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REVIEW OF THE CRETACEOUS STRATIGRAPHY OF THE FLYSCH ZONE IN WEST CARPATHIANS

PŘEHLED STRATIGRAFIE KŘÍDY FLYŠOVÉHO PÁSMA ZÁPADNÍCH KARPAT

(Textfigs. 1–7)

Abstract. Stratigraphy of the Valanginian-Cenomanian and Turonian-Maastrichtian on the basis of microfauna, macrofauna and lithology.

I. VALANGINIAN TO CENOMANIAN IN THE CARPATHIAN FLYSCH ZONE

A. *The foreland of the Carpathians*

In the Bohemian massif, which represents the foreland of the flysch zone in Moravia, there occur both fresch-water and marine Cenomanian deposits. We have no paleontological evidence of the Lower Cretaceous in this region. Because of the vast area of dry land (including the Bohemian massif) which was exposed during Upper Aptian times, it is thought that to this age probably belong certain redeposited products from red soils of the humid (northern) subtropical zone (N. M. Strachov, 1962). These are known in central Moravia as the Rudice beds (J. Dvořák, 1960). They are of small extent, but reach 100 m in thickness, and occur in the form of lenses intercalated with similarly coloured fine-to medium-grained kaolinitic sandstones with siliceous pebbles. The beds also contain fragments of cherts derived by the weathering of the Malm limestones which form part of the substratum of the Rudice beds. These beds fill up the karst depressions on the surface of the limestones. Besides the Jurassic, the substratum of the Rudice beds is also composed of Devonian limestones, and the Jurassic rests on these transgressively. The junction of the Rudice beds with the underlying limestones is frequently bordered by limonitic iron ores which were formerly exploited. The Rudice beds are dominantly sandstones, and their heavy mineral associations (kyanite, tourmaline, zircon, rutile and staurolite) differ from those of the Jurassic limestones (J. Kristek, 1959). It is clear that the Rudice beds originated from disintergration materials transported from a wide region including the crystalline rocks. They occur in the Moravian karst country north of Brno. Their age was not determined on the basis of paleontology.

Transgressive fresh-water and marine Cenomanian beds pass by gradual transition into locally transgressive marine Turonian to Coniacian of the Bohemian massif; in Moravia these extend farther to the north. North-east of Opava (near Hněvošice) the marine Coniacian lies transgressively on the Paleozoic

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(E. Hanzlíková, I. Cicha, J. Hercogová, 1959). South of Český Těšín, the Cenomanian or Turonian to Santonian transgresses on to the Bohemian massif (substratum of the Carpathians). This was found in a deep boring near Oldřichovice (W. Petraschek, 1928). The drilling was situated 21 km south of the outcrop of a moderately inclined thrust plane, which separates the Carpathians from the Bohemian massif. It passed through the Carpathian succession and probably autochthonous Neogene to reach the Cretaceous beds at a depth of 1076—1247 m. The latter are made up of "variegated" conglomerates resting on Devonian (or Lower Carboniferous) limestones; they contain blocks of the "Devonian" limestones and interlayers of "green" sandstones (1191—1247 m depth). On these beds lie spotted calcareous mudstones with interbedded conglomerates and ("green") sandstone, with *Exogyra columba* Lam., *Cyclothyris plicatilis* Sow. and fragments of Inocerami (1076—1191 m depth).

B. *The Carpathian flysch zone* (Textfigs. 1, 2, 3)

In further description and analysis we shall divide the flysch zone into post-Paleogene stratigraphical-tectonic units. We have to point out that present investigations show (Z. Roth, 1962) that these units in the Cretaceous did not exist as paleogeographically independent regions. Paleogeographical zones of similar character, and of the same age, are involved in various post-Paleogene units. On the other hand, however, the Silesia-Těšnovice unit for instance, was formed tectonically during the Paleogene and Neogene around thick Cretaceous beds which represent a solid core.

From the exterior part of the Carpathians towards the interior, we know the Hauterivian in the Subsilesia-Ždánice unit in Austria; the Valanginian to Cenomanian probably in the pre-Magura unit (E. Hanzlíková, A. Matějka, in press) and the Valanginian to Albian in the Magura unit. In addition, the Valanginian to Cenomanian of the inner klippen belt also belongs to the Paleogene Magura unit. In the Central Carpathians also, the Valanginian to Cenomanian sequence is known. However, we shall not deal with the Central Carpathians and the inner klippen belt here. In the region of the Dukla folds, Lower Cretaceous beds have not yet been found.

The Lower Cretaceous occurences in the post-Paleogene tectonic-stratigraphical units of the Carpathian flysch zone; considered from the external Carpathians inwards:

1. The Subsilesia-Ždánice unit

The Hauterivian is represented by dark-grey calcareous claystones underlying transgressive Turonian. This was found by drilling in Austria near Niederhollabrunn (R. Grill, 1953). It is characterized by a rich microfauna (R. Noth, 1951), the benthos being represented by numerous specimens of Citharina, Lenticulina and Trocholina; these resemble the fauna of the Těšín limestones (which are, however older).

The Aptian to Albian in the Subsilesia-Ždánice unit is represented by silicified limestones occuring as fragments in a conglomeratic breccia in the Molasse-like Ždánice—Hustopeče beds (upper Eocene to Lower Oligocene) which form Babylon Hill near Strážovice (near Kyjov). These beds contain both

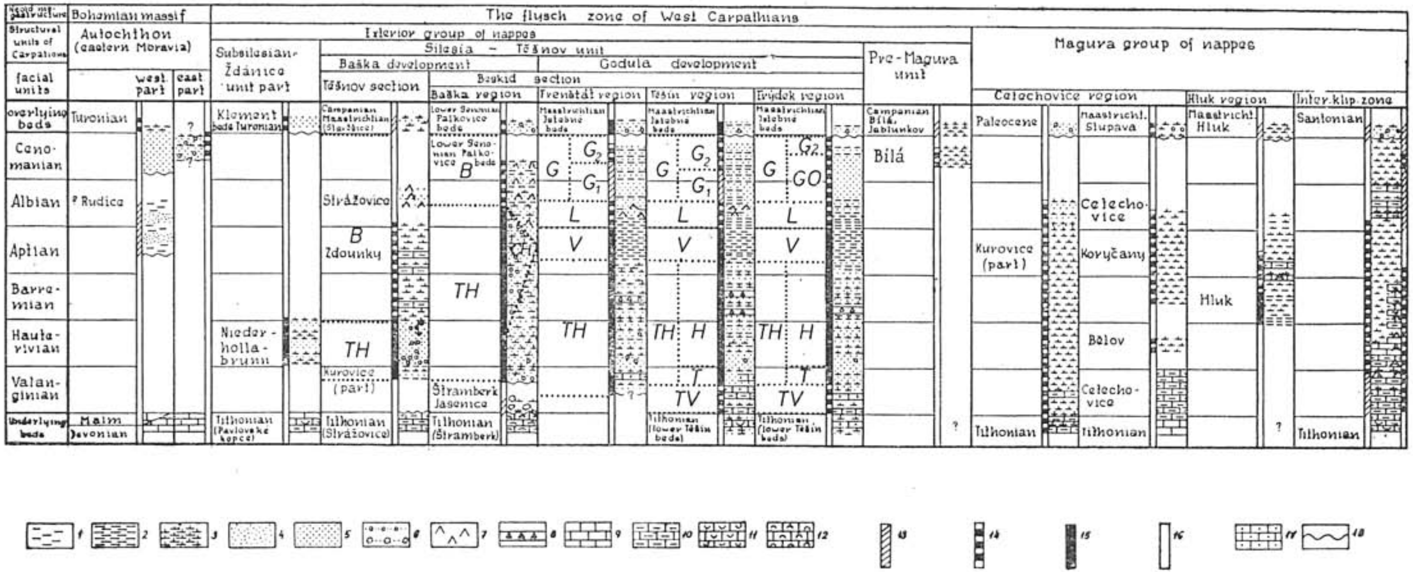

Fig. 1. Valanginian to Cenomanian of the flysch Zone of Czechoslovak Carpathians. *B* — Baška beds, *G* — Godula suite, G_1 — variegated Godula beds, G_2 — Godula beds s. s., *GO* — Ostravice sandstone (if they represent a continuous horizon), *L* — Lhota beds, *V* — Veřovice beds, *TH* — Těšín-Hradiště suite, *H* — Hradiště beds, *CH* — Chlebovice beds, *T* — Upper Těšín beds, *TV* — Těšín limestones. 1 — clays, 2 — claystones, 3 — calcareous claystones (marlstones), 4 — sand, 5 — sandstones, 6 — conglomerate breccias, 7 — cherts, 8 — pelosiderites, 9 — limestones, 10 — pelitomorphous limestones, 11 — organodetrital limestones, 12 — reefal limestones, 13 — facies with black-grey pelites, 14 — facies with spotted pelites, 15 — facies with black and black-grey pelites, 16 — facies with grey pelites, 17 — sandy limestones, 18 — interruption of sedimentation.

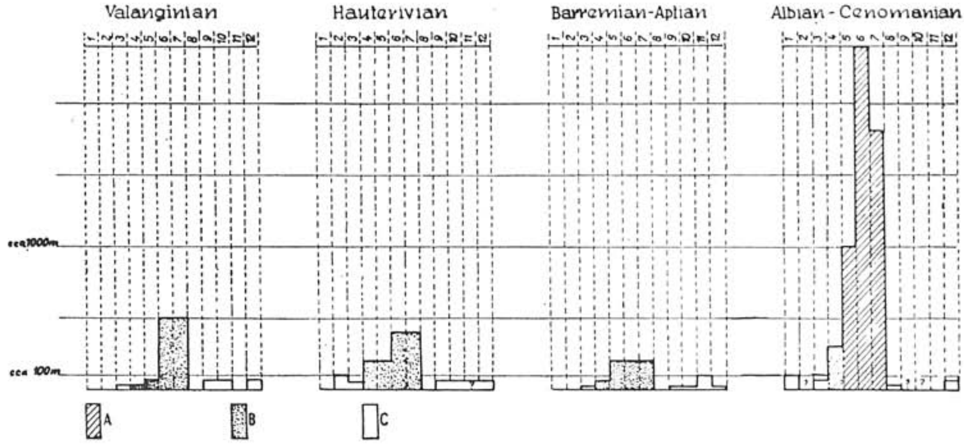

Fig. 2. Thickness of beds in the Valanginian to Cenomanian of the flysch zone of Czechoslovak Carpathians. *A* — the typical flysch, *B* — the flysch-like beds, *C* — the non-flysch developments. 1 — autochthon-Bohemian massif, 2 — Subsilesia-Ždánice unit, 3 — Silesia-Těšnovice unit — Těšnovice section, 4 — Silesia-Těšnovice unit — Baška region of the Beskid section, 5 — Silesia-Těšnovice unit — Frenštát region of the Beskid section, 6 — Silesia-Těšnovice unit — Těšín region of the Beskid section, 7 — Silesia-Těšnovice unit — Nýdek region of the Beskid section, 8 — pre-Magura unit, 9 — Magura group — Cetechovice region, 10 — Magura group — Cetechovice region, 11 — Magura group — Hluk region, 12 — Magura group — interior klippen belt.

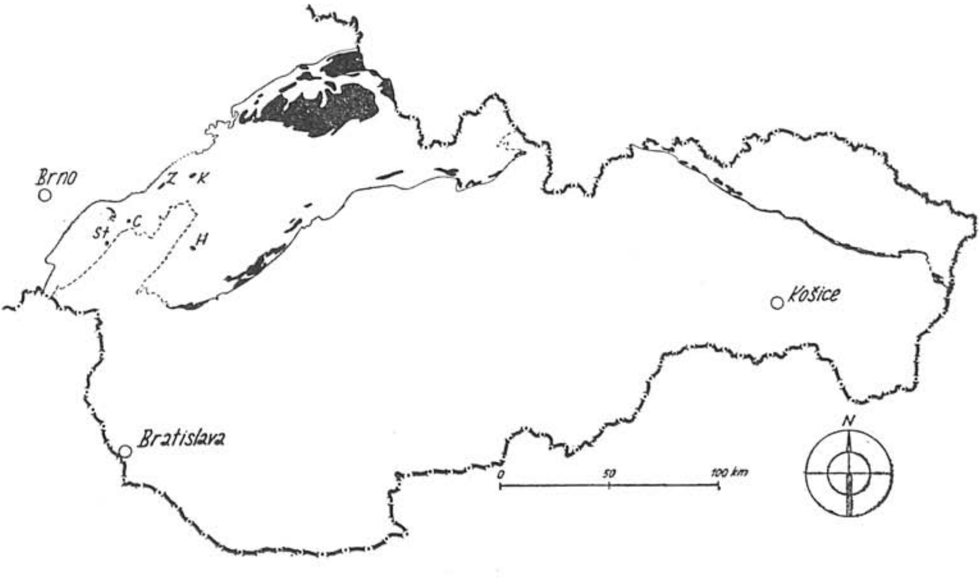

Fig. 3. Distribution of the Valanginian to Cenomanian beds in the flysch zone of Czechoslovak Carpathians. *St* — Strážovice, *C* — Cetechovice, *Z* — Zdounky, *K* — Kurovice, *H* — Hluk.

macrofauna and microfauna (E. Hanzlíková, 1955). These clastics form part of the molasse of the Pyrenean tectonic phase which caused an interruption of sedimentation in the Silesia-Těšnovice and Magura units of the flysch zone. They will be described under the Silesia-Těšnovice unit.

2. The Silesia-Těšnovice unit

This unit is divided on the basis of the development of the Lower Cretaceous to Paleogene, into the Beskid part (south-west of Valašské Meziříčí, to north-east of Kelč) and the Těšnovice section (south-west of Kelč).

a) *The Těšnovice section* (Table 1)

In the Těšnovice zone of the unit we may distinguish fragmental Valanginian to Albian. There is a great difference, partly evidently primary, in the thickness of the Middle and Lower Cretaceous beds between the Těšnovice and Beskid zones (Z. Roth, 1960, 1962).

We regard as belonging to the Valanginian to Hauterivian of the Těšnovice zone black-grey calcareous claystones with sporadic up to 5 cm thick beds of blue-grey colour, calcareous sandstones of irregular lamination. They contain poverished Lower Cretaceous associations which may be compared with those of the Těšín limestones and beds from Niederhollabrunn (samples from Kurovice Nos. 1—6) (R. Noth, 1951). Among the benthos there are numerous representatives of the genus *Trocholina* (*Trocholina* ex gr. *infragranulata* Noth), *Lenticulina subalata* (Reuss), *Citharina reticulata* Ten Dam, *Saracenaria hauterivica* Bart. et Brand, *Involutina* div. sp. The benthos is accompanied by numerous spherical Radiolaria identical with those of the Těšín—Hradiště beds.

These beds form part of the Silesia-Těšnovice unit which is in tectonic contact with the klippen fragment of the Tithonian and Cretaceous of the Magura unit near Kurovice (E. Menčík, V. Pesl, 1960). Lithologically they belong to the Těšín—Hradiště beds. The Zdounky "klippen" fragment in the Těšnovice zone is regarded as a higher part of the Cretaceous of the Silesia-Těšnovice unit.

The older portion of the beds of the Zdounky fragment is composed of light-blue-grey silico-calcareous sandstones, fine- to coarsegrained, bedded to massive, locally with fine-grained conglomerates or conglomeratic sandstones with scattered pebbles and fragments (3—5 mm in diameter) of white-grey limestones and black-grey to greenish-grey phyllites with *Hibolites jaculum* Phillips, *Duvalia dilatata* Blainville and *Lamellaptychus didayi* (Coq.). These sandstones include the Lower (and perhaps also higher) Hauterivian (D. Andrusov, 1959). They provided a microfauna composed of Radiolaria, identical with that of the Hradiště beds, and scarce Ophthalmidiid Foraminifera (Table 1). Lithologically they may be compared with the Chlebovice development of the Těšín—Hradiště suite.

On the sandstones lie white-grey, yellowish, calcareous claystones of up to 2 m in thickness, with interbeds of fine-grained calcareous sandstones with pale mica and a microfauna; still higher there are beds of about 11 m thickness consisting of intercalated light, dark-grey spotted (chondritic) calcareous claystones with interbeds of spotted limestones (of 10—60 cm thickness). Lithologically they resemble the Lhota and Baška beds (A. Matějka, 1960). On the

Table 1. The Silesia—Těšnovice unit, the Těšnovice section

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Calpionella alpina Lorenz	ss	..	..	..	..	..	..
Tintinopsella carpathica (Fil. & Murg.)	ss	..	..	..	..	..	..
Calpionella ex gr. *elliptica* Cadisch	ss	..	..	..	..	..	..
Radiolaria—Discoidea (pyritized)	..	kk	..	..	..	..	..
Trocholina ex gr. *solecensis* B. & P.	..	kk	..	..	..	..	..
Spirillina minima Shacko	..	kk	..	..	..	..	..
Trocholina infragranulata Noth	..	..	zz	..	..	..	..
Involutina sp.	..	..	zz	..	..	..	..
Citharina korneuburgensis Noth	..	..	zz	..	..	..	..
Lenticulina subalata (Reuss)	..	..	zz	..	..	..	..
Lenticulina münsteri (Roemer)	..	..	zz	zz	zz	zz	..
Lenticulina (A.) *calliopsis* (Reuss)	..	..	zz	zz	zz	zz	..
Lenticulina ex. gr. *saxonica* B. & B.	..	..	..	zz	z.	..	..
Lenticulina (A.) *scitula* Berthelin	..	..	..	zz	zz	zz	..
Rhizammina sp.	..	..	..	..	zz	zz	..
Bigenerina compacta (Reuss)	..	..	..	..	zz	zz	..
Haplophragmoides glomeratoformis Zaspěl.	..	..	..	..	zz	zz	..
Ramulina globulifera (Brady)	..	..	..	..	zz	zz	..
Frondicularia loryi (B.)	..	..	..	..	zz	zz	..
Bifarina calcarata (Berthelin)	..	..	..	..	.z	ss	..
Gyroidina globosa (Hagenow)	..	..	..	..	.s	ss	..
Globigerina ex gr. *infracretacea* Mjatl.	..	..	..	..	.s	ss	..
Lenticulina gaultina (Berthelin)	..	..	..	..	..	zz	..
Discoidea (Radiolaria)	..	..	..	..	..	zz	..
Vaginulina sp.	..	..	..	..	..	zz	..
Globigerina globigerinellinoides Subb.	..	..	..	..	..	ss	..

Explanations: s — Strážovice — pebbles in the Tertiary conglomerates, *k* — Kurovice — black—grey claystones with sandstones, *z* — Zdounky — klippen fragment.

basis of microfauna the age of this suite is Barremian to Alpian (E. Hanzlíková in E. Menčík, V. Pesl, 1956; D. Andrusov, 1959; A. Matějka, 1960). Most frequently occuring here are the species: *Lenticulina* ex gr. *saxonica* Bart. et Brand, *Lenticulina subalata* (Reuss), less frequent is *Bifarina calcarata* (Berthelin) (sample 40 R/9, 16 R/9a) (Table 1).

Fragments of sandstones, limestones and breccias with the Aptian to (Lower) Albian microfauna and macrofauna which are known from the vicinity of Kyjov, we regard as constituents of still younger members of the same suite, but secondarily redeposited in the Ždánice—Hustopeče beds (Upper Eocene to Lower Oligocene molasse). The fragments occur in the eastern, northern and western vicinity of Babylon Hill near Strážovice. Limestones, which are the most frequent among the fragments, are white-grey, finely arenaceous. They contain distinct or indistinct 2—4 cm thick bands of bluish-grey cherts which originated by secondary silicification. Rarely are found coarse-grained silico-calcareous sandstones composed of siliceous grains and fragments of white-grey massive limestones (to 0,5 cm in diameter). These pase into fine-grained calcareous calcareous breccia. Besides quartz, the clastic material of these rocks is composed also of fine-grained organogenous limestone and sericitic chloritic phyllites. The limestone fragments reach diameters of 5 mm and the phyllites 2 mm. The limestones locally cotains numerous monaxon megascleras of siliceous Sponges and like the sandstones, they were intensively silicified (Z. R o t h, 1962). Besides calcareous Foraminifera there were found here shells of lamellibranchiata. In the limestone E. H a n z l í k o v á (1960) found Foraminifera and Ostracoda of typical Aptian to Albian species. They are represented by thin walled Globigerinas of the *Globigerina infracretacea* G l a e s s n e r group, *Globigerina globigerinellinoides* S u b b. and benthonic species such as *Gyroidina* sp. and *Bifarina calcarata* (B e r t h e l i n). J. O p p e n h e i m e r (1916) described *Acanthoplites bigoureti* (S e u n e s s) (of the lowermost Albian) from a pebble of dark-brown (perhaps limonitized) limestone with numerous fragments of phyllites from near Strážovice.

On the basis of stratigraphy and lithology these rocks are closely allied to the rocks of the Baška beds. They differ from these beds mainly in their content of frequent fragments of sericite-chloritic phyllites. This character makes them similar to the above-mentioned oldest beds of the klippen fragments of the Zdounky Cretaceous. We therefore regard them as a specific facies of the Baška beds in the Těšnovice zone of the Silesia-Těšnovice unit. Also the frequent fragments of the Tithonian white-grey massive limestones with numerous species of Tintinnidae, namely *Tintinnopsella carpathica* (M u r g. et F i l i p.) together with abundant and typical *Calpionella alpina* L o r e n z (E. H a n z l í k o v á, 1955) are not known from the Baška beds of the Beskid section of the Silesia-Těšnovice unit. However, breccias of the Štramberk limestone were found in the typical basal Baška beds, for instance in the vicinity of Štramberk. They may serve as evidence that the Aptian and Albian fragments in the Upper Paleogene molasse from Strážovice did not come from the Cetechovice sedimentary district which is geographically nearer. In the Cetechovice district the Tithonian grades into the Lower Cretaceous, whereas in the southwestern part of the unit, the Cretaceous is of a transgressive character.

The Lower and Middle Cretaceous of the Těšnovice section of the Silesia-Těšnovice unit is represented by the Těšnovice—Hradiště suite of the Valanginian to Hauterivian; the upper part (Hauterivian) in the Chlebovice development displays a local special lithology. The Barremian to Aptian is made up of lithologically transitional beds, the younger constituents of which resemble to some degree the Lhota—Baška beds. The Aptian to Albian is composed of the special lithological facies of the Baška beds. The thickness of the earlier Cretaceous beds of the Těšnovice section is, in comparision with equivalent beds of the Beskid section of the Silesia-Těšnovice unit (if it is visible) very small. The specific character of the earlier Cretaceous in the Těšnovice section, besides its reduced thickness, is the presence of fragments of sericitic-chloritic phyllites in the thicker parts of the suite. The whole thickness of the Lower Cretaceous suite in the Těšnovice development of the Silesia-Těšnovice unit is more than 10 m. The thickness of the suite of the same age in the Baška development in the Beskid section, is 700—800 m.

b) *The Beskid section* (Tables 2, 3)

The Beskid section is characterized mainly by a greater thickness of the Lower and Middle Cretaceous. The Hauterivian to Cenomanian is lithologically and biofacially differentiated into the Baška and Godula developments.

Table 2. Silesia—Těšnovice unit — Beskid section, Godula development

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Radiolaria	ii	..	..	..	..	..	..
Haplophragmium agglutinans (d'Orb.) Chapman	ii	..	..	..	..	..	..
Spirillina orbicula Terquem & Berthelin	ii	..	..	..	..	..	..
Trocholina solecensis B. & B.	ii	..	..	..	..	..	..
Trocholina remesiana (Chapman)	ii	v.	..	..	..	..	..
Paalzowella feifeli (Paalzow)	.i	v.	..	..	..	..	..
Neobulimina varsowiensis B. & P.	.i	v.	..	..	..	..	..
Lenticulina (P.) *crepidularis* (Roemer)	.i	vv	..	..	..	..	..
Citharina rudocostata B. & B.	..	vv	..	..	..	..	..
Lenticulina (M.) *striatocostata* (Reuss)	..	vv	..	..	..	..	..
Trocholina sp. III	..	v.	..	..	..	..	..
Citharina pseudostriatula B. & B.	..	vv	..	..	..	..	..
Lenticulina quenstaedti (Gümbel)	..	vv	..	..	..	..	..
Lenticulina subalata (Reuss)	..	vv	..	..	..	..	..
Lenticulina bettenstaedti B. & B.	..	vv	..	..	..	..	..
Trocholina sp. II	..	vv	..	..	..	..	..
Trocholina infragranulata Noth	..	..	tt	..	..	..	..
Pseudoglandulina humilis (Roemer)	..	..	tt	..	..	..	..
Reophax neominutissimus B. & B.	..	..	tt	..	..	..	..
Gaudryinella hannoverana B. & B.	..	..	tt	..	..	..	..
Lenticulina (A.) grata (Reuss)	..	..	tt	..	..	..	..
Lenticulina wisselmanni Bettenstaedt	..	..	tt	..	..	..	..
Radiolaria	..	..	tt	hh	..	..	..
Haplophragmoides cushmani L. & T.	..	..	tt	hh	eh	..	..
Gaudryinella sherlocki Bettenstaedt	..	..	..	hh	..	..	..
Bigenerina minima Vašiček	..	..	..	hh	..	..	..
Bigenerina nana Vašiček	..	..	..	hh	..	..	..
Verneuilinoides subfiliformis Bettenstaedt	..	..	..	hh	ee	..	..
Haplophragmoides barremicus Mjatliuk	..	..	..	hh	..	..	..
Nodophthalmidium sp.	..	..	..	hh	ee	..	..
Hyperamminoides depressa (Vašiček)	..	..	..	hh	he	..	..
Gavelinella ex gr. *barremiana* Bett.	..	..	..	.h	ee	..	..
Bigenerina clavellata L. & T.	..	..	..	..	eh	..	..
Reophax minutus L. & T.	..	..	..	..	eh	..	..
Spirophtalmidium sp.	..	..	..	..	eh	..	..
Trochammina neocomiana Zaspělova	..	..	..	..	eh	..	..
Recurvoides imperfectus Hanzlíková	..	..	..	..	ee	ll	..
Haplophragmoides coronus L. & T.	..	..	..	..	.e	ll	..
Haplophragmoides nonioninoides (Reuss)	..	..	..	..	..	ll	..
Plectorecurvoides alternans Noth	..	..	..	..	..	ll	lg
Haplophragmoides spissum S. & W.	..	..	..	..	..	ll	..
Trochammina rosacea Zaspělova	..	..	..	..	..	ll	..
Bathysiphon brosgei Tappan	..	..	..	..	..	ll	lg
Silicispongia div. formae	..	..	..	..	..	ll	..
Trochammina welleri S. & W.	..	..	..	..	..	.l	g.
Trochammina rutherfordi S. & W.	..	..	..	..	..	.l	gg
Dorothia filiformis (Berthelin)	..	..	..	..	..	.l	gg
Haplophragmoides crickmayi S. & W.	..	..	..	..	..	.l	gg
Pelosina cf. *complanata* Franke	..	..	..	..	..	.l	gg
Haplophragmoides glomeratoformis Zaspěl.	..	..	..	..	..	..	gg

Continuation

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Haplophragmoides spiritense S. & W.	..	..	..	..	..	..	gg
Trochammina nodosa Zaspěl.	..	..	..	..	..	..	gg
Verneuilinoides perplexus S. & W.	..	..	..	..	..	..	gg
Dendrophrya sp.	..	..	..	..	..	..	gg
Saccammina sp.	..	..	..	..	..	..	gg
Rzehakina gaultina (Reuss)	..	..	..	..	..	..	gg
Rzehakina epigona (Rzehak)	..	..	..	..	..	..	gg
Pernerina depressa (Perner)	..	..	..	..	..	..	gg

Explanations (Godula development): *i* — lower Těšín beds (Infravalanginian), *v* — Těšín limestones and upper Těšín beds, *t* — Těšín—Hradiště beds, *h* — Hradiště beds, *e* — Veřovice beds, *l* — Lhota beds, *g* — Godula beds.

Table 3. Silesia—Těšnovice unit — Beskid section, Baška development (Baška region)

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Haplophragmium agglutinans (d'Orb.) Chapman	kk	k.	..	..	..	..	..
Haplophragmium neocomianum Chapman	kk	k.	..	..	..	..	..
Spirillina orbicula Terquem & Berthelin	kk	k.	..	..	..	..	..
Trocholina conica (Schlumb.) (Chapman)	kk	k.	..	..	..	..	..
Trocholina remesiana (Chapman)	kk	k.	..	..	..	..	..
Paalzowella (*Valvulina cuneiformis* Chapman)	kk	k.	..	..	..	..	..
Lingulina nodosaria Reuss—Chapman	kk	k.	..	..	..	..	..
Lenticulina bronni (Roemer) Chapman	kk	k.	..	..	..	..	..
Lenticulina calva (Wisniowski) Chapman	kk	k.	..	..	..	..	..
Lenticulina gibba (d'Orb.) Chapman	kk	k.	..	..	..	..	..
Lenticulina rotulata (Lamarck) Chapman	kk	k.	..	..	..	..	..
Lenticulina cultrata (Montfort) Chapman	kk	k.	..	..	..	..	..
Vaginulina truncata Reuss—Chapman	kk	k.	..	..	..	..	..
Neobulimina varsoviensis B. & P.	kk	kt	..	..	..	..	..
Lenticulina (Saracenaria) frankei (Dam)	kt	tt	..	..	..	..	..
Turispirillina amoena Dain	tt	t.	..	..	..	..	..
Lenticulina (P.) crepidularis Roemer	.t	tt	..	..	..	..	..
Involutina numismalis Terquem & Berthelin	.t	tt	..	..	..	..	..
Spirillina div. spec.	.t	tt	t.	..	..	..	..
Vaginulina kochii Roemer	..	tt	tt	..	..	..	..
Trocholina sp. II	..	tt	..	..	..	..	..
Lenticulina eichenbergi B. & B.	..	tt	t.	..	..	..	..
Citharina rudocostata B. & B.	..	tt	t.	..	..	..	..

Continuation

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Lenticulina (M.) strialocostata (Reuss)	..	tt	t.	..	..	..	..
Trocholina sp. I	..	.t	tt	..	..	..	..
Reophax neominutissimus B. & B.	..	.t	tt	t.	..	..	..
Lenticulina bettenstaedti B. & B.	..	..	tt	t.	..	..	..
Trocholina infragranulata Noth	..	..	tt	..	..	..	..
Pseudoglandulina humilis (Roemer)	..	..	tt	t.	..	..	..
Gavelinella berthelini (Keller)	..	..	tt	t.	..	..	..
Lenticulina (V.) korneuburgensis Noth	..	..	tt	..	..	..	..
Radiolaria	..	..	tt	tt	tt	..	..
Conorboides aptiensis B. & B.	..	..	tt	tt	cc	..	..
Bifarina calcarata (Berthelin)	..	..	..	..	cc	cc	..
Pseudoclavulina szakalli Hanzlíková	..	..	..	..	cc	cc	..
Gyroidina globosa (Hagenow)	..	..	..	..	cc	bb	bb
Neobulimina minima Tappan	..	..	..	..	cc	cb	bb
Ramulina aculeata (d'Orb.)	..	..	..	..	cc	cb	bb
Bigenerina clavellata L. & T.	..	..	..	..	cc	cb	..
Trochamminoides coronus L. & T.	..	..	..	..	..	bb	bb
Globigerina infracretacea Glaessner	..	..	..	..	..	bb	b.
Globigerina globigerinellinoides Subb.	..	..	..	..	..	bb	b.
Lenticulina gaultina (Berthelin)	..	..	..	..	..	bb	..
Dorothia filiformis Berthelin	..	..	..	..	..	bb	b.
Bathysiphon brosgei Tappan	..	..	..	..	..	bb	bb
Pseudoclavulina gaultina (Morozova)	..	..	..	..	..	bb	b.
Trochammina subbotinae Zaspělova	..	..	..	..	..	bb	bb
Ataxophragmium trochoideum (Reuss)	..	..	..	..	..	bb	bb
Rotalipora appenninica (Renz)	..	..	..	..	..	..	bb
Rotalipora montsalvensis Mornod	..	..	..	..	..	..	bb
Praeglobotruncana stephani (Gandolfi)	..	..	..	..	..	..	bb
Gavelinopsis cenomanica (Brotzen)	..	..	..	..	..	..	bb
Pernerina depressa (Perner)	..	..	..	..	..	..	bb

Explanations: *k* — occurence in the Kopřivnice limestones, *t* — occurence in the Těšín—Hradiště beds of normal facies, *c* — occurence in the Chlebovice beds, *b* — occurence in the Baška beds.

The Baška development is made up of the Chlebovice beds (locally lacking) which are lithologically connected with the Těšín—Hradiště suite and occur in the uppermost Hauterivian, and of the Baška beds (Upper Aptian to Cenomanian). Genetically, the Baška development is connected with occurences of the Tithonian limestones.

The typical constituents of the Godula development, different from those of the Baška development, are the Veřovice beds (Upper Aptian), Lhota beds (Lower Albian), variegated Godula beds (Upper Albian to Cenomanian) and the Godula beds s. s. (Cenomanian).

On the basis of relationship between the Lower Cretaceous and Tithonian in the Beskid section, we may distinguish the western and eastern parts. In the western part of the Beskid section (which extends east as far as the river

Ostravica and includes the Baška and probably also the Frenštát regions), there is a stratigraphical hiatus between the Tithonian and Valanginian limestones, while in the eastern part (Těšín and Nýdek section) the Tithonian grades into the Valanginian. The hiatus between the Tithonian and Cretaceous in the western part of the section probably corresponds to the upermost Tithonian (V. H o u š a, 1961). In the eastern part, the Tithonian lower Těšín beds grade upwards into the Cretaceous.

H. B e c k (1923) explains the regional absence of the lower Těšín beds in the western part of the Beskid section by regional denudation between the Tithonian and Valanginian.

Besides the hiatus in the uppermost Tithonian, we may find traces of a further hiatus in the Lower Valanginian, in the western part of the Baška section. The tectonic movements are expressed also in the eastern part of the section in the comparatively sharp contact between the younger (detrital) part of the Těšín limestones and the older, muddy part (see E. M e n č í k in Z. R o t h, 1962 a).

In the Upper Valanginian and Lower Hauterivian differences between both the western and eastern parts of the Beskid section are not so obvious. In the Upper Hauterivian the differences appear again between the western and eastern parts. Whereas in the western part, besides the Godula development, there were deposited beds of the Baška type (similar to those of the earlier Cretaceous in the Těšnovice section), in the eastern part of the Beskid section the Godula development is dominant. It is represented by normal facies in the Těšín region, and by the Nýdek facies without variegated Godula beds in the south (see A. M a t ě j k a, Z. R o t h, 1962 a). Eastwards into Poland, the normal facies develops into the Lanckoróna facies (M. K s i ą ż k i e w i c z, 1951) and the same time the variegated beds increase in importance. The Nýdek facies extends into Poland under the name Silesian facies (M. K s i ą ż k i e w i c z, 1951). The name of the Frýdek facies we use here to avoid omissions. The Godula development in the Nýdek region differs from the normal development not only in lacking the variegated Godula beds (replaced by the Ostravica sandstone in the Nýdek facies) but also by the appearance of the so-called eastern facies of the Lhota beds, lithologically closely allied to the Veřovice beds (E. M e n č í k, 1960). The Godula beds s. s. reach in the Nýdek region their greatest thickness (about 3000 m, E. M e n č í k in Z. R o t h, 1962 a).

α) The Godula development (Table 2)

The Těšín limestones occur in the earliest Cretaceous of the Godula development in both the western and eastern parts of the Beskid section. In the eastern part we may distinguish lithologically independent beds grading upwards from the Tithonian lower Těšín beds into the Těšín—Hradiště beds. In the western part they form intercalations in the lower part of the Těšín—Hradiště suite. More extended is the muddy facies of these limestones, which in the eastern part reaches 20—30 m in thickness. It is mainly composed of 2—500 cm thick layers of marly limestone, light-grey and locally spotted with chondrites, separated by 0,5—120 cm thick layers of white-grey calcareous claystones. The upper part of the Těšín limestones of up to 90 m in thickness is composed of detrital limestones, dominantly 10—180 cm thick layers of massive, grey, fine to coarsely-grained limestones with pebbles of quartz and of the Štramberk limestone, and interbeds of 1—60 cm thick slaty sandstones and black-grey, sandy, calcareous claystones. On the whole, the Těšín limestones are of the Lower Valanginian age. Detrital upper Těšín limestones pass laterally and vertically into the lower part of the Těšín—Hradiště suite (E. Menčík in Z. Roth, 1962 a). The macrofauna is composed of Crinoids, Echinoids, Bryozoans, Lamellibranchiata *(Exogyra, Lima, Pecten), Hibolites pistiliformis, Lamellaptychus* sp., *Hoplites goleszowiensis* Szajnocha, *Hoplites* aff. *perisphinctoides* Uhlig, *Calpionella alpina* Lorenz (in the lower part) (H. Frajová-Eliášová in Z. Roth, 1962 a; D. Andrusov, 1959). The microfauna is composed mainly of Foraminifera and Ostracoda (about 40 species, Table 2); it is of a shallow-water character, very similar to that of the reefal mud biotype. It is composed of ornamented species of Foraminifera which are closely allied to those of the Hauterivian from Niederhollabrunn and to the Valanginian faunas of north-west Germany.

The Těšín—Hradiště suite, we may find in both the Godula and Baška developments. It is characteristic of the Beskid section of the Silesia-Těšnov unit in the Upper Valanginian to Lower Aptian, but is exclusively in the Middle Albian Baška development. The normal development is always in the upper part of the Valanginian and Hauterivian, in the Barremian and Lower Aptian. In the Baška development, however, only the upper part of the Těšín—Hradiště suite is represented (the Chlebovice beds) which is uppermost Hauterivian to Aptian and locally lower Albian in age (Z. Roth, 1962 a). Rarely, in places, where in the Baška development of the Chlebovice beds is lacking, the normal Těšín—Hradiště suite grades upwards into the Aptian of the Baška beds (locally in the vicinity of Štramberk).

In the Godula development there occurs only the Těšín—Hradiště suite. It is characterized by the prevalance of dark-grey calcareous claystones in intercalations of 2 to 700 cm thickness. Some cm thick interbeds of black, noncalcareous claystones are characteristic of the uppermost part of the suite. Sandstones are mostly very fine-grained, light-grey, calcareous and occur in layers of 0,5 to a few dm thickness (the upper Těšín sandstones — E. Menčík, 1960). Besides these beds, there are some intercalations from a few cm to 10 m thick of massive, medium to coarse-grained, locally conglomeratic light-grey, calcareous sandstones (Hradiště-type). Thick layers (interlayers) of the Hradiště beds occur in the Hauterivian of the Godula development of the Silesia-Těšnovice unit. The uppermost part of the Těšín—Hradiště suite (Barremian to Aptian) was originally regarded as the Veřovice beds (Wesnsdorfer Schichten — Hohenegger, 1861). The suite contains, in the upper part, thin interlayers of pelosiderites. They yielded Cephalopods (mainly Ammonites, Belemnites and many Aptychi) and in sandstones of the Hradiště-type Lamellibranchiata, Gastropoda, Brachiopoda and solitary Corals. Very rare are remains of fishes and of one specimen of Reptilia. The microfauna is composed of Foraminifera and Radiolaria. In the basal part, the microfauna is composed of 80 per cent calcareous species (*Lenticulina, Spirillina*). Higher up the number of specimens and species of arenaceous and siliceous forms increases so that the upper part of the suite contains exclusively agglutinated benthos, represented by the genera *Ammobaculites, Trochammina, Haplophragmoides* and *Verneuilinoides*. The plancton is composed of spherical Radiolaria, which increase in size and abundance (from 0,3 mm to 0,6 mm); in the upper parts they are mainly pyritized.

During deposition of the younger parts of the Těšín—Hradiště suite (Barremian according to E. Hanzlíková and B. Šmída in press) there occur in the sedimentary district of the Baška and Godula beds subaquatic marine effusions of bazic eruptives of the Těšinite volcanic formation, connected in the deeper parts of the Silesia-Těšnovice unit with intrusives.

The Veřovice beds (in the sense of Z. Roth and A. Matějka, 1953) occur only in the Godula facies of the Silesia-Těšnovice unit. They are connected by gradual transition with the beds above and below. They are composed of black, hard, non-calcareous claystones, locally with mica, sometimes occurring only the form of lenses. From these beds only microfaunas are known with 15—20 species of Foraminifera. The microfauna occurs in continuous profiles only in 2—5 per cent of samples (Table 2). The microfauna is of the Middle and Upper Aptian so that it is stratigraphically equivalent with that of the upper Veřovice beds. Also the upper part of the Těšín—Hradiště suite (lithologically very different) was formerly regarded as the Veřovice beds (see above).

The Lhota beds are mostly (especially in their older parts) of the claystone character. The claystones are greenish-grey, black-grey, frequently spotted with chondrites, non-calcareous (or calcareous), massive, with very fine mica. They occur in layers, of a few cm to some m in thickness, of fine to medium-grained massive (sometimes irregularly leaf-like) disintegrated, siliceous sandstones, with thin belts of dark-grey cherts mainly in the upper part (the Mikuszowice facies). Besides the spiculae of Sponges they yielded *Acanthoplites bigoureti* (Seuness), *Inoceramus laubei* Liebus, *Inoceramus concentricus* Sow., *Holaster leavis* Agas. and a rich, exclusively siliceous, microfauna represented by more than 20 species of Foraminifera, similar to that of the upper parts of the Hluk Lower Cretaceous; also there are microfaunas from Central Povolžie (the vicinity of Uljanovsk etc., E. Mjatljuk, 1939) (Table 5). They correspond to the Lower and partly Middle Albian. The thickness of these beds is 160—400 m.

The Godula suite we divide into the variegated Godula beds (the lower part of the suite) and the Godula beds s. s. The suite grades up from the underlying Lhota beds. So the top there is a sharp boundary with the Istebná beds (Maastrichtian).

The variegated Godula beds are characteristic of the Godula development of the Silesia-Těšnovice unit, except for the Nýdek region where they are lacking. They are predominantly clayey, but in their upper parts, they are mainly sandstone. The claystones are brown-red, grey-green, dark-grey, non-calcareous, intercalated with coloured bands (from some to a few tens m in thickness). These parts are separated by 0,3 cm to a few m thick beds mainly of fine-grained, glauconitic siliceous sandstones of the Godula-type. They yielded only a microfauna of siliceous and arenaceous Foraminifera. We suppose that they are of Albian to Lower Cenomanian age (Table 2). Their thickness is from 0—350 m. Locally in the variegated Godula beds are lens-like portions (some m thick) of sandstone to breccia-like character (the so-called Ostravica sandstones), which in the Nýdek region in the eastern part of the Beskid section replace the variegated Godula beds (E. Menčik, 1960).

The Godula beds are of a flysch character with intercalated layers of green-grey to dark-grey non-calcareous claystones, partly fine-grained (1 cm to some m thick) and layers of sandstones (fine breccia-like conglomerates) (1 cm to 4,5 m thick). In the western part of the region these beds are predominantly clayey, in eastern part sandy. They always contain portions with the relations between components reversed. They carry the fauna: *Desmoceras?* sp., *Dentalinum decussatum* Sow. and a microfauna composed of about 10 species of arenaceous and siliceous Foraminifera (Table 2). A rare species is *Pernerina depressa* (Perner) quoted in the literature from the Cenomanian to Senonian inclusively. The fauna on the whole is very rare (20 : 100). It is of Cenomanian age. The thickness of the competent beds with the fauna quoted is 60–1350 m. They reach a maximum near the river Morávka (E. Menčík, 1960).

β) The Baška development (Table 3)

As belonging to the lowermost Cretaceous of the Baška development we regard breccias included usually in the Kopřivnice type of the Štramberk limestones. It frequently rests on the Štramberk Tithonian limestone. It is represented by green-grey (locally red) calcareous claystones with fragments of limestones carrying remains of Echinodermata and Brachiopoda and marly limestones locally penetrating into the massive part of the Štramberk limestone. From the muddy Tithonian limestones it differs in being of a more clayey character, and from the Upper Cretaceous beds by lacking the clastic quartz and mica. The thickness of these beds is some m.

By the macrofauna (*Pygope diphyoides* d'Orb., *Pseudobelus bipartitus* Blainv.; H. Frajová-Eliášová, 1960; V. Houša, 1961) and microfauna they represent partly an equivalent of the Těšín limestones (E. Hanzlíková, 1954) (Table 3).

The Těšín–Hradiště suite lies transgressively on the Štramberk limestones especially on the breccias in the Baška development. In many places, it has the character of the Chlebovice beds.

The Chlebovice beds of the Těšín–Hradiště suite are characteristic of the Baška development of the Silesia-Těšnovice unit. They are typically developed in the Beskid section. They are characterized by lens-like interbeds of the Chlebovice type conglomerate (with predominant fragments and pebbles of the Štramberk limestone) and by marly parallel-laminated black-grey and light-grey sandstones in interlayers of 3–50 cm thickness. Both types of interbeds are accompanied by a few cm to 150 cm thick layers of grey calcareous claystones with mica. They yielded *Neohibolites* cf. *minimus* and a microfauna most probably of the Aptian and Lower Albian age, with a redeposited microfauna of Valanginian age. Radiolarian plankton is identical with that of the upper Baška beds. Calcareous-agglutinated Foraminifera occur with the following abundant species: *Ramulina aculeata* d'Orb., *Bifarina calcarata* (Berthelin), *Bigenerina clavellata* Loeblich and Tappan, *Neobulimina minima* Tappan, *Gyroidina globosa* (v. Hagenow), *Pleurostomella subnodosa* (Reuss), *Pseudoclavulina szakalli* Hanzlíková, *Anomalina* ex gr. *ammonoides* (Reuss), *Dorothia* div. sp. Among others in this bed were found some species of Lenticulina known from the Lower Gault of northern Germany, England and other places in the Hercynian region. The associations may be compared with the Leymeriella zone of the northern Germany. The Chlebovice beds (and in places where they are lacking also the normal Těšín–Hradiště suite) grade upwards into the Baška beds.

The Baška beds are flysch-like, with predominating sandstones. The sandstones (or sandy limestones) are light-grey fine- to medium-grained, calcareous, in layers from 1,5—300 cm. They contain 0,2—5 cm thick beds passing into the grey cherts, and further into abundant fragments of yellow-white calcareous claystones with maximum diameters of 4 dm. Layers of sandstones (sandy limestones) are separated by 0,2—300 cm thick intercalations of claystones of light-grey-green, green-grey, brown-grey, dark-grey-green colours, frequently with spots and chondrites, non-calcareous, slaty beds and by layers (0,5—5 cm) of solid grey marls. The beds yielded some Ammonites (probably *Puzosia* aff. *majoriana* d'Orb., see L. Höhenegger, 1861) and a microfauna (Table 3). In fragments near the northern margin of occurences of the Silesia-Těšnovice unit (the Baška facies), north of Frýdek-Místek, instead of the Baška beds there occur the Lhota—Baška facies characterized by a predominance of calcareous spotted claystones of the Lhota type. It is accompanied by younger red claystones of the Albian, so that it resembles the Godula development. We regard it as belonging to the Těšín region of the Godula development.

The thickness of the Baška beds in the Beskid section is about 500 m, that of the Lhota—Baška beds only a few tens of m. The Baška beds are of Albian to Cenomanian age, most frequently of the upper Middle Albian to Lower Cenomanian. They are equivalent to the Lhota beds and the Godula suite, locally also to the Veřovice beds of the Godula development in the Silesia-Těšnovice unit. They are in a quite evidently discordant position in relation to the younger Pálkovice beds (Lower Senonian). From the above it follows that in the Silesia-Těšnovice unit we have two lithologically different developments: the Baška and the Godula. However, both the developments are not always separated by an obvious boundary and in many places we see their lithological affinities.

The Baška development is to some degree connected with the deeper part of the same sedimentary basin as the Godula development, which was nearer the shore bordered by the Tithonian limestones. The Baška development of little thickness is characteristic for the south-western (Těšnovice) section of the Silesia-Těšnovice unit and for the north-western region (Baška) of the Beskid section. Another part of the Silesia-Těšnovice unit represents the Godula development. In the south-western region (Frenštát) of the Beskid section the Godula development is of comparatively smaller thickness and the Valanginian and Hauterivian similarly, as in the neighboroughing Baška section they probably lay transgressively on older beds. On the other hand, in the eastern part of the Beskid section the Valanginian of the Godula development grades upwards from the uppermost Tithonian (lower Těšín beds). In the northern (Těšín) region of the eastern part of the Beskid section the Godula development is of nearly the same character as in the Frenštát region. Farther south (Nýdek region) the Godula development and the older Cretaceous of the Silesia-Těšnovice unit reach their maximum thickness and the variegated development of the Middle Cretaceous is replaced by a thick suite of sandstones.

C. *The pre-Magura unit*

To the pre-Magura unit (the fragments of which are recently described by E. Hanzlíková, E. Menčík and V. Pesl, 1962), probably belong to the Cenomanian calcareous claystones in the riverbasin of Smradlavá. They contain *Rotalipora* and *Praeglobotruncana* (E. Hanzlíková, A. Matějka, in press).

D. *The Magura group* (Tables 4, 5, 6)

The Lower Cretaceous may be found in all the separate units of this group. The last developed and known is the Lower Cretaceous in the Bystrica unit. The most extended and most studied is in the White Carpathians-Orava unit and particularly in nearklippen units of eastern Slovakia, to which other Mesozoic formations of the inner klippen belt belong. In the section of the Rača unit, the Lower Cretaceous is paleontologically proved in the fragments between Holešov and the northern outskirts of Kyjov. In the more northerly parts of the exterior margin of the Rača unit, there are known only redeposited Cretaceous microfaunas in the Soláň beds (personal communication of E. Hanzlíková). Without paleontological evidence, some authors regard some klippen fragments in the overthrust zone of the Magura group as Lower Cretaceous in age (A. Matějka, Z. Roth, 1962 a). If we compare these occurences lithologically with the Lower Cretaceous of this zone and neighbouring zones, the Cretaceous age of the klippen fragments is very doubtful.

Table 4. Magura group — Cetechovice region

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Calpionella alpina Lorenz	cc	..	..	..	..	..	..
Calpionella elliptica Cadisch	cc	..	..	..	..	..	..
Tintinopsella carpathica Fil. & Murg.	cc	..	..	..	..	..	..
Calpionella sp. Pokorný	cc	..	..	..	..	..	..
Radiolaria	cc	cc	..	..	..	..	..
Spirillina minima Shacko	.c	cc	bk	..	..	..	..
Trocholina conica (Schlumb.)	.c	cc	..	..	..	..	..
Involutina sp.	..	cc	bk	..	..	..	..
Lenticulina (Planularia) crepidularis R.	..	cc	bb	..	..	..	..
Lenticulina eichenbergi B. & B.	..	.c	b.	..	..	..	..
Trocholina infragranulata Noth	..	..	kk	..	..	..	..
Haplophragmoides cushmani L. & T.	..	..	..	cc	..	..	..
Haplophragmoides glomeratoformis Zaspěl.	..	..	..	cc	z.	..	..
Marssonella oxycona (Reuss)	..	..	..	kc	z.	..	..
Haplophragmoides spissum S. & W.	..	..	..	..	z.	..	..
Glomospira gaultina (Berthelin)	..	..	..	..	zk	k.	..
Verneuilinoides spinitense S. & W.	..	..	..	..	zk	..	..
Gyroidina globosa Hagenow	..	..	..	..	zk	zc	..
Bifarina calcarata (Berthelin)	..	..	..	..	kz	c.	..
Lenticulina gaultina (Berthelin)	..	..	..	..	.z	ck	..
Lenticulina (A.) scitula (Berthelin)	..	..	..	..	.z	ck	k.
Frondicularia lorgi (Berthelin)	..	..	..	..	.k	kc	k
Globigerina ultramicra Subb.	..	..	..	..	..	kk	..
Bathysiphon brosgei Tappan	..	..	..	..	..	kc	..
Dentalina div. spec.	..	..	..	..	..	kc	..
Vaginulina div. spec.	..	..	..	..	..	kc	..
Discoidea — Radiolaria	..	..	..	..	..	kc	b.

Explanations: *c* — Cetechovice — klippen, *k* — Kurovice — fragment, *z* — tectonic fragments near Koryčany, *b* — pebbles (Paleocene) from Bělov (Chřiby).

Table 5. Magura group — Hluk region

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Verneuilinoides neocomiensis (Mjatliuk)	..	..	..	xx	..	..	..
Bigenerina minima Vaš.	..	..	..	xx	..	..	..
Bigenerina variabilis Vaš.	..	..	..	xx	..	..	..
Haplophragmoides cushmani Loeblich & Tappan	..	..	..	xx	xx	xx	..
Reophax minuta Loeblich & Tappan	..	..	..	.x	xx	..	..
Bifarina calcarata (Berthelin)	..	..	..	..	xx	x.	..
Radiolaria — Discoidea	..	..	..	..	xx	x.	..
Glomospira gaultina (Berthelin)	..	..	..	..	xx	xx	..
Hyperamminoides depressa (Vaš.)	..	..	..	..	xx	xx	..
Ammobaculites luaevi Zaspělova	..	.	..	..	xx	x.	..
Haplophragmoides glomeratoformis Zaspělova	..	..	..	..	xx	xx	..
Ammodiscus parvus Subbotina	..	..	..	..	xx	xx	..
Bigenerina clavellata L. & T.	..	..	..	..	xx	x.	..
Lenticulina ex gr. *subalata* (Reuss)	..	..	..	..	xx	xx	..
Globigerina cf. *infracretacea* Glaessner	..	..	..	..	.x	xx	..
Trochammina nodosa Zaspělova	..	..	..	..	..	xx	..
Trochammina rosacea Zaspělova	..	..	..	..	..	xx	..
Bathysiphon brosgei Tappan	..	..	..	..	..	xx	..
Verneuilinoides spiritense Stelck & Wall	..	..	..	..	..	xx	..
Ramulina globulifera Brady	..	..	..	..	..	xx	..
Lenticulina cf. *macrodiscus* (Reuss)	..	..	..	..	..	xx	..
Haplophragmoides nonioninoides (Reuss)	..	..	..	..	..	xx	..
Plectorecurvoides alternans (Noth)	..	..	..	..	..	xx	..
Recurvoides imperfectus Hanzlíková	..	..	..	..	..	xx	..
Dorothia filiformis (Berthelin)	..	..	..	..	..	xx	..

Occurences of the Lower Cretaceous in the Rača unit in Moravia (D. Andrusov, 1927) were named by the paleogeographical expressions of the Cetechovice sedimentary district. Near Cetechovice, light-grey marly limestones (weathered blue-white) probably belong to the Lower Valanginian. On these, there lie conglomerates. These lenses, accordingly to V. Pokorný, contain *Tintinnopsella carpathica* (Murg. et Filip.) and *Calpionella* sp. (F. Chmelík, 1957) (Table 4).

In the Paleocene beds of the more inner part of the exterior marginal zone of the Magura unit, south-east Bělov in Chřiby Mnt., there was found a pebble of light-grey, calcareous claystone with a Hauterivian microfauna. Similar light-brown-grey calcareous claystones with microfaunas of Barremian to Aptian age were found in Chřiby, as a tectonic fragment near the tectonic line bordering a zone south-east of Cetechovice (A. Matějka, 1960).

Near the fault (anticlinal zone of Salaš, south-east of Stará Huť) occur ochreous grey-brown, yellow-grey to white-grey, very fine sandy calcareous claystones with a microfauna of Aptian age. Westwards in the same fault-zone, south-east of Koryčany, there are calcareous claystones sometimes with 12 cm thick layers of light-grey, dark-grey spotted calcareous claystones with an Aptian-Albian microfauna (E. Menčík, V. Pesl, 1959) (Table 4).

Table 6. Magura group — interior klippen belt

Important microfossils	Tithonian	Valanginian	Hauterivian	Barremian	Aptian	Albian	Cenomanian
Tintinnidae see V. Pokorný 1958	..	xx	xx	xx	..	..	..
Planomalina (G.) typica (Gandolfi)	..	..	..	..	xx	..	..
Anomalina djaffarovi Agalarova	..	..	..	..	xx	..	..
Epistommina cretosa Ten Dam	..	..	..	..	xx	..	..
Epistommina spinulifera (Reuss)	..	..	..	..	xx	..	..
Globigerina globigerinellinoides Subb.	..	..	..	..	xx	xx	..
Rotalipora (T.) roberti (Gandolfi)	..	..	..	..	.x	xx	..
Haplophragmoides nonioninoides (Reuss)	..	..	..	..	.x	xx	..
Nannoconus Kamptner	..	..	..	..	..	xx	..
Astrorhizidea	..	..	..	..	..	xx	..
Planulina buxtorfi Gandolfi	..	..	..	..	..	xx	..
Rotalipora ticinensis (Gandolfi)	..	..	..	..	..	xx	x.
Globigerina infracretacea Glaessner	..	..	..	..	..	??	xx
Rotalipora brotzeni (Sigal)	..	..	..	..	..	..	xx
Rotalipora appenninica (Renz)	..	..	..	..	..	..	xx
Rotalipora montsalvensis Mornod	..	..	..	..	..	..	xx
Praeglobotruncana stephani (Gandolfi)	..	..	..	..	..	..	xx
Orbitolina concava Lamarck	..	..	..	..	..	..	xx
Orbitolina mamillata Arch.	..	..	..	..	..	..	xx
Orbitolina conica Arch.	..	..	..	..	..	..	xx
Hedbergella simplicissima (Magné & Sigal)	..	..	..	..	..	.	x.
Rotalipora reicheli Mornod	..	..	..	..	..	..	.x
Praeglobotruncana imbricata (Mornod)	..	..	..	..	..	..	.?

As in the Upper Cretaceous east of Stupava, there are redeposited Foraminifera of the Albian and Cenomanian. A. Matějka (1960) suggested that the Cretaceous beds of the Cetechovice sedimentary district also contained these stages.

To some degree, a different lithological development is represented in the Kurovice klippen fragment north of the Cetechovice region. In the basal part of this fragment, on the Neocomian of the Silesia-Těšnovice unit the Tithonian massive to very fine-grained marly limestone is overthrust. This limestone is white-grey and light-grey and alternates in layers of 10—50 cm with calcareous claystones of the same colours, made up of 1 m thick layers. The beds contain Radiolaria and *Calpionella alpina* Lorenz. In thin intercalations there appear locally bioclastic limestones made up of small fragments of Aptychi and Radiolaria (D. Andrusov, 1959). In these beds were found *Punctaptychus punctatus* (Voltz), *Lamellaptychus beyrichi* (Oppel) and *Lamellaptychus lamellosus* (Park.).

The Tithonian beds grade upwards into green-grey slaty marls, in part finely arenaceous which contain (accordingly to D. Andrusov, 1959) *Lamellaptychus mortilleti* Pict. et Lory, and *Lamellaptychus herthae* (Wink.). The uppermost portions contain more sandy constituents and interbeds of fine-grained marly sandstones of 2—10 cm thickness.

Finely, in the Cetechovice sedimentary district of the Rača unit on the basis of fragments we may attribute to the Valanginian and Aptian, light brown-grey calcareous claystones (locally very finely arenaceous) to slaty limestones. These afforded a microfauna of the Valanginian, Hauterivian, Barremian. The Aptian to Albian is made up of grey calcareous claystones, sometimes with 12 cm thick layers of light-grey, dark-grey spotted calcareous solid claystones. These beds probably also contain the Cenomanian. On the whole they are of about 100 m thickness, similarly to the suite of the same age in the Těšnov section of the Silesia-Těšnovice unit. In the Kurovice klippen, the Tithonian limestones grade upwards into green-grey slaty calcareous claystones, partly finely arenaceous, the uppermost portions of which contain layers of fine-grained marly sandstones of 2—10 cm thickness. The thickness of these beds reaches 35 m. They correspond to the Valanginian to Aptian.

As is obvious from the above there are in the Cetechovice zone two, to some degree lithologically different, developments. Both these developments are connected with the Jurassic by gradual transitions. They differ in the colour of the pelites and the thickness of suites. The southern one is of a greater thickness, the northern one is more arenaceous.

Other sure occurences of the older Cretaceous of the Magura group are known from the Bystrica and White Carpathians-Orava unit. Both the units are characterized by various developments of the Lower Cretaceous of the interior klippen belt. In the exterior portion of the south-west section of the White Carpathians-Orava unit, occurs the Hluk development.

We shall not be dealing with development of the Lower Cretaceous in the succession of the interior klippen belt (Table 6). We have to point out that their sedimentation was attributed by D. Andrusov (1945, 1959), E. Scheibner (1961) to the more southerly Pienidy sedimentary district and to the Czorsztyn series lying south of the last district. In the Pienidy zone as in the Cetechovice sedimentary zone, the Jurassic grades upwards into the Cretaceous. In the Czorsztyn zone sedimentation at the beginning of the Cretaceous was interrupted locally. The relationship with the Upper Cretaceous is not yet known to the present authors.

In the Hluk region, in the tectonic fragment at the margin of the White Carpathians-Orava unit, are known 120 m thick layers of the Barremian to Albian. The older portion of these beds is made up predominantly of black-grey to black claystones, partly calcareous, locally finely arenaceous. In the younger portions of the suite are frequent layers of grey-green and blue-green claystones, alternating with black-grey intercalations. Some of the green-grey beds bear dark-grey spots. Locally the occur layers of marly limestones and white-grey and fine-grained siliceous sandstones, banded with glauconitic and dark-grey laminae. In the uppermost portion of the suite spotted light-grey to white-grey marly limestones predominate, rarely with cherts. These beds carry rich, mainly siliceous Foraminifera and Radiolaria, predominantly pyritized. The species of this assemblage are similar to those of the Hradiště beds (in the Barremian and Aptian), in the Albian to those of the Lhota beds (Table 5). On these beds lies probably transgressively the Maastrichtian (Gbely beds).

The Hluk Albian corresponds in biofacies with the Albian development in the borehole Gbely H-6 (situated near the northern margin of the interior klippen belt). A. Matějka (1955, 1960) compared it lithologically with the so-called Buntmergelserie from the klippen belt of Wienerwald. Abundant, exclusively arenaceous Foraminifera and pyritized Radiolaria, described by E. Benešová (1955) may serve as evidence of an Albian age for the lower portion of this borehole, identical with the upper members of the Hluk Cretaceous and with the so-called biostratigraphical zone of Plectorecurvoides.

The sedimentary district of older Cretaceous in the Hluk region we have to place geographically between the Czorsztyn and Cetechovice sedimentary districts. Lithofacially the main part of the older Cretaceous from Hluk corresponds to the beds of the Czorsztyn series of the same age rather than to that of the Cetechovice region. The thickness of the stratigraphically identical beds in the Hluk region is more than 6 times greater than in the Czorsztyn and Cetechovice regions. The Czorsztyn Lower Cretaceous is also more calcareous than that of the Hluk region. Furthermore the Pieniny (Kysuca) Lower Cretaceous is of a very much less thickness than that of the Hluk region. Therefore the Hluk Cretaceous fills up depressions separating the elevated areas of Cetechovice and Czorsztyn zones.

Conclusion

The Lower Cretaceous which we include in the Czechoslovakian Carpathians (based on the tectonic development of the Valanginian to Cenomanian) occupies a great area in the Moravia-Silesian Beskids and in the Central Carpathians. Among others, it includes tectonically destroyed zones isolated little fragments, partly also it includes redeposited remains in younger beds.

We may distinguish in the flysch region two zones where between the Jurassic and Cretaceous there was an interruption of sedimentation and transport of destroyed material. Locally one of these zones represents the western part of the Czorsztyn sedimentary district in the Silesia-Těšnovice unit. Probably to the last belongs also the Frenštát region of the Godula development. It is very probable that in the Baška sedimentary district (V. Houša, 1961) and in the Frenštát region of the Godula development, the Uppermost Tithonian is primarily lacking. On the basis of a hiatus in the Baška region of the Beskid section and of sharp lithological boundaries in the Valanginian of the Godula development, we suppose that throughout the whole region further regression took place during the Valanginian. On the basis of the number of blocks of the Štramberk limestone in sandstones of the Hradiště type of the Godula development (mainly in its western part in the vicinity of Nový Jičín), we may suppose that an important emergence of the region with reefal Štramberk limestones (peninsula of Silesian reefs) had already begun in the Hauterivian. From a great extension of coarse-grained conglomerates of Chlebovice type in the Albian of the Baška development from the great number of little fragments of limestones and of younger portions of the Těšín—Hradiště suite with intrusives and from the fauna in the Ostravica sandstone (Albian-Cenomanian) (J. Foldyna, J. Šuf, 1962) we suppose that during the Albian there was a gradual emergence of the peninsula of Silesian reefs. This gradual emergence was the reason for the initiation of a source of the sand in the south, in consequence of which there developed the flysch facies of the Lower Cretaceous in the Silesia-Těšnovice unit. The stability of this source is indicated by abundant fragments of limestone in some places. The source in the Albian is indicated also by the presence of red soils in the Lower Cretaceous, descending from the neighbouring dry land (the Rudice beds). In the eastern part of the Beskid section of the Silesia-Těšnovice unit, a transition was clearly proved between thick terrigenous sedimentation in the Jurassic and Cretaceous. In the western part of the unit during the Hauterivian and especially in the Albian, there was extension and elevation of the denuded region.

As is obvious from the decreasing thickness and the lithology of the Lower Cretaceous in the Silesia-Těšnovice unit from north-east to west, definite deepening of the sedimentary basin was less marked. It is clear, too, that the Tithonian to Barremian sea covered the later elevated part of the Silesian reefs as is shown by the extension and facies of the Lower Cretaceous of the Těšnovice section. However, it seems that the ridge bordering the subsiding Silesian sedimentary basin to the south was never covered by sea during the Lower Cretaceous. The southern slope of this ridge (peninsula of Silesian reefs) was the northern edge of the Cetechovice sedimentary basin. Smaller thicknesses and more arenaceous facies of the Valanginian to Albian of the Kurovice klippen are regarded as originated farther north than the comparatively thick brown-grey marly facies of more southerly fragments (Cetechovice, Koryčany, Bělov). Both the facies we known now only from fragments at the western margin of their suggested extension. Between the Cetechovice and Czorsztyn sedimentary districts we place the relatively thicker Hluk Lower Cretaceous of the Silesia-Ždánice unit described by R. Noth (1954) near Niederhollabrunn and by R. Grill (1953) in older fragments. The Lower Cretaceous beds in the Pieniny development of lesser thickness extend farther to the south. However, in the Central Carpathians, the Lower Cretaceous does not reach the same extension and thickness as does the Godula development of the Silesia-Těšnovice unit deposited on the northern slope of the Silesian reefs (relative thicknesses on Textfig. 2).

In the Turonian the tectonic movements of the Austrian phase were important in the Central Carpathians and in the more interior parts of the flysch zone. Therefore the Turonian and Senonian in the Central Carpathians are mostly lacking and in the flysch zone there is an evident transgression.

In the biofacial relations of the Lower Cretaceous of the flysch zone submarine currents, water temperature and communication with distant basins were of a great importance. They affected the extension, number and quality of Foraminiferal and Radiolarian assemblages. Up to present we may study these biofacial relations only qualitatively.

Qualitatively completely identical microfaunas may be found in the Lower Cretaceous beds of the Těšnovice section of the Silesia-Těšnovice unit near Kurovice and in that of the Beskid section of the same unit. The microfaunas are identical not only in pyritized Radiolarian plankton, but also in the small variety of calcareous arenaceous benthos. These comprise the persistent Jurassic to Cretaceous form *Lenticulina subalata* (Reuss), *Involtina* sp., ornamented *Lenticulina* ex gr. *guttata guttata* Bart. et Brand, *Marssonella* ex gr. *oxycona* (Reuss) and *Haplophragmoides chapmani* Loeblich et Tappan.

Also qualitatively identical are the microfaunas from limestone biotopes of the Lower Valanginian, made up of nannoplankton (Infusoria) within the Silesia-Těšnovice unit (Strážovice near Kyjov) — *Calpionella alpina* Lorenz, *Calpionella elliptica* Cadisch, *Tintinnopsella carpathica* (Murg. et Filip.) and also in the Těšín and Štramberk limestones and Magura group (Cetechovice region) (V. Pokorný in F. Chmelík, 1957). Identical species of Infusoria typical of the Tithonian, Berriasian to Neocomian in the whole of the exterior flysch are also in occurences in the Central Carpathians and klippen belt (D. Andrusov, 1959). Microbenthos is also qualitatively identical in both the Cetechovice (pebbles from Bělov) and Silesia-Těšnovice sedimentary districts. This identity is manifested in comparatively numerous Ophthalmidiid Foraminifera with species: *Spirillina minima* Schacko, *Spirillina orbicula* Terquem et Berthelin, *Trocholina infragranulata* Noth, *Trocholina* sp., *Conorboides hofkeri* Bart. et Brand, *Lenticulina (Planularia) crepidularis* (Reuss), *Lenticulina eichenbergi* Bart. et Brand and *Involutina* sp. The very same type of microfauna is described from black-grey slates with glauconite sandstones of the Subsilesia-Ždánice unit from Niederhollabrunn in Austria (Noth, 1951). In the unit Ždánice it occurs in samples from the vicinity of Zástřizlí [sample 340 c, (A), 1961], where are development shallow-water associations with the predominant species *Trocholina* sp. and locally with Placopsilina which may serve as evidence of close affinities with the shallow-water Heercynian developments with rich Radiolarian plankton.

Extension of the Barremian-Aptian of the Těšín—Hradiště biofacial suite in the Cetechovice zone is very limited. Near Koryčany (8 a ST) was found the typical agglutinated associations with some affinities to the Hluk Cretaceous microfaunas and to that of the Hradiště suite. They are characterized by *Haplophragmoides spissum* Stelck et Wall, *Haplophragmoides* ex. gr. *nonioninoides* (Reuss), *Glomospira gaultina* (Grzyb.), *Verneuilinoides spiritensis* Stelck et Wall, *Haplophragmoides cushmani* Loeblich et Tappan, *Haplophragmoides glomeratoformis* Zaspělova, *Ammodiscus tenuissimus* Gümbel and *Gyroidina globosa* (v. Hagenow). These species are known from higher portions of the Těšín—Hradiště suite. They resemble, to some degree, the species of the Hluk Cretaceous.

Also the Aptian-Albian microfauna of the zone with *Bifarina calcarata* (Berthelin) is typical for many sedimentary districts. These associations are in the clastics of the Upper Eocene breccias from Strážovice near Kyjov, descending probably from the Silesia-Těšnovice unit. Further in the same unit, this zone is known in the vicinity of Zdounky and it is typical for the Baška development of the Silesia-Těšnovice unit, especially for the Chlebovice beds. We may find it, also in the Lhota—Baška beds in the vicinity of Staříč. This zone is very extended in the Magura group (Cetechovice region) not only in the anticlinal zone of Salaš south-east of Stará Huť, but also south-east of Koryčany.

The quality and quantity of microfossils in this zone is very stable. It is composed mainly of Radiolarian plankton of the Baška beds-type. Among the benthonic Foraminifera it contains the species of the English Gault of the Hercynian sedimentary region and the Aptian to Albian of south-west Germany, Belgium etc. Among the important species we quote: *Bifarina calcarata* (Berthelin) which especially in occurences near Koryčany and Zdounky, reaches 0,8 mm in lenght, despite the occurrences in the Beskid region. Very frequent are: *Lenticulina (Astacolus) scitula* (Berthelin), *Lenticulina* ex gr. *gaultina* (Berthelin), *Lenticulina* ex gr. *münsteri* (Roemer), *Marssonella* ex gr. *turris* d'Orb., *Ramulina globulifera* Brady, *Frondicularia loryi* (Berthelin), *Glomospira gaultina* (Berthelin), *Ramulina aculeata* (d'Orb.), *Lenticulina rotulata* (Lamarck), *Lenticulina subgaleata* (Reuss), *Lenticulina (Astacolus) calliopsis* (Reuss), very rarely occurs *Haplophragmoides cushmani* Loeblich et Tappan and *Bigenerina complanata* (Reuss). Also abundant in the vicinity of Koryčany are smooth types of Ostracoda.

From the Central Carpathian province up to present, this zone is unknown. It indicates a comparatively shallow, well aerated sea with good communication with the exterior flysch zone. It marks an extension of this Aptian-Albian sea to the south to the Hluk sedimentary district. It does not extend to the region of the klippen belt (boring Gbely H-6).

On the basis of the above-mentioned biofacial relations we may suppose that the peninsula of Silesian reefs was in the Lower Cretaceous covered by a shallow-water sea from which emerged at the beginning of the Cretaceous (mainly an outer margin of the peninsula) and then also the Czorsztyn region. In the Aptian to Albian the Alpine tectonic movements began to separate (the Manín phase of D. Andrusov, 1959). They manifested themselves in an elevation of the original margin of the Silesian reef peninsula and in the area of the interior klippen belt and Central Carpathians, where these movements were most intensive. The absence of the zone with *Bifarina calcarata* marks an extensive interruption of sedimentation at the beginning of the Albian.

Our knowledge of biofacial relations allows us to make the above-mentioned reconstruction of paleogeographical conditions in the Lower Cretaceous. The Jurassic and Lower Cretaceous in sediments lying originally on the peninsula of the Silesian reefs (which at the end of the Cretaceous and beginning of the Paleogene were strongly elevated) were in the main denuded, and they are preserved only in little patches or redeposited beds.

II. TURONIAN TO MAASTRICHTIAN OF THE CARPATHIAN FLYSCH ZONE

A. *The Subsilesia-Ždánice unit* (Textfigs. 4, 5, 6, 7)

In the most exterior unit of the Carpathian flysch zone, in the Subsilesia-Ždánice unit, we know the uppermost Jurassic, but we do not know any member of the Cretaceous succession older than Turonian. In the form of fragments in breccias and conglomerates occur the Albian sandstones (J. Oppenheimer, 1906; E. Hanzlíková, 1955) near Kyjov which, however, represent a tectonic constituent of the molasse-like Ždánice—Hustopeče beds of the Subsilesia-Ždánice unit. Older members of the Cretaceous were found in this unit south-west of this area in Austria (Korneuburg near Niederhollabrunn, R. Noth, 1951; R. Grill, 1953), and in the north-east in Poland (M. Książkiewicz, 1951). Also in our territory, the geographical and stratigraphical extension of the Cretaceous beds increases in the Ždánice-Subsilesian unit to the south-west and north-east, eventually also in the north-east, so that the Jurassic and lowermost Cretaceous beds (Turonian) are known only in the south-west and north-east parts of the unit.

These facts allow us to distinguish three sections of the Cretaceous in the

Subsilesia-Ždánice unit: in the south-west the Pavlovské kopce-Waschberg section; in Central Moravia, the Ždánice section and in the south-east part of Czechoslovak territory, the Beskid section. While in the Beskid section, the Upper Cretaceous represents a main part of the Subsilesia-Ždánice unit in the Pavlovské kopce-Waschberg and Ždánice sections, its extension is insignificant.

In the Pavlovské kopce-Waschberg section the Upper Cretaceous is represented by the lower Upper Turonian (Klement beds in Pavlovské kopce). This Turonian lies transgressively on the Tithonian Ernstbrunn limestone, in Austria it also lies on claystone and sandy Hauterivian. The thickness of these beds in Czechoslovakia does not surpass 15—30 m. In Austria it reaches perhaps 100 m (D. A n d r u s o v, 1959). The Turonian beds are made up of sandstones and sands, of greenish claystones with interlayers of glauconitic calcareous or siliceous claystones with interlayers of glauconitic calcareous or siliceous-calcareous sandstones of 25 cm thickness. The sandstones of higher interbeds frequently contain numerous pebbles (A. M a t ě j k a, 1960). They yielded to M. G l a e s s n e r (1931) Inoceramus macrofauna (genera *Callelistoceramus*, *Sphaeroceramus*, *Striatoceramus*, *Inoceramus incostans* W o o d s, *Inoceramus latus* F i e g e) and the ammonite (*Scaphites* cf. *geinitzi* d' O r b.) which mark the lower part of the Upper Turonian. They carry a planktonic microfauna (V. P o k o r n ý, 1958) with *Globotruncana* ex gr. *marginata* (R e u s s), *Gümbelina globulifera* (R e u s s), *Globigerina* and other species. We cannot make a detailed comparision with the Bohemian Cretaceous. The plankton may be of Upper Turonian to Coniacian age (zone X of the Bohemian Cretaceous).

In the same part of the Subsilesia-Ždánice unit there still occurs a 200—300 m thick development of the Upper Cretaceous (Campanian to Maastrichtian). They are made up of grey, greenish-grey, locally green-grey, fine arenaceous calcareous claystones, locally with belts of glauconitic marls and calcareous finegrained sands and sandstones. They yielded *Belemnitella mucronata* (E. S u e s s, 1852, revised by M. G l a e s s n e r, 1931). The age was proved also micropaleontologically (E. H a n z l í k o v á, 1956; V. P o k o r n ý, 1959, see A. M a t ě j k a, 1960) (Texfig. 1).

In the Turonian and Senonian faunas of the Pavlovské kopce-Waschberg section of the unit there was evidently paleogeographical influence of Middle Europe (D. A n d r u s o v, 1959) as well as in the Turonian of the Beskid section (E. H a n z l í k o v á, 1961). Besides the Upper Senonian there occurs the so-called Brudendorf development (O. K ü h n, 1930, 1960) of lowermost Paleogene (Danian) age made up of grey marls with sandstones and Lithothamnium limestones in the Austrian part of the Pavlovské kopce-Waschberg section. It grade up from the Upper Senonian (D. A n d r u s o v, 1959; O. K ü h n, 1960). The Lower Senonian was not found in this section of the Subsilesia-Ždánice unit.

In the Beskid section of the Subsilesia-Ždánice unit the Middle Turonian to Lower Maastrichtian is represented by the Frýdek beds which grade upwards into younger beds. In these younger beds (the so-called Třinec beds), or in variegated subsilesian beds are represented not only the uppermost parts of the Upper Cretaceous, but also the Paleocene to Upper Eocene. The Frýdek beds are predominantly calcareous duststones of brown-grey colour in the main solid, but frequently regularly disjunctive. In these beds are numerous interlayers of laminae of fine-grained to medium-grained, locally non-calcareous

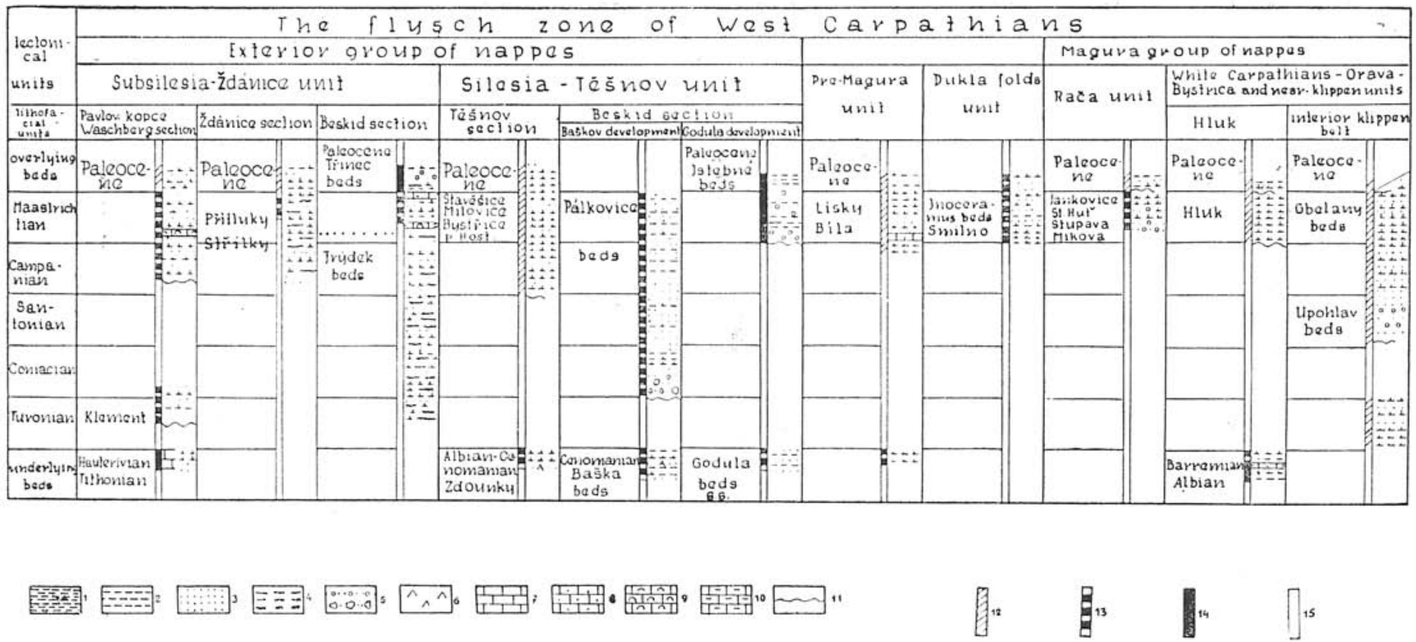

Fig. 4. Turonian to Maastrichtian of the flysch zone of Czechoslovak Carpathians. 1 — claystones, 2 — calcareous claystones, 3 — sandstones, 4 — aleurites, 5 — conglomerates breccias, 6 — chers, 7 — limestones, 8 — sandy limestones, 9 — reefal limestones, 10 — pelitomorph limestones, 11 — interruption of sedimentation, 12 — facies with black-grey pelites, 13 — facies with spotted pelites. 14 — facies of black and black-grey pelites, 15 — facies of grey pelites.

light-grey sandstone. Exclusively also have occurs a coarse-grained sandstone. The claystones and sandstones contain frequently carbonized plant remains, mica and isolated pebbles and blocks of limestone (locally crinoidal), Carboniferous sandstone (with diameter of some m), pebbles of quarzite, conglomerate and quartz. Admixtures of glauconite (distinct in the uppermost Senonian beds of the Ždánice section of the unit) in the Frýdek beds of the Beskid section was not observed. Glauconite is here mostly in redeposited roundish grains. Aggregates of pyrite and very rare pyritized ammonites show that the pyrite is authigenic. The thickness of the Frýdek beds is several hundreds m.

The Frýdek beds carry an ammonite fauna [*Baculites hochstetteri* Liebus, *Puzosia* sp. ind. aff. *planulata* Sow., *Scaphites (Discoscaphites) constrictus* (Sow.), and also *Inoceramus* sp., *Pinna* sp., *Belemnites* and traces of *Vermes* (*Keckia* sp.)]. The Turonian and Lower Senonian members carry a foraminiferal microfauna. This microfauna contain abundant species and specimens of a shallow-water character and numerous index fossils typical of the Mediterranean province; also some species typical of saxonian basins (locally 20 per cent). The rich microfauna allows zonation of the beds from Turonian to Maastrichtian into 5—7 biostratigraphical zones. Important index fossils here are: *Praeglobotruncana* aff. *helvetica* (Bolli), *Globotruncana* ex gr. *renzi* (Gandolfi), *Globotruncana arca* (Cushman), *Globotruncana citae* Bolli,* *Globotruncana contusa* (Cushman), *Gümbelina globulosa* (Ehrenberg), *Gümbelina striata* (Ehrenberg), *Pseudotextularia elegans* (Rzehak), *Pseudotextularia acervulinoides* (Egger), and a variety of benthonic species including the index fossils: *Bolivina incrassata* (Reuss), *Bolivinoides delicatula* (Cushman), *Lenticulina stephensoni* (Cushman), many species of *Cibicides, Eponides, Gyroidina, Anomalina* etc. (E. Hanzlíková, 1960; E. Hanzlíková, V. Pesl, E. Menčík, 1952; E. Hanzlíková, F. Picha, I. Cicha, 1962; Table 7).

The Třinec beds of higher Maastrichtian and Danian belong to the facies of spotted claystones. The facies of black-red claystones and sandstones occurs predominantly in younger beds. The facies characterized by intercalations of red claystones (variegated subsilesian beds) in the Turonian to Maastrichtian of the Beskid section of the Subsilesia-Ždánice unit was not found. The Třinec beds in facies of spotted claystones are predominantly made up of claystones, locally calcareous, alternating in bands or thicker layers of white-grey, black-grey, black, greenish, bluish, yellowish-grey, green-grey to yellow-green, locally brownish-grey to dark-grey (chondritic) spotted. The claystones composed of coloured bands form layers up to some m thickness. They contain mica. The sandstones are individually of some cm thick (maximum 30 cm). They are fine-grained to coearse-grained, light-grey, calcareous with scarce glauconite, with mica on the bedding planes. Locally they contain carbonized remains of plants. Rarely observed were their intercalations of pelosiderites, shells of Mollusca, quite abundant pebbles of limestone (Tithonian to Danian) of Carboniferous sandstone and claystone (up to 35 cm in diameter).

The microfauna is predominantly composed of benthonic Foraminifera. Among important species are *Reussella szajnochae* (Grzyb.), *Palmula primitiva*

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* Taxionomy of this species is not clear. It resembles *Globorotalia membranacea* Ehrenberg and also *Globorotalia pschadae* Keller.

Table 7. Subsilesia—Ždánice unit. Pavlovské kopce — Waschberg section

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Mastrichtian	Danian
Globotruncana ex gr. *marginata* (Reuss)	xx	..	..	..	..	..
Gümbelina globulifera (Reuss)	xx	..	..	..	..	..
Radiolaria indif.	xx	..	..	..	..	..
Globotruncana coronata (Bolli)	xx	..	..	..	..	..
Arenobulimina preslii (Reuss)	xx	..	..	..	..	..
Ataxophragmium cf. *trochoideum* (Reuss)	xx	..	..	..	..	..
Anomalina kelleri Mjatliuk	xx	..	..	..	..	..
Globotruncana globigerinoides Brotzen	xx	x.	..	..	..	..
Praeglobotruncana inornata (Bolli)	xx	.	..	..	..	..
Praeglobotruncana ex gr. *schneegansi* (Sigal)	xx	x.	..	..	..	..
Gümbelina globulosa (Ehrenberg)	xx	xx	..	..	..	..
Globorotalites michelinianus (d'Orb.)	xx	xx	..	..	..	..
Pernerina depressa (Perner)	xx	x.	..	..	..	..
Globigerina ex gr. *cretacea* d'Orb.	xx	xx	..	..	..	..
Globotruncana bulloides (Vogler)	..	..	..	xx	..	..
Loxostomum eleyi (Cushman)	..	..	..	.x	..	..
Stensiöina exsculpta gracilis Brotzen	..	..	..	.x	..	..
Stensiöina dictyon Pokorný	..	..	..	.x	..	..
Globotruncana tricarinata (Quereau)	..	..	..	xx	x.	..
Globotruncana thalmanni Gandolfi	..	..	..	xx	..	..
Globotruncana stuarti (Lapparent)	..	..	..	xx	xx	..
Globotruncana arca (Cushman)	..	..	..	xx	xx	..
Eponides sparksi White	..	..	..	.x	xx	..
Pleurostomella austiniana (Cushman)	..	..	..	.x	xx	..
Pullenia cretacea Cushman	..	..	..	.x	xx	..
Neoflabellina rugosa (d'Orb.)	..	..	..	.x	xx	..
Reussella szajnochae (Grzyb.)	..	..	..	.x	xx	..
Bolivinoides pustulata Reiss	..	..	..	.x	..	..
Bolivinoides decorata (Jones)	..	..	..	.x	xx	..
Rugoglobigerina rugosa (Plummer)	..	..	..	..	xx	..
Gümbelina globulosa (Ehrenberg)	..	..	..	..	xx	..
Gümbelina costata Cushman	..	..	..	.x	xx	..
Dorothia bulletta (Carsey)	..	..	..	.x	xx	..

Explanation: x = occurence of frequent or important microfossil.

Cushman, *Palmula jarvisi* Cushman, *Aragonia velascoensis* (Cushman), *Rzehakina* div. sp. and *Reophax trinitatensis* (Cushman et Renz) and *Hormosina ovulum* (Grzyb.). Very rare is Globotruncana and Chiloguembelina plankton (see planktonic Foraminifera on Table 2). The thickness of the Těšnov beds of Cretaceous age in the Beskid section is of no importance.

We regard as belonging to the Ždánice section of the Subsilesia-Ždánice unit the small occurence of the Campanian found by V. Pokorný (1954) near Střílky. It is made up of grey calcareous claystones, partly fine-arenaceous with infrequent interbeds of fine-grained, blue-grey calcareous sandstones of 1–10 cm thickness (A. Matějka, 1960). The microfauna and lithology is identical with that of the Campanian and Lower Maastrichtian of the Frýdek beds. The species content corresponds with that of the biostratigraphical zone with *Globotruncana citae* B o l l i* of the Beskid section.

To the Ždánice section belong also occurrences of higher Campanian to Maastrichtian found between Zaječí and Přítluky. They are represented by grey, locally green-grey fine-arenaceous calcareous claystones, locally with belts of glanconitic marly sands and layers of green and white-grey sandstones (A. M a t ě j k a, 1960) (Textfig. 4).

In connection with beds of the Turonian to Maastrichtian we may distinguish three different sections of the Subsilesia-Ždánice unit as follows: Pavlovské kopce-Waschberg section (contains like the Beskid section the Turonian beds). In contrast to the Beskid section, in Pavlovské kopce-Waschberg section is proved the transgressive character of the Turonian beds lying on the Tithonian to Hauterivian. The Lower Senonian was not found in the Pavlovské kopce-Waschberg section. On the basis of the unconformable extension of the Turonian and Upper Senonian beds we may suggest that the older Senonian in the Pavlovské kopce-Waschberg section corresponds to a stratigraphical hiatus.

Both the extension and the thickness of the Upper Senonian in the Pavlovské kopce-Waschberg section and in the Beskid one are greater than those of the Turonian to Lower Senonian. In the Ždánice section consequently occur only slightly younger Senonian beds. In comparision with neighbouring sections it is less arenaceous and also its extension and thickness is essentially smaller than in the Beskid section. The primary differences of the Ždánice section in comparison with the neighbouring sections are that in both the neighbouring sections there are developed in the Danian to Paleocene Lithothamnium

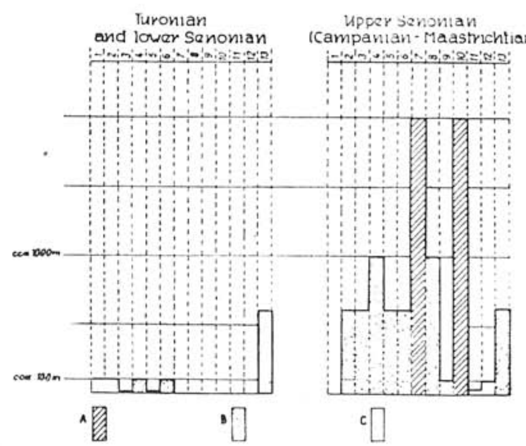

Fig. 5. Thickness of beds in the Turonian and Senonian of the flysch zone of Czechoslovak Carpathians. *A* — typical flysch, *B* — flysch-like developments, *C* — non-flysch developments. 1 — autochthon-Bohemian massive, 2 — Pavlovské kopce — Waschberg section of the Subsilesia-Ždánice unit, 3 — Ždánice section, 4 — Beskid section, 5 — Těšnov section of the Silesia-Těšnov unit, 6 — Baška region of the Beskid section, 7 — western region of the Godula development, 8 — eastern region of the Godula development, 9 — Pre-Magura unit, 10 — Dukla folds unit, 11 — Magura group — Cetechovice region, 12 — Magura group — Hluk region, 13 — Magura group — region of the interior klippen belt.

* See p. 62.

limestones (or sandstones) absent in the Ždánice section. As was mentioned above (E. Hanzlíková, 1961, see in Z. Roth, E. Hanzlíková, I. Cicha, 1962) we may see in the Turonian and Lower Senonian of the Beskid section of the Subsilesia-Ždánice unit as in the Pavlovské kopce-Waschberg section (see D. Andrusov, 1959) distinct affinity of the faunas carried by beds of the platform Cretaceous of the same age in Bohemia and north-eastern Moravia. Thus we may explain paleogeographically the formerly found (E. Hanzlíková, 1954) affinities between the Cenomanian to Lower Senonian microfauna in the north-eastern part of the interior Silesia-Těšnov unit and of the Bohemian massif. This affinity is also in lithology. As was mentioned by E. Menčík (1962) the grey facies of the Turonian to Lower Maastrichtian (mainly Campanian) (= Frýdek beds sensu Z. Roth, 1962) is restricted, apart from small occurrences near Střílky, to its Beskid section. Other parts of the Turonian and Senonian in the Subsilesia-Ždánice unit are made up of greenish-grey claystones with glauconitic sandstones, which at the end of Maastrichtian predominated. Lithologically this facies shows more affinities to the facies of the platform Cretaceous in Bohemia and Moravia than to other facies. Facies with red claystones in the Subsilesia-Ždánice unit appear in Poland. On our territory it is only in inner units, especially in the Těšnovice section of the Silesia-Těšnovice unit (E. Menčík, V. Pesl, M. Plička, 1955) and the pre-Magura unit (A. Matějka, Z. Roth, 1956). In the Těšnovice section these beds occur near the eastern end of this unit near Sanok in Poland, in place of the Istebná beds.

We may suggest that the three sections mentioned in the Subsilesia-Ždánice unit were fundamentally different, especially in the Turonian and Paleocene. The Upper Cretaceous displayed mainly in the Beskid section, is restricted to the interior part of the other sections. Its absence in the exterior anticlinal zones of the Ždánice section and its character in the Pavlovské kopce-Waschberg section indicate its primary narrow extension.

B. *The Silesia-Těšnovice unit*

As in the Lower Cretaceous so also in the Upper Cretaceous we may see some differences in lithological development of the Těšnovice and Beskid sections of the unit. In the cover of Zdounky fragment of the Lower Cretaceous near Stavěšice, Milovice and Crčovice the Campanian to Maastrichtian is developed in the form of olive-green, green-grey and grey calcareous claystones with uncommon red-brown smudges in the Maastrichtian (E. Menčík, V. Pesl, M. Plička, 1955; A. Matějka, 1960). Similar beds of a greater extension and thickness (more than 300 m) occur in the southern and south-eastern vicinity of Bystřice pod Hostýnem. They are made up of predominantly dark (frequently bluish and greenish) grey calcareous claystones, locally hard, and less arenaceous. Beds of some m thickness are separated by bands to layers of fine, locally medium-grained, light-grey, locally green-grey glauconitic calcareous or non-calcareous sandstone with mica (Z. Roth, 1959, 1962 a).

By the character of the microfauna they correspond to the Campanian and Maastrichtian. By its quality, the microfauna resembles that found in the Silesia-Ždánice unit and in some Pienidy developments and Upper Cretaceous of the pre-Magura unit (E. Hanzlíková, 1959—1962). The Upper Cretaceous beds occurring near Bystřice pod Hostýnem contain the very same foraminiferal microfauna as the Upper Cretaceous of the frontal zone of the Magura group in Chřiby (in frontal part of which lies the Těšnovice section of the Subsilesia-Ždánice unit). According to V. P e s l, E. M e n č í k (1958, p. 211) it is doubtful if this occurrence belongs to the Magura group. Micropaleontologically and lithologically it is more like a fragment of the Upper Cretaceous of the Těšnov section of the Silesia-Těšnovice unit folded at the contact with the marginal part of the Magura development. E. M e n č í k and V. P e s l (1958) describe these rocks from Chřiby in the vicinity of Újezd as green-grey and dark-grey fine-arenaceous calcareous claystones, tectonically separated from variegated Paleocene beds. The thickness of these beds is only some m. They carry a microfauna of the Campanian to Danian (Table 11).

In the Beskid section of the Silesia-Těšnovice unit, the Upper Cretaceous is made up of the Istebná beds in the Godula development and of the Pálkovice beds in the Baška development.

The Istebné beds in the western part of their outcrops (near Rožnov pod Radhoštěm and Valašské Meziříčí) are predominantly clayey, in the middle and eastern parts there are sandy. In the western part between Valašské Meziříčí and Predmír there are in the Istebná beds some tens m thick zones composed mainly of sandstones in the upper part, with a few hundreds m thick zones of claystones. From sandstones the most stable is a basal zone (below the variegated Paleocene beds). Higher sandstones are connected with basal zones of Predmír. From the western part of the region to Velký Polom the thickness of the Istebná beds without regard to the mentioned facial change is 1000—1200 m. In the vicinity of the Jablunkov depression where sandstone beds predominate, the thickness suddenly decreases to 400—500 m.

Claystones of the Istebná beds, in layers of some cm to some m in thickness, are dark-grey to black-grey non-calcareous, mostly fine-sandy with mica. Sandstones in 3—3,5 cm layers are arranged in predominantly sandy zones and they are mainly fine- to medium-grained, locally (mainly in basal parts) fine- to medium-conglomerate-like, arkose-like and non-calcareous. The pebbles in these beds reach 20 cm in diameter. They are composed of quartz exclusively. On Czechoslovak territory the Istebná beds yielded *Pachydiscus neubergicus* H a u e r. The microfauna and macrofauna corresponds to the Maastrichtian and Lower Paleocene (E. H a n z l í k o v á, 1960, Table 5). The Istebné beds lay on the older Cretaceous beds with tilloid conglomerates at the base they occur also higher up, but in the lower (Godula) beds they are lacking. This phenomenon we explain as a stratigraphical hiatus, corresponding to the Turonian and Lower Senonian. Lower Senonian and Campanian was not found in the Istebné beds of Poland (M. K s i ą ż k i e w i c z, 1951) nor on our territory, but the Upper Maastrichtian was found in the lower part. The Turonian was not proved here in the Godula and Parallel developments of the Silesia-Těšnovice unit, the microfauna of which is very rich (Baška and Těšnovice developments).

The Pálkovice beds represente an equivalent of the Istebná beds in the Baška development of the Silesia-Těšnovice unit. Sandstones predominate here. In the lower part they contain 1—5 m thick layers (often irregularly lens-like) of coarse-grained to fine-grained conglomerate-like (Breccia-like) calcareous sandstone, locally with glauconite. The upper part of the Pálkovice beds is characterized by alternations of fine- to medium-grained blue-grey, calcareous or

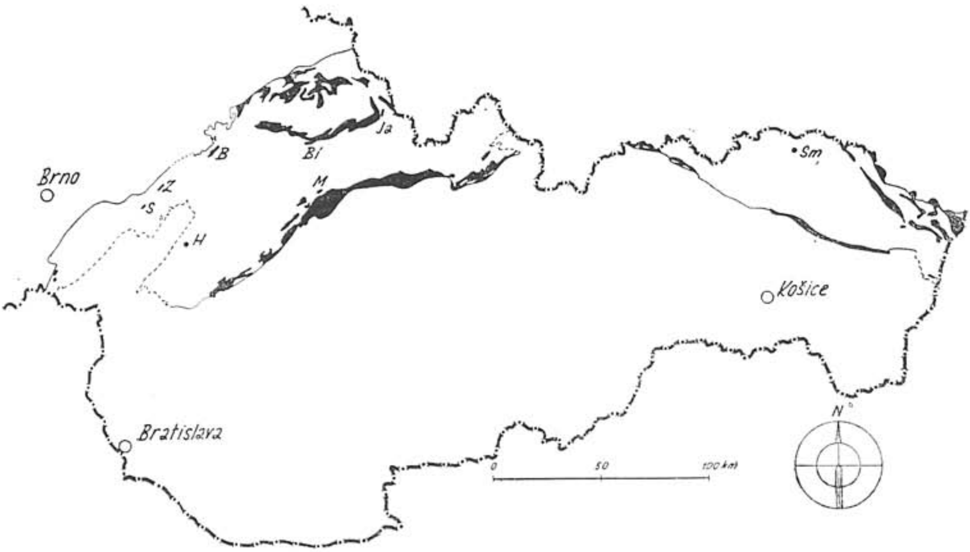

Fig. 6. Distribution of the Turonian and Senonian in the flysch zone of Czechoslovak Carpathians. *S* — Střílky, Z — Zdounky, *H* — Hluk, *Bi* — Bílá, *Ja* — Jablunkov, *Sm* — Smilno, *M* — Maríková.

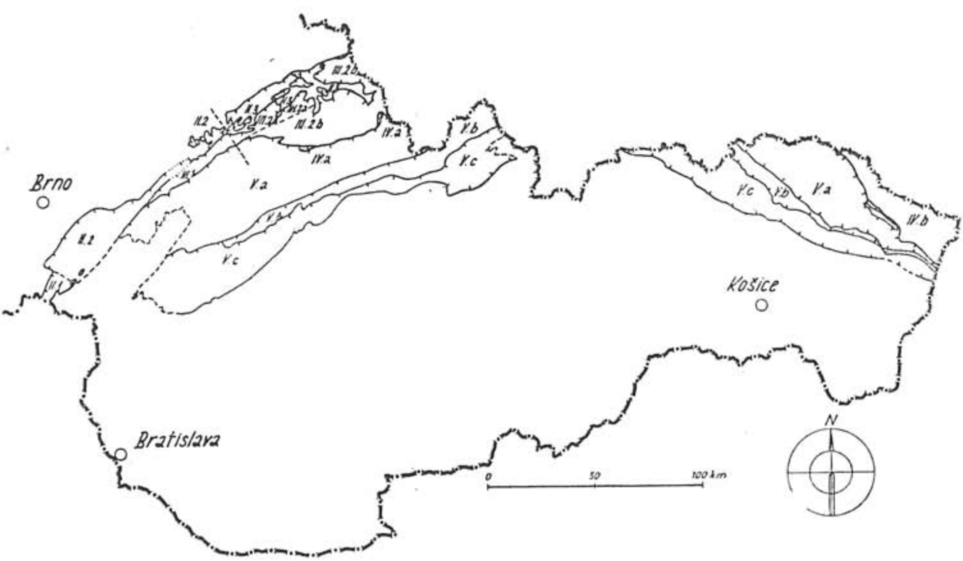

Fig. 7. Scheme of distribution of the flysch zone of Czechoslovak Carpathians in regard to extension of the Cretaceous beds. *I. Autochthonous foreland. II. Subsilesia-Ždánice unit:* II. 1. Pavlovské kopce — Waschberg zone, II. 2. Ždánice zone, II. 3. Beskid zone. *III. Silesia-Těšnovice unit:* III. 1. Těšnovice zone, III. 2. Beskid zone, III. 2a. Baška region, III. 2b. Godula region. *IVa. Pre-Magura unit, IVb. Dukla folds unit. V. Magura group:* Va. Rača unit, Vb. Bystrica unit, Vc. White Carpathians-Orava-Čerhov unit and near-klippen units.

non-calcareous sandstones at the bottom of layers (sometimes fine-conglomerate-like), locally laminated, with plant remains, in layers 3—100 cm thick, separated by 2—20 cm thick layers of grey, dark-grey (locally also darkly spotted) sandy claystones.

From the Pálkovice beds probably came *Ptychodus latissimus schlotheimi* Geinitz, found near Matylovice (A. Liebus, V. Uhlig, 1902). An impoverished microfauna marks the Lower Senonian to Maastrichtian and shows affinities with the microfauna of the Saxonian and Boreal province. The Pálkovice beds are preserved to a thickness of 350 m. They lay on the older Cretaceous with Baška beds.

As is obvious from what has gone before we may see in the Silesian unit three developments of the Upper Cretaceous. In the western part are calcareous claystones of the Těšnovice facies, resembling the Upper Cretaceous of the Subsilesia-Ždánice unit and microfacially also the pre-Magura unit. In contact with this facies is a predominantly clayey development of the Upper Cretaceous (western part of the Istebná beds). As indicated by their great thickness, the Istebná beds were deposits of a quickly deepening marine basin and then a more slowly subsiding bottom, eventually elevated in the form of submarine sills. As sediments of the elevated bottom we regard the less thick Pálkovice beds and the eastern development of the Istebná beds.

While in the Istebná beds (the Godula development of the Silesia-Těšnovice unit) the oldest member is the Maastrichtian (or probably Campanian); in the Baška development in the Pálkovice beds there is also the Lower Senonian. In the Beskid section of the Subsilesia-Ždánice unit in the Frýdek beds there is proved, besides all the Senonian, also the Middle and Upper Turonian (E. Hanzlíková, 1961; Z. Roth, E. Hanzlíková, I. Cicha, 1962). In the Bohemian massif there are the Cenomanian and Lower Turonian beds. Although the basal members of the Frýdek beds of the Subsilesia-Ždánice unit are unknown, we may suggest that the sea in Turonian times began to cover the axial part of the Beskid depression (north of Maleník, exotic sill) and in the region of the Magura group the sea penetrated contemporaneously from the southern Pienidy district where the sea had receded from the Carpathians duting the tectonic movements in the Turonian.

D. *The pre-Magura unit*

E. Hanzlíková, E. Menčík, V. Pesl (1962) regard some fragments of Upper Cretaceous in the Moravia-Silesian Beskids in the riverbasin of Bílá and Líska near Jablunkov as belonging to this unit. From the biostratigraphical view there is first of all the Maastrichtian, represented by grey-green and green-grey calcareous claystones, locally dark-grey and spotted, with interbeds of greenish-grey limestones (Textfig. 4). The Upper Maastrichtian contains besides these beds, calcareous claystones of red colour and scarce (of to 10 cm thickness) intercalations of fine-grained sandstones. This lithofacial development is very similar to that of the Upper Cretaceous of the Těšnovice section of the Silesia-Těšnovice unit, mainly at its south-western end (Textfig. 4).

E. *The Dukla folds unit*

As the tectonic equivalent of the pre-Magura unit we regard in the eastern part of the Carpathian flysch zone the unit of the Dukla folds, which is seen on Czechoslovak territory in eastern Slovakia.

To the Upper Cretaceous belong the Inoceramus beds. They occur to a thickness of 800—1000 m. Their substratum is unknown. These beds are predominantly clayey and contain only thin zones with predominant sandstones. The claystones (in layers of some cm to 3 m thick) are grey, bluish-grey, dark-grey, partly calcareous, fine-arenaceous with mica and bands of light-greenish grey claystones. The sandstones in layers of 1—120 cm thick are mostly fine- to medium-grained, calcareous (also silicocalcareous). In thin layers and in the uppermost part of thick layers, they are characterized by leaf-like splitting, by mica, and in the lower part of the thicker layers they are mostly massive. In thick sandstone layers there are abundant pebbles of sandstones. Light claystones are arkose-like. They carry the microfauna (Foraminifera) of the Maastrichtian to Paleocene (A. Matějka, 1960) (Table 8). It is possible to divide them into a lower part (Lupkov beds) of 600—800 m thickness with predominant claystones and an upper part (Cisna beds) with predominant sandstones. The claystones of the Lupkov beds are solid, dark-blue to black, frequently spotted (chondritic), calcareous with leaf-like cleavage and interlayers of massive marls. The sandstones in 10—120 cm portions are siliceous-calcareous to sandy limestones. Frequently they are laminated by light duststones (B. Leško, 1960).

The Cisna beds (B. Leško, J. Nemčok, T. Koráb, 1960) are predominantly sandy with sandstones and claystones in the proportion 10 : 1 and more. They contain, besides rocks known from the Lupkov beds, interbeds of medium-grained siliceous-calcareous sandstones to fine-grained conglomerates. The conglomerates are in the basal part of the thin-bedded sandstones, and higher up they form a smudge-like interbeds of the Upper Cretaceous members of the interior part of the exterior group of the flysch zone occur also below the Magura nappe (A. Matějka, Z. Stráník, 1961) in the tectonic window between Smilno and Nižný Mirošov (E. Hanzlíková, Z. Stráník, 1961). These beds are characteristically grey, slightly bluish claystones alternating with layers of blue-grey siliceous-calcareous laminated sandstones (3—24 cm thick). The claystones slightly pre-dominate over the sandstones. Calcareous claystones contain a planktonic Upper Cretaceous (Maastrichtian) microfauna very similar to that of the Inoceramus beds of the Dukla folds.

Between the Upper Cretaceous of the pre-Magura unit and the Cretaceous of the Dukla folds unit there are important facies changes manifested in increasing thickness eastwards, disappearance of the Maastrichtian beds with red claystones and an increasing amount of sandstone in the Dukla folds unit. Also the biotopes of the two regions are different. The biotopes of the pre-Magura unit (Table 7) shows affinities with the Pieniny biofacial development, while that of the Dukla folds represents an endemic facies of the flysch (Table 8).

F. *The Magura group*

In the Magura group, the Upper Cretaceous beds are represented only in the inner portions, i. e. in the interior klippen belt. The Mesozoic of the interior klippen belt in the western part of the Czechoslovak flysch, represents the

Table 8. Subsilesia—Ždánice unit (Beskid section)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian	Biostratigraphic zones
Praeglobotruncana stephani (Gandolfi)	ff	..	..	..	..	..	Praeglobo-
Praeglobotruncana aff. *helvetica* (Bolli)	ff	..	..	..	..	..	truncana
Allomorphina minuta Cushman	ff	..	..	..	..	..	
Gavelinopsis aff. *cenomanica* Brotzen	ff	..	..	..	..	..	
Pernerina depressa (Perner)	ff	..	..	..	..	..	
Globotruncana ex gr. *linneiana* d'Orb.	.f	ff	f.	..	..	..	
Ataxophragmium ex gr. *rimosum* (Marsson)	.f	ff	ff	..	..	..	
Spiroplectammina complanata (Carsey)	..	ff	ff	..	..	..	primitive
Saccammina sp.	..	ff	ff	..	..	..	Globotruncana
Praeglobotruncana ex gr. *renzi* (Thalmann)	..	ff	ff	..	..	..	and untypical
Globotruncana globigerinoides Brotzen	..	ff	ff	..	..	..	fauna
Globigerina cretacea d'Orb.	..	ff	ff	ff	ff	..	
Globotruncana cf. *fornicata* Plummer	..	..	ff	f.	..	..	
Globotruncana ventricosa White	..	..	.f	f.	..	..	*Gümbelina*
Gümbelina globulosa (Ehrenberg)	..	..	ff	ff	ff	..	*globulosa*
Bolivina incrassata Reuss	..	..	..	ff	f.	..	
Globotruncana arca (Cushman)	..	..	..	ff	ff	..	
Bolivinopsis delicatula (Cushman)	..	..	..	.f	ff	..	*Globotruncana*
Globotruncana citae Bolli	..	..	..	.f	f.	..	*citae*
Rugoglobigerina rugosa (Plummer)	..	..	..	.f	ff	..	
Lenticulina stephensoni (Cushman)	..	..	..	.f	ff	..	
Gümbelina striata (Ehrenberg)	..	..	..	.f	ff	..	Pseudo-
Pseudotextularia elegans (Rzehak)	..	..	..	..	ff	..	textularia and
Pseudotextularia varians Rzehak	..	..	..	..	ff	..	specific
Globotruncana mayaroensis Bolli	..	..	..	..	ff	..	Globotruncana
Globotruncana contusa (Cushman)	..	..	..	..	ff	..	
Palmula primitiva Cushman	..	..	..	..	.f	..	
Hormosina ovulum (Grzybowski)	..	..	..	..	.s	ss	
Aragonia velascoensis (Cushman)	..	..	..	..	.s	..	zone without
Reussella ex gr. *szajnochae* (Grzyb.)	..	..	..	..	ss	s.	Globotruncana
Bathysiphon taurinensis Sacco	..	..	..	..	.r	rr	
Dendrophrya div. spec.	..	..	..	..	.r	rr	
Chiloguembelina ex gr. *crinita* (Glaessner)	..	..	..	..	.r	r.	
Pseudosiderolithes heraclae (Arni)	..	..	..	..	.k	..	
Siderolithes calcitrapoides (Lamarck)	..	..	..	..	.k	..	
Coleites reticulosus (Plummer)	..	..	..	..	.k	..	
Pseudoparella toulmini (Brotzen)	..	..	..	..	.k	..	

Explanations: *f* — more frequent in lithofacies of the Frýdek beds, *s* — more frequent in lithofacies of spotted Třinec beds, *r* — more frequent in lithofacies of black—grey claystones of the Třinec beds, *k* — more frequent in lithofacies of conglomerates of the Strážov type (formerly Klokočov beds).

oldest member of the White Carpathians-Orava unit, partly also the Bystrica unit, with which we shall not deal in the present paper and the eastern part of near-klippen units. The closest development of the Upper Cretaceous to that of the interior klippen belt in the western region of the Magura group is the Upper Cretaceous of the Hluk region. Also, the Upper Cretaceous occurs in a fragmentary conditions in the exterior parts of the Rača unit as well as in both the western and eastern parts of the Czechoslovak flysch zone.

The area of the interior klippen belt at the same time represented the only part of the Czechoslovak Carpathians where the Turonian was found (E. Scheibner, V. Scheibnerová, 1958; V. Scheibnerová, 1961). Into this area, after the Austrian phase receded the Carpathian sea. The tectonics of the interior klippen belt are very complicated and therefore there are many difficulties in stratigraphical investigations.

Micropaleontologically, mainly by plankton, the Cenomanian – Lower Turonian beds are seen to grade upwards into the Senonian. Both the benthos and locally plankton are qualitatively different and show many affinities with the Senonian. These differences are distinct in the flysch-like development of the east-Slovakia part of the klippen belt more than in the western regions. As important planktonic species we regard: *Globotruncana coronata* (Bolli) developing from forms with 7–8 chambers (E. Hanzlíková, 1959, manuscript), also *Praeglobotruncana schneegansi* (Sigal), *Globotruncana* aff. *renzi* Gand., *Globotruncana* ex gr. *sigali* Reichel, higher *Globotruncana inornata* Bolli, *Globigerinella escheri clavata* (Bronnimann), *Gümbelina globulosa* (Ehrenberg) and Radiolaria. Among benthonic species the following are important: *Bulimina pusilla* (Brotzen), *Gaudryina foeda* (Reuss), *Siphogaudryina* ex gr. *carinata* (Franke), *Psudoclavulina* sp., *Stensiöina exsculpta* (Reuss), *Ramulina, Dendrophrya, Marssonella* and others.

In the Pieniny developments of the interior klippen belt, mainly in the Kysuca series, the Cenomanian grades upwards into the Lower Turonian. It is made up of red, calcareous slaty marls alternating with thin interlayers of calcareous sandstones. The thickness is 5–40 m (D. Andrusov, 1959). The beds with planktonic Foraminifera (*Rotalipora, Globotruncana* – E. Hanzlíková, 1960 – are on Table 9). (Explanations to the geological map Spišská Stará Ves, High Tatra, Košice, Považie – V. Scheibnerová, 1961; E. Hanzlíková.)

Above this portion of the Lower Turonian lies a suite of 70–200 m thickness made up of alternating dark-grey, sandy slaty marls with (up to 10 cm thickness) calcareous sandstones which predominate in the upper parts of the suite (the so-called Snežnica beds – E. Scheibner, V. Scheibnerová, 1958). To the upper part of these beds probably belong conglomerates, conglomerate-like sandstones and sandy claystones with exotic pebbles from Vranie with microfauna of the Lower Turonian (E. Scheibner, V. Scheibnerová in D. Andrusov, 1959). Between the Lower (Middle) Turonian and Santonian we may suppose the stratigraphical hiatus in the interior klippen belt.

The Senonian Upohlav beds of the western section of the Czechoslovak klippen belt lay unconformably on various members of older age. Complicated tectonic structures, however, cover the tectonic contacts. The Upohlav beds are made up of predominantly fine-grained to coarse-grained sandstones in beds up to 2 m in thickness, locally mainly exotic conglomerates. Their beds are separated by grey calcareous claystones. Among the exotic blocks are also older rocks of the Central West Carpathians and older Mesozoic rocks of the interior klippen belt (Albian to Cenomanian). Locally we may find lenses of Upper Cretaceous Rudist, Algal and Coral, coarse-grained (gravel) limestones.

Table 9. Subsilesia—Ždánice unit (Ždánice section)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Rzehakina cf. *epigona minima* Cushman & Renz	. .	. .	. .	ss	. .	. .
Globotruncana lapparenti Brotzen	. .	. .	. .	ss	. .	. .
Slensiöina labyrinthica Cushman & Dorsey	. .	. .	. .	ss	. .	. .
Gümbelina striata (Ehrenberg)	. .	. .	. .	ss	. .	. .
Globotruncana citae Bolli	. .	. .	. .	.x	x.	. .
Globotruncana arca (Cushman)	. .	. .	. .	xx	xx	. .
Pseudotextularia elegans (Rzehak)	. .	. .	. .	. .	xx	. .
Globotruncana ex gr. *fornicata* Plummer	. .	. .	pp	pp	. .	. .
Globotruncana thalmanni Gandolfi	. .	. .	. .	pp	p.	. .
Globotruncana tricarinata colombiana Gand.	. .	. .	. .	pp	p.	. .
Globotruncana arca (Cushman)	. .	. .	. .	pp	pp	. .
Globotruncana stuarti (Lapp.)	. .	. .	. .	pp	pp	. .
Globotruncana bulloides (Vogler)	. .	. .	. .	pp	p.	. .
Eponides sparksi White	. .	. .	. .	.p	pp	. .
Pleurostomella austiniana (Cushman)	. .	. .	. .	.p	pp	. .
Pullenia cretacea Cushman	. .	. .	. .	.p	pp	. .

Explanations: s — species quoted by V. Pokorný (1954) from Střílky, *x* — species found by the author (E. Hanzlíková) near Střílky, *p* — species found by the author (E. Hanzlíková) near Přítluky and Zaječí.

The microfauna indicates a Santonian to Campanian age. The thickness of the Upohlav beds is a few hundreds of m (D. Andrusov, 1959; V. Scheibnerová, 1961, Table 9).

Above the Upohlav beds there are the Gbelany beds (V. Kantorová, D. Andrusov, 1958; D. Andrusov, 1959) — the Maastrichtian part of the Púchov beds. They are made up of thick calcareous marls of light-green, grey to black and red colours, locally with thin interlayers of fine-grained (or coarse-grained) sandstones (to fine-grained conglomerates) with a rich microfauna of the Upper Maastrichtian (O. Jendrejáková, V. Kantorová, V. Scheibnerová in D. Andrusov, 1959).

To the Pieniny klippen belt are restricted the Jarmuta beds of Upper Senonian age made up of fine to coarse-grained, partly conglomerate-like sandstone in layers up to 100 m thickness which grade upwards into flysch-like sandstones with green-yellow calcareous marls.

In Orava and in eastern Slovakia in the flysch zone (E. Hanzlíková, 1958, 1960, in press) Paleogene (Paleocene-Lutétian?) lies on the Upper Cretaceous with a distinct basal breccia (see D. Andrusov, 1959, p. 324).

In the exterior marginal part of the White Carpathian unit in south-eastern Moravia appears the Upper Cretaceous in a thickness of a few tens of m, tectonically broken, together with the Hluk older Cretaceous also in a tectonic fragment near Nezdenice. It is made up of red brown calcareous marls, locally with light-green-grey spots and smudges, with a rich Maastrichtian microfauna

(E. Hanzlíková in A. Matějka, Z. Roth, 1956) (Table 10). Despite the complicated tectonics they show a distinct unconformity in regard to older beds (O. Kodym, Z. Roth, 1946).

G. *The Rača unit*

More complicated are the occurrences of the Upper Cretaceous in the frontal part of the Rača unit in Central and north-eastern Moravia. Near Újezd in Chřiby in frontal zone of the Magura group (as mentioned below) it is not clear if the Upper Cretaceous beds belong to the Magura group (see E. Menčík, V. Pesl, 1958, p. 211). Micropaleontologically and lithologically these beds belong to the fragment of the Těšnovice Cretaceous of the Silesia-Těšnovice unit over which was overthrust the Magura group. In the vicinity of Jankovice, Stará Huť and Stupava in Chřiby there were found pseudoassociations of Lower Cretaceous and Upper Cretaceous Foraminifera (E. Menčík, V. Pesl and coll., 1958). It is possible that they are younger than Cretaceous. They

Table 10. Silesia—Těšnovice unit (Těšnovice section)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Globotruncana tricarinata (Quereau)	..	..	??	mm	..	..
Globotruncana fornicata Plummer	..	..	..	mm	..	..
Globotruncana ex gr. *arca* (Cushman)	..	..	??	mm	..	..
Globotruncana cilae Bolli	..	..	..	mm	..	..
Gaudryina foeda (Reuss)	..	..	..	.m	mm	..
Bulimina parva Franke	..	..	..	.m	mm	..
Valvulineria sp.	..	..	..	.k	kk	..
Eponides bollii Cushman & Renz	..	..	..	.k	kk	..
Stensiöina exsculpta (Reuss)	..	..	..	.k	kk	..
Globotruncana arca (Cushman)	..	..	..	.z	sz	..
Globotruncana stuarti (Lapparent)	..	..	..	.z	cs	..
Globotruncana contusa (Cushman)	..	..	..	..	zc	..
Textularia dentata (Alth)	..	..	..	..	cz	..
Pseudotextularia elegans Rzehak	..	..	..	..	zs	..
Pseudotextularia acervulinoides (Egger)	..	..	..	..	zz	..
Gümbelina striata (Ehrenberg)	..	..	..	..	zz	..
Globotruncana conica (White)	..	..	..	..	ss	..
Eponides sparksi (White)	..	..	..	..	cc	c.
Hormosina ovulum (Grzyb.)	..	..	..	..	ss	ss
Trochamminoides irregularis (White)	..	..	..	..	ss	ss
Reussella szajnochae (Grzyb.)	..	..	..	..	cm	c.
Rugoglobigerina rugosa (Plummer)	..	..	..	..	cc	..
Dorothia conulus (Reuss)	..	..	..	..	cc	c.
Chiloguembelina crinita (Glaessner)	..	..	..	..	.s	s.

Explanations: *m* — occurence near Milovice, *k* — occurence from conglomerats, *s* — occurence near Stavěšice, *c* — occurence near Cvrčovice, *z* — occurence from the klippen mantles near Zdounky.

Table 11. Silesia—Těšnovice unit, Godula development (Istebná beds)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Trochammina nodosa Zaspělova	gg	..	..	..	..	..
Bathysiphon brosgei Tappan	gg	..	..	..	..	..
Rzehakina ex gr. *gaullina* (Reuss)	gg	..	..	..	..	..
Pernerina depressa (Perner)	gg	..	..	..	..	..
Gaudryina foeda (Reuss)	..	..	..	xx	xx	xx
Dendrophrya excelsa Grzybowski	..	..	..	xx	xx	xx
Globotruncana ex gr. *tricarinata* (Quereau)	..	..	..	xx	xx	..
Dendrophrya robusta Grzybowski	..	..	..	.x	xx	xx
Rzehakina minima (Cushman & Renz)	..	..	..	.x	xx	x.
Rzehakina epigona (Rzehak)	..	..	..	.x	xx	..
Rhabdammina cylindrica Glaessner	..	..	..	..	xx	xx
Hormosina ovulum (Grzyb.) div. formae	..	..	..	..	xx	xx
Nodellum velascoensis (Cushman)	..	..	..	..	xx	xx
Reophax trinitatensis (Cushman & Renz)	..	..	..	..	xx	xx
Trochamminoides irregularis (White)	..	..	..	..	xx	xx
Saccammina placenta (Grzyb.)	..	..	..	..	xx	xx
Ataxophragmium sp.	..	..	..	..	xx	..
Haplophragmoides calcula Cushman	..	..	..	..	xx	..

Explanations: xx — more frequent in the Istebná beds, *gg* — sporadic in the Godula beds.

Table 12. Silesia—Těšnovice unit — Beskid section, Baška development (Pálkovice beds)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Cibicides ribbingi Brotzen	..	xx	..	..	..	..
Cibicides excavatus Brotzen	..	xx	..	..	..	..
Cibicides sandidgei Brotzen	..	xx	..	..	..	..
Bulimina ventricosa Brotzen	..	xx	..	..	..	..
Globotruncana bulloides Vogler	..	xx	..	..	..	..
Globotruncana globigerinoides Brotzen	..	xx	..	..	..	..
Globotruncana ex gr. *linneiana* d'Orb.	..	xx	x.	..	..	..
Globigerina aspera (Ehrenberg)	..	xx	xx	..	..	..
Globotruncana ex gr. *fornicata* Plummer	..	..	xx	..	..	..
Globigerinella cf. *voluta* (White)	..	..	xx	xx	..	..
Globigerina cretacea d'Orb.	..	..	xx	xx	x.	..
Bolivina cf. *incrassata* Reuss	..	..	..	xx	x.	..
Bathysiphon taurinense (Sacco)	..	..	..	.x	xx	..
Chilostomella ovoidea (Reuss)	..	..	..	.x	xx	..
Ataxophragmium sp.	..	..	..	.x	xx	..
Eponides div. spec.	..	..	..	.x	xx	..
Rotalia div. spec.	..	..	..	..	xx	..

contain light grey-green and grey soft calcareous marls with pebbles and blocks of massive limestones, frequently with black cherts. The Cretaceous age of these beds was not paleontologically proved (drolling near Ratiškovice, Cunín and Kopčany, A. Matějka, 1960). Doubtful also is the age of the so-called Inoceramus beds close to the Czechoslovak-Poland boundary near Hrčava (Z. Roth, in press). (The Turonian to Maastrichtian microfauna in single regions on the Tables 11—17).

In the eastern section of the Czechoslovak flysch zone near Mikulová (in the inner marginal part of the Rača unit) also were found the Inoceramus beds. They are made up of blue-grey to partly calcareous claystones and calcareous (siliceous) sandstones (partly arkose-like) grading upwards into fine-grained conglomerates (with pebbles of 8 mm in diameter) in beds of 10—120 cm thickness. Near Miková they carry Inocerami (H. Świdziński, 1934). The microfauna is stratigraphically unimportant, so that their Upper Cretaceous age was not proved. In the western part of the Rača unit redepositions of the Upper Cretaceous fossils were redeposited into beds of the Lower Eocene. The Paleo-

Table 13. Pre-Magura unit

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Marssonella oxycona (Reuss)	..	..	..	xx	xx	xx
Dendrophrya excelsa Grzyb.	..	..	..	xx	xx	xx
Globotruncana ex gr. *arca* (Cushman)	..	..	..	xx	xx	..
Globotruncana stuarti (Lapparent)	..	..	..	xx	xx	..
Globotruncana tricarinata (Quereau)	..	..	..	xx	xx	..
Globotruncana ex gr. *linneiana* d'Orb.	..	..	..	xx	xx	..
Pseudogaudryina capitosa (Cushman)	..	..	..	.x	xx	xx
Saccammina placenta (Grzyb.)	..	..	..	..	xx	xx
Hormosina div. spec.	..	..	..	..	xx	xx
Rzehakina div. spec.	..	..	..	..	xx	xx
Dorothia bulletta (Carsey)	..	..	..	..	xx	..
Textulariella div. spec.	..	..	..	..	xx	..
Aragonia trinitatensis (Cushman & Renz)	..	..	..	..	xx	..
Stensiöina whitei Morozova	..	..	..	..	xx	..
Rugoglobigerina rugosa (Plummer)	..	..	..	..	xx	..
Rugoglobigerina div. spec.	..	..	..	..	xx	..
Globotruncana contusa (Cushman)	..	..	..	..	xx	..
Gümbelina striata (Ehrenberg)	..	..	..	..	xx	..
Pseudotextularia elegans Rzehak	..	..	..	..	xx	..
Reussella szajnochae (Grzyb.)	..	..	..	..	xx	x.
Eponides div. spec.	..	..	..	..	xx	x.
Spiroplectammina dentata (Alth)	..	..	..	..	.x	..
Stensiöina cf. *caucasica* Subbotina	..	..	..	..	.x	x.
Eponides bollii Cushman & Renz	..	..	..	..	.x	..
Globotruncana mayaroensis Bolli	..	..	..	..	.x	..
Globigerina div. spec.	..	..	..	..	..	xx
Radiolaria	..	..	..	..	..	xx

Table 14. Dukla folds unit (Eastern Slovakia)

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Dendrophrya excelsa Grzybowski	..	..	..	xx	xx	xx
Globotruncana ex gr. *tricarinata* (Quereau)	..	..	..	xx	xx	..
Globotruncana ex gr. *arca* (Cushman)	..	..	..	xx	xx	..
Saccammina placenta (Grzyb.)	..	..	..	..	xx	xx
Hormosina excelsa (Dalażanka)	..	..	..	..	xx	xx
Hormosina ovulum (Grzyb.)	..	..	..	..	xx	xx
Rzehakina ex gr. *epigona* (Rzehak)	..	..	..	..	xx	xx
Rzehakina minima (Cushman & Renz)	..	..	..	..	xx	xx
Plectina fallax (Grzybowski)	..	..	..	..	xx	xx
Plectina lenis (Grzybowski)	..	..	..	..	xx	xx
Reophax trinitatensis (Cushman & Renz)	..	..	..	..	xx	xx
Thalmannammina div. spec.	..	..	..	..	xx	xx
Cibicides propriurus Brotzen	..	..	..	..	xx	..
Chiloguembelina ex gr. *morsei* (Kline)	..	..	..	..	.x	x.
Radiolaria	..	..	..	..	..	xx
Globigerina div. spec.	..	..	..	..	..	xx

Table 15. Magura unit — particular White Carpathians-Orava unit and particular near-klippen units in Eastern Slovakia Region of the interior klippen belt

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Praeglobotruncana delrioensis turbinata (R.)	x.	..	..	..	..	..
Praeglobotruncana oraviensis Scheibnerová	x.	..	..	..	..	..
Trochammina welleri Stelck & Wall	xx	..	..	..	..	..
Gaudryina (S.) *carinata* (Franke)	xx	..	..	..	..	..
Dorothia kaskapauensis Stelck & Wall	xx	..	..	..	..	..
Marssonella oxycona (Reuss)	xx	..	..	..	..	..
Pseudoclavulina ex gr. *eggeri* Cushman	xx	..	..	..	..	..
Praebulimina pusilla (Brotzen)	xx	..	..	..	..	..
Gyroidinoides nitida (Reuss)	xx	..	..	..	..	..
Praeglobotruncana stephani (Gandolfi)	xx	..	..	..	..	..
Praeglobotruncana ex gr. *helvetica* (Bolli)	xx	..	..	..	..	..
Praeglobotruncana imbricata (Mornod)	xx	..	..	..	..	..
Globotruncana sigali Reichel	xx	..	..	..	..	..
Globotruncana ex gr. *linneiana* d'Orb.	.x	..	xx	xx	..	..
Globotruncana ex gr. *tricarinata* (Quereau)	..	..	xx	xx	x.	..
Globotruncana fornicata Plummer	..	..	xx	x.	..	..
Stensiöina exsculpta (Reuss)	..	..	xx	x.	..	..
Aragonia sotchiana (Keller)	..	..	xx	xx	..	..

Continuation

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Globotruncana ventricosa White	..	..	.x	x.	..	..
Globotruncana ex gr. *elevata* Brotzen	..	..	..	xx	..	..
Stensiöina dictyon Pokorný	..	..	..	xx	..	..
Steinsiöina pommerana Brotzen	..	..	..	xx	xx	..
Reussella szajnochae (Grzyb.)	..	..	..	xx	xx	x.
Gümbelina globulosa (Ehrenberg)	..	..	..	xx	x.	..
Globotruncana ex gr. *arca* (Cushman)	..	..	..	xx	xx	..
Globotruncana stuarti (Lapparent)	..	..	..	.x	xx	..
Aragonia trinitatensis (Cushman)	..	..	..	.x	xx	..
Bolivinoides decorata (Jones)	..	..	..	.x	xx	..
Orbitoides apiculata Schlumb.	..	..	..	..	xx	..
Orbitoides media Arch.	..	..	..	..	xx	..
Globotruncana contusa (Cushman)	..	..	..	..	xx	..
Neoflabellina reticulata (Reuss)	..	..	..	..	xx	..
Neoflabellina rugosa (d'Orb.)	..	..	..	..	xx	..
Pseudotextularia elegans Rzehak	..	..	..	..	xx	..
Pseudotextularia acervulinoides (Egger)	..	..	..	..	xx	..
Bolivinoides draco (Marsson)	..	..	..	..	xx	..

Table 16. Magura group — particular White Carpathians-Orava unit Hluk region

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Trochammina globigeriniformis (J. & P.)	..	..	..	xx	xx	xx
Dendrophrya excelsa Grzybowski	..	..	..	xx	xx	x.
Reussella szajnochae (Grzybowski)	..	..	..	xx	xx	x.
Pseudogaudryina pyramidata (Cushman)	..	..	..	xx	xx	..
Globotruncana ex gr. *arca* (Cushman)	..	..	..	xx	xx	..
Globotruncana stuarti (Lapparent)	..	..	..	xx	xx	..
Neoflabellina rugosa (d'Orb.)	..	..	..	..	xx	..
Pseudoparella alata (Marsson)	..	..	..	..	xx	..
Rugoglobigerina rugosa (Plummer)	..	..	..	..	xx	..
Aragonia trinitatensis (Cushman)	..	..	..	..	xx	x.
Chiloguembelina crinita (Glaessner)	..	..	..	..	.x	xx
Hormosina ovulum (Grzybowski)	..	..	..	..	.x	x.
Glomospira irregularis (Grzybowski)	..	..	..	..	.x	x.
Reophax trinitatensis (Cushman & Renz)	..	..	..	..	.x	x.
Rzehakina epigona (Rzehak)	..	..	..	..	.x	x.
Rzehakina excelsa (Dylaz.)	..	..	..	..	.x	x.
Pseudogaudryina capitosa (Cushman)	..	..	..	..	.x	x.

Continuation

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Pseudogaudryina compacta Dam & Sigal	..	..	..	..	.x	x.
Marssonella div. spec.	..	..	..	..	.x	xx
Spiroplectammina dentata (Alth)	..	..	..	..	.x	..
Pseudoclavulina amorpha (Cushman)	..	..	..	..	.x	..
Dorothia bulletta (Carsey)	..	..	..	..	.x	..
Textulariella cretosa Cushman	..	..	..	..	.x	..
Palmula jarvisi Cushman	..	..	..	..	.x	..
Eponides bollii Cushman & Renz	..	..	..	..	.x	..
Aragonia ouezzanensis Rey	..	..	..	..	..	xx
Radiolaria	..	..	..	..	..	xx

Table 17. Magura group — Rača unit

Important microfossils	Turonian	Coniacian	Santonian	Campanian	Maastrichtian	Danian
Marssonella oxycona (Reuss)	..	..	..	xx	uu	u.
Gaudryina pyramidata (Cushman)	..	..	..	xx	uu	..
Reussella ex gr. *szajnochae* (Grzyb.)	..	..	..	xx	xj	j.
Globotruncana tricarinata (Quereau)	..	..	..	xx	xj	..
Globotruncana fornicata Plummer	..	..	..	xx	u.	..
Globotruncana ex gr. *arca* (Cushman)	..	..	..	xx	jh	..
Globotruncana stuarti (Lapparent)	..	..	..	xx	jh	..
Dendrophrya robusta Grzybowski	..	..	..	.u	uu	uc
Reophax trinitatensis (Cushman & Renz)	..	..	..	.u	uu	uc
Nodellum velascoense (Cushman)	..	..	..	.c	uc	uc
Hormosina ovulum (Grzybowski)	..	..	..	.c	uc	uc
Ammobaculites fragmentarius (Cushman)	..	..	..	.c	cc	..
Haplophragmoides calcula Cushman	..	..	..	.u	uu	..
Dorothia tenuis (Grzybowski)	..	..	..	..	uu	..
Dorothia bulletta (Carsey)	..	..	..	..	uu	..
Pseudogaudryinella capitosa (Cushman)	..	..	..	..	uu	u.
Textularia dentata (Alth)	..	..	..	..	.u	..

Explanations: *u* — occurences near Újezd and Koryčany, *j* — occurence near Jankovice, *h* — occurence near Stará Huť, *c* — occurence near Cunín, x — these localities probably by the lithology and microfauna represent fragments of the Upper Cretaceous of the Těšnovice section of the Silesia—Těšnovice unit closed in the Magura unit.

cene to Lower Eocene lies transgressively on the older Cretaceous beds of the Rača unit near Kurovice (E. Menčík, V. Pesl, 1958).

The extent of the Upper Cretaceous in the Rača unit is very little known. We may say surely that in this zone as well as in the Magura (in the Mesozoic of the inner parts of this group) and mainly in the interior klippen belt where was a hiatus of great importance between the Paleocene and Upper Cretaceous, locally lasting the Middle Eocene.

Conclusion

1. While in the Magura group the sedimentary cycle of the older Mesozoic ended by the Turonian, in the exterior group on Czechoslovak territory, the Turonian marked a beginning of a new Upper Cretaceous transgression from the frontal part of the Carpathians. In general the Senonian (mainly its upper part) is transgressive.

2. While the flysch development of the Upper Cretaceous predominates in the Beskid section of the Silesia-Těšnovice unit and in the unit of the Dukla folds, in other parts of the flysch zone in the Turonian to Maastrichtian there predominated flysch-like (or other than flysch-like) developments. Beds with red claystones (calcareous) in the Upper Cretaceous are characteristic of the interior part of the Magura group, the Magura unit and south-western end of the Silesia-Těšnovice unit.

3. In the exterior parts of the Magura group and also in other exterior zones there was during the Paleocene (partly also later) denudation and redeposition of older, mainly Upper Cretaceous beds.

4. In the Subsilesia-Ždánice unit, mainly Upper Cretaceous is developed in a facies of green-grey claystones and glauconitic sandstones. A great extension of this unit is only found in the north-east Beskid section (probably primary).

5. While between the Upper Cretaceous and Paleogene in the exterior group is the flysch zone sedimentation was not interrupted, in the Magura group and in the Central Carpathians in the Paleocene sedimentation was interrupted, in consequence of movements which caused an unconformable position of the Paleogene on older beds.

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