Facial Development and Facial Relations of the Slovak Karst Middle and Upper Triassic (West Carpathians, Southern Part of Gemerids)

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3 figs., 2 pls.

Zusammenfassung

Vier Hauptfaziesgruppen können in der mittleren und oberen Trias des Slowakischen Karstes unterschieden werden: 1. Fazies des Anfangsstadiums der Karbonat-Sedimentation; 2. Fazies der Algen-Plateaus und Bioherme; 3. Fazies vom Becken-Typ; 4. Fazies der diagenetischen Dolomite (Abb. 2).

Die wesentlichen Fazies-Beziehungen in der mittleren und oberen Trias des Slowakischen Karstes können durch das folgende Schema ausgedrückt werden: Algen-Plateaus — Bioherme — Becken.

Summary

Four main groups of facies can be distinguished in the Slovak Karst Middle and Upper Triassic: 1. Facies of initial stage of carbonate sedimentation; 2. Facies of algal plains and bioherms; 3. Facies of basin type; 4. Facies of diagenetic dolomites (Fig. 2).

Basic facies relations of the Slovak Karst Middle and Upper Triassic may be expressed by the scheme: algal plains — bioherms — basins.

Introduction

The research of the West Carpathian Triassic is mostly based upon biostratigraphy, but the lithostratigraphical and facial aspects get still more important.

Numerous new data were obtained in the most southern part of the Central West Carpathians, in the Slovak Karst (Fig. 1).

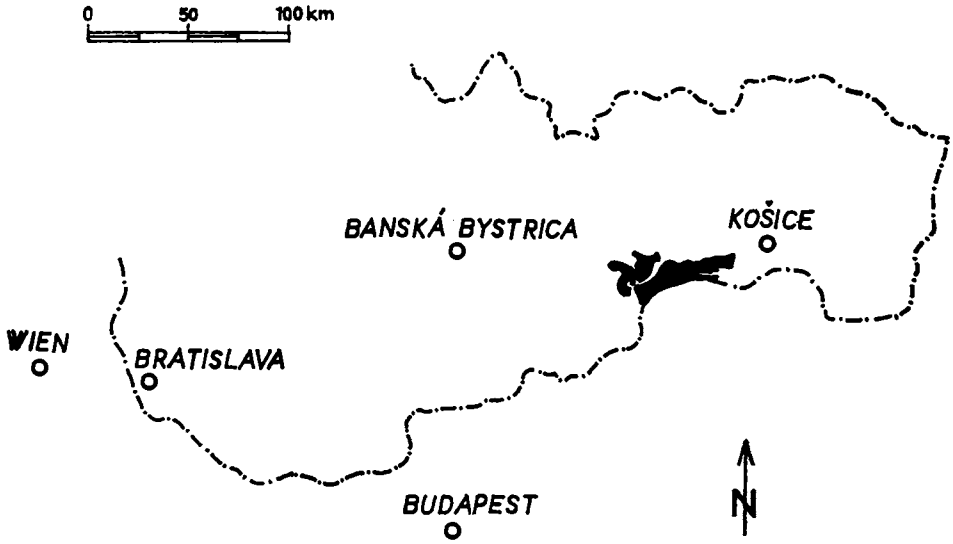

Fig. 1. Situation sketch of the area studied.

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Significant is the allochthonous position of the Slovak Karst as evidenced by the presence of the Middle and Upper Triassic beds in the "Meliata Group" indicated by conodonts (H. KOZUR — R. MOCK 1973).

The present paper is only dealing with facial evolution and facial relationships of the Middle and Upper Triassic of the Slovak Karst Mesozoic (the Silica nappe in the sense of H. KOZUR — R. MOCK, lit. cit.).

Facies Development of the Slovak Karst Middle and Upper Triassic

Four main groups of facies can be distinguished in the Slovak Karst Middle and Upper Triassic (Fig. 2):

A. Facies of initial stage of carbonate sedimentation
B. Facies of algal plains and bioherms
C. Facies of basin type
D. Facies of diagenetic dolomites.

Facies of the initial stage of carbonate sedimentation

Only the Gutenstein limestones and dolomites ("Hydaspian") prevailingly of micritic, pellmicritic and stromatolitic types (Pl. I, 1) belong into this group.

Organisms took part on their creation only in reduced scale (some groups of algae, ? bacteria, foraminifers, ostracods, molluscs).

Facies of algal plains and bioherms

The light-coloured massive limestones of the Slovak Karst determined the origin of extensive karst regions, owing to their thickness (about 2000—2500 m) and properties.

Recently, as follows particularly from the latest works of J. BYSTRICKY (1964, 1970, 1972), it is possible to divide the complex of light-coloured massive limestones into the Steinalm (Pelsonian — Illyrian), the Wetterstein (Ladinian — Cordevolian), the Tisovec (Julian — Tuvalian), the Furmanec (Norian) and the Limestones of the Bleskový prameň spring (Sevatian).

They are predominantly biogenic and bioclastic limestones. There are, however, considerable differences in qualitative and quantitative representation of organic remains, textures and microfacies. They reflect horizontal and vertical changes in facial conditions.

The Steinalm limestones (Pelsonian — Illyrian) are produced by the first, incomplete sedimentation stage of biogenic and bioclastic carbonates. Predominant are varied algal limestones, mainly algal stromatoliths, often with shrinkage pores textures (Pl. I, 2) and bioclastic dasycladaceous limestones (Pl. I, 3).

In comparison with the younger Wetterstein, Tisovec, or Furmanec limestones, further plant and animal assemblages (corals, sponges, stromatopores, hydrozoans, sessile foraminifers, etc.) are markedly poorer and much less variable.

Partially different are the Steinalm limestones from the adjacent Hungarian region near Aggtelek. G. SCHOLZ (1972) found there a reef complex composed mostly of corals, hydrozoans, and Sphinctozoa.

The Wetterstein limestones (Ladinian — Cordevolian). When compared with the Steinalm limestones, the spectrum of organisms sharing the composition of the limestones, is considerably more extensive. It is enlarged by calcareous sponges (particularly Sphinctozoa), hydrozoans, stromatopores, various problematic elements, and Solenopores and Codiaceae among algae.

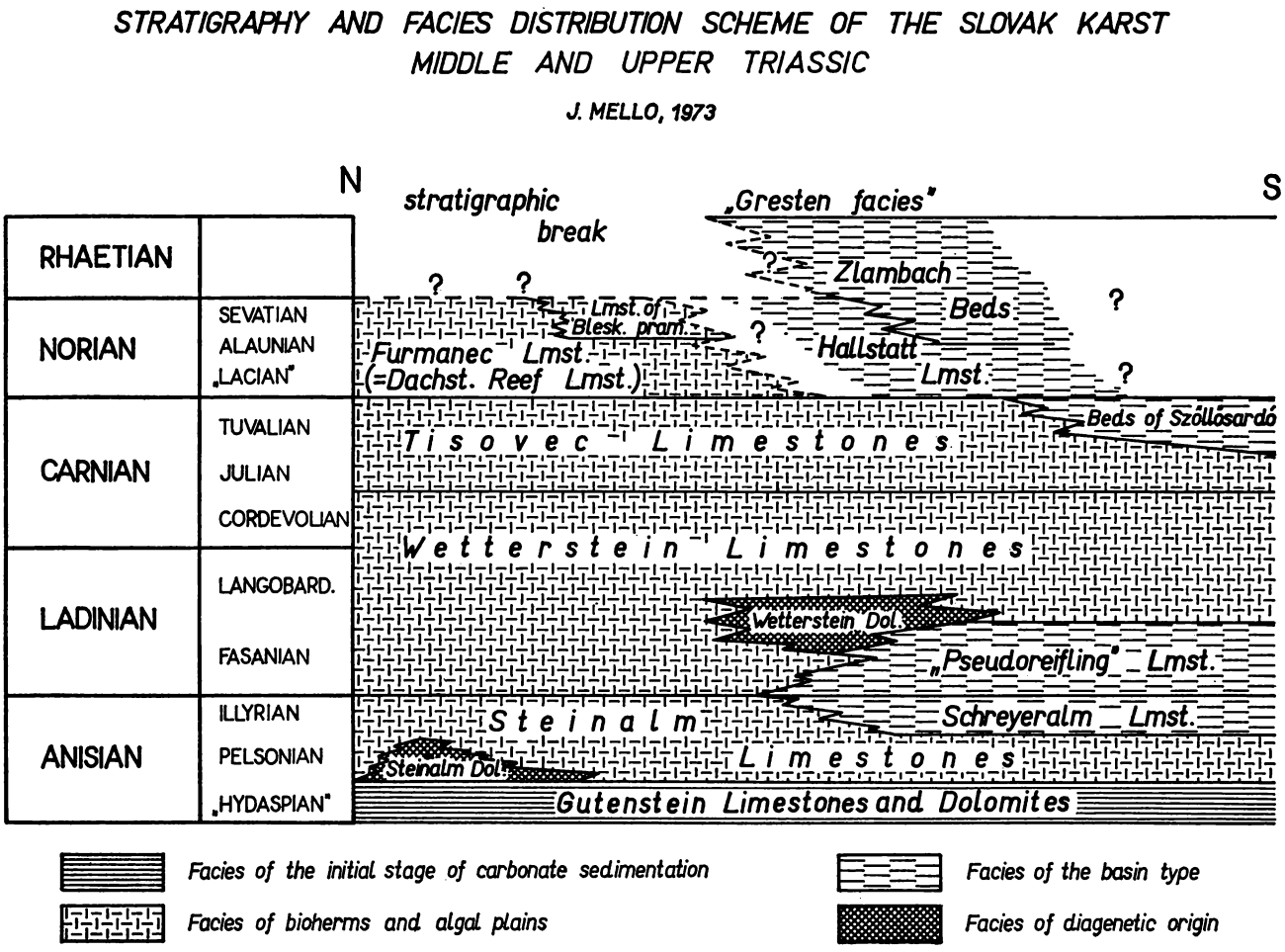

Fig. 2. Stratigraphy and facies distribution scheme of the Slovak Karst Middle and Upper Triassic.

DISTRIBUTIONS SCHEME OF THE SPONGE AND ALGAL BIOFACIES IN THE WETTERSTEIN LIMESTONES OF CENTRAL PART OF THE SLOVAK KARST

J. MELLO, 1973

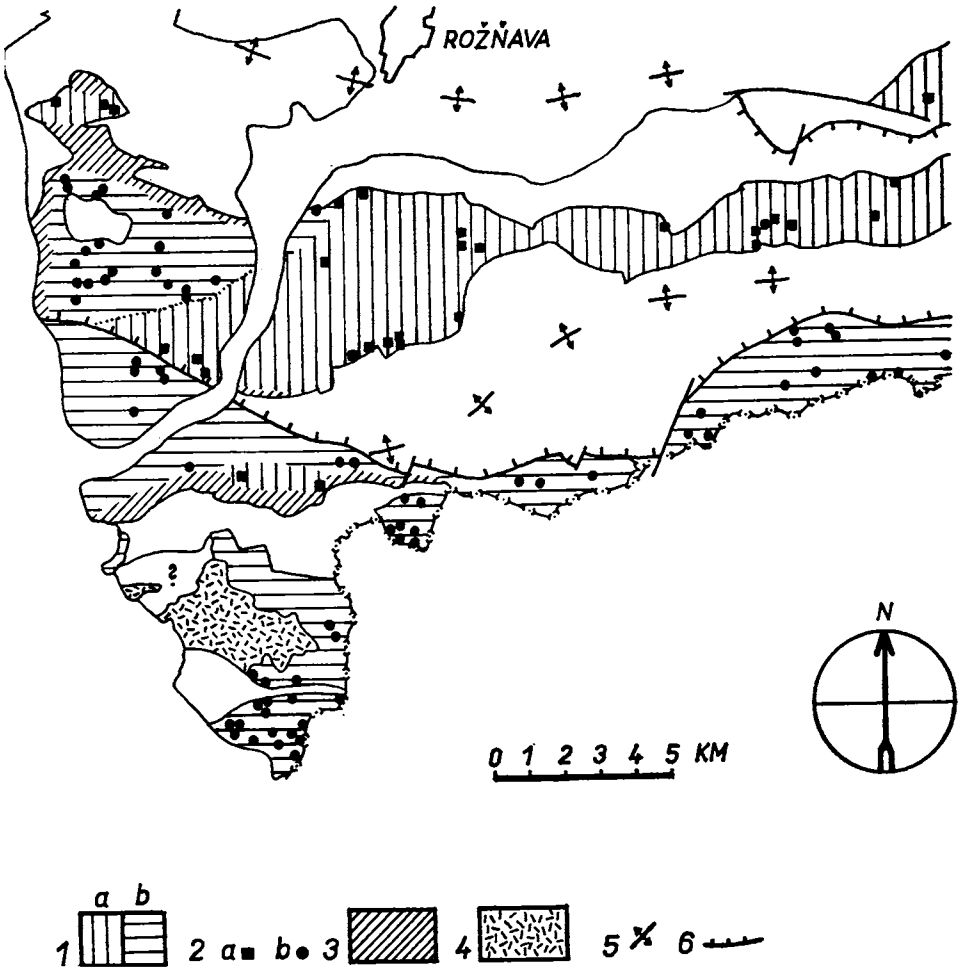

Fig. 3. Distribution scheme of the sponge and algal biofacies in the Wetterstein limestones of central part of the Slovak Karst.

1 — Wetterstein limestones: a — sponge biofacies; b — algal biofacies; 2a — localities of Sphinctozoa; b — localities of Dasycladacea; 3 — "Pseudoreifling" limestones (Lower Ladinian); 4 — Wetterstein dolomites; 5 — course of anticlines in cores with Lower Triassic complexes; 6 — younger upthrust planes.

In the Wetterstein limestones of the central part of the Slovak Karst two main biofacial areas may be distinguished (Fig. 3):

1. The algal biofacial area, mostly with algal stromatoliths, limestones with lumps and oncoids and bioclastic limestones (Pl. I, 4) with Dasycladaceae, Solenopora, and Foraminifera.

2. The sponge biofacial area. Predominant are biogenic limestones with calcareous sponges and various problematic elements (Pl. I, 5, 6). They pass into the varieties of bioclastic limestones.

In the Wetterstein limestones to the W of Silická Brezová are craks filled with Norian lumachelles, with *Halorelloidea curvifrons* (BITTN.) and *Halorelloidea rectifrons* (BITTN.), formerly regarded as the base of the Tisovec limestones (Julian).

The Tisovec limestones (Julian — Tuvalian). In the sense of the original definition by V. ANDRUSOVOVÁ-KOLLÁROVÁ & J. BYSTRICKÝ (in V. ANDRUSOVOVÁ-KOLLÁROVÁ 1960, p. 106), the Tisovec limestones represent "grey massive biogenic limestones with dispersed corals, lamellibranchiates and the so called evinosponges". From the type locality, a quarry near Tisovec, the Muránska plošina plateau, presented are ammonites (*Anatomites* aff. *fischeri*, *Megaphyllites jarbas* and *Placites placodes*), indicating its Carnian or Upper Carnian age (J. BYSTRICKÝ 1959, V. ANDRUSOVOVÁ-KOLLÁROVÁ, l. c.).

From the microfacial point of view the Tisovec limestones of the Slovak Karst are mostly varieties of algal biosparites and biosparrudites. Frequent are algal stromatolithic and oncolithic or oolithic limestones (Pl. II, 1). Sometimes there are lenses and layers of grey and pink crinoidal and crinoidal-coquinal limestones, with rich macrofauna of lamellibranchiates, brachiopods and cephalopods of Tuvalian.

In some places the top part of the Carnian limestones, especially in the substratum of the Hallstatt limestones does not correspond with the definition of the Tisovec limestones. They are rather related to the overlying Hallstatt limestones—as regards their lithology and microfacial character.

The Furmanec limestones (Norian; perhaps synonymum of Dachstein reef limestones, Hallstatt reef limestones, or Hohe Wand limestones of Eastern Alps). In the Slovak Karst occurrences of the Furmanec limestones are isolated. The most extensive locality — Drieňovec (formerly "Drienkova hora") is best known so far.

It is a part of the reef complex of which the central part and near-reef zone is preserved in Drieňovec and in its close surroundings on an area of about 2.5 sqkm, with indications of transitions into the fore-reef ("the Limestones of the Bleskový prameň spring") area.

The central reef area consists of irregularly distributed bodies of biogenic limestones (patch-reefs) surrounded by bioclastic limestones.

Corals are the most conspicuous component of biogenic limestones (biolithites). In places there are well-preserved coral bunches found already by J. STÜRZENBAUM (1879).

The biogenic skelets are also composed of other organisms — in addition to corals — especially of calcareous sponges (Pl. II, 2), stromatopores, sessile foraminifers (Pl. II, 3), some groups of algae and organisms of uncertain systematic position (problematics).

In the composition of bioclastic limestones (Pl. II, 4) most abundant is detritus of the skeletons of reefbuilders, frequent are also fragments of non-reef building organisms (echinodermates, lamellibranchiates, dasycladaceae, vagile foraminifers a. o.). Bioclasts show varied size, various degree of rounding, washing and sorting, in places graded bedding may be observed.

In the near-reef zone (transition into the back-reef area) are varieties of bioclastic — oncolithic and algal — foraminiferal limestones widespread.

The Limestones of the Bleskový prameň spring (Sevatian) represent probably facies of the transistory area to the fore-reef. They are dark-grey to dark limestones with lenses of crinoidal-coquinal and coral-crinoidal (Pl. II, 5) limestones in which was found the fauna of the Bleskový prameň spring (J. Stürzenbaum 1879). So far in the locality 15 species of cephalopoda, 70 species of lamellibranchiates and gastropods (V. Kollárová-Andrusovová — M. Kochanová 1972), and 21 species of brachiopods (M. Siblík 1967) have been found. Sporadical are finds of dasycladaceans, foraminifers and hydrozoans.

Facies of basin type

The Schreyeralm limestones (Upper Illyrian) form together with the overlying "Pseudoreifling" limestones a very conspicuous bed sequence in the seemingly monotonous sequences of lightcoloured limestones.

Lithological profiles of the 5—60 m thick bed sequence designated as Schreyeralm limestones are rather different in individual areas. In most profiles on the base are red nodular limestones with the fauna of Illyrian cephalopods. Abundant are microcoquinal layers. Higher-up are variegated cherty limestones. In some areas on bases are layers of dark nodular cherty Reifling limestones (locality Gombasek), or darkgrey chertless bioclastic limestones with *Glomospira densa* (Pantič).

The sequence of the Schreyeralm limestones is unusually rich in conodonts confirming their Illyrian age (R. Mock 1971). To the north of Silica a lateral transition of the Schreyeralm limestones into lightcoloured limestones can be observed.

The "Pseudoreifling" limestones (Lower Ladinian): represent a sequence of darkgrey bedded compact cherty limestones, loosing the cherts towards the overlier, and sometimes also laterally. Bedding also fades-out gradually, and the limestones pass into the Wetterstein limestones or dolomites.

In places, the sequence contains intercalations of subaqueous tuffs and tuffites developed in the pellitic fraction (M. Kuthan 1959, J. Bystrický 1964).

The sequence differed from the Reifling limestones — as found J. Bystrický (1964, p. 56) — in the lack of nodularity, therefore they were designated by him as "Pseudoreifling" limestones (J. Bystrický 1970, p. 226).

The limestones of Szöllösardó (Carnian). In the relict of the southernmost tectonic structure of the Slovak Karst, in the southern vicinity of Szöllösardó (Hungary), in the substratum of the Hallstatt limestones are grey cherty limestones and marls with *Halobia styriaca* Mojs., referred by K. Balogh (1961) to the Carnian.

They probably represent heteropic basin facies of the Tisovec limestones.

The Hallstatt limestones (Norian) are known in the most southern parts of the Slovak Karst (Silická Brezová, Bohúňovo, Budíkovany) and in Hungary (Szöllösardó). They are variegated, pink and red massive or bedded limestones, in places nodular and cherty. Sometimes they contain breccias of the endostratic type.

The Norian age of the Hallstatt limestones was formerly evidenced only by lamellibranchiates and cephalopods, at present it is evidenced also by rich fauna of conodonts, holothurian sclerites and other microfossils (R. Mock 1971, H. Kozur — R. Mock 1972).

From the microfacial view predominant are micrites, in places with numerous sections of thin-shelled lamellibranchiates (Pl. II, 6).

The Zlambach beds (Upper Norian — Rhaetian). The Hallstatt limestones near Bohúňovo and Silická Brezová are overlain by grey to darkgrey compact limestones and marls, in places spotty, with intercalations of shales. The limestones are microfacially related with the Hallstatt limestones. Micrites and biomicrites are predominant.

The Zlambach beds are comparatively poor in recognizable organic remains. To the east of Silická Brezová (the Malý mlynský vrch hill) they contain cephalopods, conodonts and holothurian sclerites, which indicate the Upper Norian age of the locality (R. Mock 1973).

The Zlambach beds on the locality Bohúňovo have not yield any determinable forms so far, but conodonts indicate the Upper Norian age of the underlying Hallstatt limestones (R. Mock 1971).

The determination of the age of the Zlambach beds may only be recently based on the fauna cited and on superposition.

The Zlambach beds near Bohúňovo are overlain by a sequence of the "Gresten facies", evidently of the Lower-Liassic age, passing gradually into the higher Liassic sequences (Hierlatz and Adnet limestones, "Fleckenmergel").

So near Bohúňovo, the Zlambach beds occupy the Rhaetian and perhaps the top part of the Norian, on the Malý mlynský vrch hill near Silická Brezová only their Upper Norian age was evidenced; their younger part might have been removed by denudation.

Therefore I suppose that during the uppermost Triassic and lowermost Liassic no interruption of sedimentation took place in the basin area. On the contrary the elevated areas of reef complexes emerged.

Facies of diagenetic dolomites

The Steinalm and the Wetterstein dolomites (Anisian, Ladinian). In places, a part of the sequence of the Steinalm, Wetterstein and "Pseudoreifling" limestones is replaced by lightcoloured granular dolomites which may be designated as diagenetic dolomites in the sense of the classification by G. M. Friedmann — J. E. Sanders (1967, p. 308).

Facial Relationships of the Slovak Karst Middle and Upper Triassic

As demonstrated, in the Slovak Karst Middle and Upper Triassic, the facies of algal plateaus and bioherms predominate, and only in some horizons laterally pass into the basin facies (Fig. 2).

It will be obviously possible by more detailed facial study to distinguish several reef complexes with facies corresponding to the facies of the central reef area, of back-reef and fore-reef in the facial area of algal plateaus and bioherms. Indications of such reef complexes already exist. In the Wetterstein limestone (Fig. 3) such is the area of depression to the south of the Stit in the Plešivecká planina plateau. There—in a tectonically independent block—preserved is most likely the central part of the reef, consisting mostly of sponges, corals, stromatopores and organisms of uncertain systematic appurtenance.

Analogous facies of the Wetterstein limestones of predominantly biohermal character are also in the southeastern part of the Plešivecká planina plateau, in the northern part of the Silicka planina plateau and in the area of the Horný vrch plateau. These facies are in contrast to the Wetterstein limestones of the algal biofacies, represented especially by the stromatolithic and bioclastic algal varieties, distributed in the area of the Dolný vrch plateau, and in the southern part of the Silická planina and Plešivecká planina plateaus. Perhaps they represent the extensive areas of back-reef and algal plains.

The facial differentiation is most conspicuous in the Norian: on the one hand, in the more northern structures, there are facies of the central reef and near-reef areas (the Furmanec limestones,the limestones of the Bleskový prameň spring), and on the other hand, in more southern structures, facies of the basin type (Hallstatt limestones, Zlambach beds).

The typical sediments of the back-reef (Dachstein limestones and Hauptdolomites) are only out of the region of the Slovak Karst in more northern zones: the northern Gemerides, the Strážov and the Choč nappes. The facial conditions indicate close relationship between the Triassic of the Slovak Karst and the Triassic of the above mentioned tectonic units. The fact is of considerable paleogeographical and tectonical significance.

Translated by E. Jassingerová

Plate I

1. Stromatolithic texture of the Gutenstein dolomites, 11×.
2. Algal stromatoliths with shrinkage pores textures; The Steinalm limestones, 12×.
3. Bioclastic dasycladaceous limestones with *Physoporella pauciforata* (GÜMB.) STEIN M. v *pauciforata* BYSTR.; The Steinalm limestones, 5×.
4. Bioclastic algal limestones; The Wetterstein limestones, 8×.
5. Biogenic limestones with calcareous sponges; The Wetterstein limestones, 5×.
6. Biogenic limestones with ? stromatopores, calcareous sponges and problematic elements; The Wetterstein limestones, 5×.

Plate II

1. Oolithic variety of the Tisovec limestones, 10×.
2. Calcareous sponges (? Inozoa) growing on corals; The Furmanec limestones, 10×.
3. Sessile foraminifers from biogenic coral — foraminiferal variety of the Furmanec limestones, 9×.
4. The Bioclastic Furmanec limestones with bioclasts of corals, foraminifers, solenopores, etc., 9×.
5. The Coral-crinoidal limestone of the Bleskový prameň spring, 12×.
6. Biomicrite with numerous sections of thin-shelled lamellibranchiates; The Hallstatt limestones, 5×.

References

Andrusovová-Kollarová, V. (1960): Récentes trouvailles d'Ammonoidés dans le Trias des Karpates occidentales. Geol. zborník XI, 1, Bratislava, p. 105—110.

Balogh, K. (1961): Das Mesozoikum Nordungarns. Annales Inst. Geol. Publ. Hnug.; Vol. XLIX, fasc. 2 (Verh. d. Mesozoischen Konferenz), Budapest, S. 365—379.

Bystrický, J. (1959): Príspevok k stratigrafii muránskeho mezozoika (Muránska plošina). Beitrag zur Stratigraphie des Muráner Mesozoikums (Muráň-Plateau). Geol. práce, Zoš. 56, Bratislava, S. 5—53.

— (1964): Slovenský kras. Stratigraphie und Dasycladaceaen des Gebirges Slovenský Kras. 1. Auflage, Bratislava. Ústr. ústav geologický, 204 S.

— (1970): Stratigrafia a Dasycladaceae triasu Západných Karpát. Unpubl. DrSc. thesis, Archives GÚ SAV, Bratislava, pp. 230.

— (1972): Faziesverteilung der mittleren und oberen Trias in den Westkarpaten. Mitt. Ges. Geol. Bergbaustud., 21. Bd., Innsbruck, S. 289—310.

Friedmann, G. M. — Sanders, J. E. (1967): Origin and Occurrence of Dolostones. Developments in Sedimentology 9A: Carbonate Rocks, Chapter 6, Elsevier P. C. Amsterdam, London, New York, p. 267—348.

Kollárová-Andrusovová, V. — Kochanová, M. (1972): Molluskenfauna des Bleskový prameň bei Drnava (nor, Westkarpaten). 1. Auflage, Bratislava, Vydavatelstvo SAV, in Druck.

Kozur, H. — Mock, R. (1972): Neue Holothurien-Sklerite aus der Trias der Slowakei. Geol. Pal. Mitt. Bd. 2, 12, Innsbruck, S. 1—47.

— (1973): Die Bedeutung der Trias-Conodonten für die Stratigraphie und Tektonik der Trias in den Westkarpaten. Geol. Pal. Mitt., Bd. 3, 2, Innsbruck, S. 1—14.

Kuthan, M. (1959): Spuren der vulkanischen Tätigkeit in der mittleren Trias des Slowakischen Karstes. Geol. práce, Zoš. 56, Bratislava, S. 55—74.

Mock, R. (1971): Conodonten aus der Trias der Slowakei und ihre Verwendung in der Stratigraphie. Geol. zbor. Geol. Carp. XXII, 2, Bratislava, S. 241—260.

— (1973): Über einen Fund von Zlambach-Schichten (Nor) im Slowakischen Karst (Resumé). Geol. práce, Bratislava, in Druck.

Scholz, G. (1972): An Anisian Wetterstein Limestone Reef in North Hungary. Acta Min.-Petr. Szeged, XX/2 pp. 337—362.

Siblík, M. (1967): The brachiopods of the Norian locality Drnava (Southern Slovakia). Geol. práce, Zprávy 43, Bratislava, p. 81—97.

Stürzenbaum, J. (1879): Kössener Schichten bei Dernö im Tornaer Comitate. Földtani Közlöny IX, Budapest, pp. 287—289.