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BIOSTRATIGRAPHIC EVALUATION OF METASEDIMENTS IN THE MALÉ KARPATY MTS. REGION

(Figs. 3, Pls. 2, Tabs. 3)

Abstract: In the work the palynological results of metasediments from the Pezinok—Pernek and Harmónia Groups (series) of the Malé Karpaty Mts. are summarized. We have established that sediments affected by metamorphism contained spores and *Acritarcha* partially covered with coating of strongly carbonised organic matter, but this did not prevent genetic and also many species marks from being determinable. On the basis of considering of palynomorph associations we suppose that the age of the investigated part of rocks of the Pezinok—Pernek Group is Upper Silurian to Lower Devonian. The age of the investigated part of rocks of the Harmónia Group (series) is Lower Devonian.

The associations of palynomorphs are so close in age in both groups that a more distinct difference in age between them is difficult to suppose.

Резюме: В этой работе резюмированы результаты палинологического изучения метаосадок из Пезинско-Пернецкой группы и Гармонской группы (серии) из Малых Карпат. Мы определили что метаморфизованные осадки содержат споры и *Acritarcha* частично покрытые сильно карбонизованой органической материей, но это не препятывает определению родовых и тоже многих видовых знаков. На основе обсуждения палиноморфных ассоциаций мы предполагаем, что возраст изученой нами части горных пород Пезинско—Пернецкой группы является верхносилурским — нижнедевонским. Возраст изученой нами части пород Гармонской группы (серии) является нижнедевонским.

Ассоциации палиноморфов так близки по возрасту что различать их по возрасту очень трудно.

Introduction

The work is focused on biostratigraphic evaluation of metamorphosed sediments in the Pezinok—Pernek and Harmónia Groups of crystalline rocks in the Malé Karpaty Mts. Palynological investigation carried out by P l a n d e r o v á prolongates and completes preceding works by Č o r n á, who treated a series of samples from the Malé Karpaty Mts. from various localities (Č o r n á, 1968; Č o r n á in C a m b e l—Č o r n á, 1974). On the basis of evaluation of associations of the plant tissues and other organic remants Čorná (l. c.) assigned to metasediments of the Pezinok—Pernek and Harmónia Groups the Lower Paleozoic age, disproving opinions about their Proterozoic age prevailing until that time (Z o u b e k, 1960). She assumed a relatively long period of sedimentation from the Ordovician to Lower Carboniferous for both groups. The objective of this work is to determine the

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age of metasediments more precisely on the basis of evaluation of spores from spore plants and marine plankton belonging to the group of *Acritarcha*.

Čorná (e. c.) has not given the precise location of samples as well as species determination of fossils. Anyway, some of the localities have been sampled with the help of Cambel, who knew exactly their location.

In the work there are the results of treatment of about 80 samples, in which palynomorphs (i. e. spores and *Acritarcha)* have been evaluated. On the basis of correlation with the stratigraphic range of the determined species we cite also the age of metasediments investigated. So methodically our biostratigraphic investigation of metasediments in the Malé Karpaty Mts. differs from the approach used by Čorná (1968) and Čorná in Cambel — Čorná (1974).

In the treatment of samples the maceration method for metasediments, combined with oxidation methods for removal of graphitoid coating on organic remmants was applied. The plant tissues have not been considered during evaluation, because we have no comparative material for species determination of vascular bundles at Paleozoic species of plants (this discipline is also very little covered in publications).

More than 50 % of samples, which have been treated, are sterile on spores and *Acritarcha*, 30 % are poor in palynomorphs and 20 % of samples contain few species of determinable palynomorphs.

Richest in palynomorphs are dark schists from the quarry behind Pezinok (loc. 14, Figs. 1, 2). We consider this locality as essential for consideration of the age of dark schists in both groups of crystalline rocks. The degree of carbonization (graphitization), which is connected with the grade of metamorphism of rocks, was determined by calculation of the percentage of overlapping with graphitoid coating on the exine of palynomorphs as well as according to colouring of palynomorphs.

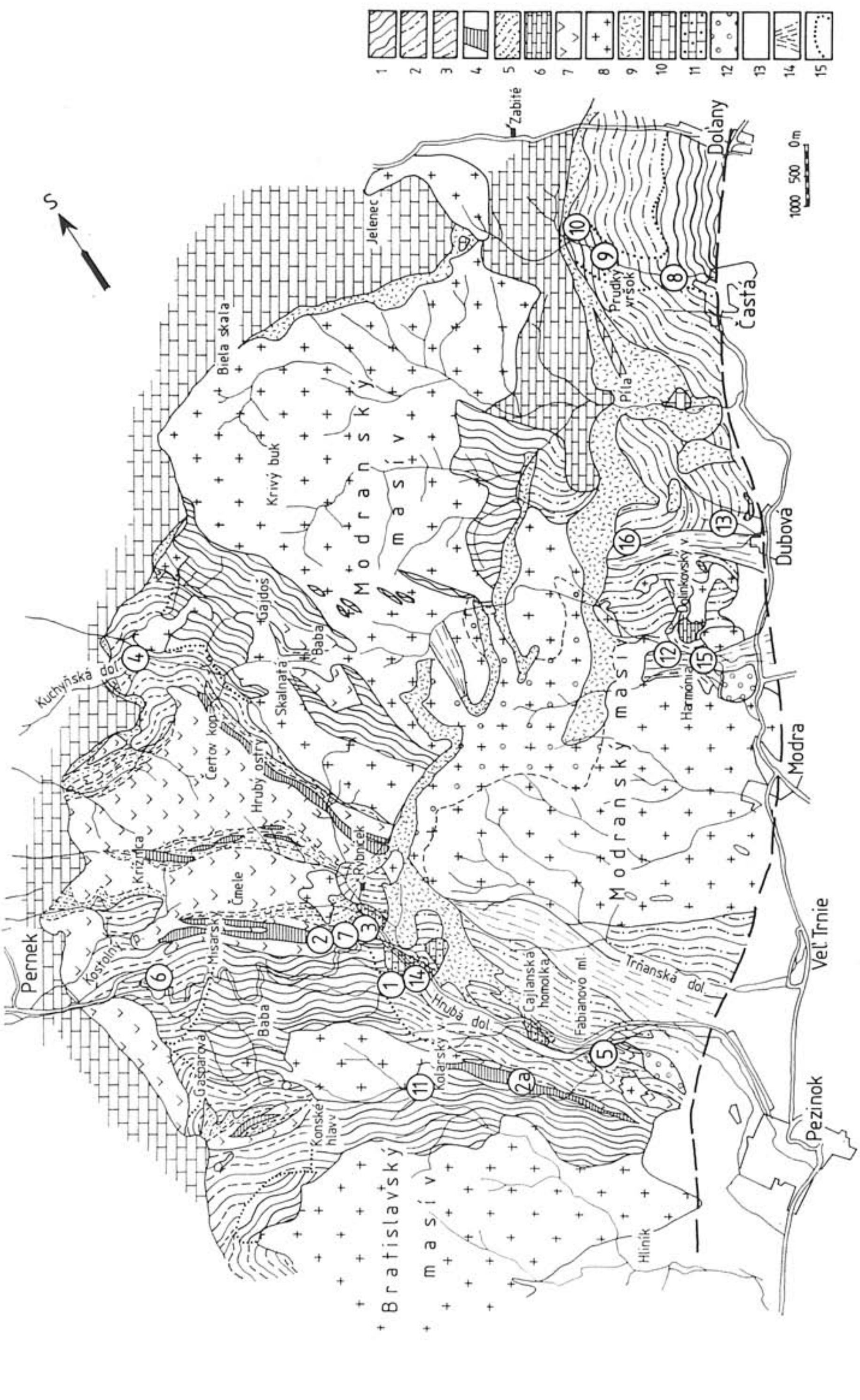
The degree of affectedness of exine by graphitic coating of the surface of palynomorph exine is following:

a) graphitoid coating	20 % — 40 %
b) graphitoid coating	40 % — 60 %
c) graphitoid coating	60 % — 80 %
d) graphitoid coating	80 % — 90 %

Fig. 1. Synoptical geological map with indication of sampling places. Compiled by B. Cambel (1957). The direction of hatching of schists indicates the general course of bedding and schistosity of rocks.

Explanations: Paleozoic: 1 — mica schists to gneisses; 2 — phyllites; 3 — phyllite and hornfels rocks of the Harmónia Formation; 4 — producing ore-bearing zones with pyrite deposits and numerous black schists; 5 — sequence of actinolite schists with prevalence of metamorphosed pyroclastics of basic volcanism; 6 — limestone layers in the Harmónia Formation; 7 — magmatogenic amphibolites and extrusive and hypabyssal amphibolic rocks metamorphosed into various grades; 8 — granitoid rocks of the Bratislava, Modra massifs.

Mesozoic and younger formations: 9 — Lower Triassic quartzites and quartz arcoses; 10 — Mesozoic on the whole; 11 — Mesozoic light-coloured limestones in the area of the Hrubá dolina valley (Middle Triassic?); 12 — Quaternary gravels; 13 — Scree. loam and Quaternary on the whole. Dejection and solifluction cones; 15 — agreed boundary between gneisses and phillites (hornfelses).


Pernek
Kostolný
Krížnica
Misarský
Čmele
Hrubý ostrý
Čertov kop
Kuchyňská dol.
Skalnatá
Baba
Gajdoš
Krivý buk
Biela skala
Jelenec
Zabité
Dolany
Prudký vršok
Častá
Píla
Dubová
Dolinkovský v.
Harmónia
Modra
Vel'Trnie
Pezinok
Hliník
Rybníček
Čajlanská homolka
Fabianovo ml.
Trňanská dol.
Hrubá dol
Kolársky v.
Konské hlavy
Gašparová
Baba
Bratislavský masív
Modranský masív
1000 500 0m

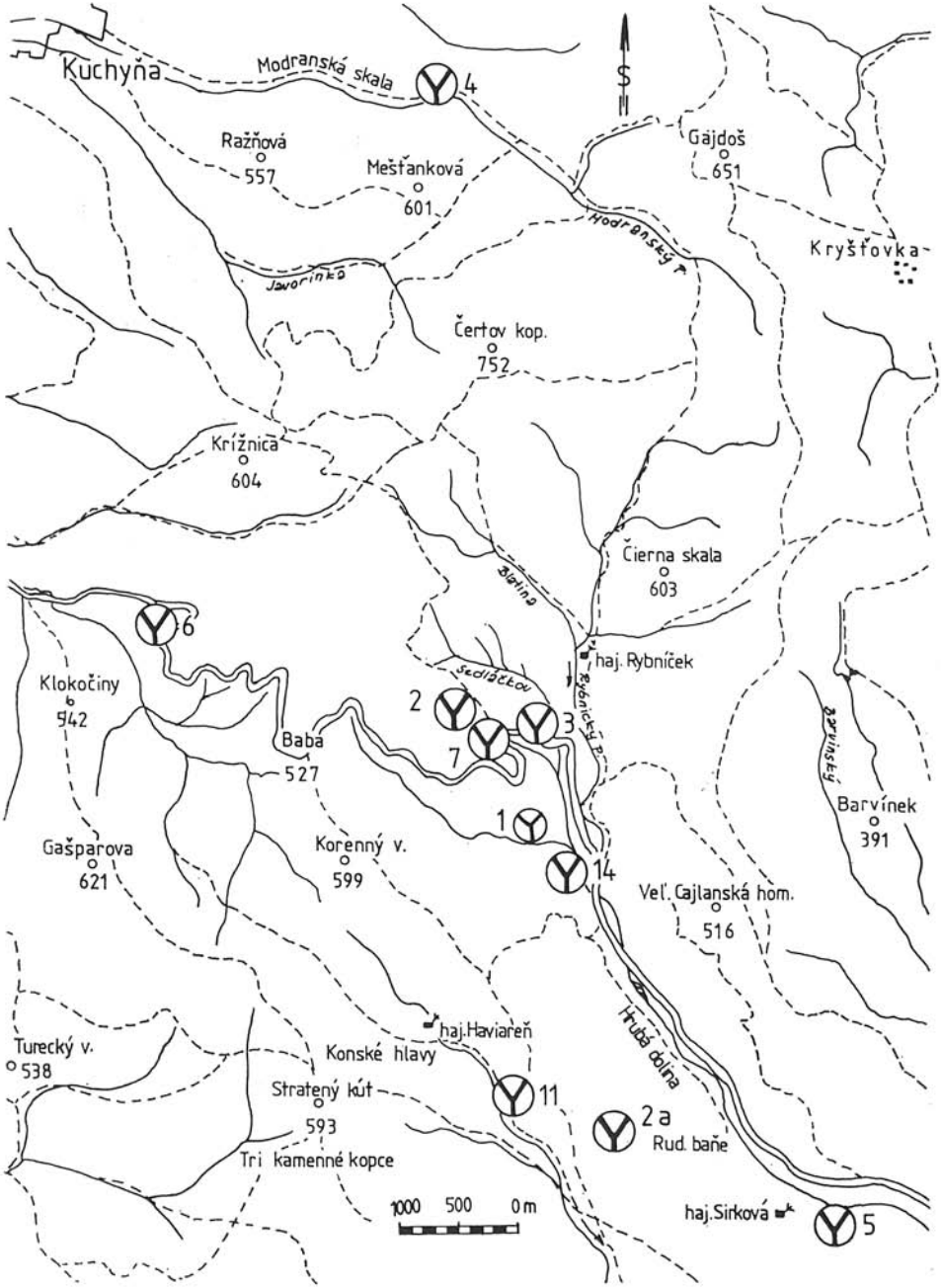


Fig. 2. Geographical map with indication of sampling places from the area of the underlying Pezinok–Pernek crystalline rocks.

It has been established that metasediments of the Pezinok—Pernek Group contain palynomorphs with a higher affectedness of exine by graphitization (50 % — 85 %), whilst palynomorphs from the Harmónia Group have been affected by graphitization up to 60 % only. This is given by a different type of me-

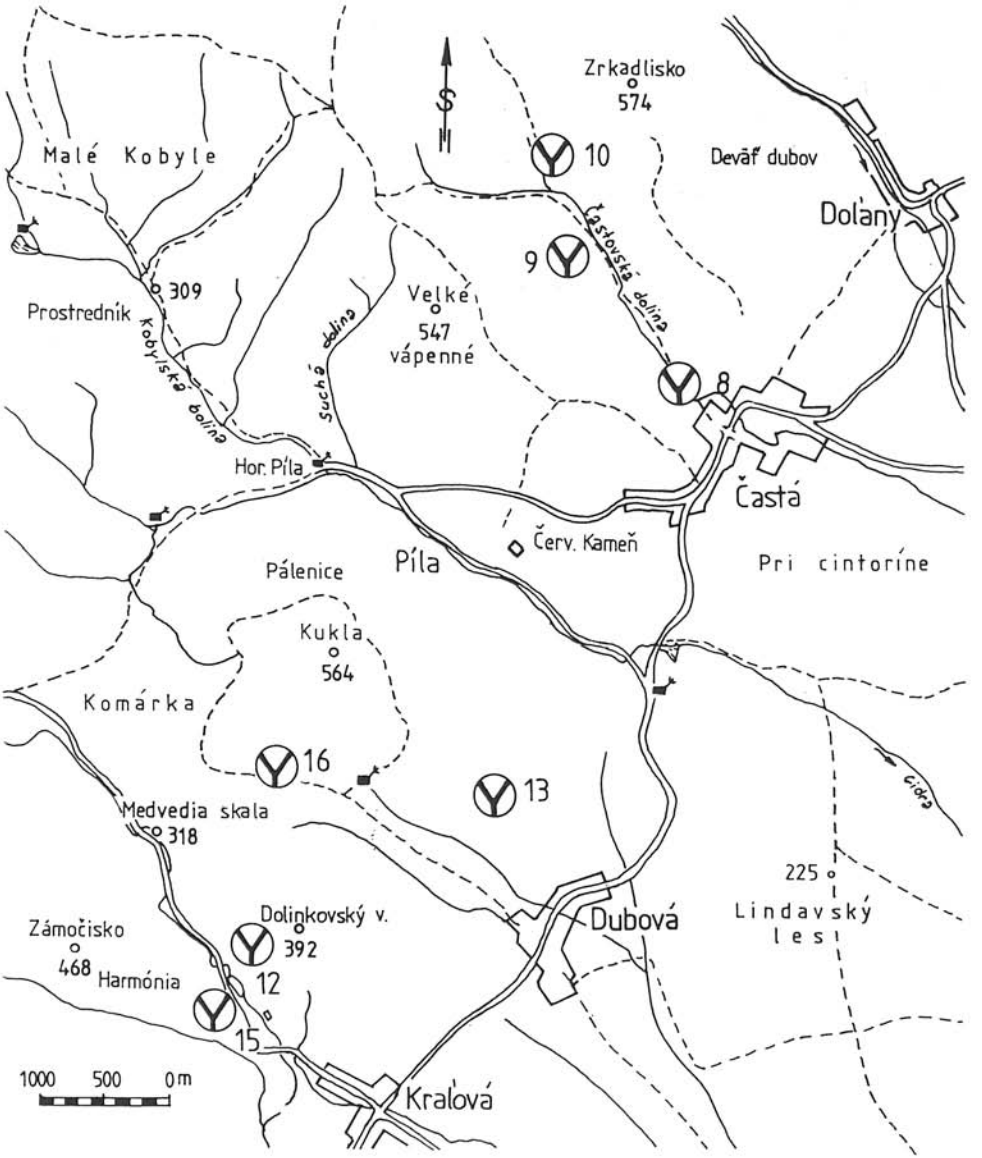


Fig. 3. Geographical map of sampling places from the area of crystalline rocks of the Harmónia Group.

tamorphic alteration. The Bratislava granitoid massif brought about a regional periplutonic metamorphism in the form of a wide metamorphic aureole. Metamorphism caused by the magma of the Modra granodiorite is of the contact type causing formation of hornfelses and spotted shales (andalusite-cordierite and biotite hornfelses).

The samples from localities 4, 5, 6 have been provided to us kindly by M. P u t i š. Results are taken into account for the purpose of correlation with localities evaluated in this work. Detailed palynologic evaluation of samples from localities 4, 5 and 6 will be carried out, following treatment of some problematic samples of the Pezinok—Pernek Group.

In Tabs. 1, 2 the range of species from all localities sampled by us is plotted. Results from the localities 4, 5 and 6 are not mentioned but they correspond in their palynomorphic composition to associations of the Pezinok—Pernek Group. The range is in the Tab. 3.

The determination of palynomorph species is based mainly on the works of the following authors: E i s e n a c k (1971); C r a m e r (1964, 1966); C r a m e r — D i e z (1972) and others.

In the work we cite palynologically evaluated samples from the following localities:

Loc. 1 Road from Pezinok to Baba. Black schists at the slope above the great quarry, Pezinok—Pernek Group.

Loc. 2a Borehole KV-43 depth 423,0 m. Black schists of the Pezinok—Pernek Group, district of antimonite drift (Sb-deposit Pezinok).

Loc. 2 Black schists, district of Augustin drift, sequence with layers of syngenetic pyrite.

Loc. 3 Black schists of the Pezinok—Pernek crystalline complex. Cut of the road from Pezinok to Baba, distance about 1.5 km from the great limestone quarry, to E of the producing zone Augustin—Čmela.

Loc. 4 764/82 SE of Ostrý vrch. Clayey-quartzy shales with intercalations of metaquartzites. Pezinok—Pernek Group.

Loc. 5 187/82 SE of Pezinok. Dark graphite schists of the Pezinok—Pernek Group. Road below the forest along the hospital area.

bolites with pyroclastics — part of the formation of graphitoid schists of the pro-

Loc. 6 779/82 west of the Misary "islet". Conglomerates with fragments of amphiducing sequence (Pezinok—Pernek Group).

Loc. 7 Road from Pezinok to Baba, about 2 km from the great quarry. Lithologically there are dark schists.

Loc. 88 51/81 Častá — quartzy biotite phyllite from the small natural outcrop close behind the village Častá in the Častianska dolina valley, 450 m E of elev. p. Kamenný vŕšok.

Loc. 9 Častianska dolina valley, Častá big quarry, upper part of the Pezinok—Pernek Group. Dark to grey phyllite schists.

Loc. 10 55/81/M about 30 m above the road 192°/520 m SSW of elev. p. 357, gamekeeper's lodge Dolina, transitional type of schists. Quartz biotite phyllite from the outcrop at the ridge between the quarry and phyllites altered by metasomatism.

Loc. 11 3C/81 Limbach—Slnečné údolie valley, cut of the way directly at the eastern slope. Biotite paragneiss.

Loc. 12 Harmónia, big quarry near Kamenný potok (road to Piesky). Dark phyllite schists occurring as layers in granodiorite of the Modra massif (Harmónia Group).

Loc. 13 Dubová N margin of the village in the cut of the field path above vineyards. Black phyllite schists bordering a lenticle of limestones of the Harmónia series (Harmónia Group).

Loc. 14 Big limestone quarry "Pezinok", which is situated in the Hrubá dolina valley at the road from Pezinok to Baba. Dark-grey biotite schists above limestones. Samples were taken from the whole profile in the quarry.

Loc. 15 Cut of the road Harmónia—Piesky. Dark phyllites in the cut of the road from the big quarry in direction to Harmónia (Harmónia Group).

Loc. 16 Recreation centre in the area of the forester's house Fugelka NW from the village Dubová. Dark schists in the road cut.

Biostratigraphic evaluation and discussion about the age of metasediments

As we already mentioned, the palynological investigation of crystalline rocks of the Malé Karpaty Mts. was carried out in order to find out a more precise age of metasediments of the Pezinok—Pernek and Harmónia Groups and to clear up mutual relation of these two groups from the viewpoint of biostratigraphy and lithology.

1) The metasediments of the Pezinok—Pernek Group were treated palynologically from several localities (Pls. 1 and 2). Although the organic remnants were affected by carbonization (graphitization), neverthless, it was succeeded in obtaining associations by treatment of a relatively great amount of samples, on the basis of which we can consider the age of the schistose part of the Pezinok—Pernek Group. The majority of species of the producing sequence of black schists of the Pezinok—Pernek Group have a range? Upper Silurian to Lower Devonian.

As stratigraphically important species we can mention *Filisphaeridium brevispinosum* LISTER from the Upper Silurian, *Multiplicisphaeridium arbusculiferum* var. *variabile* (LISTER), from the Upper Silurian, *Ammonidium rigidium* (DEUNFF.) LISTER from the Lower Devonian, *Riculasphaera fissa* LOEBL. et DRUGG from the Gedinnian, *Pterospermella* cf. *pernambucensis* (BRITTO) EIS. from the Lower Devonian, *Ammonidium sannemani* DEUNFF. from the Lower Devonian, *Cymatiosphaera nebulosa* DOWNIE from the Upper Silurian to Lower Devonian, *Cymatiosphaera kreuseli* EIS. from the Silurian and other (Tab. 1).

Besides these species, which convincingly prove the Upper Silurian to Lower Devonian age of metasediments of the Pezinok—Pernek Group, also other species of palynomorphs prove sufficiently that the sedimentation of the black schistose sequence passed from the Upper Silurian to Lower Devonian. This sedimentation period was possible to study and consider genetically and stratigraphically at localities 1—7, 10—11 (Tab. 1).

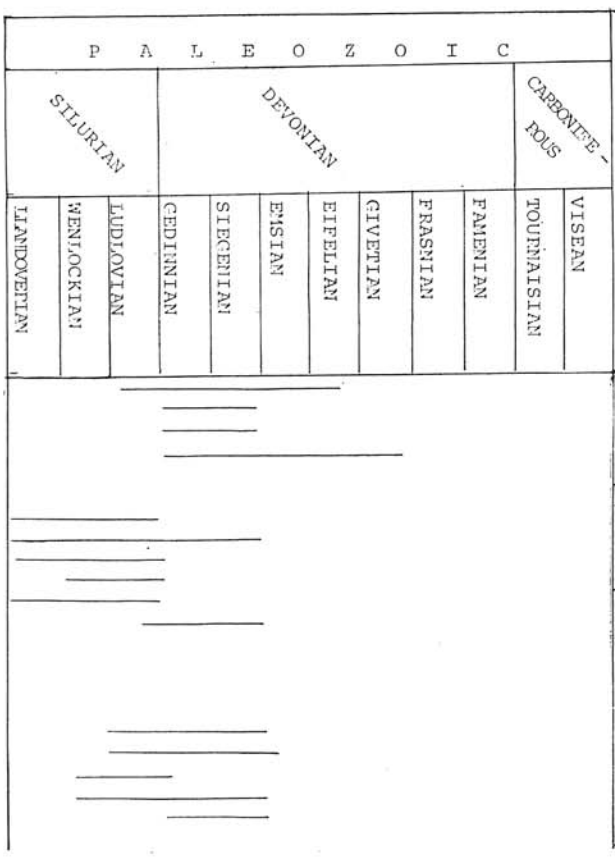
The metamorphites, considered as transitional sequence between the Pezinok—Pernek and Harmónia Groups from the locality Častá (loc. 8—9), are of Lower Devonian age.

When we observe representation of palynomorphs of this group, we can consider as oldest the schists from the district of the antimonite drift near Mount Kolársky vrch, borehole KV-43 and the sequence of black schists of the Augustin drift with content of pyrite, with determination of the age Upper Silurian—Lower Devonian age (loc. 1—2, 2a) (Tab. 1).

Metasediments of the Harmónia Group were already treated according to localities mainly from the eastern part of the Malé Karpaty Mts., localities 12—15 (Figs. 1, 3; Tab. 2). The samples from the big quarry at the road from Pezinok to Baba (No. 14) were already treated in the past (P l a n d e r o v á — P a h r, 1983). In the last time the association of palynomorphs was completed by treatment of further samples from this locality.

Table 1

Graphical representation of the age diapason of palynomorph species of the Pezinok—Pernek Group



Loc. 8	Cymatiosphaera cf. canadensis Deunff
	Cymatiosphaera sp.
	cf. Verrucosisporites uncatus (Naum.) Rich.
	Caliptosporites proteus (Naum.) Allen
	Chitinozoa sp.
	Acritarcha indet.
Loc. 1	Micrhystridium cf. henryi Perisot. Dff.
	Cymatiosphaera nebulosa Deunf.
	cf. Samarisporites
	Eilisphaeridium Brevispinosum Lister.
Loc. 2	Veryhachium cf. celestum Martin.
	Multiplicisphaeridium cf. raspa (Cramer)Eis.
	Duvernaysphaera sp.
	Baltisphaeridium sp.
	Quadraditum sp.
	Polyedryxyum sp.
	Acritarcha sp. 1 Cramer
	Quadraditum incissum Cramer
	Multiplicisphaeridium arbusculiferum var.variabile(Lister)
	Falcisporites australis (de Jersey) Pelby
	Ammonidium rigidum (Deunff.) Lister
	Chitinozoa sp.

Locality	Taxon
Loc. 3	Dibolisporites sp.
	Duvernaysphaera tenuicingulata Staplin
	Piculasphaera fissa Loebl. et Drugg
	? Chelinospora sp. A. Rich. Lister
Loc. 7	Pterospermella cf. pernambucensis (Britto) Eis.
	Cymbosporites sp.
	Trachytriletes cf. nigratus Naum.
	Discina sp.
	Punctatisporites sp.
	Ammonidium sannemani Deunff.
	Acantotriletes incertus Naum.
	Grandispora velata (Rich.) Mc. Gregor
	Eymenozonotriletes sp.
	cf. Emphanisporites
Loc. 11	Cymatiosphaera cf. canadensis Deunff.
	Camptotriletes cf. corrugatus (Ibr.) Pot.Kr.
	Cymatiosphaera sp.
	Hymenozonotriletes sp.
	Acritarcha indet.
	Cymatiosphaera cf. canadensis Deunff.
Loc. 10	cf. Cincturosporites densus Bharadw.
	Cymbosporites conatus Bharadw.
	Baltisphaeridium lophophorum Eis.
	Archeoperisaccus sp.
Loc. 9	Cymatiogalea sp.
	Cymatiosphaera sp.
	Polyedryxium membranaceum Deunff.
	Tornacia sp.
	Fimbrioglomerella divisa Loebl. et Drugg.
	Micrhystridium sp.
	Baltisphaeridium sp.
	Polyedryxium sp.
	Pterospermopsis sp.
	Raistrickia sp. clavata Lacq.
	Duvernaysphaera aranoides Cramer
	Ambitisporites cf. dilutus Hoffm.
	Florisphaeridium castellum Lister
	Baltisphaeridium hirsutoides homatum (Downie)Eis.
	Cymatiogalea sp.
	Polyedryxium decorum Deunff.

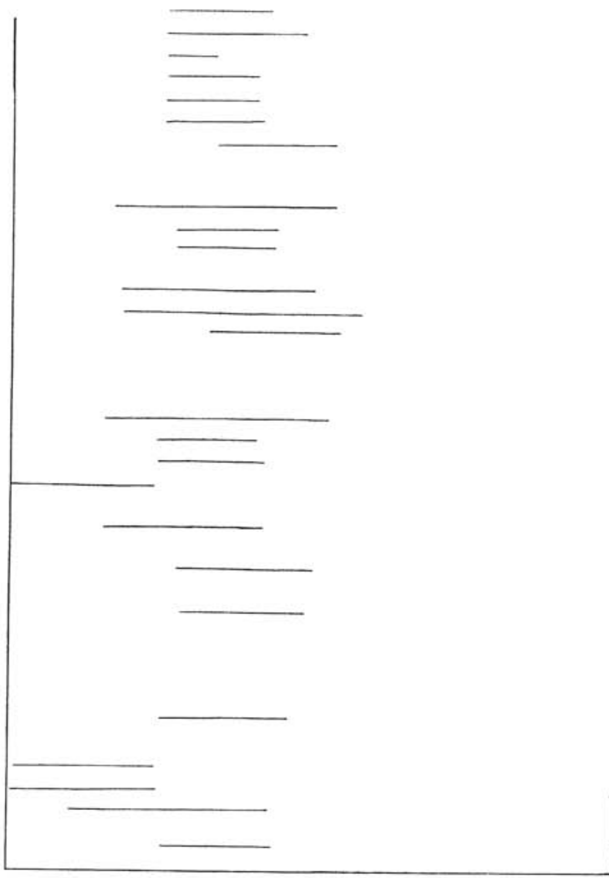
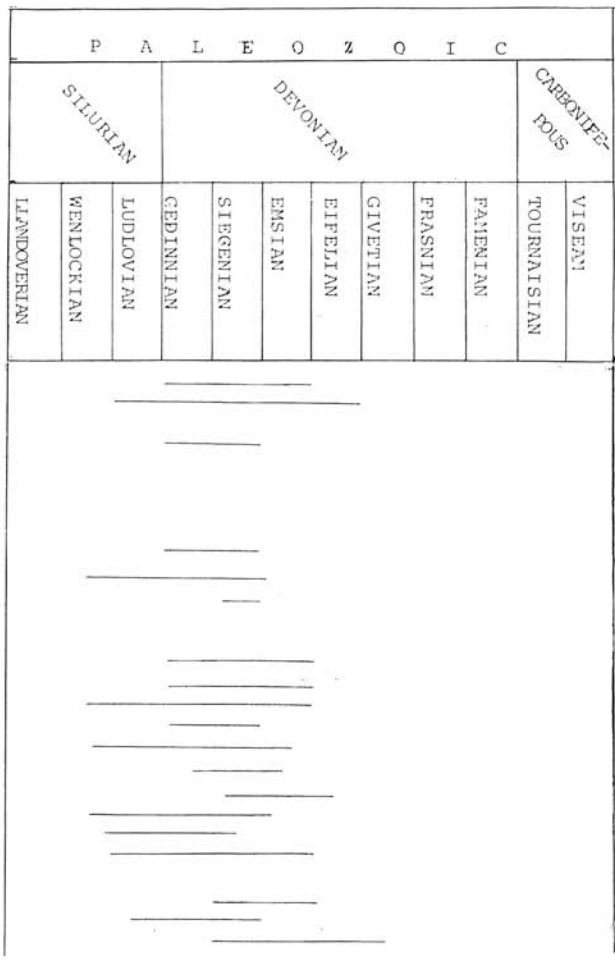


Table 2 Graphical representation of the age diapason of palynomorph species of the Harmónia Group



Loc. 12	Angochitina sp. Emphanisporites sp. Pterochitina sp. Brochopsophosphaera diligens Tchibr. Baltisphaeridium sp. Cymatiosphaera sp. Polyedryxium sp.
Loc. 13	Polyedryxium sp. Polyedryxium cf. prismaticum Deunff. Polyedryxium membranaceum Deunff. Cymatiosphaera jardinei Cramer-Diez. Dictyotriletes sp. Pulvinosphaeridium sp.
Loc. 14	Discina asperella Tchibr. Pterospermella pernambucensis (Britto) Eis. Acantodiacrodium sp. II. Martin Micrhystridium lapellum Loebl. et Wic. Ammonidium rigidum (Deunff.) Moreau - Benoit Diexallophasis remata (Deunff.) Playf. Dibolisporites echinaceus (Eis.) Rich. Ammonidium cf. rigidum (Deunff.) Lister Ammonidium cf. loriferum Moreau - Benoit Ammonidium cf. alloiteaui (Deunff.) Moreau -Benoit ? Ammonidium rigidum (Deunff.) Lister Multiplicisphaeridium ramusculosum macrolodium (Deunff)Eis. Multiplicisphaeridium raspa (Cramer) Eis. Verrucosisporites pseudospinosus Streel

Locality	Taxa
Loc. 14	Evittia granulatispinosa (Down.) Lister
	Emphanisporites minutus Allen
	Multiplicisphaeridium cf. rabiosum (Cramer) Cramer
	Lophosphaeridium sp.
	cf. Dterospermella
	Baltisphaeridium tuberosum (Sanneman) Eis.
	Baltisphaeridium cf. tuberosum (Sann.) Eis.
	Retusotriletes cf. triangulatus Streel.
	Retusotriletes sp.
	Onondogella deunffi Cramer.
	Onondogella sp.
	Lagenochitino sp.
	Quadraditum fanitasticum Cramer.
	Cymatiosphaera nebulosa Downie
	Cymatiosphaera leonensis Cramer.
	Cryptostromatium ondagonense Moreau - Benoit.
	Azonomonoletes usitatus Tchibr.
	Emphanisporites minutus Allen
	Dictyopsphosphaera polygonia (Stapl.) Tchibr.
	Pulvinosphaeridium deunffi Moreau - Benoit.
	Moyeria uticansis Thusu
	Dictyotriletes emsiensis (Allen) Mc. Gregor
	Acantotriletes parvispinosus Naum. var. rotundus Tchibr.
	Stenozonotriletes extensus Naum.
Loc. 15	Baltisphaeridium cf. calicispinae Gorka
	Cymatiosphaera pavimenta (Defl.) Downie
	Lophozonotriletes kuschulikus Tchibr.
	Retusotriletes microaculeatus Tchibr.
	Pterospermopsis sp.
	Sparae triletae
	Acritarcha indet.
Loc. 16	Baltisphaeridium cf. astartes Sann.
	Emphanisporites sp.
	Veryhachium valiente Cramer
	Retusotriletes sp.
	Cymatiogalea cristata (Down.) Raucher
	Baltisphaeridium cf. longispinosum Eis.
	Cymatiosphaera nebulosa Downie
	Riculaesphaera cf. fissa Loebl. et Drugg.
	Hystrichosphaeridium toyetae Eis.
	Ammonidium cf. rigidum (Deunft.) Lister
	Leiofusa sp.
	Micrhystridium nannacanthum Deff. et Defl.
	cf. Buedingisphaeridium astartes Sann.

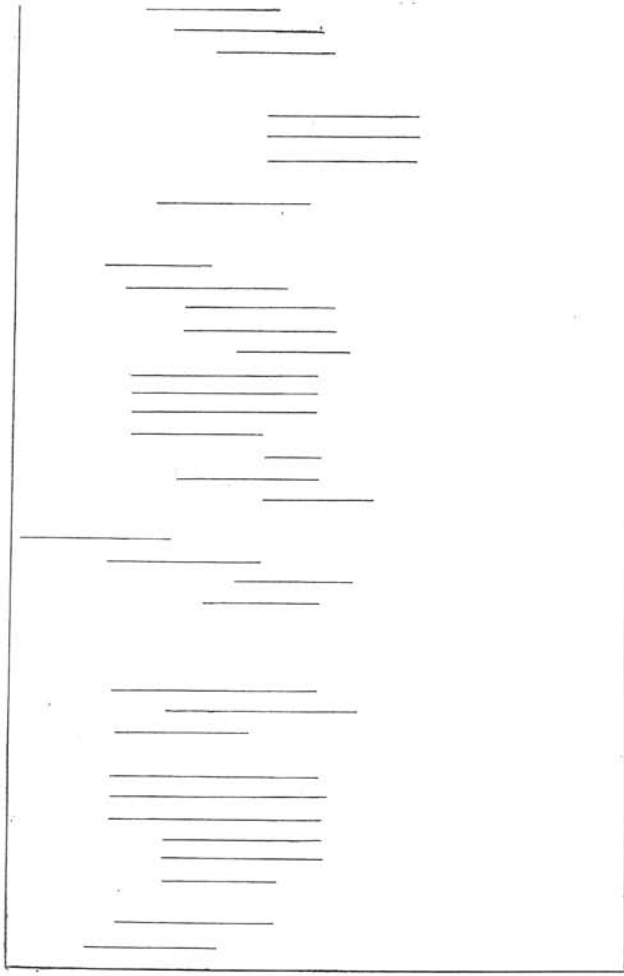
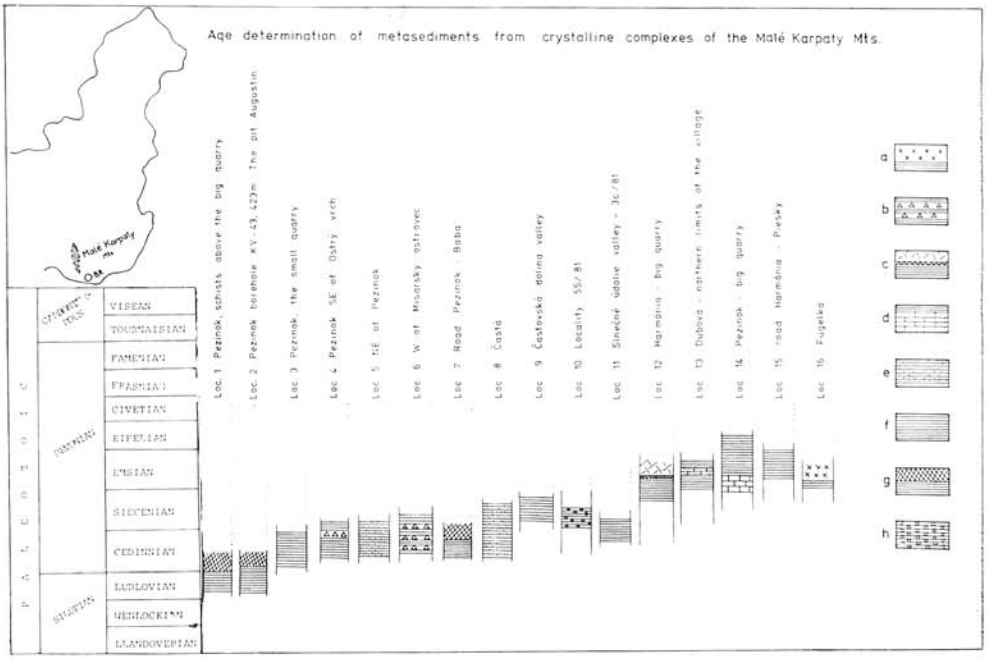


Table 3

Graphical representation of the age of metasediments from crystalline rocks of the Malé Karpaty Mts.



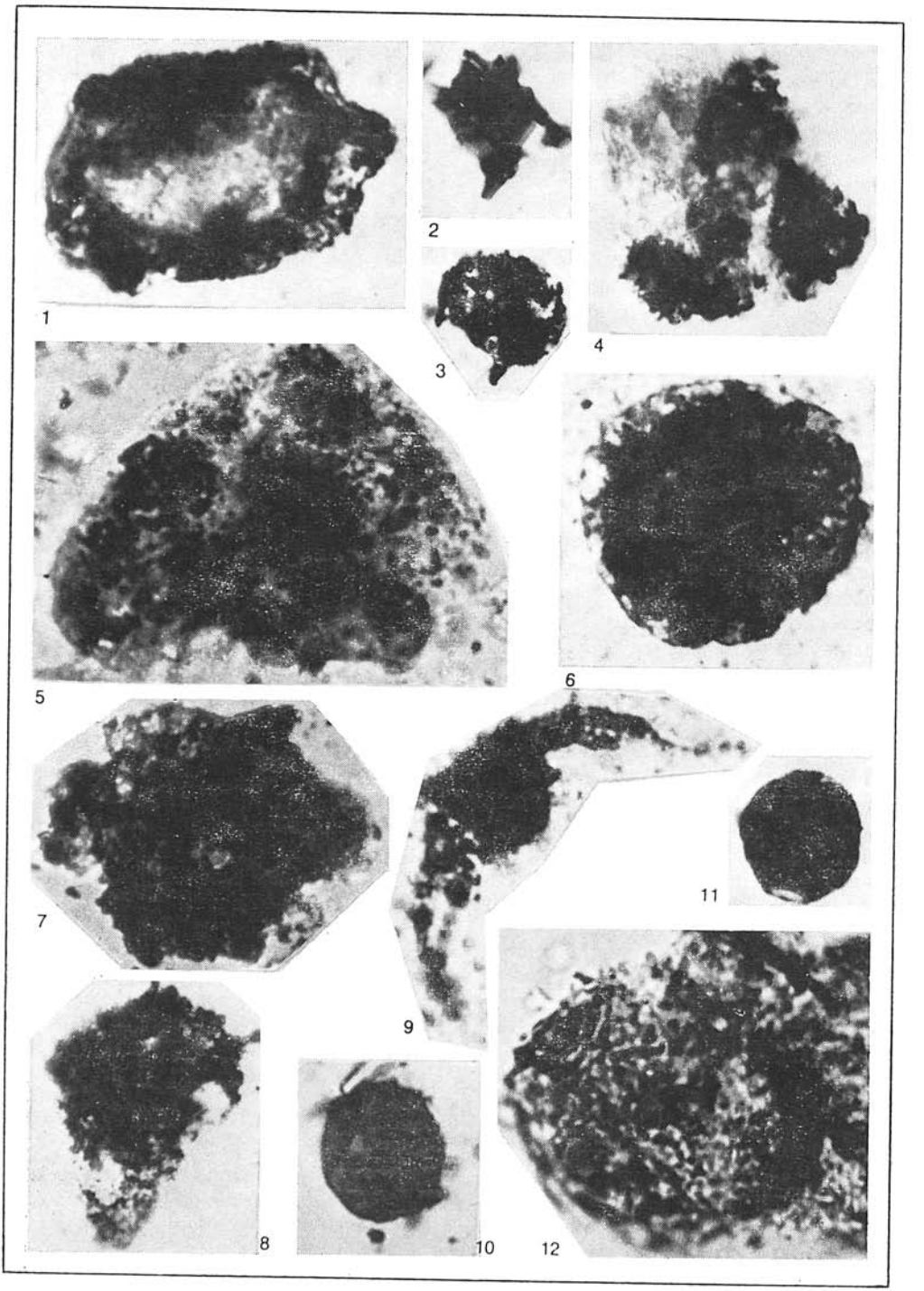
Explanations: a — arkoses, metaarkoses and phyllites, shales; b — phyllites with metaquartzite intercalations; c — granites, phyllites of the Harmónia Group; d — phyllites of the Harmónia Group, limestones; e — quartz biotite phyllites; f — dark phyllites (black schists); g — Sb-bearing schists of the Pezinok—Pernek Group; h — laminated black schists and metasandstones.

Stratigraphically important species for determination of the age of metasediments of this group are: *Dictyotriletes cf. emsiensis* (ALLEN) Mc GREGOR, *Baltisphaeridium tuberosum* (SANN.) EIS., *Retusotriletes* cf. *triangulatus* STREEL, *Multiplicisphaeridium' ramusculosum macroladum* (DEUNFF.) EIS.,

Plate 1

Pezinok—Pernek Group

1. *Cymatiosphaera* sp.; 2. *Polyedryxium* sp.; 3. *Baltisphaeridium* sp., loc. 4; 4. *Cryptostromatium inflatum* MOREAU — BEN., loc. 2; 5. *Pterospermopsis carminae* CRAMER, loc. 6; 6. *Cymatiosphaera kreuseli* EIS., loc. 5; 7. *Polyedryxium decorum* DEUNFF.; 8. *Triangulina alorgada* CRAMER, loc. 6; 9. *Baltisphaeridium longispinum* EIS., loc. 5; 10. *Leiosphaeridia orbiculata* (STAPL.) MOREAU — BEN., loc. 6; 11. *Filisphaeridium brevispinosum* LISTER, loc. 1; 12. *Buedingisphaeridium* sp. LISTER, loc. 4.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Cymatiosphaera jardinei CRAMER—DIEZ, *Stenozonotriletes extensus* NAUM., *Duvernaysphaera tenuicingulata* STAPLIN, *Micrhystridium nannacanthum* DEFF., and others (Tab. 2), which have a narrower age diapason, from the boundary of the Lower Devonian to Emsian. Species with a wider diapason of age, Upper Silurian — Lower Devonian are, of course, also present.

On the basis of evaluation of the whole association of palynomorphs we suppose that a great part of the schistose complex of the Harmónia Group belongs to the period of the Lower Devonian.

Ranging of metasediments from the locality Fugelka (loc. 16, Tab. 2) to the Harmónia Group is problematic so far. According to the degree of graphitization as well as ranging of age, they would rather correspond to the upper part of the Pezinok—Pernek Group.

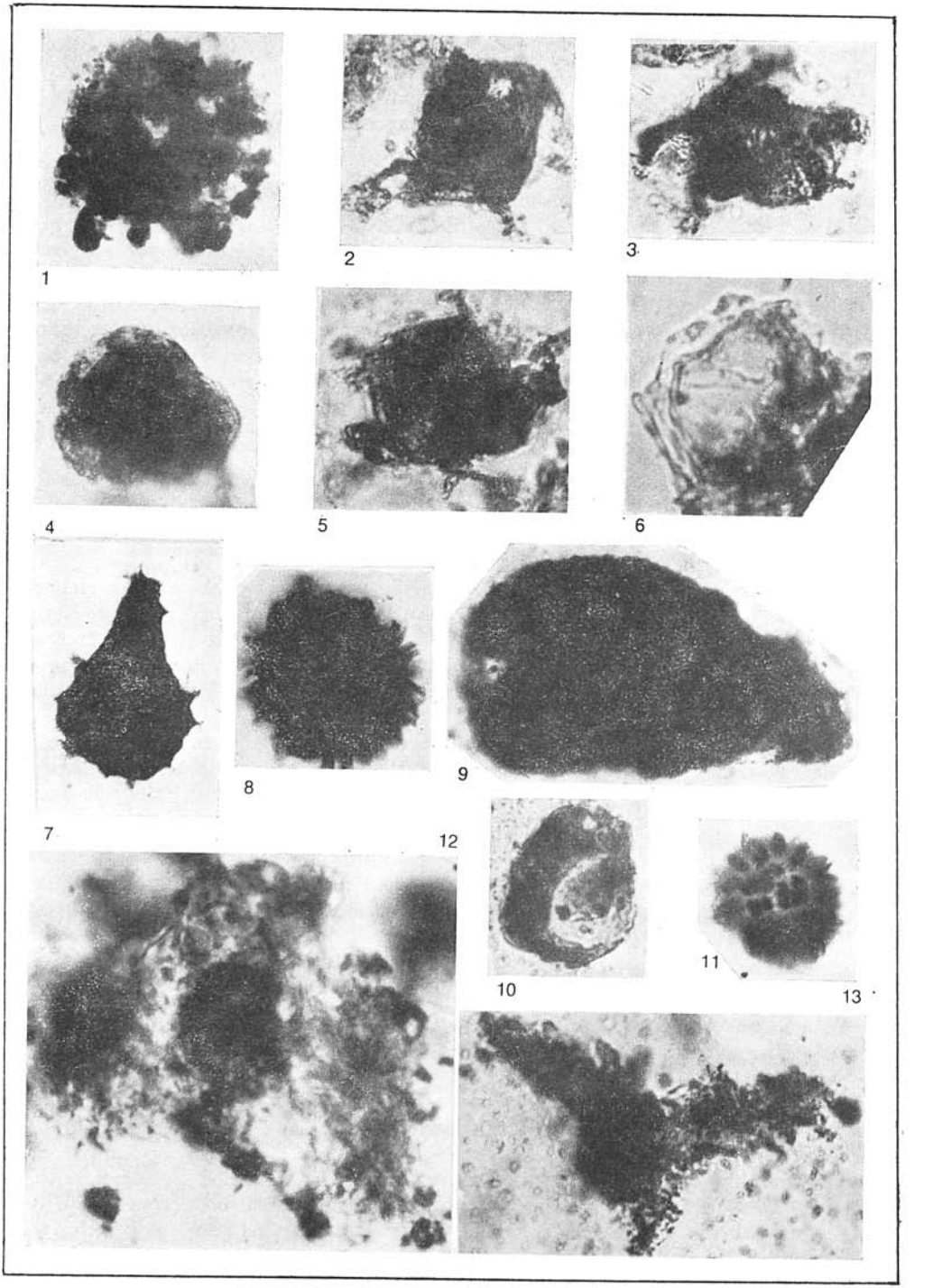
When comparing the ages of the Pezinok—Pernek Group and Harmónia Group it has been established that there is no hiatus between both groups. The metasediments of the Pezinok—Pernek Group pass without interruption into the Harmónia Group. On the basis of up to present palynological investigations it is possible that the dark schists of both groups fall into an equal period of sedimentation.

On the contrary to statement of Čorná (1986; 1974), who mentioned a great diapason of age, Cambrium to Lower Carboniferous for both groups, new investigations established a relatively short period of Upper Silurian—Lower Devonian sedimentation for both discussed groups. As a matter of fact, mainly schists without palynological remnants from the underlying Pezinok—Pernek Group can stratigraphically reach deeper as there are stratigraphically barren schistose horizons in lower horizons without appropriate palynological determination. On the basis of determination of microfossils of both groups, where the ranges of species are overlapping at the boundaries of the Pezinok—Pernek, transitional and Harmónia Group, we suppose that there was essentially a continuous gradual sedimentation in that period, when also the lithology of rocks and tectonic style indicate visibly changing conditions of sedimentation in the time of formation of the Harmónia Group sediments as a consequence of tectonic activity. The succession of sedimentation of the Pezinok—Pernek and Harmónia Groups was so also confirmed by palynological investigation, whilst Cambel expressed such an opinion already in the work from the year 1954 and in further works, which came out later (Cambel—Khun, 1983), on the

Plate 2

Harmónia Group

1. *Raistickia* sp. A. RICH, loc. 15; 2. *Acantodiacrodium* sp. MARTIN, loc. 14; 3. *Evittia granulatispinosa* (DOWN.) LIST. loc. 14; 4. *Cymatiosphaera nebulosa* DOWNIE; 5. *Ammonidium rigidum* (DEUNFF). MOREAU — BEN., loc. 14; 6. *Duvernaysphaera tenuicingulata* STAPLIN, loc. 14; 7. *Angochitina* sp., loc. 12; 8. *Hystrichosphaeridium brevispinosum* CRAMER loc. 14; 9. *Chitinozoa* sp.; 10. *Discina asperella* TCHIBR., loc. 14; 11. *Micrhystridium nannaconthum* DEFF., loc. 16; 12. *Pterospermella pernambucensis* (BRITTO) EIS., loc. 14; 13. *Onandogella deunffi* CRAMER, loc. 14.
All photographs are magnif. 1000 x.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basis of observation of lithological relations of the schistose Harmónia (later) and Pezinok—Pernek (older) sequences as well as also on the basis of lithological study of drill cores in the area of the quarry near Častá. It was already mentioned that palynomorphs from metasediments of the Pezinok—Pernek Group are more affected by metamorphism (carbonization).

The age data concern only a part of dark schists from both groups, which were positive on determinable palynomorphs. As it was already mentioned, about 70 % samples did not provide satisfactory results for ranging of their age. A part of metasediments did not still undergo palynological treatment and a great part of rocks of both groups is unsuitable in their character for palynological evaluation.

On the whole, evaluating the character of palynomorphs associations, we can state that they are represented to a greater extent by *Acritarcha* than spores. Comparing with the associations from the Gelnica Group from the Spišsko-gemerské rudohorie Mts. (S n o p k o v á — S n o p k o, 1979) a percentage abundance of palynomorph associations, i. e. prevalence of *Acritarcha* over spores and resemblance in percentage of affectedness of exine by graphitoid coating were established.

The palynomorph associations of both groups from the Malé Karpaty Mts. essentially differ from those of the Veporide crystalline rocks in representation of species and genera as well as the grade of metamorphism affecting the palynomorph exine by graphitoid coating.

Palynomorph associations from the Veporide crystalline rocks have a richer component of spores whils associations from metasediments of the Malé Karpaty Mts. are richer in marine planktic forms of *Acritarcha* similarly as in the SGR the Gelnica Group. Because of these differences also correlation of palynomorph associations from the Malé Karpaty Mts. with Veporide ones is difficult.

When comparing the Malé Karpaty metasediments with those of the Wechselserie in Austria (P l a n d e r o v á — P a h r, 1984) differences in age have been found. Whereas the Malé Karpaty crystalline rocks are of Early Paleozoic age, the investigated Wechselserie metasediments are of Late Paleozoic age.

Remarks to paleoecology of the sedimentation environment in the period of sedimentation of the Malé Karpaty crystalline rocks

Reconstruction of ecological conditions in the period of sedimentation of metasediments of both groups of rocks is very complicated because a part of the associations of palynomorphs is preserved in rocks only. Therefore also the data of paleoenvironment are only preliminary and can be completed by treatment of further samples, making gradually possible to receive a more complete survey of palynomorph associations.

In the area of sedimentation of the Pezinok—Pernek Group and Harmónia Group a marine environment more distant from dry land may be supposed, as the prevailing part of palynomorph association was formed by *Acritarcha*, which are a component of marine plankton. The sporadical occurrence of Upper Silurian to Lower Devonian spores does not permit to suppose proximity of dry land with vegetation of spore plants already present in that time.

1. The evolutionary increase of spore plant species, which were growing on dry land, began some where in the Silurian, we recorded their products-spores in the investigated sediments. This development of terrestrial vegetation provides the prerequisite to record an increasing amount of spores from the Silurian to younger formations.

2. For finding of spores in metasediments we suppose emerged dry land in proximity. A gradually increasing amount of spores of the Pezinok—Pernek and Harmónia Groups may also testify to closer proximity of dry land to the investigated localities. Formation of black schists in the Malé Karpaty Mts. in near-shore (shelf) areas was also stated in the work by C a m b e l — K h u n (1983), K h u n (1985) on the basis of geochemical study of organic substance in rocks.

Conclusion

By palynological treatment of metasediments from crystalline rocks of the Malé Karpaty Mts. the following results have been established:

a) From all samples treated in laboratory of mostly less metamorphosed sediments only one fourth was positive on palynomorphs, evaluation of which provided data for determination of age.

b) The degree of affectedness by carbonization at polynomorph exine varied between 35 ans 85 %. Palynomorph exines in metasediments of the Pezinok—Pernek Group from the so called producing sequence, characterized by black schists, were mostly affected. Less affectedness by graphitization was found in palynomorphs of the Harmónia Group 35—55 %. According to affectedness of organic remnants the effect of changes caused mainly by the character of metamorphism and its duration may be supposed. An influence of dynamic metamorphism (lattice structure) has not been established on palynomorph exine.

c) The age of the investigated metasediments, so far as they contained some organic remnants, is from the Upper Silurian to Lower Devonian for the Pezinok—Pernek Group (series). The age of metasediments of the Harmónia Group (series) falls to the Lower Devonian.

d) According to representation of palynomorphs gradual sedimentation without break and hiatus at the boundary of schists of the Pezinok—Pernek and Harmónia Groups is confirmed.

e) From the viewpoint of paleoecological conditions it is evident that the environment of sedimentation was marine. The presence of spores of terrestrial plants, however, points to close proximity of emerged dry land, from which the spores could have been redeposited or blown by wind.

f) When comparing with palynomorph associations of the Veporide and Tatride crystalline rocks we see differences in preservation and species composition of sporomorphs. We see an affinity of age in species composition of *Acritarcha* between crystalline rocks of the Malé Karpaty Mts. and Gelnica Group in the Spišsko-gemerské rudohorie Mts.

Closing we remark that the results mentioned in this paper are not solving the age of crystalline rocks of the Malé Karpaty Mts. in the whole extent, but so far as palynological analysis has made it possible only. With further investigation, mainly of part of conglomerates and sandstones, we probably shall arive

more knowledge, which will refine the age of Malé Karpaty Mts. crystalline rocks.

The biostratigraphical results obtained from several positive samples of the Pezinok—Pernek and Harmónia Groups thus clarify the age of a part of metasediments of the studied rock groups only. Further on, open problems remain, not only of sequences, in which are no organic remnants and so there is no prerequisite to obtain data of the age on the basis of fossils, but also of those promising for palynomorphs and which will be necessary to investigate gradually from several localities of the Malé Karpaty Mts. In the work probably the results from only the upper part of the Pezinok—Pernek Group and lower part of the Harmónia Group, which was not denuded, are included.

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