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Jurassic brachiopods and sedimentological study of the Babiná klippe near Bohunice (Czorsztyn Unit, Pieniny Klippen Belt)

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Abstract

Approximately synchronous neptunian dykes traverse Middle Jurassic limestones. A new lithostratigraphical member - Bohunice Limestone Formation (Oxfordian - Lower Tithonian) is described. Fine pyroclastic admixture from the distant Upper Tithonian basic volcanism was enregistered. First occurrence of a special microfacies of Coniacian fine-grained limestone breccia with lithoclasts of Kimmeridgian, Tithonian and Neocomian was ascertained. Association of seven brachiopod species of the Bathonian is described.

Key words: Western Carpathians, Pieniny Klippen Belt, Jurassic, Cretaceous, brachiopods, microfacies, neptunian dykes

Sedimentological characteristic of the lithostratigraphical members

An overturned Czorsztyn Succession from the Middle Jurassic to the Neocomian is outcropped in an abandoned quarry Babiná between the villages Bohunice and Krivoklát (Fig. 1 and Tab.1).

1. White and pink crinoidal limestones - Bajocian - Bathonian form the dominant part (left wing) of the quarry. Like in the Mestečská skala klippe (Aubrecht, 1992), there is no differentiation in the white crinoidal limestones in the lower layers and the red ones in the upper part, typical in the standard sections of the Czorsztyn Unit. On the contrary the pink crinoidal limestones are situated more at the

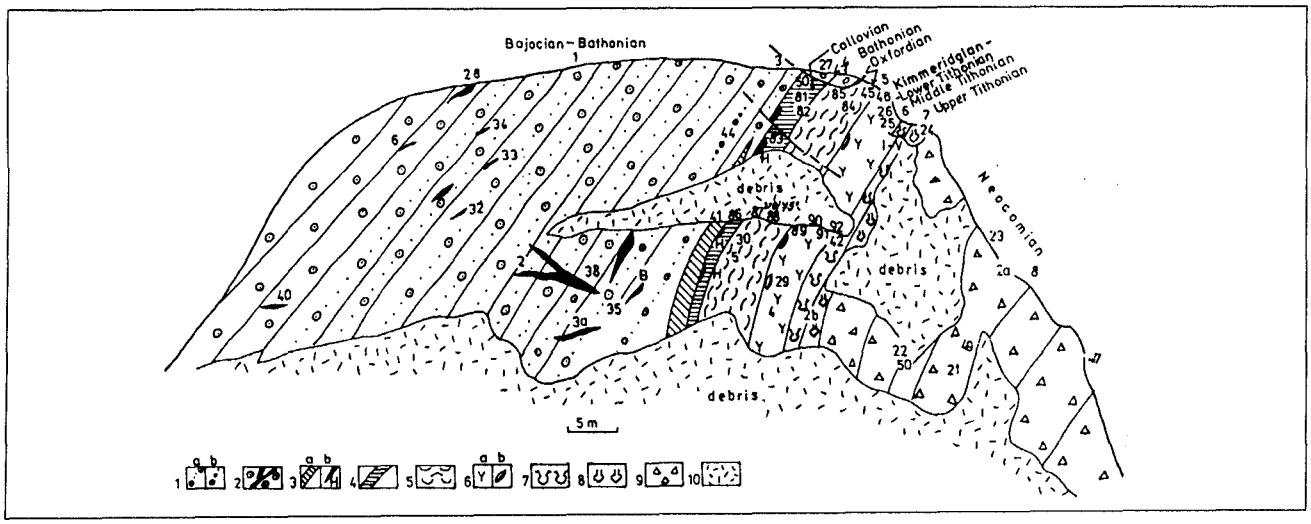


Fig. 1. Babiná quarry near Bohunice. 1a - White and pink crinoidal limestones - Bajocian - Bathonian, 1b - Conglomerate intercalation, 2 - Neptunian dykes - Upper Bathonian - Lower Callovian, 3a - pink biomicrite with "filaments" and stromatactis - Callovian, 3b - Hardground, 4 - 7 - Bohunice Limestone Formation: 4 - red limestones with "protoglobigerina" - Callovian, 5 - creamy and pink biomicrites with bivalves and Cadosina parvula - Oxfordian, 6a - pink biomicrite with Saccocoma and higher with Parastomiosphaera malmica, 6b - brachiopods with polarity structures, 7 - pink biomicrite with black coated bivalves - Kimmeridgian - Lower Tithonian. 8 - 9 - Sobótka Limestone: 8 - white and creamy biomicrite with Chitinoidella - Middle Tithonian, 9 - pink biomicrite with black-coated bivalves and Crassicollaria - Upper Tithonian, 10 - Walentowa Breccia - pink and grey limestone breccia with crinoidal matrix - Neocomian.

Tab.1. Stratigraphical summary of the Babiná klippe near Bohunice (Czorsztyn Succession)

Coniacian	limestone breccia (transgression)
Neocomian	Walentowa Breccia
Upper Tithonian Middle Tithonian	Sobótka Limestone - with Crassicollaria - with Chitinoidella
Lower Tithonian Kimmeridgian Oxfordian	Bohunice Limestone Formation - with Parastomiosphaera malmica - with Saccocoma - with Cadosina parvula
Callovian	Fe-Mn hardground layer with Stromatactis and „filaments" - 1 m; filling of clefts with „filaments" = neptunian dykes
Bathonian Bajocian	Smolegowa (and Krupianka?) crinoidal limestone

stratigraphical base of the outcropped sequence. The higher layers are just white and separated by a hardground from the next member - creamy biomicrite with bivalves. The eventual interruption of sedimentation with primary absence of the higher complex of red (red-violet) crinoidal limestones does not seem probable. It is but noteworthy that red biomicrites with "filament" microfacies are the predominant filling of the neptunian dykes and „filaments" are almost entirely absent in the layered succession. The fracturation of the white crinoidal limestones and the filling of these fractures took place before the deposition of the next member - creamy and pinkish biomicrites with "protoglobigerina" microfacies.

Pevný (1969) cited from the white and light-pinkish limestones from Bohunice (obviously this quarry) eight brachiopod species (nearer comment at page 261). The association is according to him typical for the Bajocian.

The crinoidal limestones are biosparites with sandy admixture of clastic quartz grains and small yellowish dolomite lithoclasts. A thin intercalation of the fine-grained conglomerate with a pebble of maximum size 6 cm (spongolite) was found at the point 44. The most numerous are pebbles of the vein-quartz (white, pink, honey-yellow), silicates (spongolites or without organic remnants), dolomites (some of them with traces of boring bivalvians - Pl.I, Fig.1), dedolomites, single pyroclastic rock of acid volcanites - tuffite (Pl.I, Fig.2) and greywacke with kaolinized feldspars. The interpretation of the source area has been discussed in another paper (Mišík & Aubrecht, 1994).

The temporary increased transport capacity is reflected also in the matrix (identical with the crinoidal limestone) by the high proportion of heavy minerals; in the thin section 5 zircon grains and one grain of garnet were present. This anomalous intercalation might represent a tempestite or tsunamite.

The heavy fraction of the sandy admixture in the crinoidal limestones is dominated by zircon, followed by garnet, rutile, tourmaline, apatite with single grains of anatas, titanite and hornblende (Halajová, 1981).

Echinoderm plates (mainly crinoidal columnalia) are most numerous among the bioclasts; benthonic foraminifers (including sessil nubecularids), bivalvian and brachiopod fragments, uniserial bryozoans and serpulid worms (Pl. III, Fig. 1) are common. In the highest part on the edge of the quarry the following association of Bathonian brachiopods was found: *Monsardithyris ventricosa* (Ziet.), *Cymatorhynchia* ex gr. *quadriplicata* (Ziet.), *"Terebratula"* aff. *decipiens* Eud. - Desl., *Linguithyris curviconcha* (Oppel), *Antiptychina* aff. *bivallata* (Eud. - Desl), *Caucasella trigona* (Quenst.) and *Sphenorhynchia latereplanata* Seifert; the paleontological description is on the page 261. It should be noted that the succession there is disturbed by a fault so that the Bathonian rocks contact the Oxfordian strata.

No silicification of the bioclasts, no authigenic quartz occur. Only once in the immediate neighbourhood of the mentioned pyroclastic lithoclast the authigenic anhedral quartz grains have been found; the silica was evidently derived from the volcanic glass. The total absence of chert nodules and other silicification phenomena were probably connected with the absence of sponge spicules in the environment. No voids filled with red micrite known from other localities with corresponding lithotype (Kyjov, Krasín) were found here, but red micrite filling is in the abundant neptunian dykes.

2. *Neptunian dykes.* Crinoidal limestones are densely penetrated by neptunian dykes with maximum width 35 cm. Their directions are largely scattered; the prevailing extension was NE - SW (Fig. 2), parallel to the strike of the Klippen Belt in this area. The filling is red, partly cream-coloured, often with an irregular lamination, some-

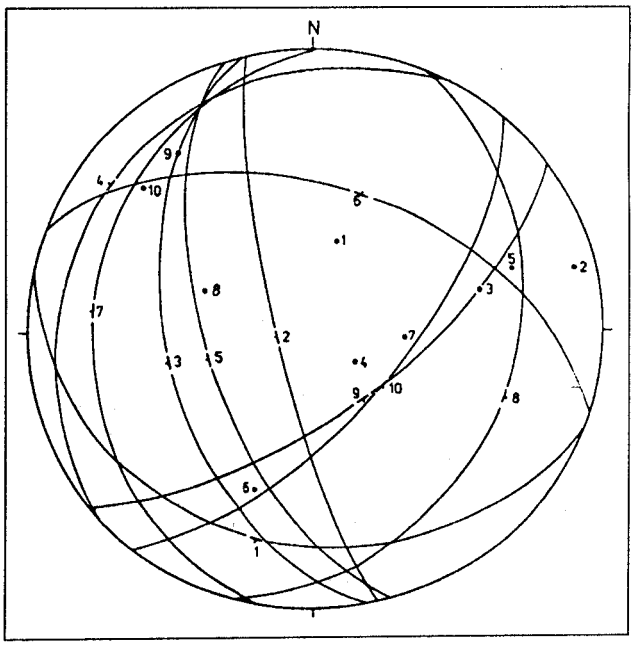


Fig. 2. Strike and dip of the neptunian dykes turned to the stratification plain (310/75°).

times oblique or lenticular. Biomicrite (wackestones and packstones) laminae alternate with those of micrite and pelmicrite; frequent intraclasts were derived from the fracture walls. The remaining empty spaces were filled by radiaxial calcite cement. The following microscopical characteristic is based on 16 thin-sectioned samples.

From the organic remnants "filaments" predominate (juvenile bivalves of the Bositra-type, rarely also with thicker shells strongly bored by algae, their tiny canals are impregnated by Fe-hydroxides); the "umbrella effect" (sparite formed under the concave side protected against the micrite deposition) was frequently observed. Current constituents are echinoderm plates and foraminifers: *Ophthalmidium* cf. *carinatum* Leischner, *Ophthalmidium* sp., *Lenticulina* sp., *Marssonella* sp., *Nodosaria* sp., microforaminifera - basal membranes of juvenile foraminifers; single ostracods, globochaete cells, uniserial bryozoans and fucoids occur. Small brachiopods were found in a dyke. Clastic quartz (to 0.25 mm) and fragments of hardgrounds are very rare. Cubes and skeletal crystals of epigenetic pyrite to 0.3 mm (Pl. I, Fig. 3) were observed several times. Tiny sterile microdykes used to penetrate transversally the described neptunian dykes.

There are no direct age indicators concerning the filling of the dykes. It is probably not much younger than the surrounding crinoidal limestones. With regard to the dominant "filament" microfacies and the fact that the dykes do not penetrate into the younger strata, we assume that they are of Upper Bathonian - Lower Callovian age.

3. Pink limestones with stromatactis structure - probably Callovian. They are only 80 cm thick and occur in the middle part of the quarry at the contact of the crinoidal limestones and the hardground. The structure can be characterized as dismicrite with small, not typical stromatactis - irregular anastomosed voids elongated along the plane of the stratification (Pl. II, Fig. 1). The voids are usually limited by thin-shelled bivalves - "filaments" (shelter porosity). They are filled by the radiaxial calcite cement with fluid inclusions and a younger clear blocky cement in their central parts. Sparitic areas are probably enlarged by the recrystallization what can be deduced from the radial aggregates of calcite around the relics of pellets (Pl. I, Fig. 4). Besides small bivalves unusually frequent microforaminifers (basal membranes impregnated by Fe-oxides - Pl. I, Fig. 5), echinoderm plates, spicules of siliceous sponges filled by calcite, nubecularids, ophthalmids, single small gastropods and worm tubes occur. Quartz grains are very rare but their size is up to 3 mm. The stromatactis horizon passes in the upper part of the quarry into pink biomicrite with typical "filamentous" microfacies (sample 81).

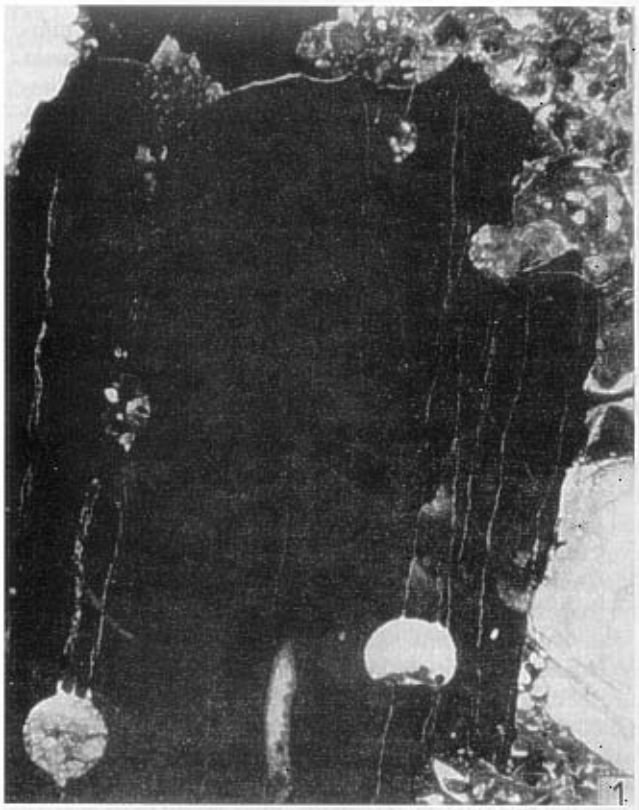
4. Pink and red limestone layers impregnated by the Mn-Fe oxides, with black hardground crust (2 cm) on their base - Oxfordian. Biointramicrites with "protoglobigerina" microfacies. They contain frequent *Globuligerina* sp., less numerous *Ophthalmidium* sp., *Marssonella* sp., *Spirillina* sp., *Lenticulina* sp., abundant voids after the radiolarians filled by drusy calcite or dark micrite (these radiolarian "ghosts" resemble the round coprolites - Pl. III, Fig. 2), originally aragonitic bivalves with red coatings (dissolved and filled by micrite, often with collapsed micritic rims), globochaete cells, ostracods, *Cadosina parvula* Nagy (Pl. I, Fig. 6), single juvenile ammonite, rhyncholite, phosphatized fish scale, uniserial bryozoan and echinoid spine. Several intraclasts with the red coatings and traces of dissolution and the fragments of Fe-Mn hardgrounds are further signs of the condensed sedimentation. The hardground crust contains 14.3% Mn (= 18.46% MnO), 15.34% Fe_2O_3, 1.92% SiO_2 and 0.54% TiO_2. The presence of *Cadosina parvula* signalized the appurtenance to Oxfordian.

Bohunice Limestone Formation (new name). Age: Oxfordian - Lower Tithonian. Name: after the type locality quarry Babiná near Bohunice. Thickness: about 11 m. Dominant lithology: creamy and pink micritic and biomicritic limestones with bivalves and brachiopods. According to the detailed lithology, three members were discerned (here No.5 - 7); preliminary, no formal names were proposed for them. Lateral equivalents: Czorsztyn Limestone (red nodular), Vršatec Limestone (white biohermal) and Rogoznik Coquina.

5. Creamy and pink micritic limestones with bivalves - Oxfordian. The composition: abundant radiolarians (frequently only their phantoms reminding coprolites), variable amount of "protoglobigerina" (*Globuligerina* sp.), *Cadosina parvula* Nagy, single *Colomisphaera* sp. etc. Clastic quartz was absent except one thin-section with a grain 3 mm; cubes of epigenetic pyrite occur. A slight nodularity was observed. The thickness is about 5 m.

6. Pink micritic limestones - Kimmeridgian - Lower Tithonian. Generalized characteristic from 5 thin sections: biomicrite mostly packstone with Saccocoma-Globochaete microfacies, further with numerous juvenile ammonites, foraminifers (genera *Marssonella, Involutina, Lenticulina, Nodophthalmidium* etc.), fragments of brachiopods and bivalves, rare echinoid spines, ostracods and aptychi. The voids in the microfossils and macrofossils (mainly in brachiopods) contain an internal sediment with the polarity structures confirming the inverted sedimentary succession. Clastic quartz (terrigenous admixture) is absent; rare cubes of epigenetic pyrite up to 0.4 mm occur. Brachiopods *Nucleata bouei* (Zejsz.) and *Lacunosella* aff. *spoliata* (Suess) from the point 46 indicate the Kimmeridgian. The thickness is about 4.5 m.

7. Pink micritic limestone with small black-coated bivalvians - Lower Tithonian. They can be differentiated only by means of the microscope based on the presence of *Parastomiosphaera malmica* (Borza) and the absence of *Chitinoidella* (Borza, 1984). They are biomicrites with Saccocoma microfacies, abundant globochaete cells, bivalves (originally aragonitic ones with the mentioned black coating, red in the thin-sections), rare large crinoidal columnalia (also corroded and with red coatings), *Lenticulina* sp., *Frondicularia* sp., *Bullopora* sp., agglutinated foraminifers, several *Parastomiosphaera malmica* (Borza) (Pl. I, Fig. 7), *Cadosina parvula* Nagy, *Colomisphaera* sp., tiny filaments genetically connected probably with globochets, single juvenile ammonites, gastropods, calcified radiolarians, aptychi, ostracods, single fish tooth and serpulid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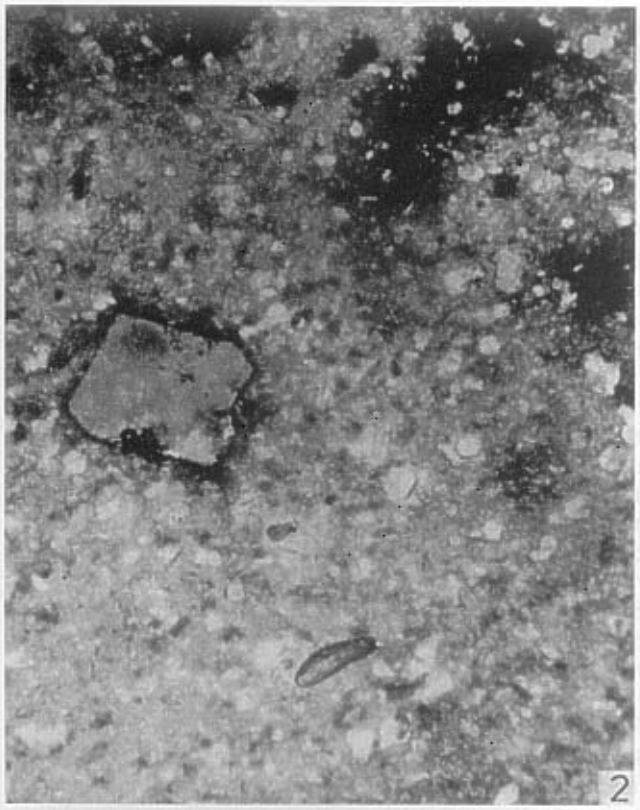
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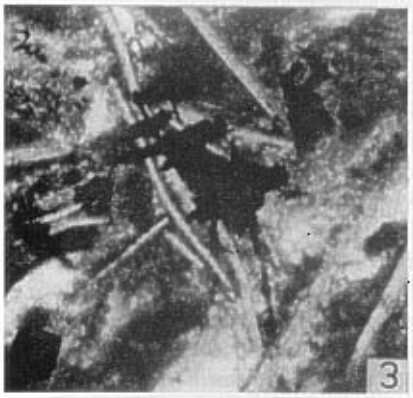
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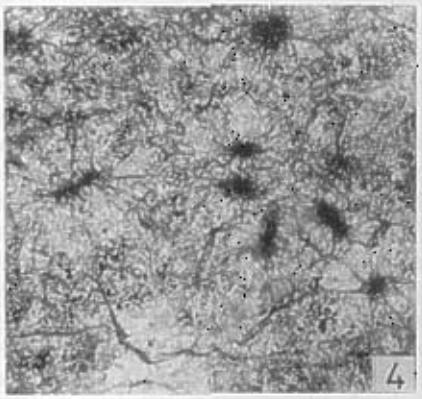
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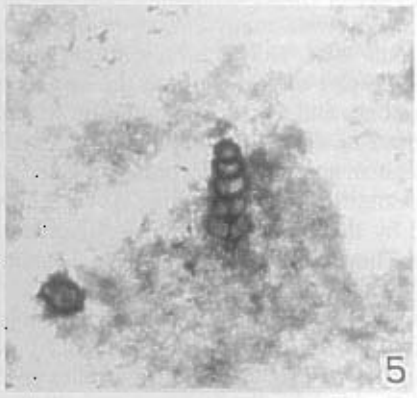
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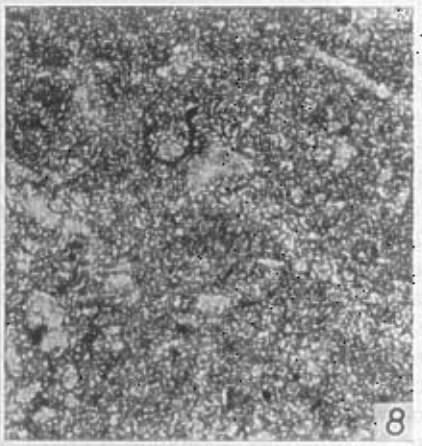
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worm *Durandella* sp. (Pl. II, Fig. 3, 4). The author of this genus - Dragastan (1970) described it also from Tithonian but attributed erroneously to the Tintinida. Rare voids with polarity structures occur. The thickness is 1 m.

8. White and creamy micritic limestones - Middle Tithonian. They belong to the Chitinoidella zone indicating the Middle Tithonian (Borza, 1984). The generalized description was carried out from the 9 thin-sections: biomicrites-packstones with Globochaete-Saccocoma microfacies containing *Chitinoidella boneti* Doben (Pl. I, Fig. 8; Pl. III, Fig. 5), voids after the dissolved radiolarians filled by the calcite, foraminifers (*Involutina* sp., *Marssonella* sp., *Lenticulina* sp.), juvenile ammonites, tiny filaments with special sculpture, probably connected with globochete cells, ostracods, *Colomisphaera* sp., aptychi and basket-like sections probably of a calcareous sponge (Pl. II, Fig. 7). The total lack of the clastic quartz should be stressed once more. A juvenile specimen of *Pygope* sp. proceeded from these limestones.

9. Pink micritic limestones containing bivalves with the black coatings - Upper Tithonian. They correspond to the Korowa Limestone Member of Birkenmajer (1977). They can be characterized as biomicrites-wackestones, frequently bioturbated with Crassicollaria microfacies, mostly with *Crassicollaria intermedia* Durand Delga, single *Calpionella alpina* Lorenz and *Chitinoidella* sp., abundant globochaete cells and voids after radiolarians filled by calcite, fragments of bivalves, originally aragonitic, with red margins in transmitted light, rarely bordered with black Mn-dendrite (Pl. III, Fig. 3); they were dissolved and filled by the micritic sediment or by the sparitic cement; their micritic rims sometimes collapsed. Single bivalves with prismatic layer in the calcitic shell, several juvenile ammonites, ostracods, aptychi, brachiopod fragments, *Spirillina* sp., *Marssonella* sp., *Patellina* sp., *Involutina* sp. and *Cadosina fusca fusca* Wanner have been observed. Corroded and bored intraclasts with the thin Fe-crusts occur, as well as voids with polarity structures.

The peculiar very fine-grained pyroclastic admixture (about 20 grains under 0.15 mm in a thin-section) of basic volcanic rocks containing tiny mostly calcified feldspars (Pl. III, Fig. 4) was identified. The total lack of the clastic quartz points to a distant aerial transport from the remote volcanic centers probably at the territory of the actual Carpathian Ukraine. Another case was identified from the Kyjov-Pusté Pole klippe, Eastern Slovakia, concerning the same stratigraphical horizon and the identical unit (Mišík, 1992). Basic volcanites (pikrobasalts and basanites) of the same age occur also in the High-Tatric Unit but those submarine effusions hardly could introduce the volcanic ash into the atmosphere.

10. Pink and grey fine-grained limestone breccias - Neocomian. They correspond to the Walentowa Breccia of Birkenmajer (1977) with the exception that Calpionellites was not found in the matrix. The predominating size of clasts is 1 - 2 cm, up to 15 cm. The matrix with echinoderm plates is yellowish or red, the clasts are white, creamy and red. The microscopical description was derived from the thin-section study of 13 samples.

The most abundant are lithobiosparrudites. Their matrix is dominated by echinoderm plates including typical brachialia of the planctonic crinoids (*Roveacrinidae ?*) with syntaxial rims, frequently limited by the crystal faces. Echinoderm plates used to be corroded by Fe-hydroxides along the fissibility. Aptychi with celular structure and bivalves are rare, phosphatic fish teeth exceptional. Some *Hedbergella* sp. found in the matrix allow to suppose the Hauterivian age. The peculiar phosphate intraclasts and intraplasts containing arborescent calcite grains have been already found by us in the Neocomian limestones in the Krasín klippe (Mišík, Sýkora and Aubrecht, in press, Pl. V, Fig. 2). Their syngenetic origin is confirmed by the fact that the phosphate occurs also as the interstitial mass amidst the echinoderm plates in the matrix. The most frequent lithoclasts are biomicrites with the association *Saccocoma* + *Globochaete* + calcified radiolarians (fragments of Kimmeridgian - Lower Tithonian limestones), rarely with *Chitinoidella* (Middle Tithonian); the lithoclasts with *Crassicollaria* (Upper Tithonian - Pl. II, Fig. 6) are rarer and smaller. The breccia lacks the quartz. It contains the same cubes and skeletal crystals of the epigenetic pyrite mentioned in the preceding members what confirms that the pyrite originated in the whole Callovian - Neocomian successions in the same time, in one of the post-Lower Cretaceous periods.

Sometimes an association of biomicritic lithoclasts with *Saccocoma* surrounded by the matrix with the structure of *?Saccocoma (Roveacrinidae)* biosparite has been observed. It can be explained by the existence of the intraformational breccias already in the Kimmeridgian - Lower Tithonian limestones. The different size of the brachialia in clasts and in the matrix might indicate that they belong to two different genera of planctonic crinoids or it was caused only by hydrodynamic sorting. The existence of the big blocks of Kimmeridgian - Lower Tithonian in the Neocomian breccia cannot be excluded (e.g. the lowermost rockwall on the left flank of the quarry).

11. Fine-grained limestone breccia with yellow or red matrix and white micritic limestone lithoclasts - Coniacian. The matrix of this lithosparrudite is formed by the densely packed detritus of double-keeled globotruncanas (Pl. III, Fig. 6) with some hedbergellas, echinoderm plates

◀ **Pl. I.** Klippe Babiná near Bohunice. 1 - Lithoclast of the Triassic dolomite with traces of the bivalvian borings; conglomerate intercalation in the Middle Jurassic crinoidal limestone; sample 44, thin section No. 20 704, x7, 2 - Small pebble of the tuffite belonging to the acide volcanism (a feldspar porphyroclast is visible); thin section No. 20 531, x26, 3 - Epigenetic skeletal pyrite in the neptunian dyke filled by the biomicrite with the „filament" microfacies, probably Callovian; sample 33a, thin section No. 12 398, x60, 4 - Radial calcite aggregates formed around the pellets in the Stromatactis horizon (see Pl. II, Fig. 1), probably Callovian; thin section No. 21 288, x60, 5 - Microforaminifer (basal membrane of a juvenile foraminifer) in the limestone with stromatactis; thin section No. 21 191, x160, 6 - Cadosina parvula Nagy in the biomicrite with the „filament" microfacies, Oxfordian; sample 30, thin section No. 12 397, x88, 7 - Parastomiosphaera malmica (Borza) in the pink limestone of the Bohunice Formation, Lower Tithonian; thin section No. 12 693, x152, 8 - Chitinoidella boneti Doben (two specimens) in the Middle Tithonian limestone; thin section No. 12 403, x52.


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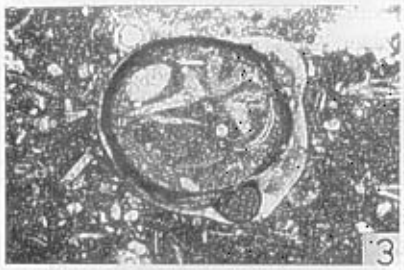
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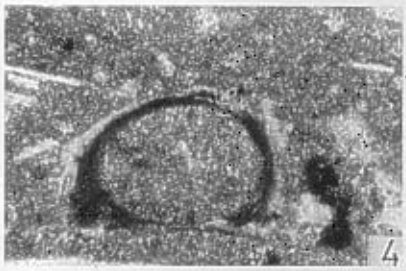
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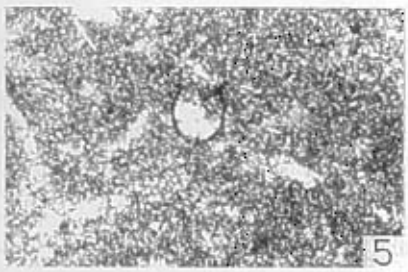
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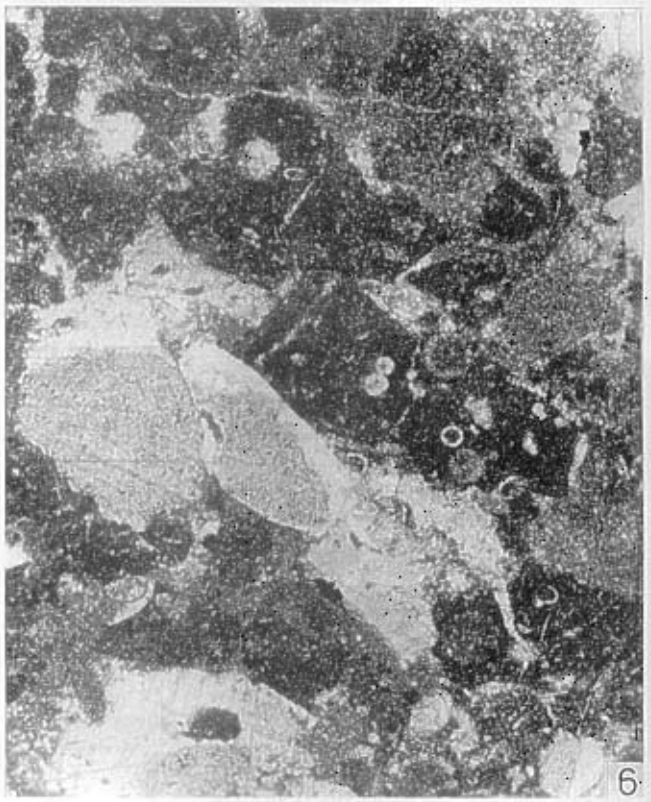
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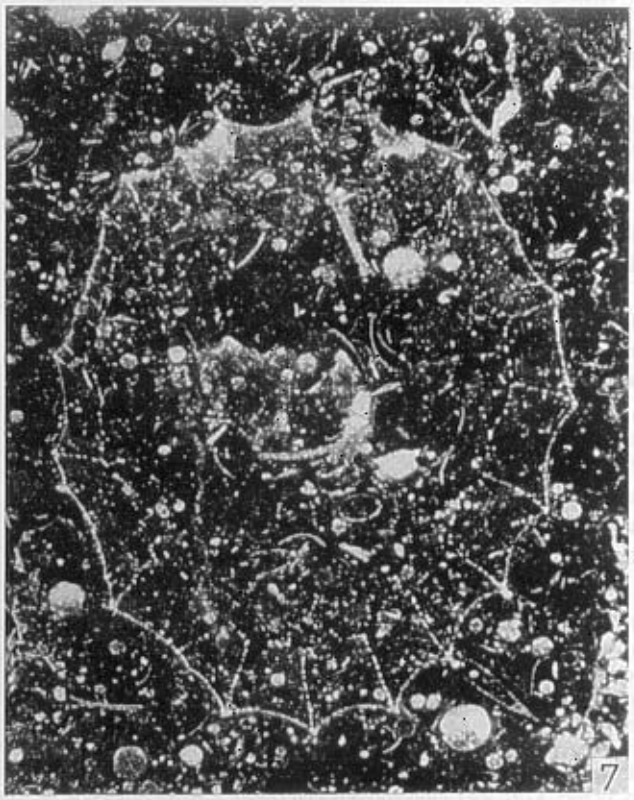
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with syntaxial rims, fragments of inoceramid bivalves (including isolated prisms) and rare phosphatic fish scales. From foraminifers the following species were determined: *Falsomarginotruncana angusticarinata* (Gandolfi), *F. pseudolinneiana* (Pessagno), *F. coldreriensis* (Gandolfi), *F. desioi* (Gandolfi), *Marginotruncana schneegansi* (Sigal) and *Clavulinoides* sp. (determined by RNDr. J. Salaj, DrSc., GÚDŠ). This fauna indicates Coniacian age; no younger forams have been found.

The lithoclasts belong mostly to the biomicrites with *Saccocoma* (Kimmeridgian - Lower Tithonian), rarer with *Crassicollaria* (Upper Tithonian - Pl. III, Fig. 5). Neocomian lithoclasts contain small fragments of biomicrites with *Crassicollaria*, without tintinids in the matrix and with phosphatic intraclasts. A lithoclast of red biomicrite with the Middle Cretaceous planctonic foraminifers has been found also.

The rock is macroscopically very similar to the Neocomian fine-grained limestone breccia. Such a rock type of Senonian age was unknown from the West Carpathians up till now. We have found it already in 1981 in the outbursted exploitation material in the quarry. The breccia should have filled a pocket within the transgression plane on the emerged Upper Jurassic and Neocomian limestones.

12. Quarternary speleothems occur in the form of a thin sinter crusts covering the cleft walls.

Brachiopod fauna of Bathonian and Kimmeridgian (M.Siblík)

The preservation of brachiopods found at Babiná is often unsatisfactory. Many of them are fragmentary and only very limited information on their internal structures could be obtained by serial sectioning. The brachiopod fauna from Babiná has been dealt with already by Pevný (1969) who reported *Ptyctothyris stephani* (Dav.), *"Terebratula" pseudocrithea* Arc.-Roché, *"Terebratula" solitaria* Szajn., *"Terebratula"* aff. *arcelini* Arc.-Roché, *"Terebratula" lineatula* Roll., *"Terebratula" craneae* Dav., *Lobothyris ventricosa* (Hartm.) and *Sphenorhynchia rubrisaxensis multicostata* (Rothpl.). All species came from the light-coloured crinoidal limestone of Bajocian age.

I focused my attention on younger beds and determined the following species: sample 41 (Bathonian) - *Monsardithyris ventricosa* (Ziet.), *Cymatorhynchia* ex gr. *quadriplicata* (Ziet.); sample 43 (Bathonian) - *Monsardithyris ventricosa* (Ziet.), *"Terebratula"* aff. *decipiens* Eud.-Desl., *Linguithyris curviconcha* (Oppel), *Antiptychina* aff. *bivallata* (Eud.-Desl.), *Caucasella trigona* (Quenst.), *Sphenorhynchia latereplanata* Seifert.

The great similarity to the brachiopods from the ammonite-proved Bathonian of the Kostelec locality helped when the age of the sample 41 and 43 was considered.

From the higher horizon (sample 46) proceeded *Nucleata bouei* (Zejszn) and *Lacunosella* aff. *spoliata* (Suess) most probably of Kimmeridgian age.

Descriptions

Monsardithyris ventricosa (Zieten, 1830)
(Pl. IV, Fig. 4)

1969 *Lobothyris ventricosa* (Hartmann) - Pevný, p. 150, Pl. 29, Fig. 3.
1971 *Monsardithyris ventricosa* (Hartmann-Zieten) - Alméras, p. 202, Pl. 7, Figs. 1 - 2; Pls. 8 A - B; Pl. 9; Pl. 12, Fig. 1; Text - Figs. 57 - 62 (cum syn.).
1979 *Monsardithyris ventricosa* (Zieten) - Siblík, p. 53, Pl. 8, Fig. 1.

30 specimens of smaller size and mostly incomplete, up to 30.0 mm long, 24.5 mm wide and 15.5 mm thick. Extensive description and discussion of the species was given by Alméras (1971).

Bajocian - ?Bathonian of Vršatec, Lower Bathonian age from Algeria was reported by Alméras (1971).

Babiná - samples 41 and 43, Dohňany, Mestečko, Podhorie, Vršatec, Malé Karpaty Mts. (Prístodolok).

„Terebratula " aff. *decipiens* Eud.-Deslongchamps, 1873

1966 *"Terebratula"* aff. *decipiens* Eud.-Deslongchamps - Siblík, p. 138, Pl. 3, Fig. 3.

5 fragmentary specimens identical with those cited above from Kostelec.

Babiná - sample 43, Kostelec.

Nucleata bouei (Zejszner, 1846)

1979 *Nucleata bouei* (Zejszner) - Siblík, p. 56, Fig. 4 (cum syn.).

2 incomplete specimens showing characteristic features of the species.

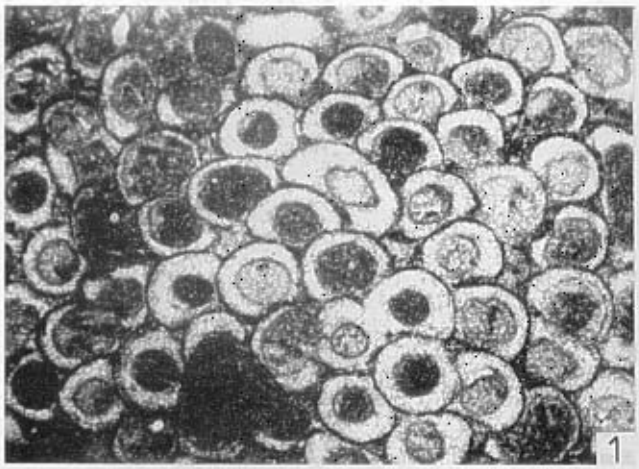
Oxfordian - Tithonian (?L. Berriassian).

Babiná - sample 46, Kostelec, Nižná, Kruchý vrch.

Linguithyris curviconcha (Oppel, 1863)
(Pl. IV, Fig. 3)

1863 *Terebratula curviconcha* Opp. - Oppel, p. 206, Pl. 5, Fig. 6.

◀ Pl. II. Klippe Babiná near Bohunice. 1 - Limestone with the stromatactis-like structure, top part of the crinoidal limestones, Bathonian - Callovian; sample 41, polished section, slightly enlarged (1.3x). 2-3 - Tube of the serpulid worm Durandella sp. in the Lower Tithonian limestones; thin section No. 12 693, x38. 4 - Durandella sp. in the stromatactis horizon, Bathonian - Callovian; sample 41, thin section No. 21 288, x50. 5 - Chitinoidella boneti Doben, Middle Tithonian; thin section No. 12 403, x152. 6 - Breccious limestone (Walentowa Breccia) with lithoclasts of the Upper Tithonian biomicrite containing Crassicollaria, Neocomian; thin section No. 12 525, x48. 7 - Problematic basket-like fossil (probably calcareous sponge) in the middle Tithonian limestone; thin section No. 12 403, x19.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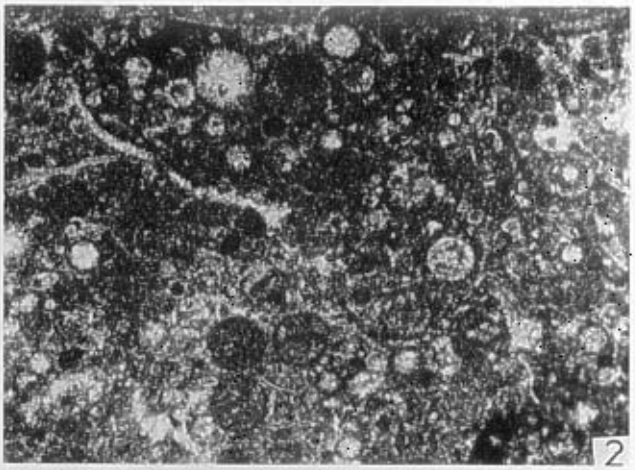
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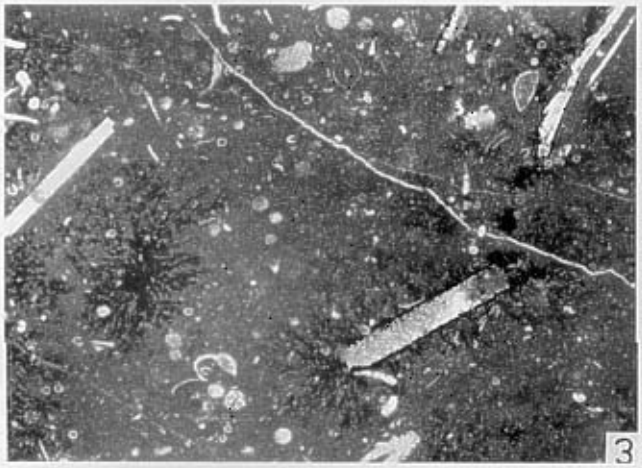
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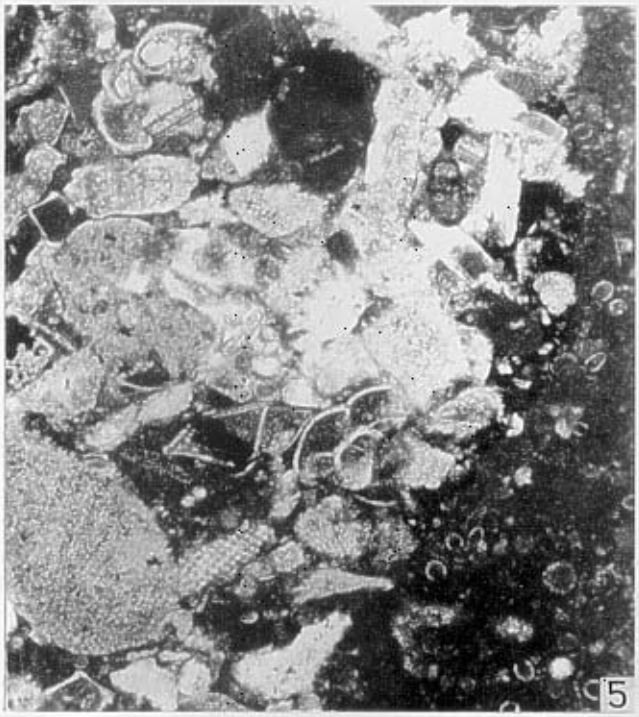
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1923 *Terebratula* (Glossothyris) *curviconcha* Opp. - Trauth, p. 193 (cum syn.).
1966 *Linguithyris curviconcha* (Oppel) - Siblík, p. 139, Pl. 4, Fig. 1.
1967 *Linguithyris curviconcha* (Oppel) - Kunz, p. 267, Pl. 1, Figs. 3 - 6.
1969 *Linguithyris curviconcha* (Oppel) - Pevný, p. 154.
1993 *Linguithyris curviconcha* (Oppel) - Radulovic' and Rabrenovic', p. 119, Pl. 2, Fig. 6.

12 specimens up to 20.0 mm in length and 21.0 mm in width. They reveal subangular sulcation of anterior commissure conformable well to that of the material from Kostelec as figured by Siblík (1966).

Bathonian - rarely Bajocian. Aalenian occurrences were reported from Italy (Rovereto).

Babiná - sample 43, Dohňany, Mestečko, Štepnická skala, Homolovačka, Kostelec, Strážovské vrchy Mts. (Čierna Lehota), Humenské pohorie Mts.(Jasenov).

Antiptychina aff. *bivalvata* (Eud.-Deslongchamps, 1859)
(Pl. IV, Fig. 2)

1979 *Antiptychina* aff. *bivallata* (Eud.-Deslongchamps) - Siblík, p. 60, Pl. 10, Fig. 3.

9 specimens up to 15.0 mm long and 13.0 mm wide. Punctation clearly visible. The internal structure revealed short dental lamellae, shallow septalium, very deep sockets with strongly developed socket ridges, and a high septum.

The specimens agree well with *Antiptychina* aff. *bivallata* from Vršatec as was presented by Siblík, 1979. In that paper the differences from both *A. bivallata* and *A. puchoviensis* Pevný were pointed out.

Babiná - sample 43, Vršatec (?Bathonian).

Caucasella trigona (Quenstedt, 1852)
(Pl. IV, Fig. 1)

1852 *Terebratula trigona* - Quenstedt, p. 548, Pl. 36, Fig. 34.
1922 *Rhynchonella trigona* Quenst.- Trauth, p. 235 (cum syn.).
1964 *Gnathorhynchia trigona* (Quendstedt, 1851) - Pevný, p. 169, Pl. 6, Fig. 2.
1966 *Gnathorhynchia trigona* (Quendstedt) - Siblík, p. 155, Pl. 3, Fig. 1.
1969 *Gnathorhynchia trigona* (Quenstedt, 1851) - Pevný, p. 146, Pl. 28, Fig. 2.
1970 *Caucasella trigona* (Quenstedt) - Tchorževskij, p. 53, Figs. 3 - 4, Text - Fig. 3.

4 specimens reach 11.0 mm in length, 15.0 mm in width and 8.5 mm in thickness. Their outlines and length/width ratios are varied. This supports Trauth's opinion (1922) of the difficulties in distinguishing this species externally from *Rhynchonella trigonella* Rothpletz, 1886. The generic attribution of *"trigona"* to *Caucasella* was proved by Tchorževskij (1970) who ascertained the internal structure of *"trigona"* without dorsal septum which is the main character distinguishing *Caucasella* from *Gnathorhynchia*.

Bathonian; the specimens studied by Tchorževskij (1970) came from Bajocian.

Babiná - sample 43, Dohňany, Hatné, Štepnická skala, Podhorie, Kostelec, Malé Karpaty Mts. (Prístodolok), Strážovské vrchy Mts. (Čierna Lehota).

Sphenorhynchia latereplanata Seifert, 1963

1963 *Sphenorhynchia latereplanata* n. sp. - Seifert, p. 176, Pl. 10, Fig. 16, Text - Fig. 26.

1 specimen measuring 25.0 x 21.6 x 14.2 mm. It reminds one of the Bajocian *Sphenorhynchia plicatella* (Sow.) or some variants of Callovian *Sphenorhynchia ferryi* (Eud.-Desl.) but differs from them in the development of large lateral planareas.

According to Seifert, 1963 *Parkinsoni*-Oolith (Upper Bajocian - Lower Bathonian).

Babiná - sample 43.

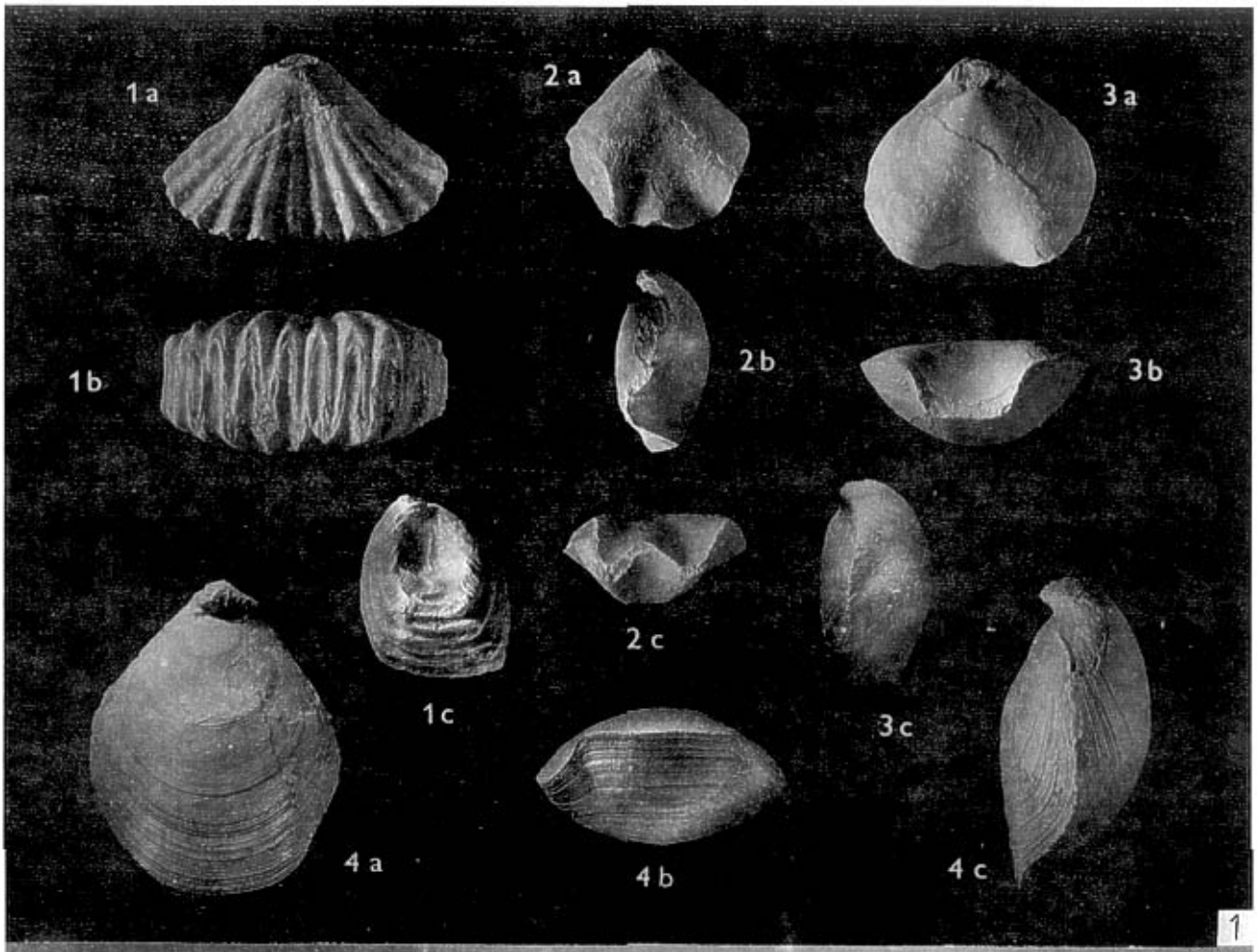
Cymatorhynchia ex gr. *quadriplicata* (Zieten, 1830)

1966 *Rhynchonella* ex gr. *quadriplicata* (Zieten) - Siblík, p. 146.
?1969 *Cymatorhynchia quadriplicata* (Zieten) - Pevný, p. 143, Pl. 28, Fig. 1.

25 mostly fragmentary specimens have been seen up to about 23.0 mm long, 25.0 mm wide and 16.0 mm thick. The similarity to the Bajocian *Cymatorhynchia quadriplicata* seems apparent. The present material is identical with that from Kostelec (Siblík, 1966) and also does not warrant further discussion of the relations to the highly variable Zieten's species.

Babiná - sample 41 and 43, ?Mestečko, Kostelec.

◀ Pl. III. Klippe Babiná near Bohunice. 1 - Tubes of serpulid worms in the crinoidal limestone, Bajocian - Bathonian; thin section No. 20 296, x20, 2 - Different cases of the preservation of radiolarians; several voids formed by their dissolution were filled by micrite and remind coprolites; Oxfordian part of the Bohunice Limestone Formation; thin section No. 20 194, x30, 3 - Mn-dendrites formed on the fragment of the bivalvian shell originally aragonitic (the void after its dissolution was filled by the drusy calcite); Upper Tithonian biomicrite with Crassicollaria; thin section No. 20 636, x20, 4 - Two small fragments of the synchronous volcanic admixture (volcanic ash) with tiny feldspar laths, besides them Crassicollaria sp., Globochaete alpina, Involutina sp., calcite filling of radiolarian voids and bivalvian fragments are visible, Upper Tithonian; thin section No. 11 793, x60, 5 - Fine-grained breccia limestone with Upper Tithonian lithoclasts (biomicrites with Crassicollaria), with the abundant double-keeled globotruncans and echinoderm plates in the matrix, Coniacian (probably pocket filling); thin section No. 21 927, x30, 6 - Matrix of the Senonian breccia with the abundant double-keeled globotruncans and prisms of the inocerams; thin section No. 11 447, x30.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Lacunosella **aff.** ***spoliata*** **(Suess, 1858)**

1956 *Rhynchonella* aff. *spoliata* Suess - Ksiazkiewicz, p. 208, Pl. 23, Fig.7.

1 specimen with dimensions 17.6 x 17.8 x 11.0 mm. It agrees to the mentioned Polish find that is of Kimmeridgian age.

Babiná - sample 46.

Summary and interpretation

An inverted succession of the Czorsztyn Unit with following peculiarities outcrops in the quarry Babiná: crinoidal limestones are not differentiated into the lower white and upper red part, the Czorsztyn red nodular limestones are absent (both pattern as well as a conglomerate intercalation in the crinoidal limestones are characteristic for the Mestečko development - Aubrecht, 1992); instead of Czorsztyn Limestone the Bohunice Limestone Formation (new name) is present; the Rogoznik coquina lacks.

During the Bajocian a shallow-water sedimentation of the crinoidal detritus influenced by the coastal currents and by the transport of the terrigenous clastics took place. One conglomerate intercalation with pebbles up to 6 cm could be interpreted as tempestite. The pebbles belong to Liassic spongolites, Triassic dolomites, probably Lower Triassic sandstones and pyroclastics probably of Permian age. The higher part of the crinoidal limestones belongs to Bathonian as was proved by the brachiopods (seven species have been described). In the Upper Bathonian and Callovian a synsedimentary tectonics (faulting) took place; the clefts were filled mostly by the red micrite with the "filament" microfacies forming neptunian dykes. The red Bathonian - Callovian limestones with the "filament" microfacies occur frequently in other profiles but here their continuous beds were extremely reduced to 1 m and accompanied by the stromatactis-like horizon.

The condensed sedimentation at the beginning of the Oxfordian in the limestones with *Globuligerina* and first *Cadosinidae* led to the precipitation of the Mn-Fe hardground crust. The transport of terrigenous material ceased completely. The deepening of the sedimentation area resulted in the predominance of the plankton: *Globuligerina*, radiolarians, *Cadosinidae* and later, in the Kimmeridgian and Tithonian *Saccocoma*, *Tintinnidae* and ammonoids (only their juvenile specimens were found). The bivalves with the black coatings have been brought from time to time from the shallower waters but they occur only sporadically in comparison with the other localities of the Czorsztyn Succession (e.g. Vršatec: Mišík, 1979, p. 22; Kyjov-Pusté Pole: Mišík and Sýkora, 1993). The occurrence of the brachiopods in the Kimmeridgian strata indicates that the environment was not very deep. The differentiation of the Lower and Middle Tithonian strata was carried out due to the presence of the zonal microfossils *Parastomiosphaera malmica* and *Chitinoidella*.

A very fine-grained pyroclastic admixture from the remote centers of the basic volcanism was enregistered in the Upper Tithonian limestone.

The Neocomian (its Hauterivian part was proved by hedbergellas) is characterized as in the other localities of the Czorsztyn Unit by the shallowing signalized by the crinoidal detritus. It was accompanied by the synsedimentary faults. In their probably submarine scarps the Kimmeridgian - Upper Tithonian strata were uncovered what is evidenced by their abundant clasts.

A Coniacian *Globotruncana*-bearing limestone with lithoclasts of the Kimmeridgian, Tithonian and Middle Cretaceous has been found in a material proceeded from an exploitation outburst. Such a special lithotype (microfacies) was not found in the Western Carpathians yet.

As to the formal lithostratigraphic units the following remarks are needed. Crinoidal limestones are not differentiated into the white and the red ones (Smolegowa and Krupianka Limestones according to Birkenmajer, 1977). Their typical upper red strata are absent. Such a lack in some Polish localities was interpreted by Birkenmajer (1977, p.53) by the intrastratal erosion caused by Meso-Cimmerian movements. In our case the lateral transition of facies is more probable.

Creamy and pink micritic limestones locally with bivalves and brachiopods (Oxfordian - Lower Tithonian, here No. 5 - 7) have not participated in the list of the lithostratigraphic units proposed for the Klippen Belt by Birkenmajer (1977). We suggest a new term for them - Bohunice Limestone Formation. Its lateral equivalents are red nodular Czorsztyn Limestone, Oxfordian biohermal Vršatec Limestone and Rogoznik Coquina. The sporadic occurrence of the originally aragonitic bivalves with black coatings and local accumulations of the biodetritus remind some patterns of the Rogoznik Coquina. The Birkenmajer's (l. c.) term Walentowa Breccia was accepted for the pink breccious Neocomian limestones.

For the time being no name is proposed for the Coniacian fine-grained breccious limestone; further occurrences are needed.

As to the diagenetic patterns, the total lack of the authigenic feldspars as well as authigenic quartz should be stressed; the only exception - anhedral authigenic quartz has been found in the immediate vicinity of the lithoclast of an acid pyroclastic rock. The skeletal aggregates of the epigenetic pyrite were present in all strata from the Bajocian up to Neocomian; then they were formed after the Lower Cretaceous.

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◀ **Pl. IV.** 1. Brachiopods from the Bathonian crinoidal limestone, Babiná klippe near Bohunice, sample 43; the specimens were coated with ammonium chloride before photographing. 1 - Caucasella trigona (Quenst.), x2.5, 2 - Antiptychina aff. bivallata (Eud.-Desl.), x2.5, 3 - Linguithyris curviconcha (Oppel), x1.5, 4 - Monsardithyris ventricosa (Ziet.), x1.5. 2. General view of the Babiná quarry.

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Jurské brachiopóda a sedimentologické štúdium bradla Babiná pri Bohuniciach (čorštynská jednotka, pieninské bradlové pásmo)

Bradlo Babiná obsahuje prevrátený vrstvový sled, ktorý má v porovnaní so štandardnou čorštynskou sukcesiou tieto osobitosti: krinoidové vápence dogeru nie sú diferencované na spodnú, bielu a vrchnú, červenú časť, chýbajú tu čorštynský hľuznatý vápenec, chýba rogožnická lumachela. Súbor ružových a krémových vápencov (biomikritov) oxfordu až spodného titónu nemá v terminológii navrhnutej Birkenmajerom (1977) ekvivalent. Navrhujeme preň nový termín - bohunické vápencové súvrstvie.

V bajoku a bate prebiehala plytkovodná sedimentácia krinoidového detritu ovplyvňovaná príbrežnými prúdmi a terigénnym prínosom. Je tu vložka zlepenca (pravdepodobne tempestit) s obliakmi veľkými až do 6 cm: liasové spongolity, triasové dolomity, pieskovce spodného triasu alebo permu, permské pyroklastikum kyslých vulkanitov. V ťažkej frakcii dominuje zirkón. Z najvyššej časti pochádza fauna brachiopód batu (opisuje sa sedem druhov).

Vo vrchnom bate a keloveji rozpukávali krinoidové vápence (synsedimentárna tektonika) a pukliny v podobe neptunických dajok vyplnil mikrit a "vláknová" mikrofácia. Súvislá poloha červeného vápenca s "vláknovou" mikrofáciou je hrubá iba okolo 1 m a sprevádza ju stromataktisová vložka.

Kondenzovaná sedimentácia na začiatku oxfordu (vápence s "protoglobigerínovou" mikrofáciou a prvými kadosínami) sa prejavila vytvorením Fe-Mn kôry - hardgroundu. Úplne ustal prínos terigénneho materiálu. Sedimentačný priestor sa prehlboval (prevaha planktonických organizmov: Globuligerina, Radiolaria, Cadosina). Prevaha planktonických a nektonických organizmov pokračovala aj v kimeridži a titóne (Saccocoma, tintinidy, juvenilné amonity). Občasné splachy lastúrnikov s čiernym povlakom z plytšieho prostredia boli zriedkavejšie ako napr. v bradle Vršatec a Kyjov. Časté brachiopóda v kimeridži však ukazujú, že hĺbka nebola príliš veľká. Podarilo sa vyčleniť spodný titón - zóna Parastomiosphaera malmica, stredný titón - zóna Chitinoidella a vrchný titón - zóna Crassicollaria.

Vo vrchnom titóne sa zaregistrovala veľmi jemná pyroklastická prímes bázického vulkanizmu zo vzdialených centier. Splytčovanie prebiehalo opäť v neokóme (hojný krinoidový detrit). Synsedimentárna tektonika sa prejavila vytváraním podmorských klifov a na nich sa obnažili súvrstvia kimeridžu a titónu, čo dokazujú klasty v neokómskej brekcii.

Z odstreleného bloku sme zaregistrovali senónsky globotrunkánový vápenec s litoklastmi kimeridžu, titónu, neokómu a ojedinele aj strednej kriedy. Takýto litotyp (mikrofácia) sa doteraz v Západných Karpatoch nenašiel.