae, Sci. nat.), 71, 1/2, *23–53*. Brno.

Explanation of plates

Pl. I

1. *Palmatolepis crepida* SANNEMANN, bed 20, Palmatolepis crepida Zone, ×60.
2. *Palmatolepis minuta wolskae* SZULCZEWSKI, bed 16, Palmatolepis crepida Zone, ×65.
3. *Palmatolepis minuta wolskae* SZULCZEWSKI, bed 16, Palmatolepis crepida Zone, ×60.
4. *Palmatolepis crepida* SANNEMANN, bed 20, Palmatolepis crepida Zone, ×65.
5. *Palmatolepis quadrantinodosalobata* SANNEMANN, interval V, Palmatolepis crepida Zone, ×60.
6. *Palmatolepis minuta minuta* BRANSON et MEHL, bed 16, Palmatolepis crepida Zone, ×65.
7. *Palmatolepis quadrantinodosalobata* SANNEMANN, bed 20, Palmatolepis crepida Zone, ×65.
8. *Palmatolepis quadrantinodosalobata* SANNEMANN, bed 20, Palmatolepis crepida Zone, ×60.
9. *Palmatolepis subperlobata* BRANSON et MEHL, interval VI, Palmatolepis crepida Zone, ×65.
10. *Palmatolepis tenipunctata* SANNEMANN, bed 20, Palmatolepis crepida Zone, ×60.
11. *Palmatolepis termini* SANNEMANN, interval V, Palmatolepis crepida Zone, ×65.
12. *Palmatolepis* cf. *regularis* COOPER, bed 20, Palmatolepis crepida Zone, ×65.

Pl. II

1. *Palmatolepis tenuipunctata* SANNEMANN, interval V, Palmatolepis crepida Zone, ×85.
2. *Palmatolepis glabra lepta* ZIEGLER et HUDDLE, interval VI, Palmatolepis crepida Zone, ×70.
3. *Palmatolepis glabra lepta* ZIEGLER et HUDDLE, interval VI, Palmatolepis crepida Zone, ×70.
4. *Palmatolepis glabra pectinata* ZIEGLER, interval VII, Palmatolepis marginifera Zone, ×70.
5. *Palmatolepis termini* SANNEMANN, bed 16, Palmatolepis crepida Zone, ×80.
6. *Palmatolepis glabra prima* ZIEGLER et HUDDLE, interval VII, Palmatolepis marginifera Zone, ×80.
7. *Palmatolepis glabra distorta* BRANSON et MEHL, interval VIII, Palmatolepis marginifera Zone, ×65.
8. *Palmatolepis quadrantinodosa* cf. *inflexoidea* ZIEGLER, interval VII, Palmatolepis marginifera Zone, ×60.
9. *Palmatolepis glabra pectinata* ZIEGLER, interval VII, Palmatolepis marginifera Zone, ×60.
10. *Palmatolepis quadrantinodosa inflexa* MÜLLER, interval VII, Palmatolepis marginifera Zone, ×85.
11. *Palmatolepis stoppeli* SANDBERG, interval VII, Palmatolepis marginifera Zone, ×60.
12. *Palmatolepis stoppeli* SANDBERG, interval VIII, Palmatolepis marginifera Zone, ×60.

Pl. III

1. *Polygnathus normalis* MILLER et YOUNGQUIST, interval VII, Palmatolepis marginifera Zone, ×50.
2. *Polygnathus normalis* MILLER et YOUNGQUIST, interval VII, Palmatolepis marginifera Zone, ×50.
3. *Polygnathus semicostatus* BRANSON et MEHL, interval VII, Palmatolepis marginifera Zone, ×50.
4. *Polygnathus semicostatus* BRANSON et MEHL, interval VII, Palmatolepis marginifera Zone, ×50.
5. *Palmatolepis perlobata schindewolfi* MÜLLER, interval V, Palmatolepis crepida Zone, ×70.
6. *Palmatolepis marginifera marginifera* HELMS, interval VII, Palmatolepis marginifera Zone, ×60.
7. *Palmatolepis marginifera marginifera* HELMS, interval VII, Palmatolepis marginifera Zone, ×60.
8. *Palmatolepis quadrantinodosa* BRANSON et MEHL, interval VII, Palmatolepis marginifera Zone, ×65.
9. *Polygnathus triphyllatus* (ZIEGLER), interval VII, Palmatolepis marginifera Zone, ×42.

10. *Polygnathus triphyllatus* (ZIEGLER), interval VII, Palmatolepis marginifera Zone, ×42.
11. *Polygnathus glaber glaber* ULRICH et BASSLER, interval VII, Palmatolepis marginifera Zone, ×95.

Pl. IV

1. *Polygnathus nodocostatus ovatus* HELMS, interval VII, Palmatolepis marginifera Zone, ×70.
2. *Nothognathella sublaevis* SANNEMANN, interval VIII, Palmatolepis marginifera Zone, ×75.
3. *Nothognathella condita* BRANSON et MEHL, interval V, Palmatolepis crepida Zone, ×90.
4. *Diplodella franca* (SANNEMANN), interval V, Palmatolepis crepida Zone, ×80.
5. *Polylophodonta linguiformis* BRANSON et MEHL, bed 20 B, Palmatolepis crepida Zone, ×95.
6. *Spathognathodus strigosus* (BRANSON et MEHL), interval VI, Palmatolepis crepida Zone, ×80.
7. *Ligonodina franconica* SANNEMANN, interval V, Palmatolepis crepida Zone, ×70.
8. *Nothognathella? falcata* HELMS, interval VIII, Palmatolepis marginifera Zone, ×70.
9. *Ozarcodina elegans* (STAUFFER), interval VI, Palmatolepis crepida Zone, ×70.
10. *Ozarcodina regularis* BRANSON et MEHL, interval VII, Palmatolepis marginifera Zone, ×60.

Pl. V

1. *Multiseptida* sp., sample from the bed 16, Geinitzina — Multiseptida foraminiferal zone No. 3, ×200.
2. *Multiseptida* sp., bed 16, Geinitzina — Multiseptida foraminiferal zone No. 3, ×200.
3. *Multiseptida* sp., bed 19, Geinitzina — Multiseptida foraminiferal zone No. 3, ×200.
4. *Multiseptida* sp., bed 16, Geinitzina — Multiseptida foraminiferal zone No. 3, ×150.
5. *Paratikhinella cannula* BYKOVA, internal VII, Septatournayella rauserae — Septabrunsiina foraminiferal zone No. 5, ×210.
6. *Caligella gracilis breviseptata* POYARKOV, interval VII, Septatournayella rauserae — Septabrunsiina foraminiferal zone No. 5, ×210.
7. *Caligella gracilis breviseptata* POYARKOV, the same level, ×210.
8. *Tournayellidae* indet., interval V, zone of unilocular foraminifers and Tournayellidae No. 4, ×210.
9. *Septabrunsiina* sp., top of the int. V, ?foraminiferal zone Septatournayella rauserae — Septabrunsiina No. 5, ×210.
10. *Sphaerocodium?* sp., interval VII, ×225.
11. *Auroria ferganensis* POYARKOV, interval VII, foram. zone Septatournayella rauserae — Septabrunsiina No. 5, ×225.
12. *Auroria ferganensis* POYARKOV, the same level, ×242.
13. *Auroria?* sp., the same level, ×225.

Pl. VI

1. *Scoliopora denticulata rachitiforma* HLADIL, bed 19, zone according to tabulate corals: Scoliopora denticulata vassinoensis, ×7.
2. *Scoliopora denticulata rachitiforma* HLADIL, *Amphipora tschussovensis* YAVORSKI, bed 17, zone according to tabulate corals: Scoliopora denticulata vassinoensis, ×7.

Pl. VII

1. *Scoliopora denticulata vassinoensis* DUBATOLOV, bed 17, zone according to tabulate corals: Scoliopora denticulata vassinoensis, ×7.
2. *Natalophyllum perspicuum* HLADIL, *Stromatopora* sp. and *Stromatoporella* sp., bed 20, zone according to tabulate corals: Scoliopora denticulata vassinoensis, ×5.

Pl. VIII

1. *Amphipora moravica* ZUKALOVÁ and *Solenoporaceae* indet. (top left), Amphipora-algal bed No. 3, zone according to stromatoporoids: Amphipora moravica — Syringostroma vesiculosum, ×9.

2. *Habrostroma* cf. *incrustans* (HALL et WHITEFIELD), bed 20, zone according to stromatoporoids: Amphipora moravica – Syringostroma vesiculosum, ×8.

Pl. IX

1–9. *Disphyllum veronika* GALLE, bed 17, zone according to rugose corals: Tabulophyllum maria – Alaiophyllum jana, ×3.3.

10, 11. *Alaiophyllum jana* GALLE, bed 17, zone according to rugose corals: Tabulophyllum maria – Alaiophyllum jana, ×3.3.

Pl. X

1–4. *Tabulophyllum maria* GALLE, bed 20A, zone according to rugose corals Tabulophyllum maria – Alaiophyllum jana, ×4.5.

5, 6. *Alaiophyllum jana* GALLE, beds 14 and 17, the same zone, ×4.5.

7–9. Sections of unidentifiable rugose corals, bed 14, the same zone, ×4.5.

Pl. XI

1. *Labechia cumularis* YAVORSKI, bed 5, ×3.
2. *Syringopora volkensis* TCHERNYSCHEV, bed 5, ×2.5.
3. *Tienodictyon* sp., bed 5, ×2.8.

Pl. XII

A general view of the face of the Western Quarry at Mokrá, the eastern, entrance part of the quarry. Beds numbered as shown on the picture. State of the face – November 1986.

Photographs by M. Molčík (I–IV), J. Kalvoda (V), ÚÚG – K. Navrátilová (VI–XI) and J. Hladil (XII).

Fauna z vápenců při hranici frasn/famen v Mokré (devon, Morava, Československo)

(*Résumé anglického textu*)

Jindřich Hladil - Jiří Kalvoda - Olga Friáková - Arnošt Galle - Zuzana Krejčí

Předloženo 6. října 1986

V jižní části Moravského krasu, v. od Brna byl podrobně studován profil zachycující styk macošského souvrství (tvořeného karbonátovými nárůsty s útesovou faunou) a líšeňského souvrství (tvořeného poútesovou karbonátovou sedimentací). Ukončení tvorby karbonátových nárůstů a vymření útesotvorné fauny bylo datováno pomocí konodontů do vyšší části konodontové zóny Palmatolepis crepida, do spodního famenu.

Korálová a stromatoporoidová fauna, nalezená spolu s konodonty zóny Pa. crepida, může být použita pro korelaci spodního famenu v úsecích, kde konodonti v tomto údobí chybějí (např. jv. od Brna na paleozoické nítkovicko-němčičské platformě). Jde např. o druhy: *Natalophyllum perspicuum* Hladil, *Tabulophyllum maria* Galle, *Labechia cumularis* Yavorski a *Amphipora tschussovensis* Yavorski.

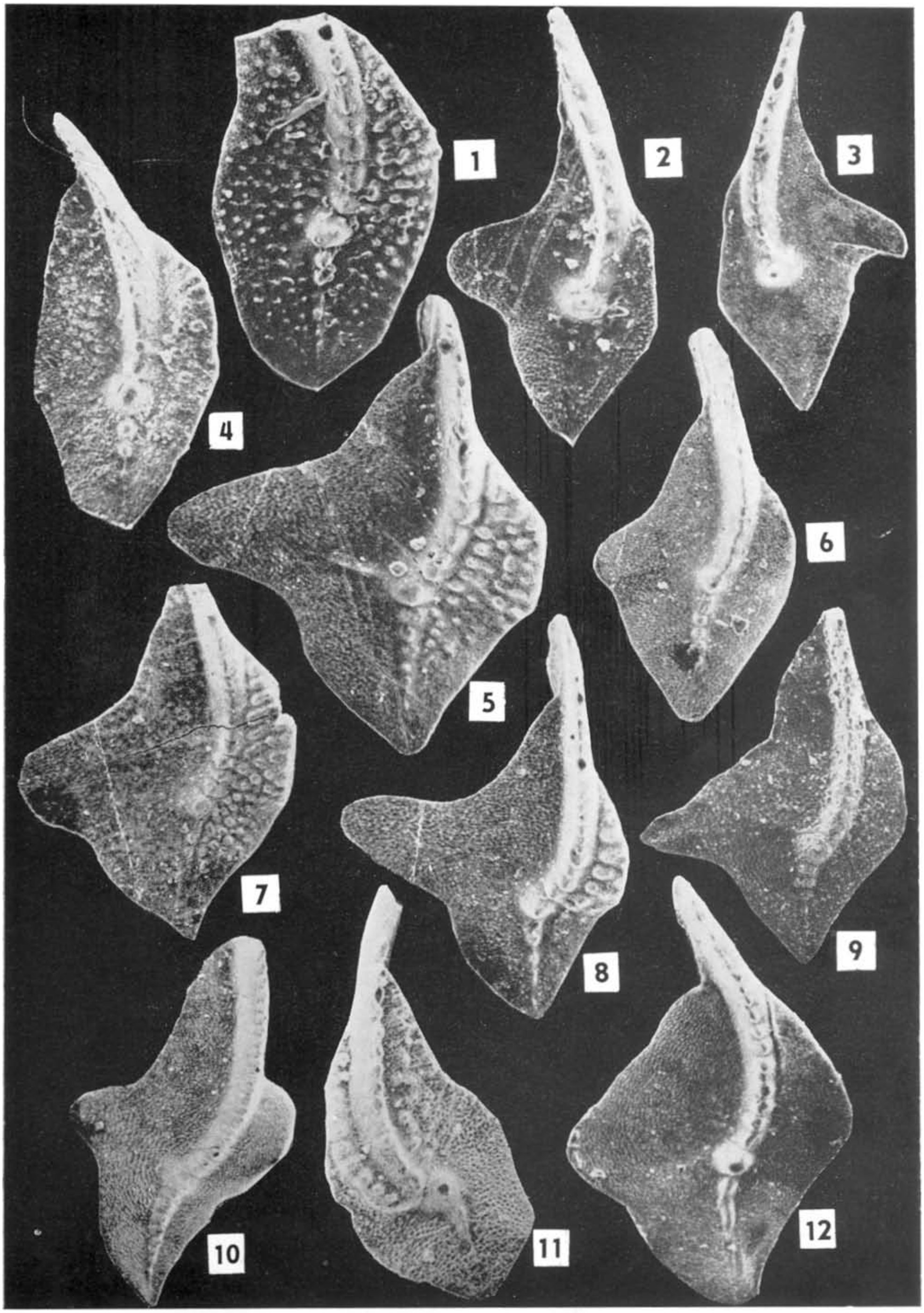
Sedimentační prostředí bylo charakterizováno jako postupně plošně se zmenšující mělká karbonátová rampa nebo komplex mělčin, dosti odkrytý vůči pánvi. Při bázi cyklů metrového řádu, které je možno vyčlenit v odkrytém sledu macošského souvrství, jsou temnější vápence s *Moravamminidae* indet., někdy s oogoniemi charofyt. V nižší části profilu tyto sedimenty nasedají na původní skalní dno. Vyšší části cyklů jsou světleji zbarveny, obsahují pestře tvarované úlomky útesotvorných organismů svazované jejich povlaky. Hojné jsou i laminované textury. Směrem do nadloží jsou častější výskyty konodontů, radiolárií (indikace kontaktu s pánevním prostorem), jinde i oogonií charofyt (kontakt s vyslazovanými příbřežními prostory).

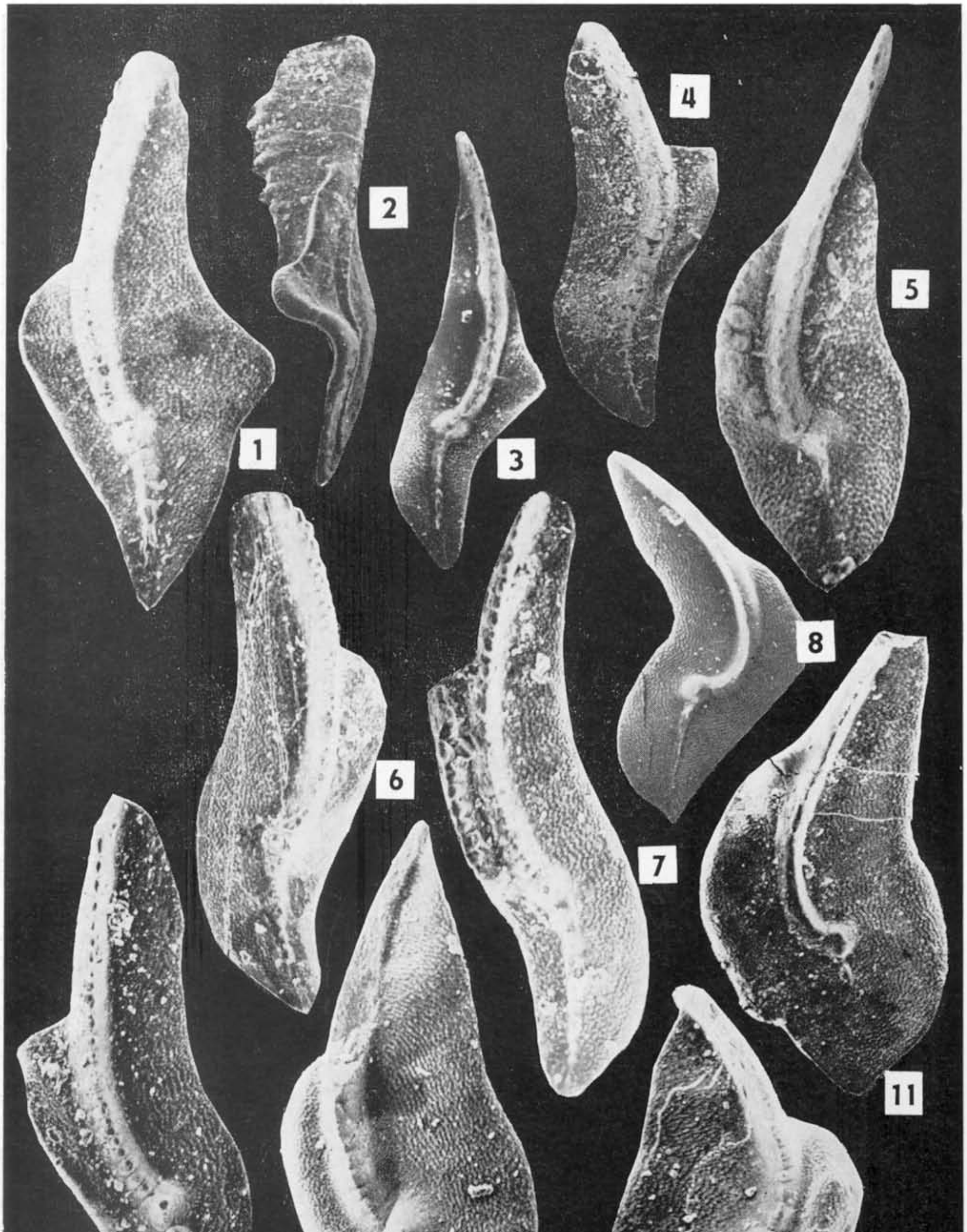
Hranice frasnu a famenu je charakterizována podle stromatoporoideí a korálů. Je kladena mezi intervaly I a II, ca 4 m pod strop nárůstů. Za indikátory nesporných svrchofrasnských poloh jsou považovány poslední výskyty *Scoliopora kaisini* (Lecompte) a *Nanicella* sp.

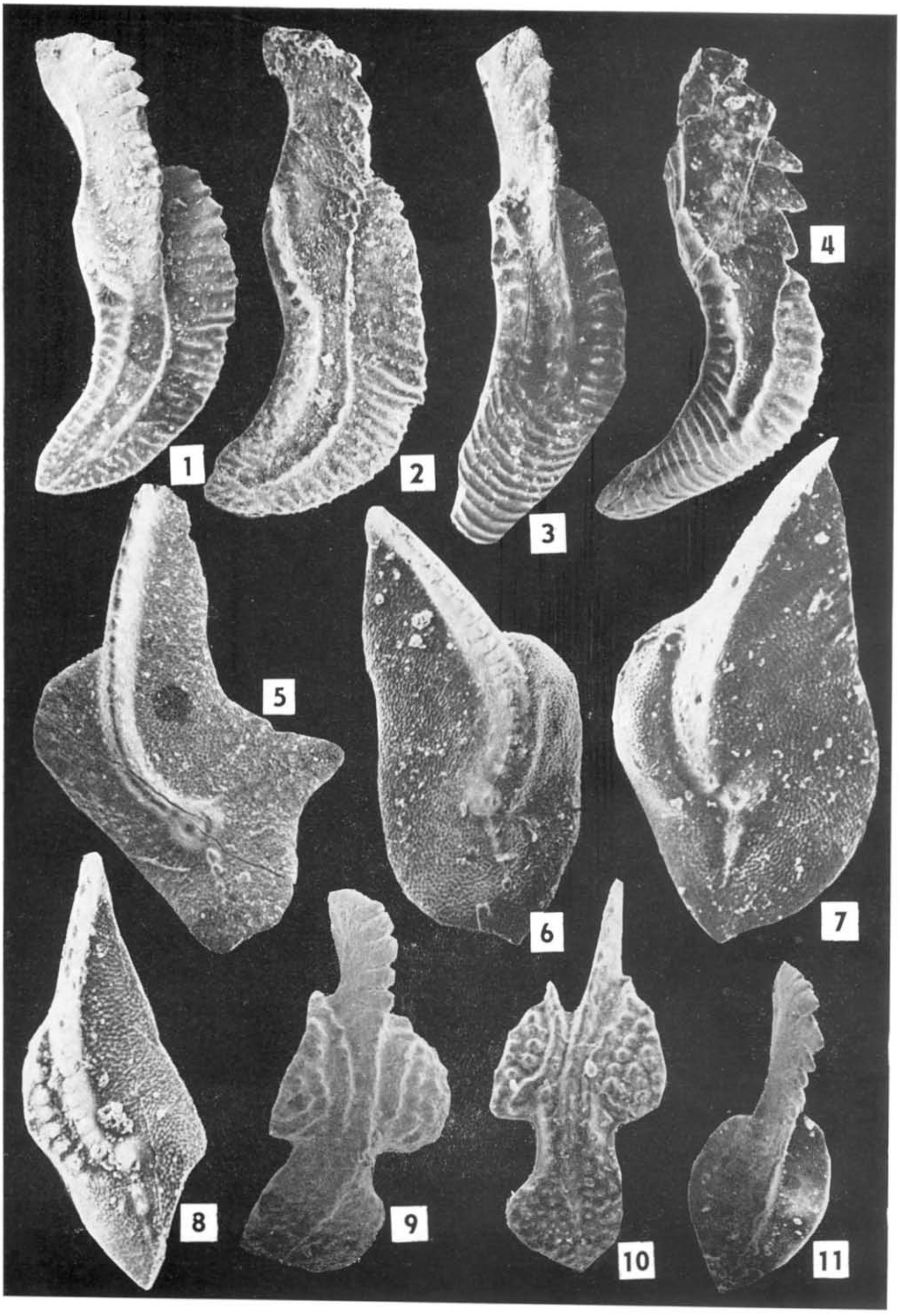
Фауна известняков при границе между франом и фаменом на м. Мокра (девон, Моравия, Чехословакия)

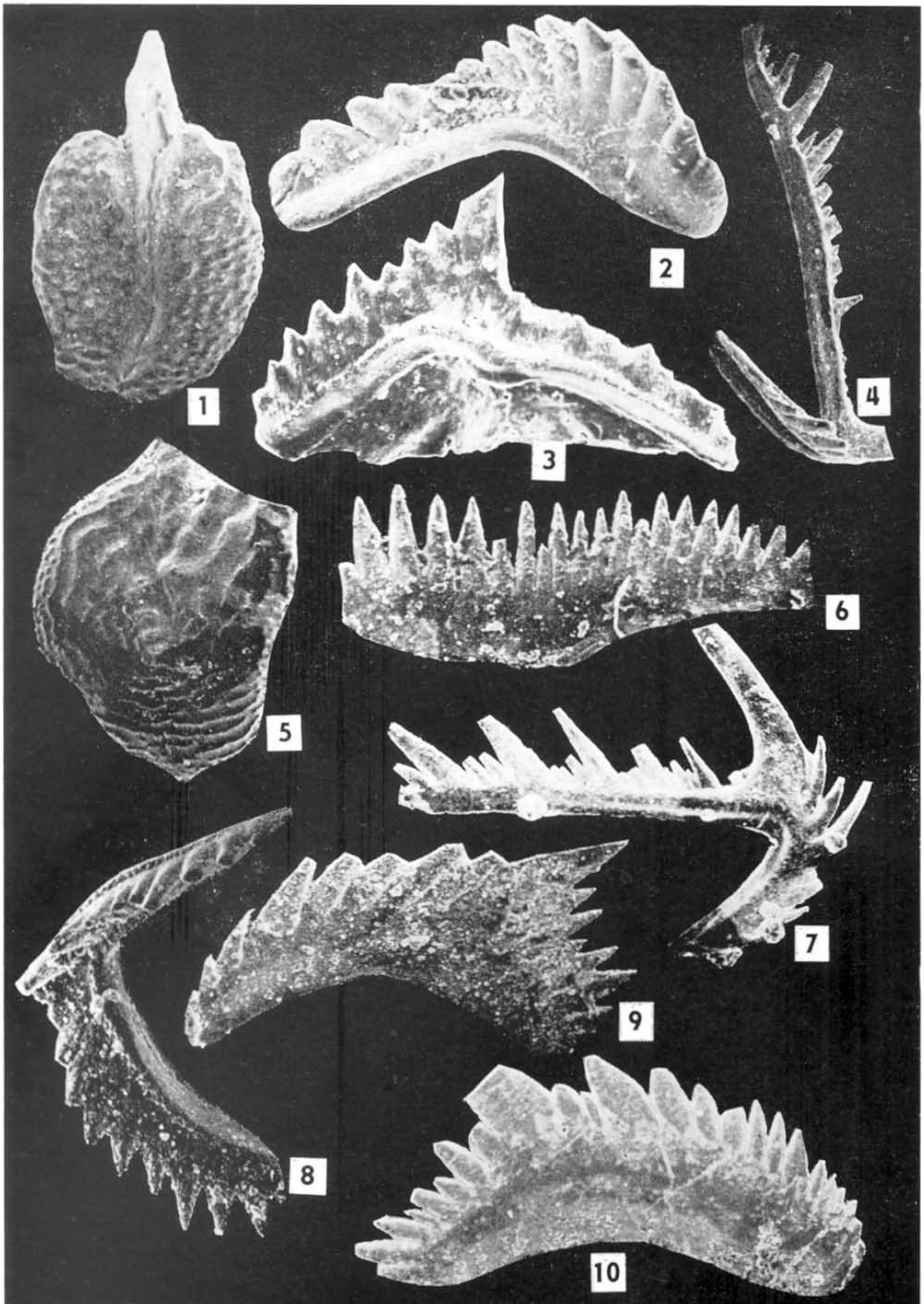
Рифовая фауна вымирает в профиле на м. Мокра в верхней части зоны конодонтов Palmatolepis crepida. В нижний фамен переходят особенно эврифациальные виды и сообщество показывает малую разнообразность. Понижение разнообразности ставят авторы в причинную связь с келльвассерскими эвстатическими и климатическими событиями, доказанными в настоящее время с общей точки зрения от средних уровней зоны Palmatolepis gigas по ее высшую часть (WALLISER 1985, 1986) и продолжающимися, возможно, до средних уровней зоны Palmatolepis triangularis (т. наз. Crickites event — см. KALVODA 1986). Граница между франом и фаменом проведена в профиле в стратиграфическом перерыве между интервалами I и II. Ниже упомянутого перерыва встречаются *Scoliopora kaisini* (LECOMPTE) и фораминифера *Nanicella* sp., значит, элементы, известные в Моравии до сих пор исключительно по кровлю зоны конодонтов Palmatolepis gigas, а выше него появляется уже *Labechia cumularis* YAVORSKI и *Syringopora volkensis* TCHERNYSCHEV, принимаемые авторами видов за элементы нижнефаменского возраста. Упомянутый стратиграфический перерыв охватывает, по всей вероятности, критический промежуток проведения границы между франом и фаменом, соответствующий нижней трети зоны Palmatolepis triangularis. В противоположность этому, выразительное изменение литологии между мацошской и лищеньской свитами (выше интервала IV) и вымирание сидячего бентоса (на 3—5 см ниже в профиле) не сопровождаются отсутствием биостратиграфических следов, так как лежачие и висячие пласты содержат автохтонные конодонты зоны Palmatolepis crepida, именно ее верхней части.

Přeložil A. Kříž

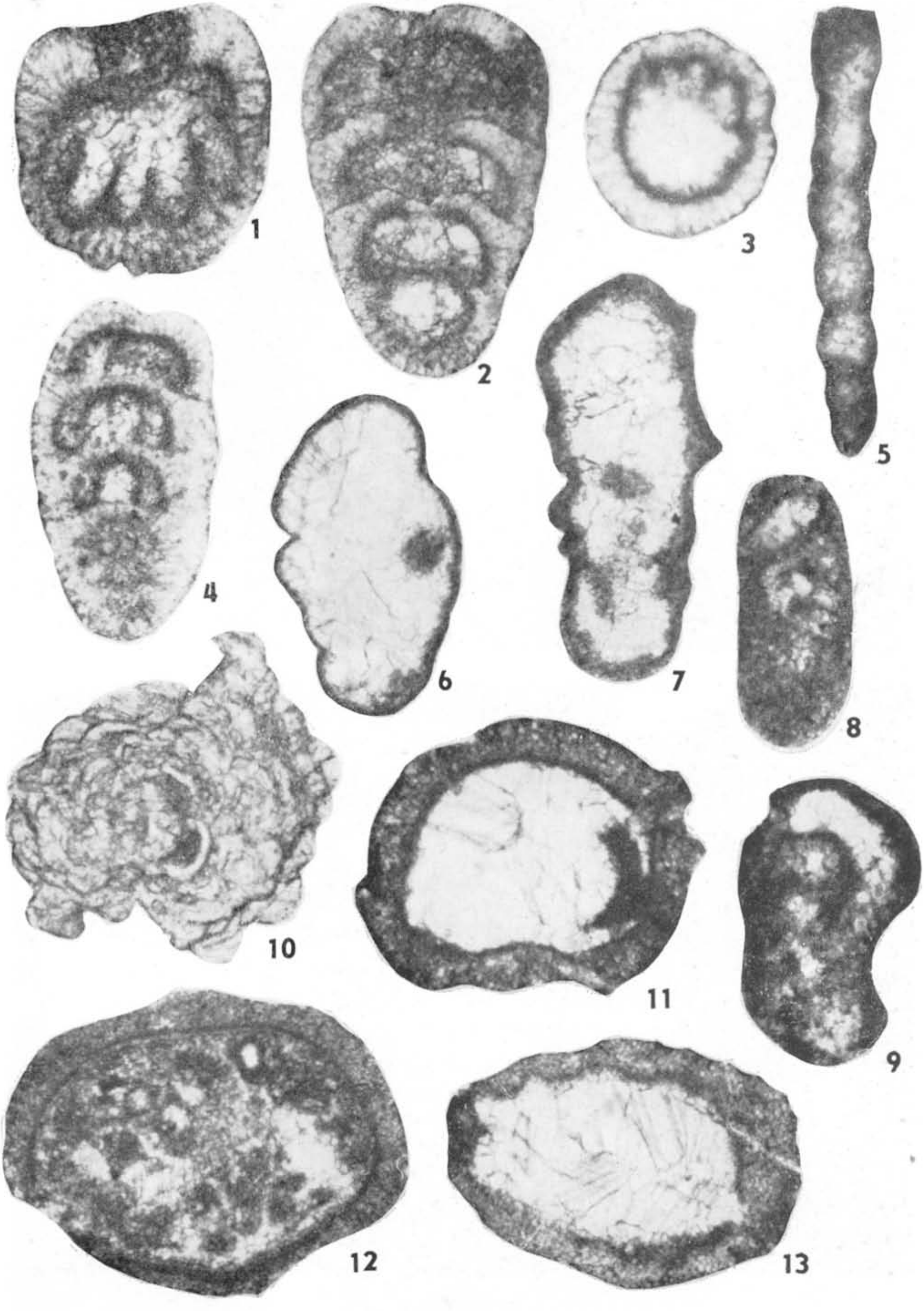

1
2
3
4
5
6
7
8
9
10
11
12

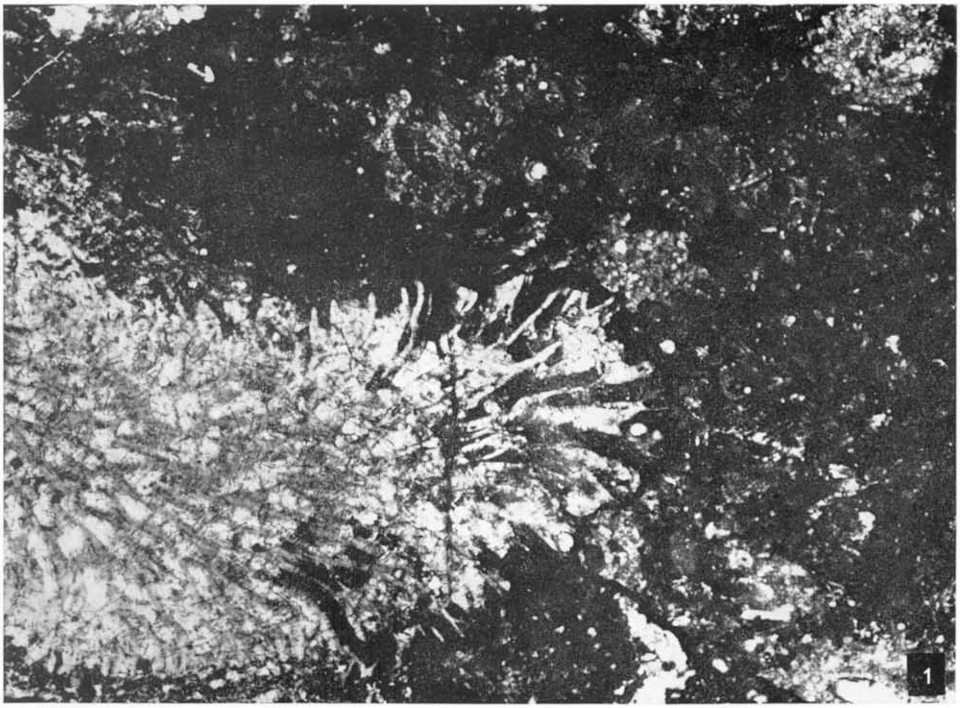

1
2
3
4
5
6
7
8
9
10
11
12

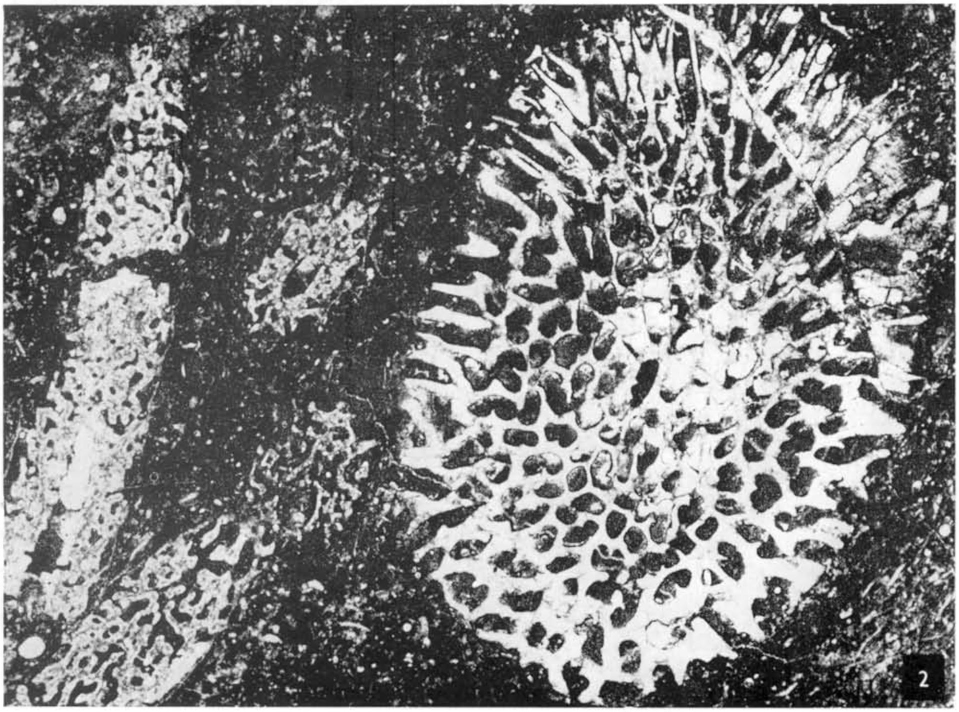

1
2
3
4
5
6
7
8
9
10
11

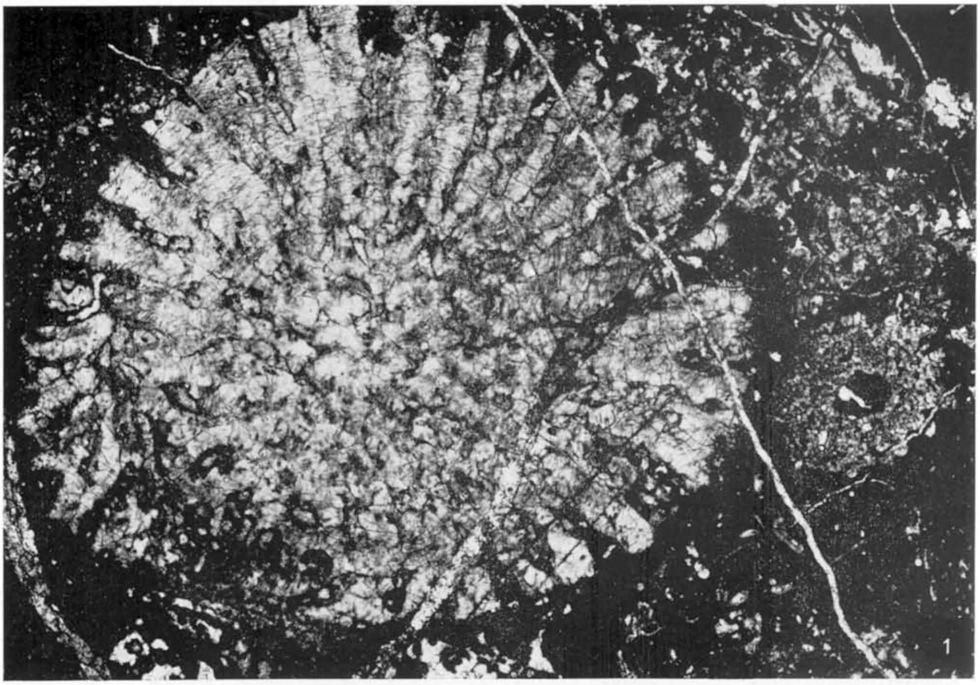

1
2
3
4
5
6
7
8
9
10

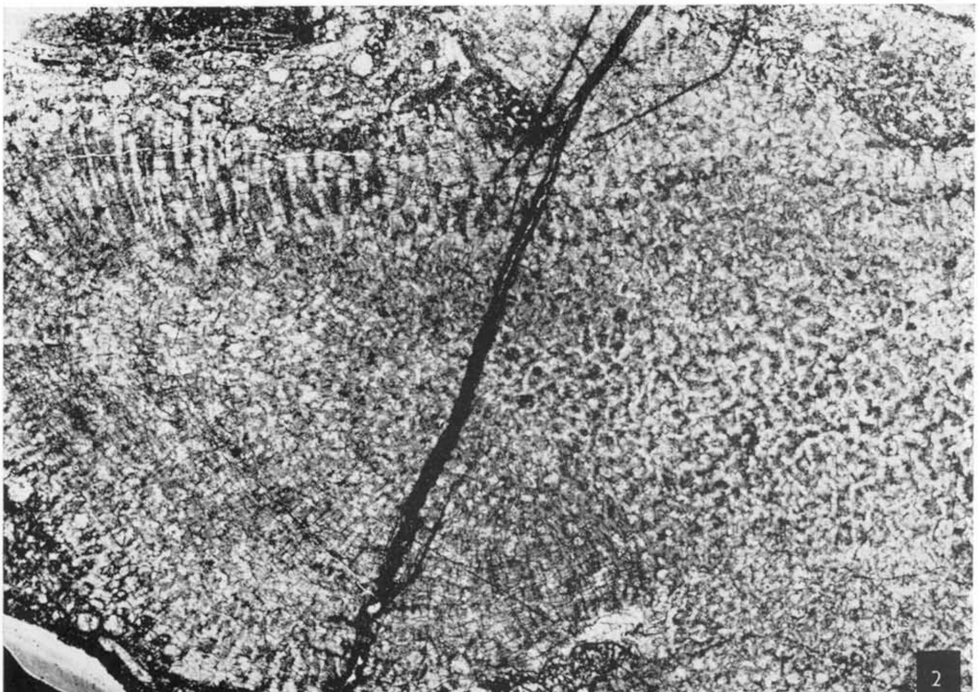
J. Hladil - J. Kalvoda - O. Friáková - A. Galle - Z. Krejčí: Pl. V
Fauna from the limestones at the Frasnian/Famennian boundary at Mokrá (Devonian, Moravia, Czechoslovakia)



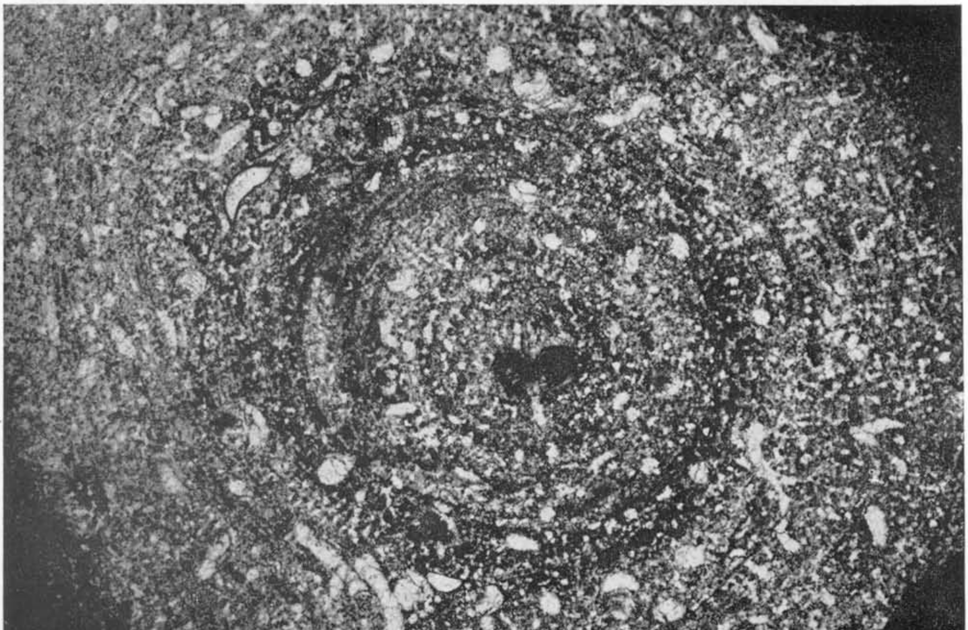

1

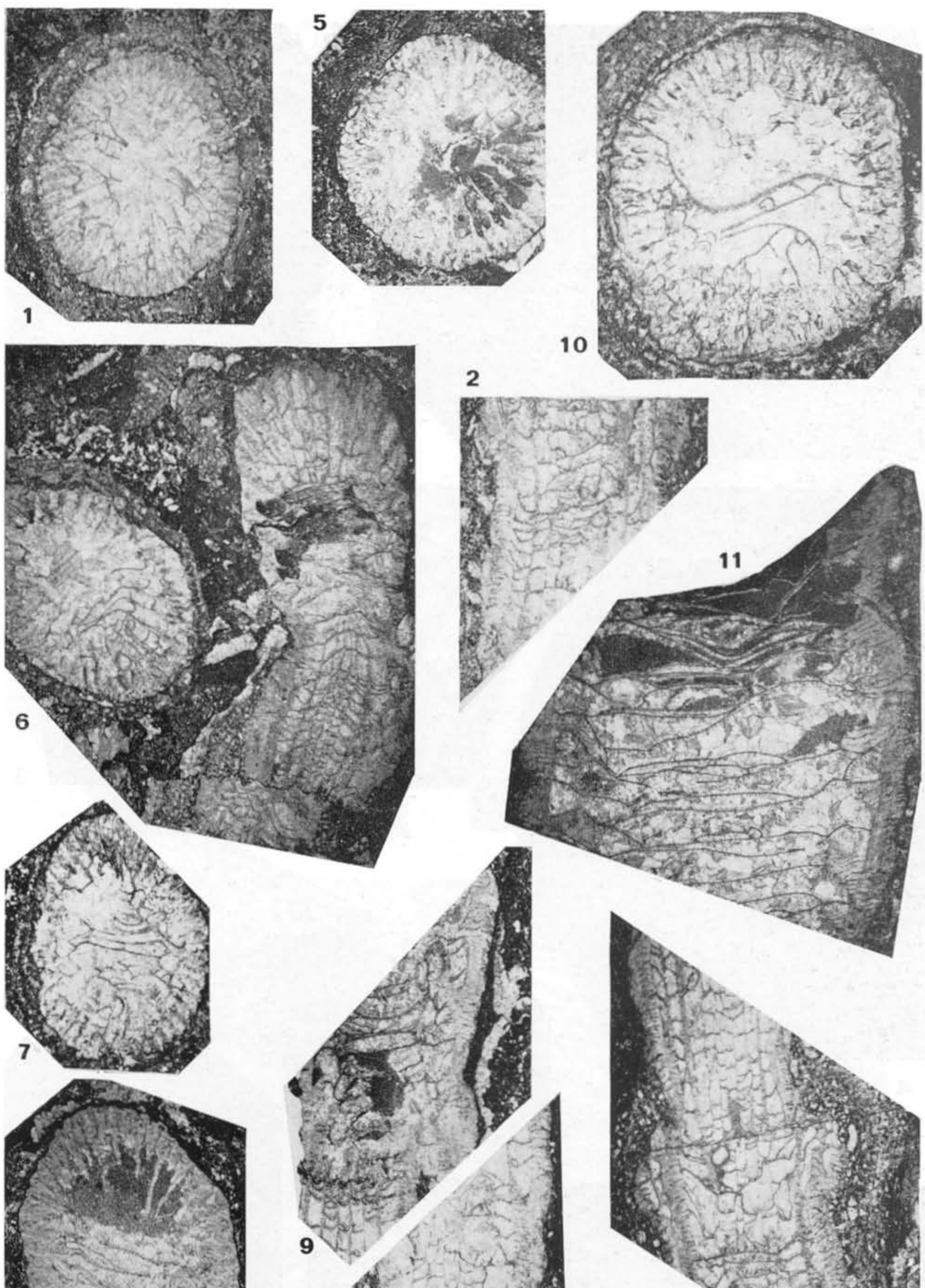

2

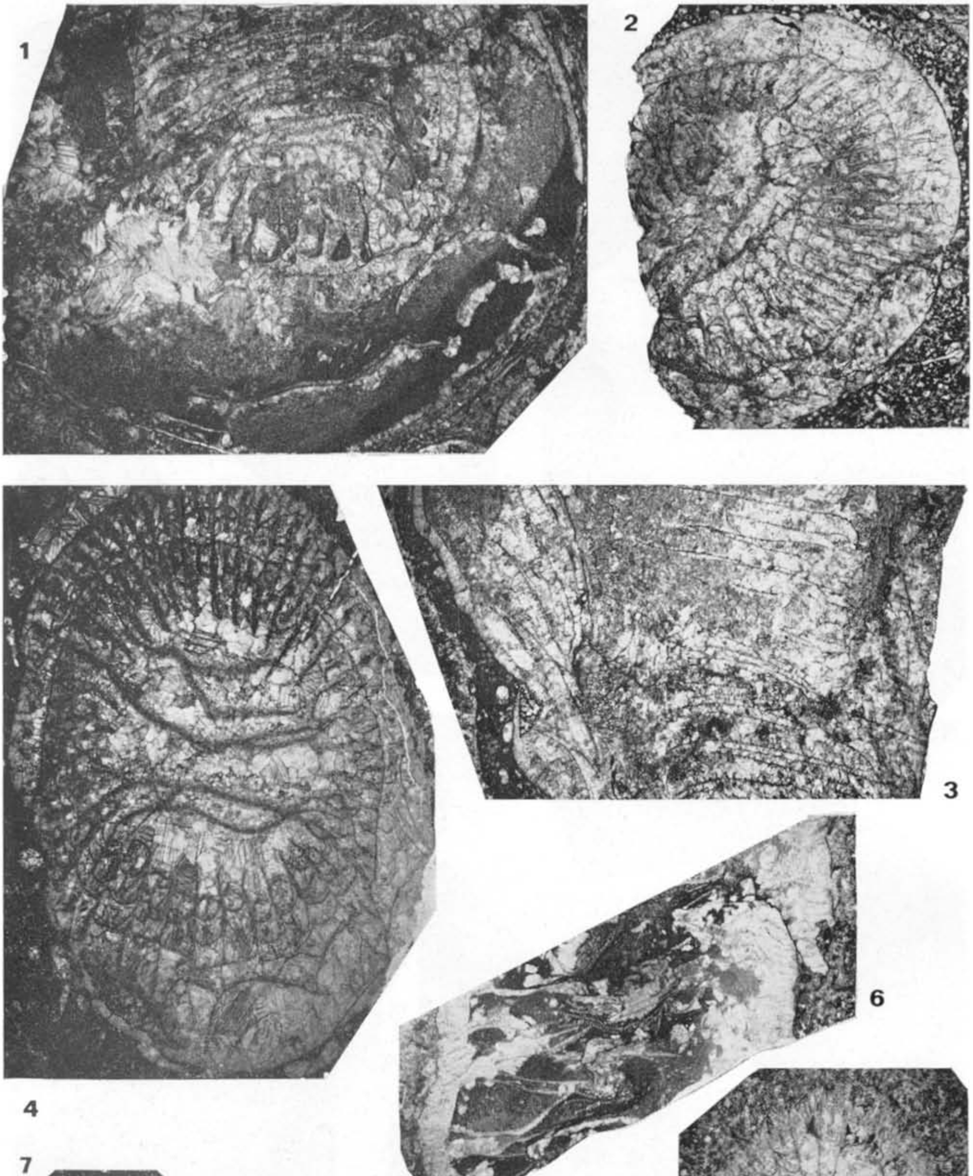

1


2

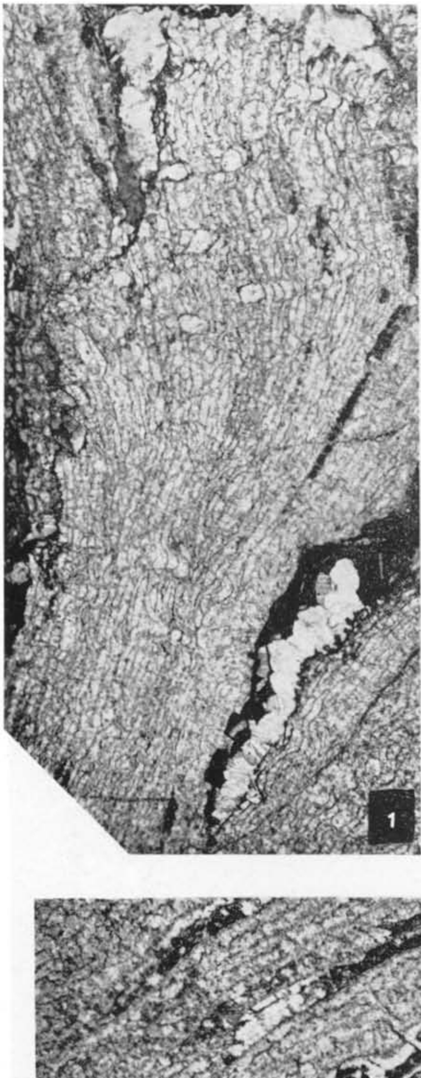
Pl. VIII

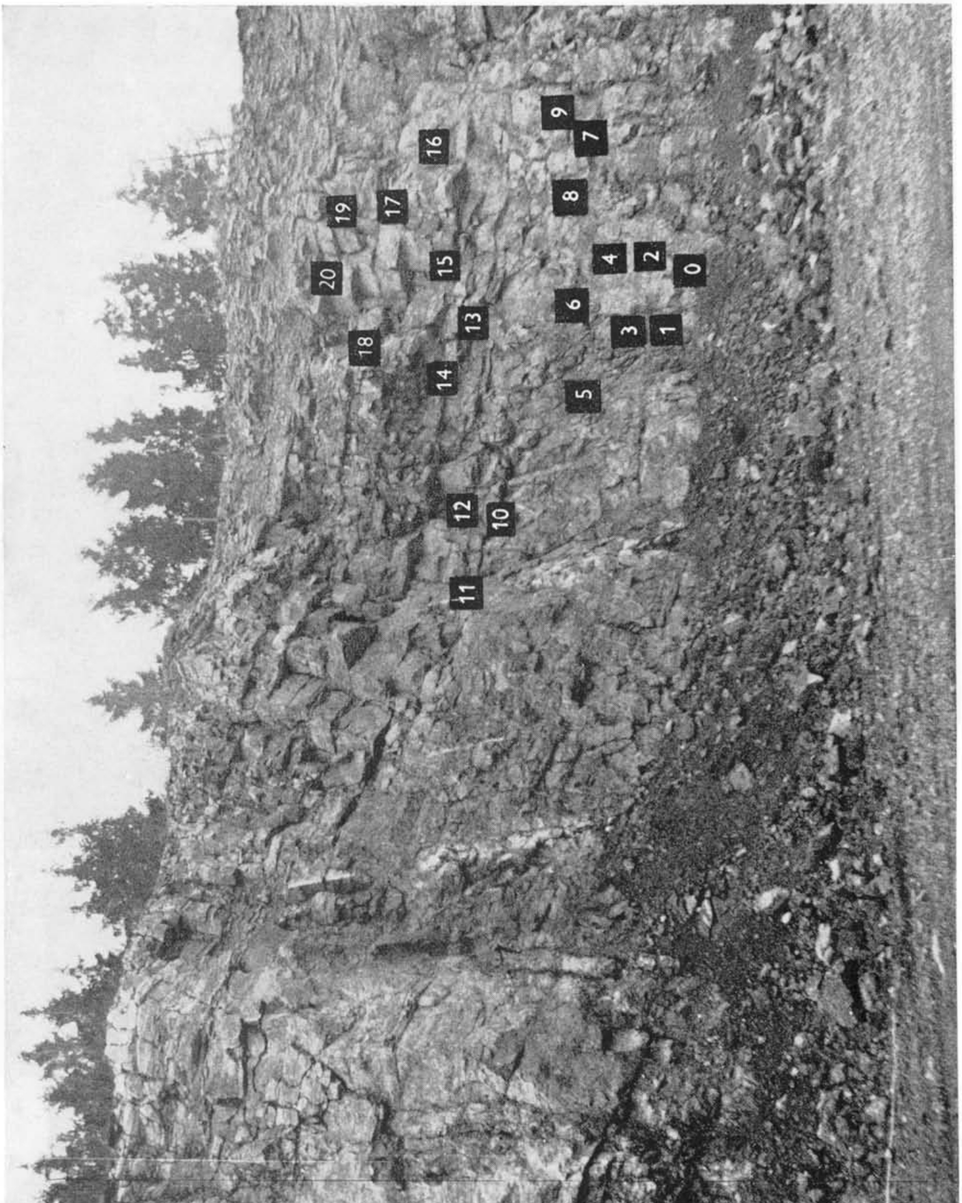



5
1
10
2
11
6
7
9
8
3
4


1
2
3
4
5
6
7
8
9

J. Hladil - J. Kalvoda - O. Friáková - A. Galle - Z. Krejčí: Pl. XI
Fauna from the limestones at the Frasnian/Famennian boundary at Mokrá
(Devonian, Moravia, Czechoslovakia)




0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20