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RELATION OF THE CRETACEOUS TO THE PALEOGENE IN THE KLIPPEN BELT OF THE VÁH RIVERSIDE (WEST CARPATHIANS)

(Text-figs. 1—3, Plate III—VIII)

A b s t r a c t: The present work deals with the relation of the Cretaceous to the Paleogene in the area in the south-west to the town Žilina, and with their tectonic relationship. Solving this problem, the authors deal with the stratigraphic position of the *Operculina heberti zone*, too.

Introduction

In solving the problem of the geological structure of the Paleogene, which has been developed directly in the klippen belt or along its inner side, two most important problems were met with: the relation of the Cretaceous to the Paleogene sediments, and the tectonic relationship of the latter. The explanation of the questions is to be contributed to by the present investigation in the area between Považská Bystrica and Žilina (the matter is in the so-called Hričov—Žilina. Lower-Paleocene development in the sense of D. A n d r u s o v 1965, pp. 218—220). Before dealing with its stratigraphical and sedimentary-petrographical analysis, we shall quote the opinions about the above problems.

Up to the present, there has been the opinion about the Paleogene envelope of the klippen belt being formed by the Magura Flysch which — due to the post-Paleogene orogenetic movements — together with the Pienid Mesozoic formed a unit of the higher order — the Magura nappe. According to the existing opinions, the Magura Paleogene commenced to deposit in the north to the klippen belt, while along its inner (i. e. southern or south-eastern) side the Paleogene sedimentation started with extensive transgression, as late as in the Upper Lutetian. According to D. A n d r u s o v' and E. S c h e i b n e r (1960), the bordeline between the two developments had to be running somewhere in the middle of the klippen belt. The two authors deny the transition between the Magura and the Central-Carpathian Paleogene, and explain the manner of the transgression into the Central-West-Carpathian units by means of the „coastal flexure".

Nevertheless, the last investigations in eastern Slovakia (cf. B. L e š k o and O. S a m u e l 1960) as well as in western Slovakia (cf. O. S a m u e l and J. S a l a j 1961, 1963) have shown that the Paleogene developed either directly in the klippen belt or along its inner side is lithologically, palaeogeographically and stratigraphically different from the remaining development of the Central Carpathian Paleogene. It is characterized by continuous sedimentation between the Cretaceous and the Paleogene in the places with indictinct Laramic folding. In the places with marlstone development characterized by continuous sedimentation between the Cretaceous and the Paleogene has been developed in unaltered marly facies. In the places, where the Upper Cretaceous

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is formed by the Flysch facies, sedimentation continued up to the Paleogene usually in the sandstone-conglomerate development with intercalations of bioherm limestones, or in the Flysch facies.

Such is also the territory between Žilina and Považská Bystrica, in western Slovakia. The section near the village Hlboké n/Váh r. is especially noteworthy. It may serve well to prove the genetical relationship of the Cretaceous and the Paleogene, and in connection with that, also the position of the *Operculina heberti* zone.

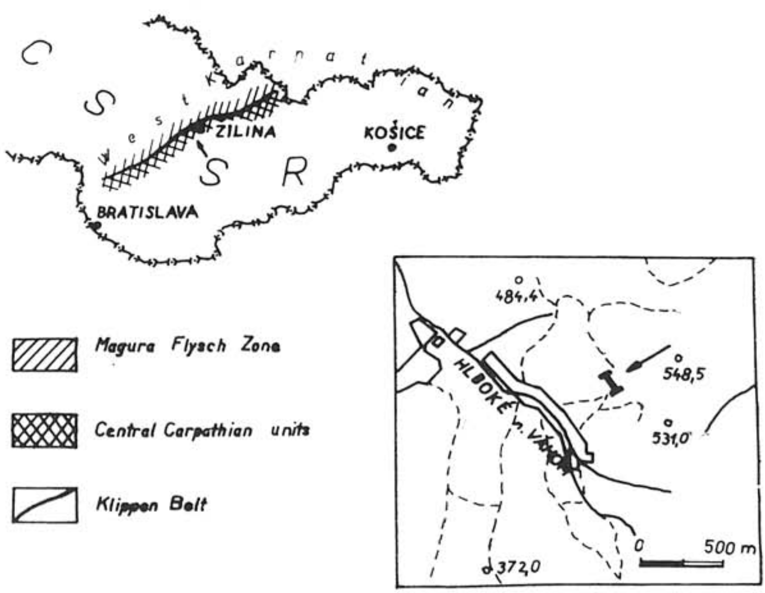
Description of the Section under Study

The section is situated in the Nort-East to the village Hlboké n/Váh r. (about 500 m in the south-west to the elevation point 551,0 m) in the cut of a road (text-fig. 1).

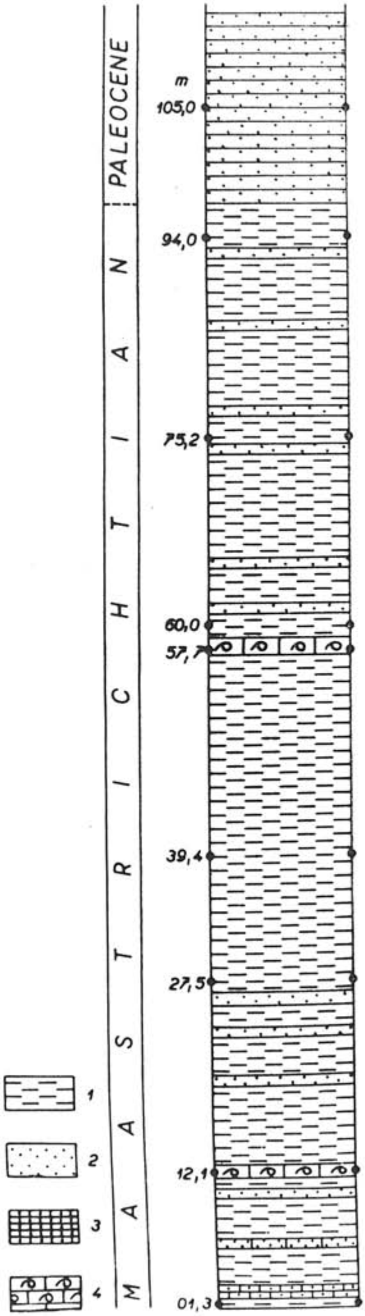
The U p p e r C a m p a n i a n is the oldest observable bed sequence in the profile. It is formed by grey-green marls to marlstones with conchoidal desintegration. There are rudimentarily developed reddish marls and 0,5—5,0 cm thick beds or intercalations of fine-grained calcareous sandstones. This part of the sequence preserved poor and remarkably recrystallized Upper-Campanian microfauna with the species *Globotruncana rugosa* (M a r i e, 1941) predominating.

The M a a s t r i c h t i a n occupies the substantial part of the profile under study (text-fig. 2). It is formed predominantly by greenish marls. In its lower part, there are thin strata of sandy limestones and in its upper part — the strata of calcareous sands. In the lower and middle parts of the profile the strata of organogene limestones filled with larger Foraminifera have been found. The limestones and sandstones are grey to blue in colour, weathering to blue colour.

The sandstones are predominantly fine-grained, less medium-grained. Thickness of



Text-fig. 1. Orientation Map.



Operculina heberti, Globigerina compressa, Gl. pseudobulloides

Anomalina (G.) midwayensis, Rugoglobigerina rugosa rugosa, Globotruncana ex gr. rosetta, Abanthomphalus mayaroensis, Racemiguembelina varians, Planoglobulina acervulinoides

Reussella szajnochae californica, Bolivinoides draco draco, Globotruncana ex. gr. contusa, G. falsostuarti, Abanthomphalus mayaroensis, Racemiguembelina varians, Planoglobulina acervulinoides

Stensioeina excolata, S. pommerana, Globotruncana ex gr. contusa, Racemiguembelina varians, Planoglobulina acervulinoides Orbitoides apiculata plana, O. apiculata apiculata, O. gensacicus gensacicus, Lepidorbitoides socialis, Siderolites calcitrapoides

Rugoglobigerina rugosa rugosa, Globotruncana contusa contusa, Racemiguembelina varians, R. textulariformis

Reusella szajnochae, Globotruncana ex gr. contusa, G. falsostuarti, Pseudotextularia elegans

Orbitoides apiculata plana, O. apiculata apiculata, O. media media, O. gensacicus praevius, Lepidorbitoides socialis, Siderolites calcitrapodes

Bolivina incrassata incrassata, Bolivinoides draco miliaris, Anomalina (G.) monterelensis, Globotruncana elevata stuartiformis, G. falsostuarti, Pseudotextularia elegans, Ventilabrella eggeri.

Text-figs. 2. Lithological Section. 1 — Marls, 2 — Calcareous sandstones, 3 — Arenaceous limestones, 4 — Organogeneous limestones.

beds moves within 3—15 cm. Together with limestones the sandstones form only a small component in the whole complex. The sandstone (marlstone ratio is 1 : 4 in the lower part of the section; the middle part is formed purely of marls, and in the upper part of the section again sandstone beds are increasing. The sandstone/marls ratio is approximately 1 : 5 there. Thicker sandstone beds show graded bedding. Fine-grained sandstones are sometimes characterized by horizontal lamination and platy parting. The lamination is conditioned by carbonized plant debris forming thin lamines or lenticles. On the bed surfaces there were traces of worms crawling.

Sandy limestones form 5—10 cm thick beds. The thin-sections show that limestones are recrystallized, fine-grained. The clastic admixture is formed by quartz grains (15—20 %), fragments of carbonate rocks (10—20 % — limestones and dolomites), rare fragments of silicites and of igneous rocks. There are micas including muscovite, biotite, and from accessoric minerals there are tourmaline, zircon and rutile present there. Autigene minerals from rhombohedron of carbonates, and pyrite. The size of the clastics moves within 0,05—0,25 mm. Organic remnants include *Lepidorbitoides* sp., smaller Foraminifera *(Globotruncana*, representatives of the genus *Heterohelix*, rotaloid forms), Ostracodes, sponge spicules and calcispheres.

Calcareous sandstones differ only by higher amount of the clastic admixture from the sandy limestones. Substantial component is formed by quartz grains (30—50 %) and fragments of carbonate rocks (10—30 %). There is a small amount of feldspar grains, fragments of silicites, phyllites, igneous rocks, muscovite, biotite, chlorite, accessories including garnet, zircon, rutile and tourmaline. Autigene minerals include small rhombohedrons of dolomite, and pyrite. Organic remnants are similar to those in the sandy limestones, only they are less numerous here.

Organogene limestones are grey, with organic component covering about 70 %. The proper limestone is irregularly grained, recrystallized, with organogene texture. Clastic admixture includes quartz grains (2 %), fragments of carbonate rocks (1 %), rare feldspars, muscovite, chlorite, garnet, zircon and tourmalite. The most numerous organic remnants include larger and smaller Foraminifera. Except Foraminifera there are still fragments of Lameellibranchiate shells, red Algae, fragments of rudisten and crinoid segments. A part of the organic remnants has been pyritized, especially Eiderolites, red Algae, and partly smaller Foraminifera.

Paleontological analysis has shown that this part of the section is rich in Foraminifera. Important is the common occurrence of the smaller and larger Foraminifera, because it enables the mutual comparison between the assemblages.

In the lower part of the above sequence there are assemblages with the plankton represented mainly by *Globotruncana* and representatives of the genus *Heterohelix* predominating. Important forms include *Globotruncana falsostuarti* S i g a l, 1952, *Globotruncana elevata stuartiformis* D a l b i e z, 1955, *Pseudotextularia elegans* (R z e h a k, 1891) and especially abundant *?Globotruncana havanensis* V o o r w i j k, 1937. This type of an assemblage corresponds to J. S a l a j and O. S a m u e l's (1966) assemblage of *Globotruncana falsostuarti* — the Lower and Middle Maastrichtian. The most abundant larger Foraminifera include *Orbitoides apiculata plana* K ö h l e r, 1962, *Orbitoides apiculata apiculata* S c h l u m b e r g e r, 1901, *Orbitoides gensacicus praevius* K ö h l e r, 1962, *Lepidorbitoides socialis* (L e y m e r i e, 1851) and *Siderolites calcitrapoides* L a m a r c k, 1801. The species *Orbitoides media* (d'A r c h i a c, 1835) is very rare.

The Upper Maastrichtian (= the assemblage of *Racemiguembelina varians* in the sense of J. S a l a j and O. S a m u e l's 1966 division) is characterized by the presence of the species and subspecies of *Orbitoides apiculata plana* K ö h l e r, 1962, *Orbitoides*

Table 1

1 = *Globotruncana falsostuarti* Zone 2—7 = *Racemiguembelina varians* Zone 8 = *Globigerina compressa* Zone	0,0 m	27,5 m	39,4 m	60,0 m	75,2 m	80,5 m	94,0 m	98,0 m
	1	2	3	4	5	6	7	8
Dendrophrya robusta Grzybowski, 1897	+	+	+	+	+	—	—	—
Ammodiscus hoernessi (Karrer, 1866)	+	+	+	+	+	+	+	—
Glomospira charoides (Jones & Parker, 1860)	—	—	—	+	—	—	—	—
Trochamminoides cf. *ammonoides* (Grzybowski, 1897)	—	—	—	+	—	—	—	—
Trochamminoides irregularis White, 1929	—	—	—	+	—	—	—	—
Textularia agglutinans Orbigny, 1840	+	—	—	+	—	—	—	—
Gaudryina rugosa Orbigny, 1840	—	+	+	+	—	—	—	—
Marssonella oxycona (Reuss, 1860)	—	—	+	+	—	—	—	—
Marssonella crassa (Marsson, 1878)	—	—	+	+	—	—	—	+
Dentalina marcki Reuss, 1860	—	—	+	—	—	—	—	—
Dentalina monile Hagenow, 1892	—	—	+	—	—	—	—	—
Dentalina proteus Reuss, 1862	—	—	+	—	—	—	—	—
Neoflabelina sp.	—	—	—	+	—	—	—	—
Ramulina globotubulosa Cushman, 1938	—	—	—	—	+	—	—	—
Oolina orbignyiana (Seguenza, 1862)	—	—	+	+	—	+	+	—
Reussella szajnochae szajnochae Grzybowski, 1896	+	+	—	+	+	+	—	—
Reussella szajnochae californica Cushman & Goudkoff, 1944	—	—	—	—	+	—	—	—
Bolivina incrassata gigantea Hiltermann & Koch, 1950	—	—	—	+	—	—	—	—
Bolivina incrassata incrassata Reuss, 1851	+	—	—	—	—	—	—	—
Bolivinoides draco draco (Marsson, 1878)	—	—	—	—	+	—	—	—
Bolivinoides draco miliaris Hiltermann & Koch	+	—	—	—	—	—	—	—
Allomorphina allomorphinoides (Reuss, 1860)	+	+	—	—	—	+	—	—
Pullenia coryelli White, 1929	—	—	+	—	—	—	—	—
Pullenia kasakhstanica Dain, 1952	—	—	—	—	—	+	—	—
Gyroidina umbilicata (Orbigny, 1840)	—	+	+	—	—	+	+	—
Eponides beisseli Schijfsma, 1946	+	+	+	+	+	+	—	—
Stensioeina excolata Cushman	—	—	—	+	—	+	—	—
Stensioeina pommerana Brotzen, 1936	—	—	—	+	—	—	—	—
Osangularia lens Brotzen, 1940	—	—	—	—	+	—	—	—
Anomalina (Gaveelinella) midwayensis (Plummer, 1926)	—	+	+	+	+	—	+	—
Anomalina (Gavelinella) monterelensis Marie, 1941	—	—	+	+	—	—	—	—
Anomalina (Gavelinella) velascoensis (Cushman, 1925)	—	—	—	—	—	—	—	—
Globigerina compressa Plummer, 1926	—	—	—	—	—	—	—	+
? *Planomalina (Globigerinelloides) aspera* (Ehrenberg, 1854)	+	+	+	+	+	+	+	—
? *Planomalina (Globigerinelloides)* sp.	+	+	+	+	+	+	+	—
Rugoglobigerina rugosa rugosa (Plummer, 1926)	—	—	+	—	+	+	+	—
Globotruncana membranacea (Ehrenberg, 1854)	—	+	+	+	—	—	—	—
Globotruncana cf. *arca* (Cushman, 1927)	+	—	—	—	—	—	—	—
Globotruncana contusa contusa (Cushman, 1826)	—	+	+	+	+	+	+	—
Globotruncana contusa galeoidis Herm, 1962	—	+	—	+	+	—	—	—

? *Globotruncana havanensis* Voorwijk, 1937	+	—	—	—	—	—	—	—
Globotruncana elevata stuartiformis Dalbiez, 1955	+	+	—	—	—	+	—	—
Globotruncana falsostuarti Sigal, 1952	+	+	+	+	+	+	+	—
Globotruncana rosetta insignis Gandolfi, 1957	—	—	—	+	—	+	+	—
Globotruncana rosetta rosetta (Carsey, 1926)	+	—	—	—	—	—	—	—
Globotruncana rugosa (Marie, 1941)	+	—	—	—	—	—	—	—
Globotruncana stuarti (Lapparent, 1918)	—	—	—	—	—	+	+	—
Globotruncana sp. (redeposited)	—	—	—	—	—	—	—	+
Abanthomphalus mayaroensis (Bolli, 1957)	—	—	—	—	+	+	+	—
Heterohelix globulosa (Ehrenberg, 1840)	+	+	+	+	+	+	+	—
Heterohelix pupa (Reuss, 1860)	+	+	+	+	+	+	+	—
Heterohelix ultimatumida (White, 1926)	+	+	+	+	+	+	+	—
Heterohelix tessera (Ehrenberg, 1854)	+	+	+	+	+	+	+	—
Gublerina glaessneri Brönnimann & Brown, 1953	—	—	—	—	—	+	—	—
Ventilabrella eggeri Cushman, 1928	+	—	—	—	—	—	—	—
Pseudotextularia elegans (Rzehak, 1891)	+	+	+	+	—	+	+	—
Pseudotextularia nuttalli (Voorwijk, 1937)	+	+	—	+	—	—	—	—
Racemiguembelina textulariformis (White, 1929)	—	—	+	+	+	—	—	—
Racemiguembelina varians (Rzehak, 1895)	—	—	+	+	—	+	+	—
Planoglobulina acervulinoides (Egger, 1900)	—	+	+	+	+	+	+	—

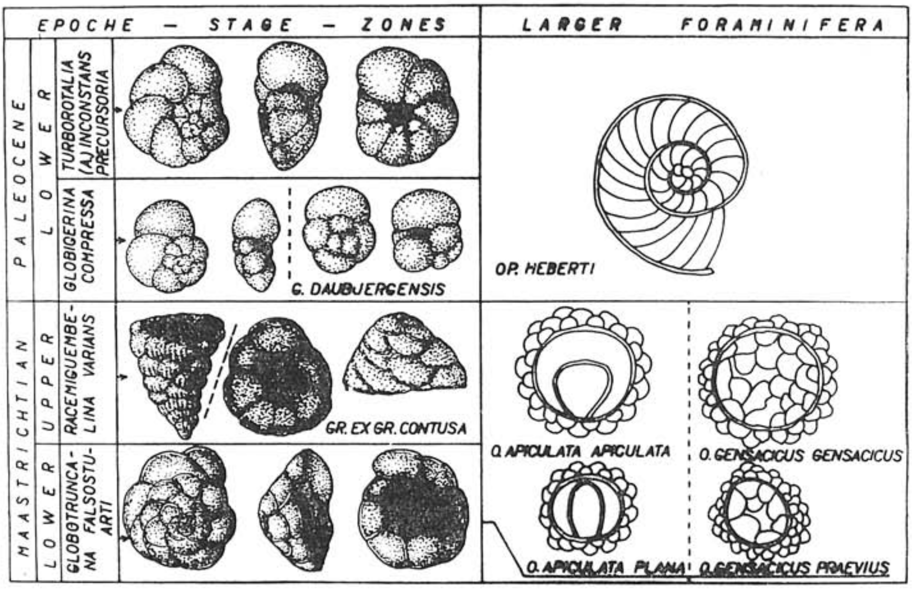
apiculata apiculata Schlumberger, 1901, *Orbitoides gensacicus gensacicus* (Leymerie, 1851), *Orbitoides gensacicus praevius* Köhler, 1962, *Lepidorbitoides socialis* (Leymerie, 1851) and *Siderolites calcitrapoides* (Lamarck, 1801). Predominating smaller Foraminifera include — similarly to the assemblage of *Globotruncana falsostuarti* zone — *Globotruncana* and representatives of the family *Heterohelicidae*. To the stratigraphically important elements belongs the common occurrence of the species *Abanthomphalus mayaroensis* (Bolli, 1957), *Globotruncana* ex gr. *contusa* (Cushman, 1926), *Globotruncana stuarti* (Lapparent, 1918), *Racemiguembelina varians* (Rzehak, 1895) and *Gublerina glaessneri* Brönnimann, 1953. This will be completed by the enclosed table 1 presenting the list of the species of smaller Foraminifera found in the section under study.

Sandstones with fauna characteristic of the Lower Paleocene develop immediately from the beds of the palaeontologically provable Upper Maastrichtian, in an unaltered facies and in the same tectonic style.

As for petrography, this part of the sequence is formed by organogene limestones and calcareous organogene sandstones. Between the limestones and sandstones there are various transitions. Without respect to the fact, weather there are limestones or sandstones, both types of rocks are filled with the operculine shells. In some rare cases, the amount of the organic remnants is as high as 75 %. The limestones are recrystallized.

The most abundant component of the sandstones are quartz grains (up to 40 %) and fragments of carbonate rocks (up to 25 % — limestones and dolomites). There are small amount of feldspars, fragments of igneous rocks, silicites, phyllites and fragments of rocks with graphitic admixture. Micas include biotite, muscovite, chlorite, heavy minerals — garnet, zircon, tourmaline and rutile. Autigene minerals are represented in sandstones by rhombohedrons of dolomites partly suppressing operculine shells.

Due to the diagenetic processes there are sometimes grains of the clastic quartz pressed into the operculine shells. Organic remnants include except operculines also smaller Foraminifera bound to the shallow-water neritic environment (milliolides, *Rotalia* sp. or *Pararotalia* sp.), fragments of solenopores, crinoid segments and fragments of the Lamellibranchiate shells.



Text-fig. 3. Correlation Table of Microbiostratigraphy.

It is probable, that the *Nautilus (Hercoglossa)* sp. quoted by D. Š t ú r (1860) from the vicinity of the village Hričovské Podhradie, may have come from this sequence.

In the lowermost sandstone strata there were found — except operculine — also larger Foraminifera representing the primitive forms of *Discocyclina* sp.

The sandstones and limestones contain only rare smaller Foraminifera, while then species *Operculina heberti* M u n i e r - C h a l m a s is quite abundant there. In thin sections the species *Globigerina pseudobulloides* P l u m m e r, 1926, *Globigerina compressa* P l u m m e r, 1926 an *Globigerina triloculinoides* P l u m m e r, 1926 have been found. The first occurrences of these species were those in the Lower Paleocene.

Conclusions

On the base of the detail study of the section near Hlboké n/Váh r. as well as on the study of a larger territory, a conclusion may be drawn, that:

1. The Cretaceous sediments of the klippen belt are in genetical relationship with the Paleogene sediments. On the base of this, and due to their lithological-stratigraphical characteristics, they may be correlated with the Paleogene of the klippen belt representing the intermediate development between the proper Central-Carpathian Paleogene and the Magura Flysch, as for the petrographical standpoint.

2. With respect to this information, it will be necessary to revise the existing

opinion about a stratigraphical hiatus between the Cretaceous and the Paleogene of West Carpathians caused by the Laramic orogenetic movements. They were not so strong in West Carpathians as it was supposed earlier; in the klippen belt they had only a local importance.

3. Genetical relationship between the Cretaceous and the Paleogene is proved by the clastic material in sandstones and limestones, its qualitative composition being essentially unaltered, only the quantitative representation of its component being changed.

4. In the area under study, there are associations of larger and smaller Foraminifera occuring together (text-fig. 3). This enables the correlation between these stratigraphically important animal groups. On the borderline of the Cretaceous and the Paleogene, there is sudden extinction of almost all the important Cretaceous groups and their replacement by the Paleocene species. This is the main microfaunistic reason why the bordeline between the Cretaceous and the Paleogene is placed before the Danian referred to the Lower Paleocene, and not after the Danian.

5. The leading species of the Lower Paleocene — *Operculina heberti* Munier-Chalmas — occurs as early as on the base of the Paleocene with the primitive *Discocyclina* sp. forms.

Translated by E. Jassingerová.

REFERENCES

Andrusov D., 1959: Geológia československých Karpát II. Bratislava. — Andrusov D., 1965: Geológia československých Karpát III. Bratislava. — Andrusov D., Scheibner E., 1960: Prehľad súčastného stavu poznatkov o geológii bradlového pásma medzi Vlárou a Tvrdošínom. Geol. sborn. Slov. akad. vied 11, 2, Bratislava. — Köhler E., 1960: Kriedové orbitoidy z bradlového pásma na Považí. Geol. sborn. Slov. akad. vied 11, 1, Bratislava. — Köhler E., 1962: Veľké foraminifery v senóne Brezovského pohoria. Geol. sborn. Slov. akad. vied 13, 1, Bratislava. — Leško B., Samuel O., 1966: Geológia bradlového pásma pri Podhorodi. Geol. práce, Zprávy 20, Bratislava. — Salaj J., Samuel O., 1966: Foraminifera der Westkarpaten-Kreide. Bratislava. — Samuel O., Salaj J., 1961: Niekoľko poznámok k mikrobiostratigrafii „Dán"-paleocénu. Geol. sborn. Slov. akad. vied 12, 2, Bratislava. — Samuel O., Salaj J., 1963: Contribution to Paleogene of Myjavská pahorkatina, vicinity of Považská Bystrica, Žilina and Eastern Slovakia. Geol. sborn. Slov. akad. vied 14, 1, Bratislava. — Štúr D., 1860: Bericht über die geol. Übersichtsaufnahme des Wassergebietes der Waag und Neutra. Jahrb. der k. k. Geol. Reichsanst. 11, Wien.

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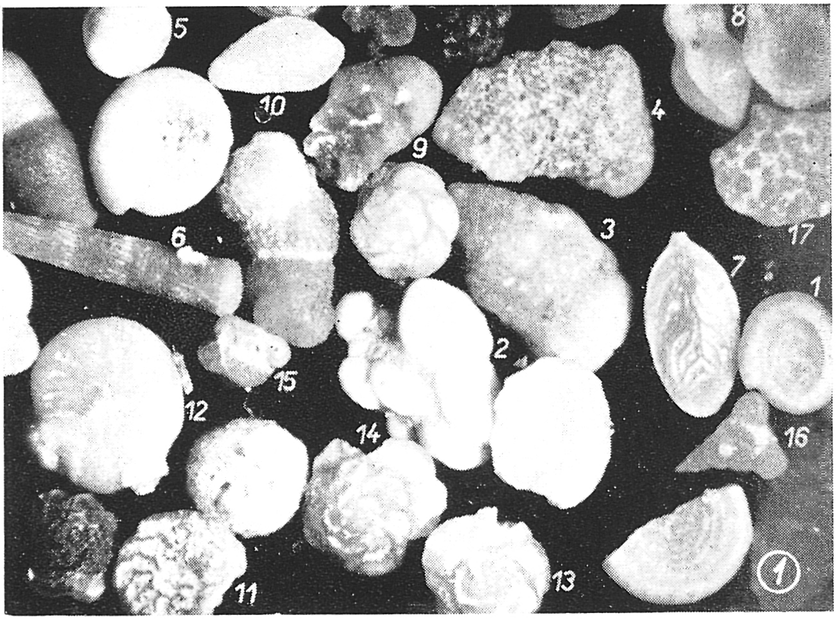


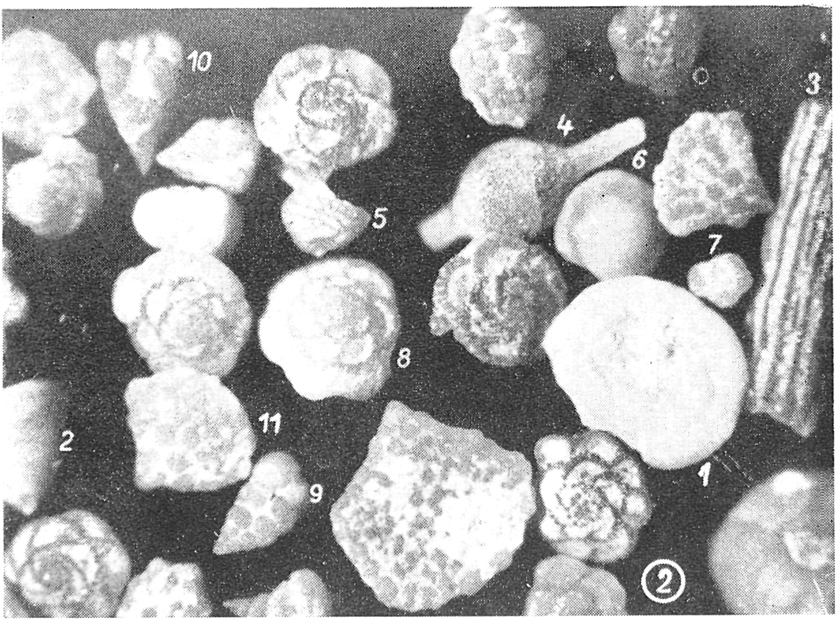


Fig. 1. Upper Maastrichtian microfauna assemblage — *Racemiguembelina varians* Zone, greyishgreen marls, sample 4, Hlboké n/Váh r. magn. 27×. 1 *Ammodiscus hoernessi* (Karper), 2 — *Trochamminoides irregularis* White, 3 — *Textularia conulus* Reuss, 4 — *Gaudryina rugosa* (Orbigny), 5 — *Quinqueloculina stolleyi* Brotzen, 5 — *Dentalina proteus* Reuss, 7 — *Neoflabellina* sp., 8 — *Oolina orbignyiana* (Seguenza), 9 — *Reussella szajnochae* Grzybowski, 10 — *Bolivina incrassata gigantea* Wicher, 11 — *Stensioeina pommerana* Brotzen, 12 — *Anomalina* (*Gavelinella*) *velascoensis* (Cushman), 13 — *Globotruncana elevata stuartiformis* Dalbiez, 14 — *Globotruncana falsostuarti* Sigal, 15 — *Racemiguembelina varians* (Rzehak), 16 — *Racemiguembelina textulariformis* White, 17 — *Planoglobulina acervulinoides* (Egger).

Fig. 2. Upper Maastrichtian microfauna assemblage — *Racemiguembelina varians* Zone, greyishgreen marls, sample 6, Hlboké n/Váh. r. magn. 27×. 1 — *Ammodiscus hoernessi* (Karrer), 2 — *Marssonella* cf. *oxycona* (Reuss), 3 — *Dentalina marcki* Reuss, 4 — *Ramulina* sp., 5 — *Bolivinoides draco draco* (Marsson), 6 — *Eponides beisseli* Schijfsma, 7 — *Hedbergella cretacea* (Orbigny), 8 — *Globotruncana falsostuarti* Sigal, 9 — *Pseudotextularia elegans* Rzehak, 10 — *Racemiguembelina varians* (Rzehak), 11 — *Planoglobulina acervulinoides* (Egger). Photo F. Vrbovský.

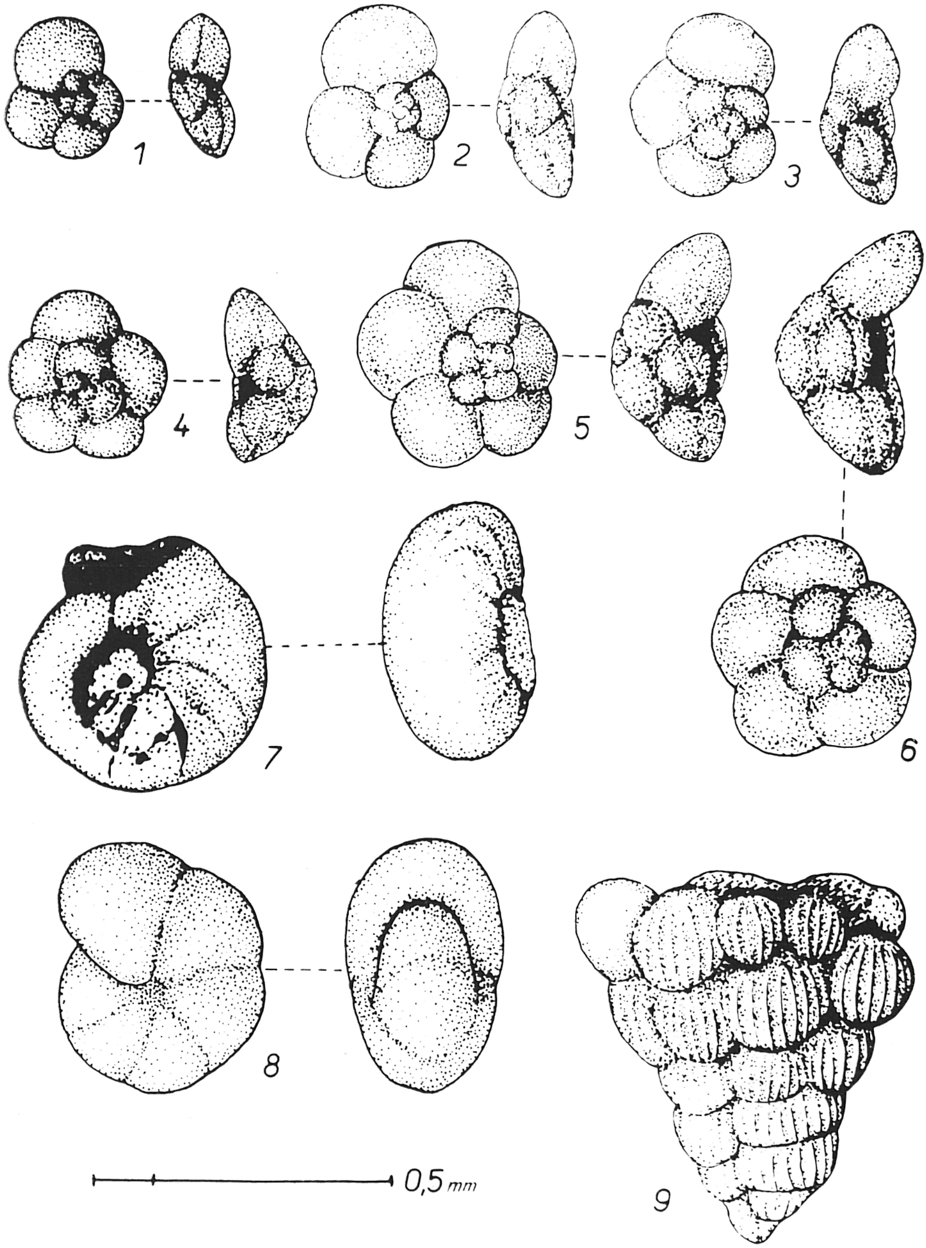
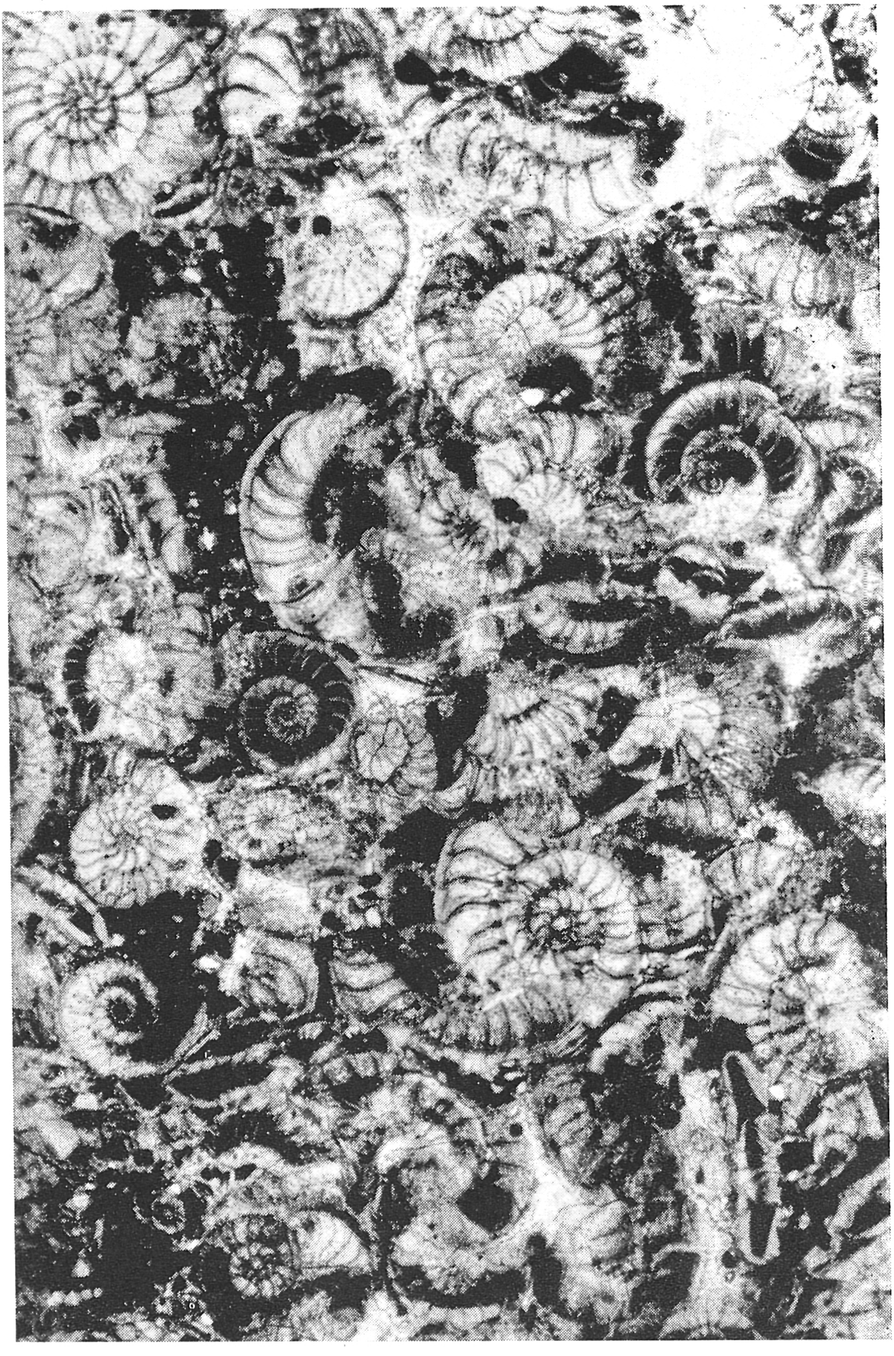


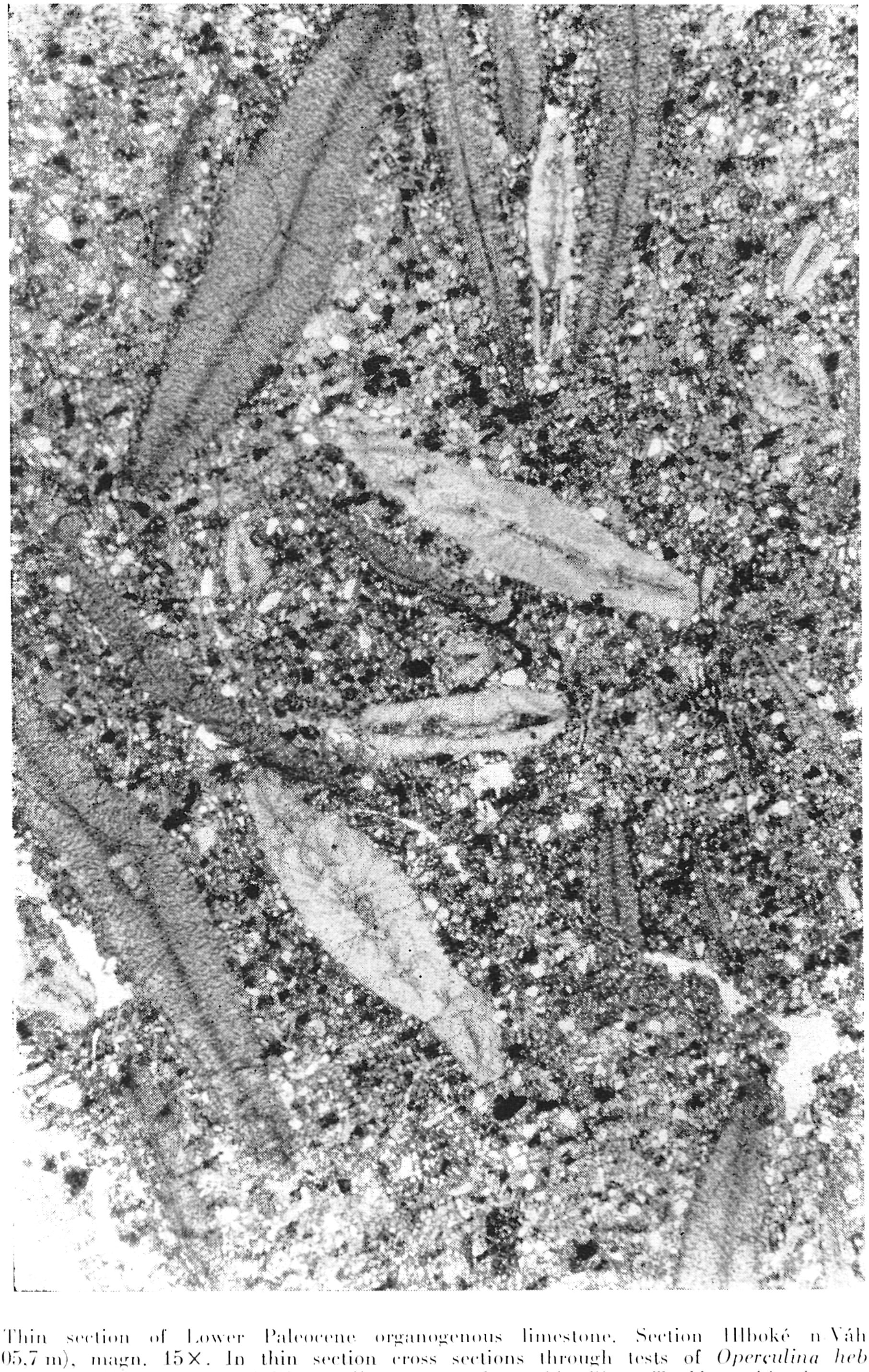
Fig. 1. *?Globotruncana membranacea* (Ehrenberg). No. 00326 — Hlboké n/Váh r., greyishgreen marls of the Lower Maastrichtian. *Globotruncana falsostuarti* Zone. — Fig. 2. Intermediate form between *?Globotruncana membranacea* (Ehrenberg) and *?Globotruncana pschadae* (Keller). No. 00327 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone. — Figs. 3—4. *?Globotruncana pschadae* (Keller). No. 00328—00329 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone. — Figs. 5—6. *?Globotruncana aff. pschadae* (Keller). No. 00330—00331 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone. — Fig. 7. *Anomalina (Gavelinella) velascoensis* (Cushman). No. 00332 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone. — Fig. 8. *Pullenia coryelli* White. No. 00333 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone. — Fig 9. *Racemiguembelina varians* (Rzehak). No. 00334 — Hlboké n/Váh r., greyishgreen marls of the Upper Maastrichtian. *Racemiguembelina varians* Zone.

Thin section of Lower to Middle Maastrichtian organogenous limestone. Section Hlboké n Váh r. (12,1 m), magn. 12 ×. In thin section cross sections through *Orbitoides gensacicus praevius* Köhler, *Siderolites calcitrapoides* Lamarck and *Orbitoides apiculata plana* Köhler are observable. Photo T. Mastihuba.

Thin section of Upper Maastrichtian organogenous limestone. Section Hlboké n Váh r. (52,7 m), magn. 12×. In thin section cross section through test of *Orbitoides apiculata apiculata* S c h l u m b e r g e r, *Lepidorbitoides socialis* L e y m e r i e, *Siderolites calcitrapoides* L a m a r c k and Rudist fragment are observable. Photo T. M a s t i h u b a.



Thin section of Lower Paleocene organogenous limestone. Section Hlboké n Váh r. (101,0 m), magn. 12×. In thin section cross section through tests of *Operculina heberti* Munier-Chalmas are observable. Photo T. Mastihuba.



Thin section of Lower Paleocene organogenous limestone. Section Hlboké n. Váh r. (105,7 m), magn. 15×. In thin section cross sections through tests of *Operculina heberti* Munier-Chalmas and *Discocyclina* sp. are observable. Photo T. Mastihuba.
Translated by E. Jassingerová.