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CONTRIBUTION TO PALEOGENE OF MYJAVSKÁ PAHORKATINA, VICINITY OF POVAŽSKÁ BYSTRICA, ŽILINA AND EASTERN SLOVAKIA

NOVÉ POZNATKY O PALEOGENE MYJAVSKEJ PAHORKATINY, OKOLIA POVAŽSKEJ BYSTRICE, ŽILINY A VÝCHODNÉHO SLOVENSKA

(Textfigs. 1–5, Plates III–IV)

Abstract. The authors of the article deal with the question of gradual transition between the Cretaceous and Paleogene of the Klippen Belt and adjacent Central-Carpathian Paleogene.

Earlier works dealt with the stratigraphy of the Paleogene of the Klippen belt of its relations to the Cretaceous sediments and to the Central-Carpathian Paleogene only roughly, and predominantly without paleontologic proofs. As far as the relations of the Paleogene to the Cretaceous are concerned, generally the opinion predominated, according to which in the West-Carpathians of Slovakia between the Cretaceous and the Paleogene there existed an interruption of sedimentation caused by the Laramian phase of folding. Although its effect is evident also in our territory, yet it has not been so intensive as to cause the interruption to a regional extent. In the majority of the territory it has only evoked the shallowing of the sedimentation environment.

Yet more spread — even in the present — is the opinion about the transgression and stratigraphic diapason of the Central-Carpathian Paleogene. It has been supposed, that the Paleogene transgression took place during the Upper Lutetian. Last investigations show, however, that the Paleogene transgression proceeded from the Klippen Paleogene basin and gradually covered core mountains of the Central-Carpathians beginning in Lower Paleocene, and reaching its culmination in the Lutetian (e. g. in the area of Handlová—Bojnice, Banská Bystrica—Lubietová).

These problems are dealt with in the present paper on the ground of the last microbiostratigraphic investigations of the Myjavská pahorkatina highlands, of the area of Považská Bystrica, the Žilina basin and Eastern Slovakia.

Myjavská pahorkatina Highlands

The Upper Cretaceous in the area of Myjavská pahorkatina highlands is built of sediments of the so-called Gosau Cretaceous and of the Cretaceous of the Klippen belt, gradually passing into each other. Similar situation may

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be observed between the Paleogene rocks of the Klippen belt, the "Gosau" Paleogene (= Central-Carpathian Paleogene) and Biele Karpaty unit of the Magura zone. Great lithofacial similarity and genetic relations between the two — otherwise independent — units make it difficult to determine between them the respective boundary. It is probable, that preliminarily the question will be solved only conventionally. In consequence of the facts mentioned the Paleogene sediments of the "Gosau" development and of the Klippen belt will be described here uniformly.

The Maastrichtian. The uppermost Cretaceous stage, i. e. the Maastrichtian in the Myjavská pahorkatina highlands is developed in two alternating facies. The first one, representing the deeper marly facies, may be found in wider vicinity of Myjava in the anticline near Horná and Dolná Polianka. The second, shallower facies is built of Orbitoid beds (cf. J. Salaj, 1960). The uppermost Maastrichtian is in both facies represented by associations with occurrence of the following species:

Reussella szajnochae (Grzybowski), *Reussella szajnochae californica* Cushman & Goudkoff, *Stensiöina pommerana* Brotzen, *Anomalina* (*Gavelinella*) *danica* Brotzen, *Globorotalia membranacea* (Ehrenberg), *Globorotalia pschadae* Keller, *Globotruncana contusa* (Cushman), *Globotruncana falsostuarti* Sigal, *Gublerina glaessneri* Brönnimann & Brown, *Gublerina ornatisissima* (Cushman & Church), *Heterohelix nuttalli* (Voorwijk), *Pseudotextularia elegans* (Rzehak), *Racemiguembelina varians* (Rzehak).

The Lower Paleocene (= the Danian).¹ The Danian beds in the Polianka anticline have been developed in marly facies, similar with the Maastrichtian, from which they are gradually developing. Except redeposited *Globotruncana* in a mass amount there appear *Globigerina compressa* Plummer together with *Globigerina triloculinoides* Plummer, *Bulimina arcadelphiana midwayensis* Cushman & Parker, *Stensiöina? caucasica* (Subbotina), *Eponides vortex* (White), *Eponides plummerae* Cushman. The mass occurrence of the species *Globigerina compressa* Plummer together with above mentioned species excludes the Upper-Maastrichtian age of the association. On the other hand, the absence of such forms as *Globorotalia angulata* (White), *Globorotalia pseudomenardii* Bolli etc. appearing later, in our sense in the uppermost part of the Lower or at the base of the Middle Paleocene, testifies the Danian (= Lower-Paleocene) age of associations from the uppermost part of marly sequence of the Polianka anticline.

The Middle Paleocene-Lower Eocene. The above described facies gradually passes into the sequence formed by bluish organogenous limestones and conglomerates, alternating with marls or calcareous claystones. According to paleontologically proved fauna of Foraminifera they correspond to the Middle Paleocene — the Lower Eocene, as to the age.

¹ In the last time several authors dealt with the problem of position and paleontologic characteristics of the Danian. It has been one of the points of the program of the XXII International Geological Congress. According to the Foraminifera fauna its inclusion in the Paleogene is well founded. Unsolved remains the question whether the stage mentioned may be identified with the Montian (A. R. Loeblich and H. Tappan, 1957), or whether the Montian, too, represents an independent stage (J. Hofker, 1961).

In the present paper, the authors divide the Paleocene into the Lower, Middle and Upper ones, the Lower Paleocene considering identical with the Danian.

Toward the top the sequence is replaced by Flysch with beds of variegated clays to marls with the stratigraphic diapason from the Middle to the Upper Eocene (J. Salaj, 1962).

To the North from Bradlo there is another facies developed from Cretaceous Orbitoid beds, formed by Flyschoidal sequence with abundant strata of exotic conglomerates and reef coralline Algae limestones. From the point of the view of bathymetry, sediments of this type belong to shallow, predominantly coastal facies, in this case to the Paleocene or even Lower-Eocene sea. Besides the Myjavská pahorkatina highlands, sediments with reef limestones are developed also in a narrow belt running parallel with the Klippen belt to Žilina. In Orava and Eastern Slovakia they occur just sporadically.

In the area of Myjavská pahorkatina highlands the reef Algae coralline limestones with exotic conglomerates have been considered as Senonian (D. Andrusov, 1933; O. Kühn—D. Andrusov, 1937). Stratigraphic investigations by M. Mišík and J. Zelman (1959) have shown that part of reefs, besides others also on the elevation point 453 m near Široké bradlo, contains *Discocyclus* (*Discocyclus* sp., *D. cf. marthe Schlumberger* = *D. seunesi* Douvillé, fide E. Köhler, 1961) and other organisms. Thus it has been concluded that the reefs and adjacent rocks are of Eocene age. They were studied also by E. Köhler (l. c.), who included them in the Middle Paleocene at the base of the Yppresian. However the stratigraphic diapason of the Flyschoid sequence with exotic conglomerates and reef limestones in the Myjavská pahorkatina highlands is wider. Sediments described gradually develop from the sequence called Orbitoid beds here. Already in this bed sequence appear occasionally the exotic conglomerates. Their amount increases toward the top and the greatest extension reach in Paleocene. Gradual transition from Cretaceous to Paleogene may be observed in the village U Kopeckých and Končiny. In the first locality directly above the sequence with the proved Maastrichtian fauna occur limestones with Hippurites and in close vicinity in an analogical facies, appear Algae-coralline limestones with *Discocyclus*, viz. *Discocyclus seunesi* Douvillé. In the locality Končiny there is a conglomeratic sequence with shale intercalations. One of these intercalations bear the Lower-Paleocene microfauna, represented by the species: *Ammodiscus hoernessi* (Karrer), *Glomospira charoides* (Jones & Parker), *Stensiöina? caucasica* (Subbotina), *Aragonia ouezzanensis* (Rey), *Aragonia velascoensis* (Cushman), *Bulimina arcadelpiana midwayensis* Cushman & Parker, *Globigerina compressa* Plummer, *Globigerina triloculinoides* Plummer, *Globigerina varianta* Subbotina and *Globorotalia cf. conicotruncata* Subbotina. The above described association shows striking similarity with the Danian association described by C. A. Wicher (1956) from Austria.

The upper boundary and the stratigraphic diapason of the Flyschoid sequence with exotic conglomerates is determined by microfauna from lower beds of overlying sandstone-claystone Flysch development. Microfauna of the uppermost Paleocene has been found there represented by species: *Dendrophrya robusta* Grzybowski, *Globigerina triloculinoides* Plummer, *Globorotalia marginodentata* Subbotina and *Turborotalia* (A.) *mckannai* (White). In some places, sediments with reef limestones show transgressive character, as e. g. in the locality U Holíčov (2 km SSW of Myjava). Together with reefs around Stará Lúka and with the Flysch sequence they have been considered as Santonian.

Table 1. Paleogene Stratigraphy in the area W and SW from Žilina and in the surroundings of Bojnica

Age	Microfauna	Area W of Žilina	Area SW of Žilina	Area of Bojnica
Lower Oligocene	<i>Globigerina ampliapertura</i> Bolli <i>Globigerina officinalis</i> Subbotina <i>Globigerina posterelacea</i> Mjatluk <i>Chliguembelina gracillima</i> (Andreae)	paleontologically unverified	sandstone-argillite lithofacies with considerably prevailing of psammitic component (found from Rajecké Teplice)	flysch-like sequence composed of dark gray marls and calcareous argillites, irregularly alternating with medium—to fine grained sandstone layers
Eocene	Upper	<i>Globigerina</i> sp. 1/ = <i>G. inflata</i> d'Orb., in sense of N. N. Subbotina, 1953) <i>Globigerinoides</i> ex gr. <i>index</i> Finlay <i>Turborotalia</i> (A.) <i>rotundimarginata</i> (Subb.) <i>Turborotalia</i> (A.) <i>rugosoculeata</i> (Subb.)	? ?	flysch-like sequence composed of dark gray, black rarely green and red marls and calcareous argillites, alternating with medium to coarse grained sandstones and conglomerate layers
	Middle	<i>Cyclammina amplexens</i> Grzybowski <i>Globigerina eocaena</i> Gumbel <i>Globigerina</i> ex gr. <i>eocaenica</i> Terquem <i>Globigerina senni</i> (Beckmann) <i>Turborotalia</i> (A.) <i>densa</i> (Cushman) <i>Turborotalia</i> (A.) <i>spinuloinflata</i> (Bandy)	flysch sequence, sometimes with individual layers of variegated marls and conglomerates, occurring mainly in the lower parts of the sequence	fine to medium grained carbonatic (mainly dolomitic) breccias and conglomerates
	Lower	<i>Globigerina</i> ex gr. <i>eocaenica</i> Terquem <i>Globigerina linaperta</i> Finlay <i>Globorotalia aragenensis</i> Nuttal <i>Globorotalia crater</i> Finlay <i>Chiloguembelina wilcoxensis</i> (Cush. et Pon.)		
	Upper	<i>Globigerina linaperta</i> Finlay <i>Globigerina triloculinoides</i> Plummer <i>Globorotalia aequa</i> Cushman et Renz <i>Turborotalia</i> (A.) <i>mckannai</i> (White) <i>Turborotalia</i> (A.) <i>triplex</i> (Subbotina) cf.		
Paleocene	Middle	<i>C. primitiva</i> Finlay <i>Globigerina triloculinoides</i> Plummer <i>Globorotalia</i> ex gr. <i>angulata</i> (White) <i>Globorotalia elongata</i> Glaessner <i>Globorotalia pusilla pusilla</i> Bolli <i>Globorotalia pseudomenardii</i> Bolli	gray and red marls or calcareous argillites, containing layers of reef algal-coral limestones in the lower part (Paleocene—? Lower Eocene) and layers of fine to middle-grained sandstones in the upper part	fine to coarse grained carbonatic conglomerates and breccias with reefalgal-coral limestone layers
	Lower = Danian	<i>Globigerina compressa</i> Plummer <i>Globigerina pseudobulloides</i> Plummer <i>Globigerinoides daubjergensis</i> (Bronnimann) <i>Cyroidina? whitei</i> (Morozova)		
Upper Maastrichtian	<i>Stensiöna pommerana</i> Brotzen <i>Globotruncana contusa</i> (Cushman) <i>Gublerina glaessneri</i> Bronnimann et Brown <i>Pseudotextularia elegans</i> (Rzehak) <i>Racemiguembelina varians</i> (Rzehak)	gray-green marls		

(D. Andrusov—E. Scheibner, 1960). On the ground of the Nummulites occurrences as well as Discocyclus it is necessary to replace all reefs of the area into the Paleocene. Also the prevailing part of the Flysch here belongs to the Paleocene according to the Nummulites occurrences in the road scarp U Majdlenov (250 m south from the elev. point 457,2 m) and northwest from Šimkov (725 m SW of the elev. point 324,5 m).

The study of reef coralline-Algae limestones from wider vicinity of Stará Turá northwest from Palčkov Vrch, northern slope of Tučkovec, southeastern slope of Čirkov Vrch, northwestern slope of Kubinka, Ůboč) has been recently carried out by M. Mišík—J. Zelman (1959) and E. Köhler (1961) who included the limestones in the Paleogene. E. Köhler presents closer stratigraphic determination within the Middle Paleocene recognizing Ypresian. However, part of these reef limestones the above authors left in the Senonian. We should like to mention that all reef limestone developed in this territory—similarly to those around Stará Lúka—belong to the Paleocene or even to the Lower Eocene because of the following reasons:

1. All the reef limestones show essentially uniform lithofacial characteristics.
2. There are no organogenous limestones in the Senonian sequences developed here in marly and Flysch facies.
3. The reef limestones occur predominantly as blocks in the Flysch series, from which E. Köhler (1961) presents Nummulites testifying unambiguously Paleocene age of the sequence.

Besides that, reef limestones in localities e. g. near the railway bridge south of elev. point 298,1 m and in the road scarp near the viaduct to Lubina contain Discocyclus represented by species *D. seunesi* Douvillé and *D. douvillei* Schlumberger.

Series of thick-bedded Algae-coralline limestones and fine-grained conglomeratic limestones alternating with marls, is exposed in the field road scarp running north of the railway bridge along the main road from Stará Turá to Hrnčiarová. Marls in the mentioned road-cut contain relatively poor Upper-Paleocene association consisting of species *Globigerina* cf. *eocaenica* Terquem, *Globigerina linaperta* Finlay, *Globigerina triloculinoidea* Plummer, *Globigerina* aff. *variata* Subbotina, *Globorotalia pseudomenardii* Bolli, *Globorotalia* cf. *pusilla laevigata* Bolli, *Turborotalia* (A.) *convexa* (Subbotina), *Turborotalia* (A.) *acarinata* (Subbotina), *Turborotalia* (A.) cf. *intermedia* (Subbotina) and *Turborotalia* (A.) *mckannai* (White). Reef limestones of this series are rich in Algae, essentially the same as mentioned by M. Mišík and J. Zelman (1959).

Besides Algae and corals in thin-sections rotaloid Foraminifera and Discocyclus by species *D. seunesi* Douvillé, may be observed. Comparing this series with the development of the overlying marly facies near H. and D. Polianka it may be found that they are facially equal. After sedimentation of the described sequence near Stará Turá, started the sedimentation of the Flysch series with abundant blocks and boulders of reef limestones. The Flysch series contains numerous Nummulites of the Lower-Eocene age and thus we may suppose that suitable conditions for the formation of reef limestones ended earlier here than in the area near H. and D. Polianka and approximately at the same time around Široké bradlo and Kravárikov.

Middle Eocene developed in flysch formation, and with beds of variegated marls, represents the very end of the reef limestone formation. If they anyhow occur there, then only in the form of redeposited boulders. Middle-Eocene beds are exposed in the trench Nr. 42 (250 m northeast of elev. point 405,5 m northeast of Šimková) with rich microfauna in variegated marls (Textfig. 1).

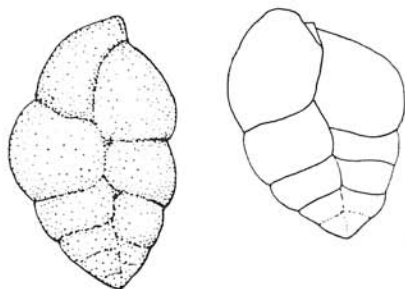


Fig. 1. *Chiloguembelina wilcoxensis* (Cushman & Ponton, 1932) = *Gümbelina compacta* Maslaková (1955). Southern slope of Hradisko (632 m, W from Zilina). Red Lower Eocene marls. \times cca 50.

Paleogene in the Vicinity of Považská Bystrica

Description of the Cretaceous sediments (J. Salaj—O. Samuel, 1963) has shown that a remarkable part of sediments of the Manín series and adjacent part of the Klippen belt included in the Santonian, belongs to the Lower Paleogene. Sediments which according to new discoveries belong to the Paleogene, crop out in relatively extensive territory of the wider vicinity of Považská Bystrica, between elev. point 390,7 m (south of P. Bystrica) and elev. point Račov (Dolné Kočkovce). Since classical localities are concerned where the so-called Rašov development of the Senonian sediments was defined, we are going to present the main reasons leading us to the inclusion of the discussed series in Paleogene (especially into the Paleocene).

In the sequence under question appear essentially two types of organogenous limestones, differing but a little viz. the reef Algae-coralline (rather predominating) and Hippurites limestones. The latter—on the ground of Hippurites occurrence—have been included in Santonian or Santonian-Campanian (O. Kühn—D. Andrusov, 1937; D. Andrusov—O. Kühn, 1942; D. Andrusov, 1959) together with the reefs, i. e. the Algae-coralline limestones and with the surrounding conglomerates.

Certain lithofacial analogy of this sequence with the Lower Paleogene development of the Myjavská pahorkatina highlands inspired us also to a more detailed investigation of this territory. We found out that immediately below the organogenous conglomerates, occasionally sandy limestones and conglomerates—Maastrichtian sediments are developed. The fact opposes the Santonian age of this series. Moreover in some localities among others also as in Rašov and Rybárikov cross-sections of Nummulites in thin-sections have been

detected. In organogenous conglomeratic limestones in Rybárikovo also Discocyclines have been found, belonging to the species *D. seunesi* Douvillé. Besides Discocyclina also other organisms may be observed in the respective thin sections, first of all Algae from Myjavská pahorkatina highlands (M. Mišík—J. Zelman, 1959), and *Distichoplax biserialis* (Dietrich).

In another locality, in fine-grained conglomeratic facies near Sv. Helena church south from Pov. Bystrica occur abundant little forms of Nummulites, so far not determined. The conglomerates are transgressive and probably younger than the Middle Paleocene. All the above mentioned proofs are considered to testify sufficiently the Paleogene, age of this series.

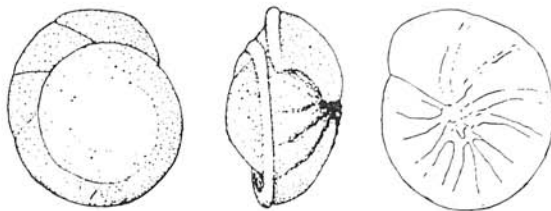


Fig. 2. *Gyroidina? whitei* (Morozova, 1953). Southern slope of Hradisko (632 m W from Zilina). Grey-green Lower Paleocene marls. \times cca 50.

In connection with the replacement of the above mentioned series to the Paleogene arises the question about the stratigraphic position of Hippurites limestones. According to O. Kühn's determination their the Cretaceous age should be doubtless. Then their presence in the Paleogene sequence must be explained by redeposition. There are, still many objections against that possibility.

1. If the Hippurites limestones have been redeposited to the Paleogene, then where to find their origin? According to the recent stratigraphic characteristics—obviously in the Santonian or Santonian-Campanian. However, according to the last investigations—not only in the area studied but in the whole Klippen belt—the Santonian and Campanian sediments are built either of marly or Flysch facies, where no limestones of the similar type have been found till now.

2. In some places the Hippurites limestones are free of any traces of redeposition, therefore they might be considered as autochthonous.

3. Lithofacially they are very similar to the reef Algae-coralline limestones with Discocyclina with which they were originally included in the same stratigraphic horizon.

4. Specimens for thin-sections have been taken from the locality Pod Húšťom, where D. Andrusov (1945) has found Hippurites limestones. Although the limestones of this locality are rather poor in fossil remnants, in one case a cross-section of a large Foraminifera has been found, reminding ? Nummulite by its structure.

The above reasons as well as the data about the occurrence of Hippurites in the Danian (E. Neaverson, 1955, p. 543) where they are extinguishing, lead us to the supposition that the series with Hippurites in the western part of the Klippen belt belongs to the Danian (= Lower Paleocene) or that it reaches

the uppermost Maastrichtian. It is necessary, however, to carry out the revision of Hippurites fauna of our territory, in the sense of that supposition.

From the lithofacial standpoint, the Paleocene series of Myjavská pahorkatina highlands and Pov. Bystrica area is very similar to the Danian of the Burderdorf development in Austria, considered as a shallow-water facies. (Textfig. 2.)

The Territory West of Žilina (Table 1)

In the past, the stratigraphic diapason of the Central-Carpathian Paleogene of the Žilina basin had been determined within the Upper Lutethian to Upper Eocene. Microfauna of variegated intercalations of the Flysch development from P. Závadka (South from Žilina) has been lastly studied by H. Bystrická (1961). According to her opinion the Foraminifera associations—except one case after revision considered as Paleocene (p. 116)—are either pseudoassociations or they are of Middle-Eocene age. The last investigations carried out by the authors besides other areas (Pružina-Domaníža, Rajecké Teplice etc.) also in the part adjacent to the Klippen belt, brought a number of new informations about the relations of the Cretaceous and Paleogene as well as about the stratigraphy of the Žilina basin (O. Samuel et J. Salaj, 1962).

Cretaceous (Maastrichtian) and Paleogene sediments on the slopes of the elev. point Hradisko (632 m, W of Žilina) are developed in a marly facies. Maastrichtian beds were considered as Albian and Paleogene while beds formed by grey-green and red marls or by calcareous claystones, were regarded as Upper Eocene. Wrong stratigraphic evaluation of Cretaceous and Paleogene rocks supported the opinion about the tectonic contact of the Central-Carpathian Paleogene with the elements of the Klippen belt. Microbiostratigraphic analyses of specimens indicate however that immediately above the Upper-Maastrichtian marls [*Abathomphalus mayaroensis* (Bolli), *Globotruncana contusa* (Cushman), *Pseudotextularia elegans* (Rzehak), *Racemiguembelina varians* (Rzehak) etc.], rest the grey-greenish marls in the similar tectonic style corresponding to the Lower Paleocene. No transgressive surface plane has been observed between the Upper Cretaceous and Lower Paleogene so far. This fact, and the paleontologically proved Upper Maastrichtian developed in a marly facies of the deep-sea origin, as well as the Lower Paleocene (= the Danian) with pelagic microfauna—do not indicate any interruption of sedimentation between the Cretaceous and the Paleogene.

The Lower Paleocene is represented by associations consistig of *Globigerina triloculinoides* Plummer (very abundant), *Globigerina pseudobulloides* Plummer (rare), *Globigerina compressa* Plummer (very rare). Above this association appears a very rich, mainly planctonic fauna with predominating *Globigerina triloculinoides* Plummer and very variable species *Globorotalia angulata* (White). A number of individuals belonging to the species completely correspond to regular forms with five angular, sometimes very fine-keel chambers, described in literature. The second part predominating represents six-, but most frequently five-chamber individuals with straight dorsal part and with obtuse-angled to rounded chambers in the periphery. E. K. Šuckaja (1956) considers such forms as independent variety of the species under question and considers it as *Globorotalia angulata praepentacamerata*. Into the group of *Globorotalia angulata* belongs also a sporadically occur-

ring form, by E. K. Šuckaja described as *Globorotalia angulata kubanensis*. Besides the predominating forms there are also *Globigerina varianta Subbotina*, *Turborotalia* (A.) *intermedia* (Subbotina), *Globorotalia elongata* Glaessner, *Globorotalia pseudomenardii* Bolli, *Globorotalia pusilla pusilla* Bolli, *Globorotalia* cf. *pusilla laevigata* Bolli and *Globorotalia occlusa* Loeblich & Tappan (Textfig. 3).

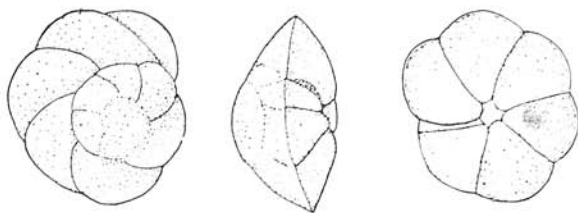


Fig. 3. *Globorotalia pusilla pusilla* Bolli, 1957. Southern slope of Hradisko (632 m, W from Zilina). Grey-green Middle Paleocene marls. \times cca 50.

Benthos component is represented by almost calcareous forms. Besides species usual in the Paleocene, e. g. *Gyroidina octocamerata* Cushman & Hanna, *Gyroidina subangulata* (Plummer), *Anomalina praecuta* Vassilenko, *Bulimina* cf. *arcadelphiana midwayensis* Cushman & Parker occurs here also *Gyroidina? whitei* (Morozova) although in higher horizons of the Paleocene series it has not been observed.

Foraminifera associations of such species composition are mentioned from Middle Paleocene, either of Eastern Europe (N. N. Subbotina, 1953; N. I. Maslakova, 1955; E. K. Šuckaja, 1956; V. G. Morozova, 1960 etc.) or of Western Europe (H. M. Bolli and B. M. Cita, 1960; A. v. Hillebrandt, 1962), of America (H. M. Bolli, 1957; A. R. Loeblich and H. Tappan, 1957, etc.), they are obviously bound to the Middle Paleocene.

The marly facies reaches the Middle Eocene and toward the East or Southeast swiftly passes into the Flysch development, with the age diapason the Paleocene-Middle Eocene, in the vicinity of P. Závadka.

Paleogene transgression over the core mountains of the Central Carpathians started already in the Paleocene, in this area. In places, where the Paleogene series has transgressive character, the bed sequence starts with carbonatic conglomerates or with breccias of the Súľov type. At the places, where basal carbonatic conglomerates are completely absent, appear the rocks of quite a different character deposited over an articulated Mesozoic basement sometimes rich in fauna. Such case may be observed on the slope north from Mojtin, where immediately above the Mesozoic there are organogenous sandy limestones with fauna corresponding to the lower part of the Lower Eocene: *Alveolina oblonga* d'Orb., *Alveolina ovulum* Stache, *Alveolina rütimeyeri* Hottinger, *Operculina* sp., *Discocyclus* aff. *douvillei* Schlumberger and *Discocyclus* aff. *seunesi* Douville.

From the preliminary studies it follows, that it is necessary to devote special attention to the Súľov conglomerates, considered as purely transgressive, of the

Upper-Lutetian age. The investigations have shown that the extension of carbonatic conglomerates is wider. For instance near Hričovské Podhradie the conglomerates alternate with reef limestones, considered as Eocene here (J. Pí a, 1934; J. P f e n d e r, 1936; D. A n d r u s o v and M. K u t h a n, 1944). However, besides other organic remnants, they also contain *Alveolina* represented by the species *Alveolina (Glomalveolina) ex gr. primaeva* R e i c h e l. This form has been found in the quarry in Hričovské Podhradie. Reef limestones with the admixture of clastic material, exposed on the slope opposite to the quarry, are more rich as to the fossil remnants. Differing from the preceding locality, *Disccyclina seunesi* Douvillé quoted mainly from the Paleocene, may also be found here together with Algae, Coralls and Nummulites (*Nummulites* sp.). Since *Alveolina (Glomalveolina) primaeva* R e i c h e l—according to L. H o t t i n g e r (1930) does not exceed the limits of the Paleocene, the reef limestones in the Hričovské Podhradie locality are considered as Paleocene. None of the so far mentioned organic remnants opposes that consideration, but rather supports the supposition. Since the reef limestones of Hričovské Podhradie gain large extension and their upper parts have not yet been studied, the possibility of their occurrence up to the Lower Eocene cannot be completely excluded.

The investigations have shown, however, that the main body corresponds to the Paleocene and not to Eocene as it has been supposed till the present.

In other places, carbonatic conglomerates are of Lower-Eocene age (e. g. near Chmelisko). According to F. B i e d a (1957) they belong even to the Upper Eocene.

Eastern Slovakia

Microbiostratigraphic conditions of Cretaceous sediments from the vicinity of Hanušovce and from the part east from Hanušovce are presented in other papers by the authors (J. S a l a j—L. S a m u e l, 1963). In this district, — the Maastrichtian sediments are developed in two facies, viz. in the Flysch (upper part of the Jarmut beds) and in the marly facies. Foraminifera association, characteristic for the Maastrichtian stage of the Jarmut beds has been found north from Radvanovce, in a little Trench on the elev. point 458 m. There is the following microfauna: *Marssonella crassa* (M a r s s o n), *Heterohelix nuttalli* (V o o r w i j k), *Globotruncana contusa* (C u s h m a n), *Globotruncana falso-stuarti* S i g a l, *Globotruncana* aff. *stuarti* (L a p p a r e n t).

The Upper Maastrichtian fauna from red marls has been taken directly from Ďurďoš. The quantitative representation and qualitative composition of the association is much more diverse than that of the preceding one. Besides above mentioned *Globotruncana* from the Jarmut beds there are *Globorotalia membranacea* (E h r e n b e r g), *Pseudotextualria elegans* (R z e h a k), *Racemiguembelina varians* (R z e h a k), *Gublerina acuta robusta* d e K l a s z, *Gublerina* aff. *glaessneri* B r o n n i m a n n and B r o w n.

Paleogene sediments of the Klippen belt, according to authors working in separate districts of the Eastern Slovakia (A. M a t ě j k a, 1959; B. L e š k o, 1960; E. M e n ě i k and V. P e š l, 1959; Z. S t r á n i k and Z. R o t h, 1959), are deposited unconformably upon the Cretaceous basement, folded during the Laramian. A. M a t ě j k a (l. c.) supposes, that interruption of sedimentation between

Cretaceous and Paleogene sedimentation cycles corresponds to the diapason Danian-Lower Paleocene.

In the easternmost part of the Klippen belt (Podhorod') and in the vicinity of Prosačov, in variegated marls appears a planctonic association, corresponding to the zone of *Globorotalia uncinata*, determined by H. M. Bolli (1957) in the formation Lizard Springs of Trinidad. The zone was later on considered as the Upper-Danian (H. M. Bolli and B. M. Cita, 1960). According to this, the amplitude of the interruption of sedimentation should correspond only to the Lower Danian. It should be mentioned, that in the territory of Eastern Slovakia the problem of relations between the Paleogene series and the Cretaceous has not been devoted sufficient attention yet. It may be one of the reasons why the Lower-Danian sequence of rather small thickness has not been found yet, so that its probable existence may have been proved only by a detailed study of suitable profile sections. (Textfig. 4.)

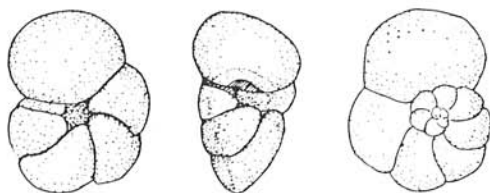


Fig. 4. *Turborotalia (Acarinina) uncinata* (Bolli, 1957). Variegated Paleogene marls of the Klippen-zone. Upper part of the Lower Paleocene (= Danian). Eastern Slovakia, Podhorod'. \times cca 50.

Beds, considered as analogical with the zone of *Globorotalia uncinata*, contain very rich planctonous component (95 %). From among predominating Globigerina best represented is *Globigerina triloculinoides* Plummer. Further Globigerina, or Globigerinoides. [*G. compressa* Plummer, *G. quadrata* White, *G. spiralis* Bolli, *G. varianta* Subbotina, *Globigerinoides daubjergensis* (Bronnemann)] except *Globigerina pseudobulloides* Plummer — occur just sporadically. Characteristic for this zone is the form *Turborotalia (A.) indolensis* (Morozova) form the upper part of the Danian (V. G. Morozova, 1959, 1960) and *T. (A.) uncinata* (Bolli) appearing also in the upper part of the Danian and sporadically passing to the Middle Paleocene. In our material all the transitional forms may be observed between the species *T. (A.) uncinata* and *G. pseudobulloides*. N. N. Subbotina (1953) describes some forms convergating by their structure rather to *G. pseudobulloides* as *Globigerina inconstans*. Higher-specialized forms with obtuse angle chambers — except the last one, that may be ball-like in the periphery — have been determined as a new species *Globorotalia uncinata* [= *T. (A.) uncinata* by H. M. Bolli, 1957].

A. V. Hillebrandt (1962) considers the last forms as the synonymum of *Globigerina inconstans* Subbotina [= transitional form between *G. pseudobulloides* and *T. (A.) uncinata*, presented by H. M. Bolli, 1957, T. 17, Fig. 16–18]. Comparison of holotypes and our material, too, show that between

these two phylogenetically closely connected forms there are such differences in the shape chambers, that are sufficient for preventing their identification.

The Middle Paleocene. Microfauna of the Middle Paleocene has been found — besides other localities — also in the profile section of the Babalonka creek north from Prosačov. The main component in the marl intercalations is plancton with predominating *Globigerina triloculinoidea* Plummer and *Globigerina varianta* Subbotina, while the rest of *Globigerina* species (*G. compressa* Plummer, *G. pseudobulloides* Plummer, *G. spiralis* Bolli) occur only sporadically. From among species, absent in the associations corresponding to the zone of *T. (A.) uncinata*, there are *Globorotalia* ex. gr. *angulata* (White), *Globorotalia elongata* Glaessner and *Globorotalia pseudomenardii* Bolli. Benthos component is variably represented. None of the following species is distinctly represented: *Buliminella* cf. *parvula* Brotzen, *Angulogerina* aff. *europaea* Brotzen, *Aragonia ouezzanensis* (Rey), *Pullenia coryelli* White, *Stensiöina?* *caucasica* (Subbotina), *Gyroidina octocamerata* Cushman & Hanna, *Gyroidina subangulata* (Plummer), *Eponides* cf. *lunata* Brotzen, *Eponides toulmini* Brotzen, *Eponides vortex* (White), *Nuttallides trümpyi* (Nuttall), *Osangularia florealis* (White), *Coleites reticulosus* (Plummer), *Anomalina preacuta* Vassilenko, *Thalmanita madrugensis* (Cushman & Bermudez).

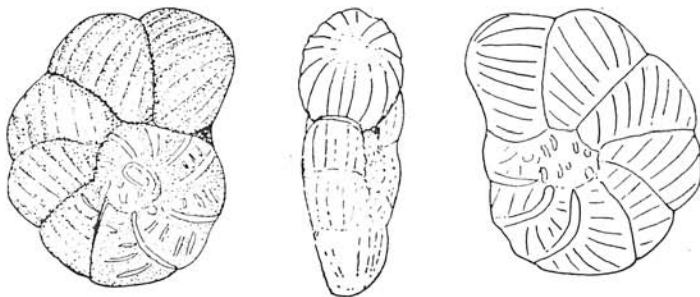


Fig. 5. *Thalmanita madrugensis* (Cushman & Bermudez, 1947). Paleogene variegated marls of the Klippen-zone. Lower part of the Middle Paleocene. Eastern Slovakia, brook Babalonka (N from Prosačov). \times cca 50.

The Upper Paleocene. Sediments with the Upper-Paleocene fauna have been recovered from the bore-hole from the vicinity of Škrabské (V-6). Microfauna from the specimen taken from red marls is qualitatively remarkably different from the preceding associations. *Globigerina triloculinoidea* Plummer and *Globigerina varianta* Subbotina — abundant in the Middle Paleocene — occur only rarely here. Instead of them there appears *Globigerina linaperta* Finlay. From among the *Globorotalia* forms remarkable share have "Acarinina", represented by species *Turborotalia (A.) intermedia* (Subbotina), *Turborotalia (A.) acarinata* (Subbotina), *T. (A.) convexa* (Subbotina), *T. (A.) soldadoensis* (Bronnimann), *Globorotalia* ex. gr. *aequa* Cushman and Renz, *Globorotalia pseudomenardii* Bolli. (Textfig. 5.)

The above described Middle and Upper-Paleocene associations originate from the sequence of the so-called upper portion of the Lackovec unit, considered of the Upper-Eocene age by V. P e s l and E. M e n č í k (1959). The preliminary investigations have shown that remarkable amount of sediments, included in the so-called upper portion of the Lackovec unit, belong to the Paleocene or even to Lower Eocene.

Microbiostratigraphic characteristics of the Lower to Upper Eocene series of the Paleogene of the Klippen belt from the various districts of the Eastern Slovakia may be found in works of E. H a n z l í k o v á (1959), B. L e š k o and O. S a m u e l (1960), O. S a m u e l (1961).

Translated by E. J a s s i n g e r o v á and J. K o v á č í k.

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Review by D. Andrusov.

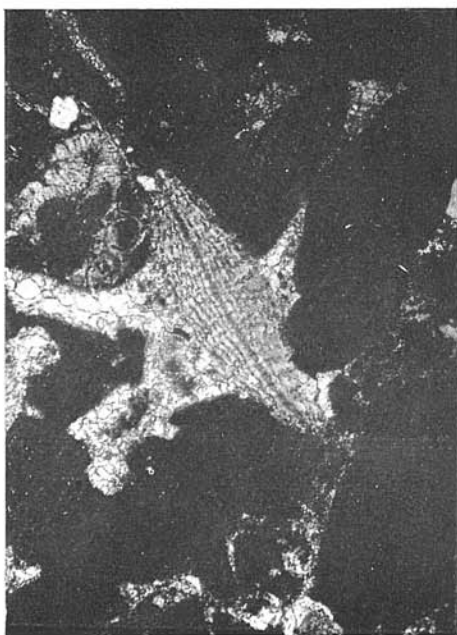
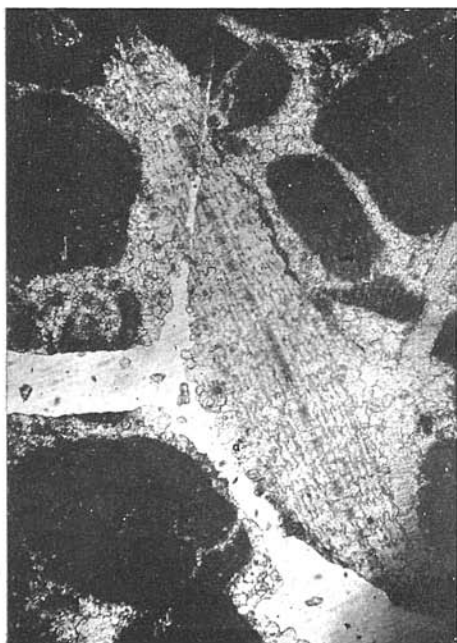
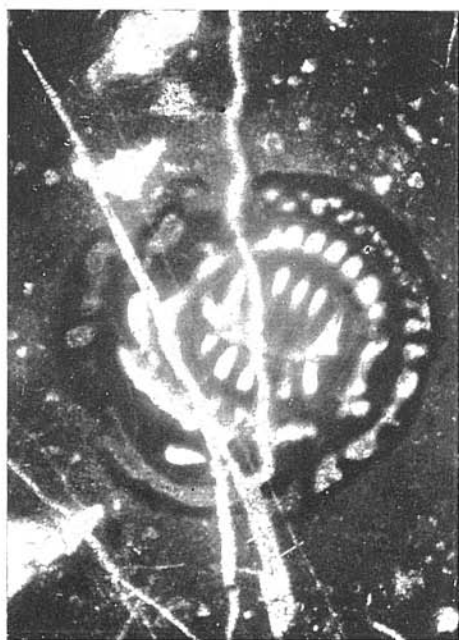
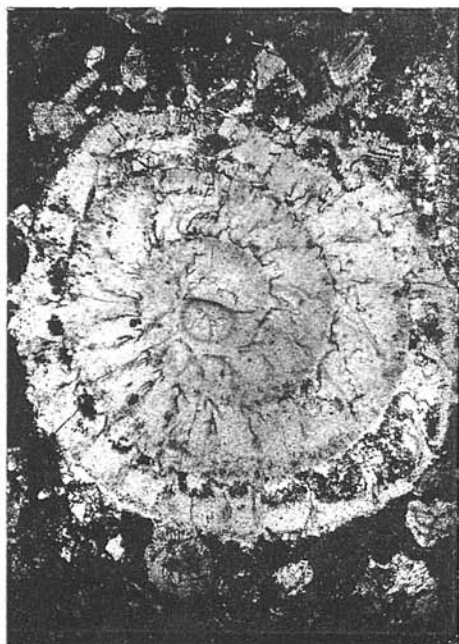


Fig. 1. *Numulites cf. deserti* De la Harpe. Mojtiň. Lower part of the Lower Eocene. Basal conglomerates of the Central-Carpathian Paleogene. $\times 17$. — Fig. 2. *Alveolina (Glo-malveolina) ex gr. primaeva* Reichel. Reef limestones; Hričovské Podhradie. Upper Paleocene. $\times 17$. — Fig. 3–4. *Discocyclus seunesi* Douvillé. Reef limestones; Hričovské Podhradie. Upper Paleocene. $\times 17$.



Fig. 1. *Alveolina oblonga* d'Orbigny and *Alveolina rütimeyeri* Hottinger. $\times 17$. — Fig. 2. *Alveolina oblonga* d'Orbigny. $\times 17$. — Fig. 3. *Alveolina oblonga* d'Orbigny. $\times 17$. — Fig. 4. *Alveolina rütimeyeri* Hottinger and *Alveolina oblonga* d'Orbigny. $\times 17$. — All material from lower part of the Lower Eocene. Mojtiń.