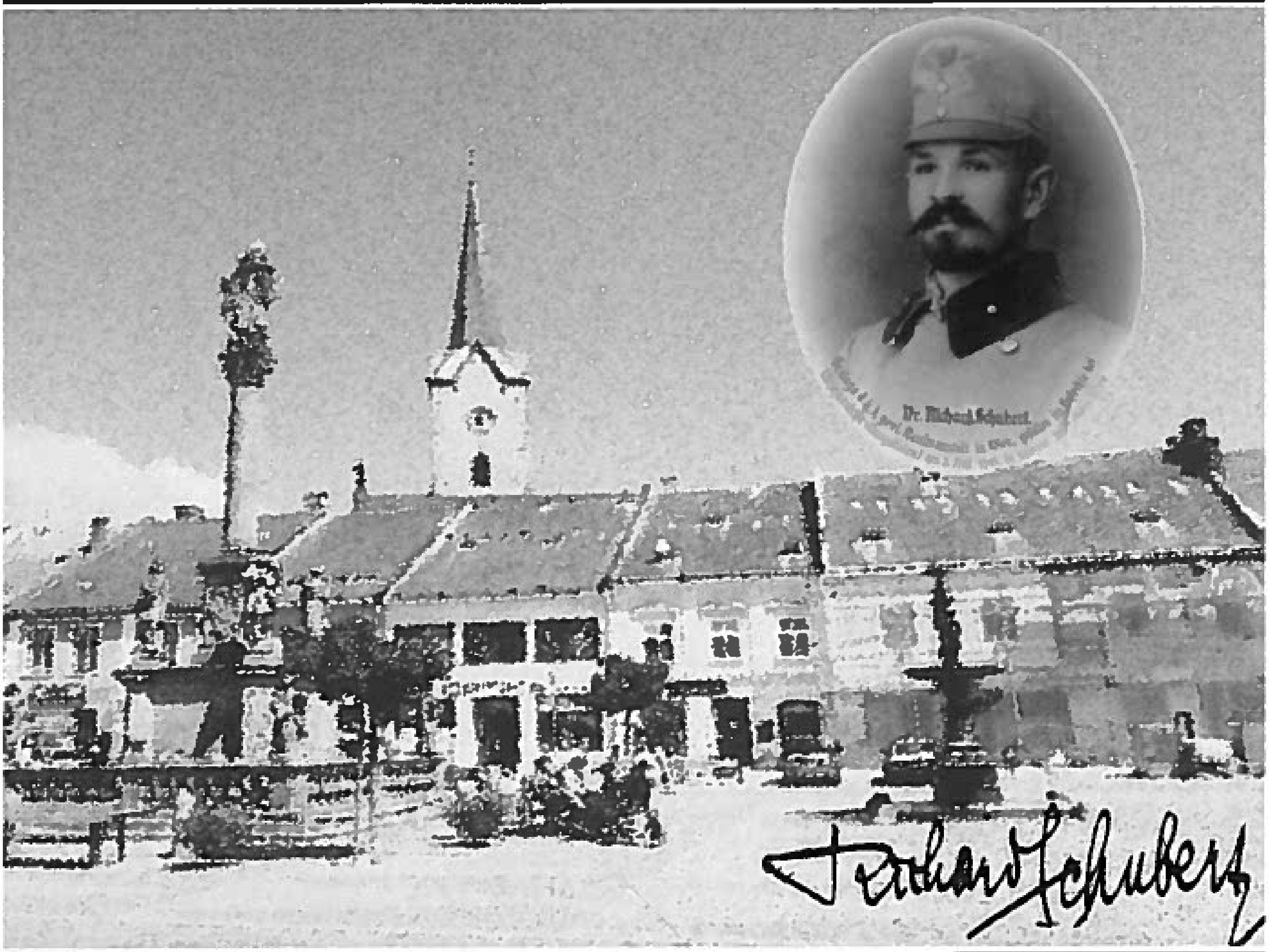
h Czech-Slovak-Polish Palaeontological Conference
10th Polish Micropalaeontological Workshop

Abstracts Book and Excursion Guide



Edited by:

16th Czech - Slovak - Polish Palaeontological Conference

and

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September, 2015

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10th Polish Micropaleontological Workshop

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16th Czech - Slovak - Polish Palaeontological Conference and 10th Polish Micropalaeontological Workshop

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Cover artwork is by Miroslav Bubik and Septriandi Chan
The front cover presents Mohelnice town, the birthplace of R.J. Schubert, and his portrait in military uniform.

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Preface

The Grzybowski Foundation supports joint meetings of micropalaeontologists and palaeontologists from all over the world. In partnership with Polish geological or palaeontological institutions the Grzybowski Foundation has organized micropalaeontological workshops called the "MIKRO" meetings which are held approximately every two years. The first meeting was organized in 1998 in Kraków.

The 10th Polish Micropalaeontological Workshop MIKRO-2015 provides a venue for Polish-speaking Micropalaeontologists to network and present current research topics. For the second time, the MIKRO – meeting is held in conjunction with the annual Czech - Slovak - Polish Palaeontological Conference.

This year, the Organizing Committees of both meetings are pleased to welcome you to Olomouc. It is a large town with a dramatic history, just in midway from Brno to Ostrava, in a flat landscape of a traditional agricultural area called Haná. However, a flat landscape does not mean a boring place for geologists in this case. In Olomouc, the Carpathian Foredeep meets the Pliocene Upper-Morava Graben and the Carpathian Orogen meets the Variscian orogen of Jeseníky. The easternmost extension of the Bohemian Cretaceous Basin and the Permian Boskovice Graben is nearby.

The meeting will consist of two days of technical sessions and a one-day field excursion in the Olomouc area. The excursion will guide you to four stops in Mohelnice, Jevíčko, Vlčice, Loštice on the traces of the life and scientific activities of Richard J. Schubert, who was an outstanding micropalaeontologist and geologist. Schubert died tragically on the eastern front on May 3, 1915. Our meeting commemorates the 100th anniversary of his death.

We take this opportunity to thank the Organizing Committee of the meeting. All members have worked together to make this meeting possible. We also wish to thank our Sponsors of the meeting – the Czech Geological Survey, Brno; Micropress Europe, Kraków - New York; The Grzybowski Foundation, London, and Palacký University, Olomouc.

We are sure that this conference will offer you the ideal environment to discuss cutting edge micropalaeontology and palaeontology, as well to explore new scientific networks and to share ideas.

Mirek Bubík, Agnieszka Ciurej & Mike Kaminski

He spent Vacations and Christmas back home in his beloved Mohelnice with his parents. In 1908 Richard married Marie Deutscher – the daughter of the district veterinarian in Mohelnice and the very next year their daughter Felicitas was born into the young family. Care for his family brought Richard to ask for a transfer back to Moravia and in 1908 he already redirected his geological survey to the area of Uherské Hradiště – Uherský Brod. After the first map sheet was done, Richard started another but its completion was disrupted by the Great War.

Palaeontological studies

Richard Schubert was an excellent and flexible palaeontologist. His main achievement is – however – in the field of micropalaeontology, particularly fish otoliths and foraminifers. Fish otolith studies are summarized by R. Brzobohatý (this volume) and we refer to this contribution for more details. Regarding his foraminifer studies, Richard Schubert possessed amazing flexibility and dealt with agglutinated benthics, calcareous benthics, Cenozoic large foraminifers, fusulinids and planktonics. While today the listed foraminifer subgroups are a subject of almost separate scientific subdisciplines, Richard Schubert lived in a heroic time of geology when scientists dealt a with broad range.

In a series of papers he dealt with foraminifer faunas spanning from the Devonian to Recent and described 102 new taxa. He studied foraminifers from samples he collected but also samples received from other researchers. In this way he was able to analyse material from very exotic overseas countries, like New Guinea, the Bismarck Archipelago, Celebes and Timor. The published foraminiferal results from southeastern Asia and Oceania deserve respect.

His other papers were focused on systematics and taxonomy of particular genera: *Flabellinella, Textularia, Ellipsoidina, Cyclammina, Heteroclypeus, Miogypsina, Lepidocyclina, Frondicularia, Lituonella, Coskinolina, Pavonitina* etc. He also contributed the nomenclature of foraminifers by preparing an index of genera and subgenera to Schulze's "Nomenclator animalium generum et subgenerum". One of his late works on foraminifer systematics and phylogenesis was published years after his death (1921). Out of his nine new genera four survive as valid to this day (*Globivalvulina, Palaeotextularia, Planopulvinulina* and *Tritaxis*). Schubert's experience with Paleozoic foraminifers was acquired during geological survey of upper Carboniferous and Permian strata in Dalmatia, Croatia and Albania. This experience was later applied to late Paleozoic foraminifers from Timor. He also described several Paleozoic genera: *Valvulinella, Globivalvulina* and *Palaeotextularia*. His contribution to the knowledge of Paleozoic foraminifers was recognized by Staff and Wedekind (1910) who named their new genus *Schubertella* after Richard Schubert. To the present day this genus as well as *Eoschubertella, Mesoschubertella* and *Neoschubertella* containing about 90 species reminds Schubert's name to Paleozoic foraminifer workers. Schubert together with his teacher Adalbert Liebus were first to discover Devonian foraminifera in the Barrandian area near Prague already in year 1902.

Other activities and interests

Schubert's flexibility and inquisitive nature were already mentioned. It is not a surprise that in his short papers he also dealt with Pleistocene terrestrial gastropods, Silurian and Carboniferous algae, Ordovician rostroconchs *Ribeiria*, Cretaceous bivalves from rudist limestones and others. He often used his field observations from various regions in papers oriented on regional geology and geological structure. His work at the geological institute also involved practical tasks like mineral deposits and mineral waters. He wrote about natural combustible gas from Hluk in Moravia and about Whewellite from coal mines in Brüx (=Most) in Bohemia. As a mapping geologist of the geological institute, Schubert submitted several geological maps including explanatory booklets. Not all of them were published. For some areas like Croatia, they are still a basic source of regional geological knowledge. His personal character is completed by his love of literature, music and gardening.

War and sudden end of Richard Schubert's lifestory

During his university studies, Richard Schubert was attracted to the army. He joined the army as a one-year volunteer 1896-1897 and received the rank of reserve lieutenant. In 1914 after the outbreak of war he enlisted in the "Landsturm" in Kroměříž where he stayed during his geological survey.

Fig. 7. Portrait of Richard Schubert wearing his uniform, courtesy of the Museum Mohelnice.

He was accepted to the Kremsier 25th Infantry Regiment with the rank of a Lieutenant. The regiment was soon sent to the vicinity of the Russian Border in the Lublin area. In November 1918, he was wounded during an attack on a Russian machine gun position near Nida. It was close – a Russian soldier stabbed him with his bayonet in the chest but Richard's rolled up coat luckily absorbed the hit. However after short recovery he returned to his regiment where he was decorated by "Signum laudis" and raised to the rank of First Lieutenant. During the winter he suffered various hardships with his soldiers – day and night marches, setting up positions. The Austrian Offensive was planned for the spring. On May 3, 1915 he led his soldiers to attack a Russian defensive position near Ujście Jezuickie, and was mortally wounded and died several hours later. He was buried in the cemetery near the church in Wietrzychowice. At the request of his family, the body was later exhumed, transported to Moravia and buried in the Mohelnice cemetery as confirmed by the record in the Registry of Deaths (Fig. 8).

A Brief Biography of Richard Johann Schubert (1876-1915)

Miroslav BUBÍK[1] and Pavla TOMANOVÁ PETROVÁ[1]

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Roots of Richard J. Schubert

Richard J. Schubert was born on December 18, 1876 in Mohelnice (Müglitz in German) into the family of Josef and Marie Schubert. He was given the names Johann Josef at his christening. The family was living in a house in the very heart of the city on today's Náměstí Svobody (the main square) on the corner of Olomoucká Street (Figs. 1 and 2). Richard's father was a shopkeeper and a respected man, serving as a city councillor between the years 1905–1920 and was even elected as mayor for the years 1921–1924, which was already the times of the Czechoslovak Republic. We do not know much about the other relatives of Richard. At the Mohelnice cemetery there is tomb of Josef E. Schubert (1825-1915) with the title "Fürst Salmscher Bergingenieur i. R." Salm's were an aristocratic family that introduced mining and metallurgical industries during the 19th century in Moravia.

Fig. 1. Historical photograph of Schubert's family house at Mohelnice; Mohelnice Museum.

According to a record within the Register of Deaths in the Provincial Archive in Opava, Aegid Josef Schubert was born in Mährisch Aussee (=Úsov in Czech) not far from Mohelnice, got married 1854, and retired in Mohelnice. He may likely be the grandfather of Richard and that would surely influence his focus on geology. Right now it is only speculation and an interesting subject for historians.

Briefly about Mohelnice (Müglitz): Originally a Slavic settlement, first mentioned in the 12th century. German colonization promoted by the Olomouc Bishop in the 13th century set a German character of the city for ages. In the last decades of the 19th century the city was, after wars and devastating fires, finally doing better. The local industry comprised of a sugar refinery, a starch factory, several spirit factories, a soft-drinks company, a cotton wool plant, and others. According to a census from 1910 Mohelnice had 4,294 inhabitants. Cultural life was concentrated in 36 associations including political parties.

Fig. 2. Another view of Schubert's family house as seen from the church tower on a postcard Náměstí Svobody square in centre of Mohelnice comparing with view on a postcard from 1904.

The relations between the German-speaking majority and the Czech minority were not smooth. City authorities represented by German inhabitants did not allow education in the Czech language, for example (Hüblová, 2012). This animosity contributed to the unhappy history of the 20th century. At the end of the 19th century Mohelnice experienced development of infrastructure. Sidewalks of streets were paved. The new building of the elementary school (germanophone "Volks- und Bürger Schulle") was built in Mohelnice in 1878 (Fig. 3). Richard had been going to school in this building undoubtedly.

Fig. 3. Mohelnice elementary school building (on the left) in a photograph from 1960, still having the original historical appearance from the end of the 19th century.

Studies and scientific career

After five years of elementary school in Mohelnice, Richard Schubert started attending the Gymnasium in Olomouc. Later he moved to Melk (Lower Austria) where he attended the Benedictine Abbey and successfully finished his secondary school studies. Richard's interest in natural sciences led him to study at the "Deutsche Carl Ferdinands-Universität" in Prague. Here he met several great professors – the famous paleontologists and geologists Viktor Uhlig and Karl Laube, and mineralogists Friedrich Becke and Anton Pelikan. His steep career started here. He took the position of Demonstrator at the Geological Institute of the University in Prague. In 1899 he exchanged his "alma mater" for the "Karl Eberhard-Universität" in Tübingen (Germany) where he studied palaeontology under the supervision of Professor Ernst Koken. From the years of his university studies a set of Richard's hand-written notebooks is still preserved in the Regional Museum in Šumperk. Numerous detailed colour illustrations show his deep interest in zoology and biology (Fig. 4). During 1899-1900 he became an assistant of Professor Uhlig at the Institute of Geology at the "Deutschen technischen Hochschule" in Prague. In 1900 he received the title Doctor of Geology in Prague.

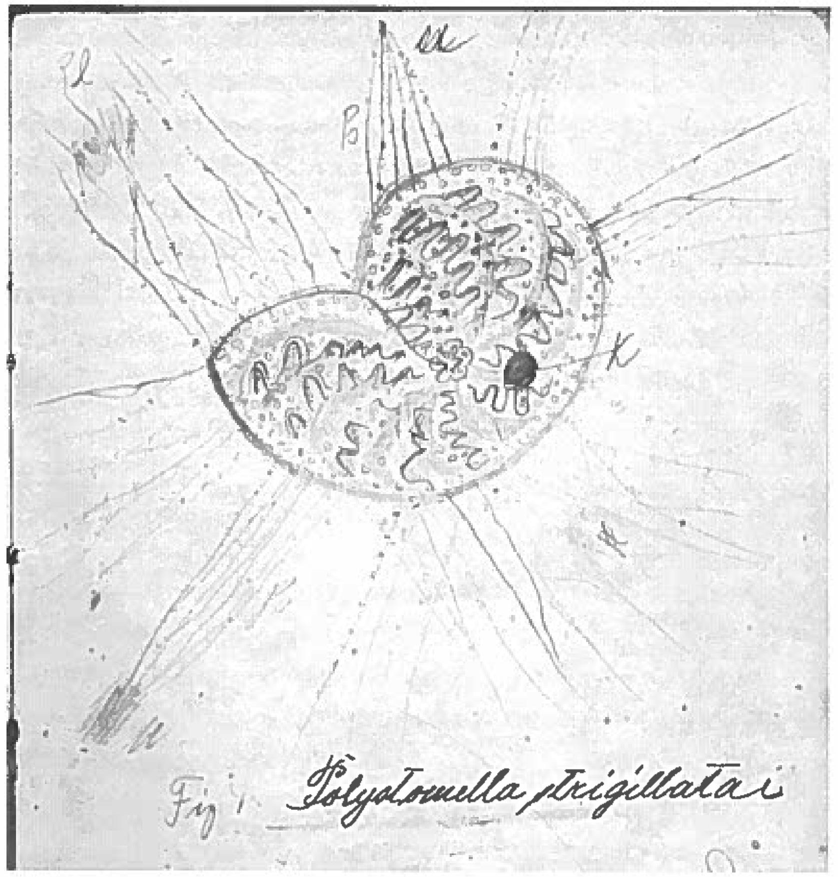

Fig. 4. Possibly the first picture of foraminifer drawn by Richard Schubert from a hand-written notebook, Regional Museum Šumperk.

In these times Richard J. Schubert accompanied Prof. V. Uhlig on a series of field trips to the Carpathians. Based on an excellent education as well as recommendation from his teachers, he was admitted into the "K.-K. geologischen Reichsanstalt" as a volunteer (1900) and later as an assistant (1901).

Fig. 5. Label of Richard Schubert's hand-written notebook with his signature, Regional Museum Šumperk.

The Director of the institute G. Stache offered him to take a part in a geological survey of Dalmatia and he accepted it with youthful enthusiasm. During his field observations he mainly encountered Oligocene coal-bearing Promina Beds and various formations of Eocene age but also Cretaceous rudist limestones, Liassic and Triassic strata and Carboniferous limestones. Richard Schubert finished six map sheets before the end of his activities in Dalmatia in a scale of 1:75000: Zaravecchia-Stretto, Benkovac-Novigrad, Medak-Sv. Rok, Pago, Ervenik-Knin and Zadar (Fig. 6). During his trips he also visited other areas of Croatia and Dalmatia adjacent to his mapping area and later utilized this experience in his two published field guides (1909 and 1912) and in the handbook of regional geology of the Balkans (1914). The field work in the Balkans far from home were surely not without difficulties. He moreover succeeded to conduct his palaeontological studies and publish regularly.

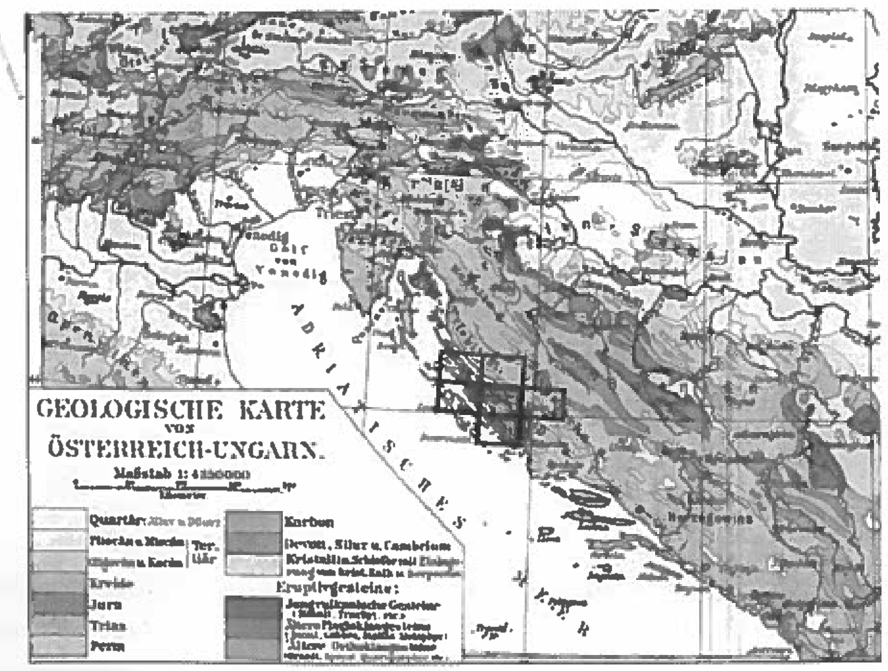

Fig. 6. Position of the sheets of geological map 1:75000 finished by R.J. Schubert in Dalmatia.

Revízia typového profilu gaderských vápencov vo Vápennej doline (Veľká Fatra, Západné Karpaty)

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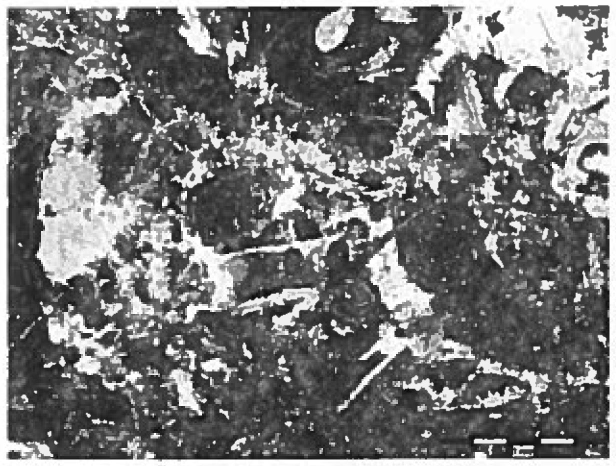
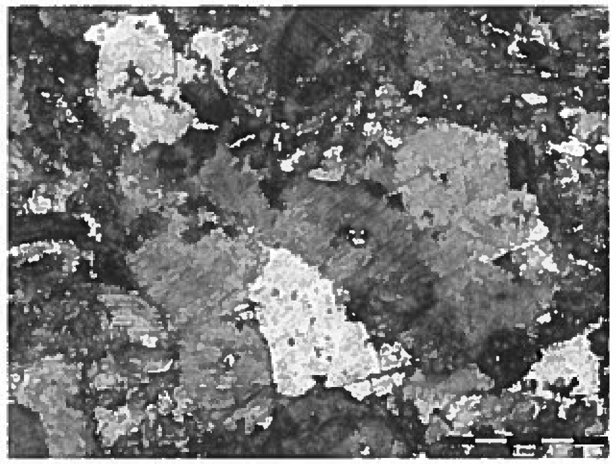
We introduce results of our revision of the type section of the Gader Limestone Fm. at the Vápenná dolina valley (Veľká Fatra Mts., area of the Tlstá Fold), originally defined by Polák *et al.* (1996) from Triassic of the Hronic complex (Central Western Carpathians). We are in agreement with Havrila's statement (Havrila, 2011), that only a part of the whole sequence at type section can be defined as a new lithostratigraphic unit. This is formed only by light crinoidal limestones and forms the uppermost part of the section. The whole section from bottom to top consist of: Guttenstein Limestone, Steinalm Limestone, sedimentary breccia (representing emersion of the platform), Gader Limestone (sensu M. Havrila, l. c.). The Gader Limestone represents SMF 12. The limestones originated after drowning of the Steinalm carbonate platform. We determined the age of the Gader Limestone on the presence of benthic Foraminifera as Late Pelson to Illyr, which correspond to the zone Pilammina densa (Acma zone) – Permodiscus pragsoides (Interval-range zone) in sense of Salaj *et al.* (1983).

Gaderské vápence ako novú litostratigrafickú jednotku v triase hronika centrálnych Západných Karpát vyčlenili v západnej časti pohoria Veľká Fatra, v oblasti vrásy Tlstej Polák et al. (1996) a zaradili ich do pelsónu (Abstract, Fig. 3, 4, str. 300), resp. vrchného pelsónu – spodného ilýru (Fig. 5). Podľa paleogeografickej rekonštrukcie vykonanej M. Havrilom (2011) gaderské vápence vystupujú v priestore karbonátovej plošiny. Na základe mikroskopického štúdia pôvodných 16-tich výbrusov (VD 1 – VD 16) z typového profilu Vápenná dolina (900 m jv. od zrúcanín Blatnického hradu), ako aj analýzy litologickej charakteristiky uvedenej Polákom et al. (l. c.) sme zistili, že sekvenciu hornín na profile Vápenná dolina nie je možné celú definovať ako novú litostratigrafickú jednotku. Stotožňujeme sa s prácou M. Havrilu (l. c.), ktorý dospel k názoru, že v dôsledku tektonického opakovania vrstevného sledu pod termín gaderské vápence Polák *et al.* (1996) zahrnuli sled troch fácií: gutensteinských vápencov, steinalmských vápencov a nad nimi vystupujúcich svetlých krinoidových vápencov. Z nich len posledne menované možno považovať za novú litostratigrafickú jednotku. Na typovom profile boli zaradené Polákom et al. (1996) do vrchného pelsónu (Fig. 3), resp. vrchného pelsónu – spodného ilýru (Fig. 5). Podľa našich štúdií (hlavne mikrofaciálneho výskumu) na profile Vápenná dolina tvoria sekvenciu hornín smerom z podložia do nadložia: a) gutensteinské vápence (VD 16 až VD 7): identifikovali sme v nich *Meandrospira dinarica* KOCHANSKY-DEVIDÉ et PANTIĆ (VD 16, ?VD 14); b) steinalmské vápence (VD 6 a VD 5): po prvýkrát sa objavuje *Pilammina densa* PANTIĆ (VD 6); c) čiastočne dolomitizované vápence (VD 4), ktoré je pre dolomitizáciu problematické zaradiť; d) brekcia (VD 3), ktorá pravdepodobne vznikla počas vynorenia steinalmskej platformy; e) gaderské vápence (sensu M. Havrila, 2011): nástup ich sedimentácie indikuje najpravdepodobnejšie už vzorka VD 2 (obr. 1), v ktorej dochádza k „miešaniu" hlbokovodnejších fosílnych zvyškov s plytkovodnejšími; nasledujú svetlé krinoidové vápence (VD 1, obr. 2). Gaderské vápence reprezentujú SMF 12. Vznikli po ponorení (zaplavení) (drowning event) steinalmskej karbonátovej platformy. Vek gaderských vápencov vrchný pelsón – ilýr sme stanovili zo študovaných výbrusov (VD 1 a VD 2; doplnené o 7 nových výbrusov) na základe bentických dierkavcov. Jedná sa o zóny Pilammina densa (Acma zone) – Permodiscus pragsoides (Interval-range zone) v zmysle Salaja *et al.* (1983). Dierkavce reprezentujú okrem indexových foriem *Pilammina densa* (obr. 1) a *Permodiscus pragsoides* OBERHAUSER (zistený v nových výbrusoch) ako aj Polákom *et al.* (1996) uvádzaných zástupcov, aj iné nodosaridné formy, *Vavulina azzouzi* SALAJ, *Arenovidalina chialingchiangensis* HO, *Ophthalmidium* cf. *tricki* (LANGER), *Duostomina* cf. *alta* KRISTAN-TOLLMANN a sesilne dierkavce. Ďalšie fosílne zvyšky patria hlavne fragmentom ostnatokožcov, resp. krinoidov, hrubostenných lastúrnikov, ramenonožcov, schránkam ulitníkov, ostňom ježoviek, úlomkom holotúrií, ophiuroideí, rias, miskám lastúrničiek a biodetritu. Zóna Pilammina densa (Acma zone) bola v gaderských vápencoch indikovaná aj v pohorí Žiar (Olšavský a Boorová, 2014). Z konodontovej mikrofauny z krinoidových vápencov na typovom profile Vápenná dolina určili vek vrchný pelsón – spodný ilýr M. Havrila a Pevný (1996), čo je v súlade s nami stanoveným vekom pomocou dierkavcov.



Obr. 1. Nástup sedimentácie gaderských vápencov s *Pilammina densa* PANTIĆ. Vzorka VD 2.



Obr. 2. Svetlé krinoidové vápence (gaderské vápence).Vzorka VD

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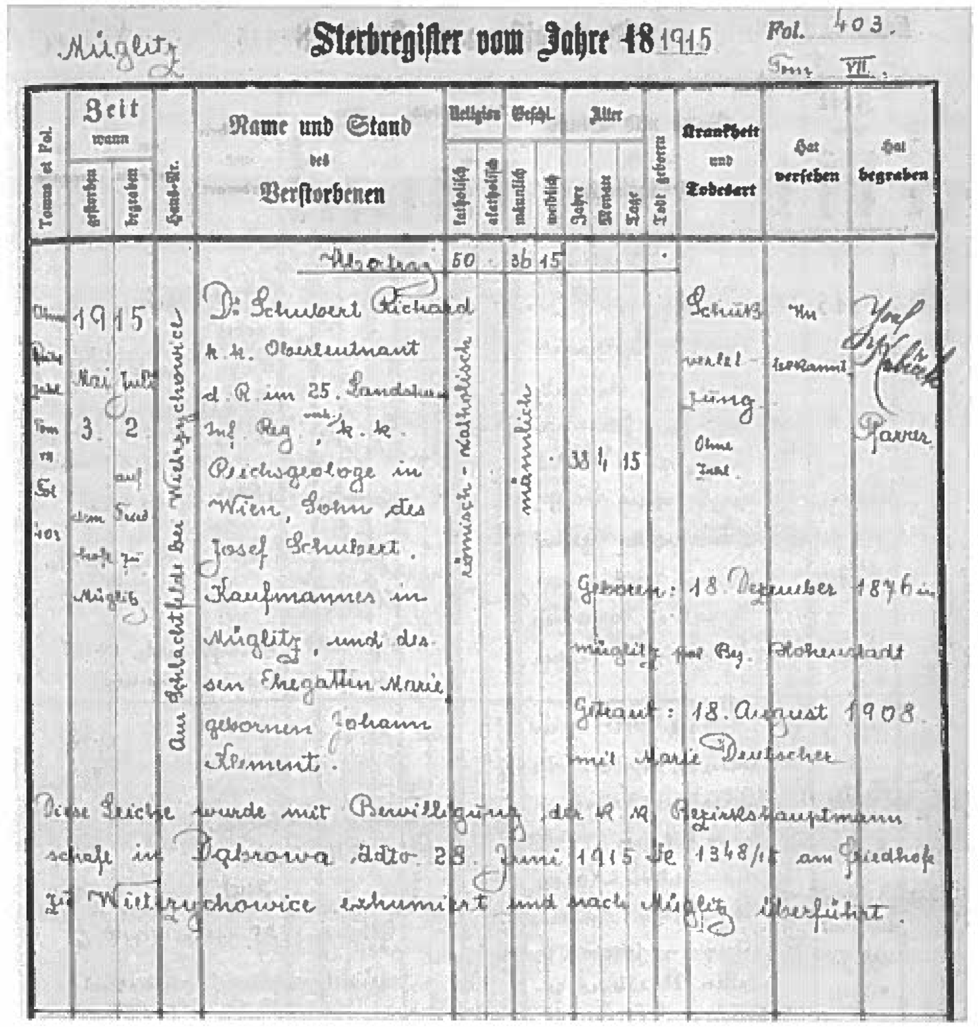

Müglitz
Sterbregister vom Jahre 1915
Fol. 403
Name und Stand des Verstorbenen
Dr. Schubert Richard
k. k. Oberleutnant
Paläontologe in Wien, Sohn des Josef Schubert, Kaufmannes in Müglitz
römisch - katholisch
männlich
Geboren: 18. Dezember 1876
Getraut: 18. August 1908

Fig. 8. Neatly written record about Richard Schubert's death in the Death Register, Provincial Archive in Opava.

Richard J. Schubert's legacy

Obituaries were written soon after Schubert's early death by E. Tietze, O. Ampferer, L. Waagen, F.E. Sueß, F. Koch, G. Schönith and others. The orbituary by Ampferer is the most comprehesive and contains the bibliography of Schubert (Ampferer, 1915). The publications with Schubert's name as author/coauthor kept appearing until 1923. Ampferer (1915) mentioned that Richard Schubert assembled a comprehensive collection of foraminiferal literature of his times and planned a series of monographs starting with Tertiary foraminifers of Austro-Hungarian Empire. He prepared a set of self-made plates for this monograph. This work was not finished as well as other of Schubert's publication plans.

In 1936, the "Museumsverein" (Museum Association) in Mohelnice commemorated Richard Schubert by placing a bronze plaque on the family house. This act was appreciated by a handwritten card from the family that was preserved this day (Fig. 9). After reconstruction of the house – perhaps in the 50s – the plate was unfortunately lost. An even more unfortunate story is the fate of Richard Schubert's grave at the Mohelnice cemetery. During the decades after the World War II and the expulsion of Germans from Czechoslovakia, the tombstone was likely removed and the exact location of his grave is now unknown.

Authors of obituaries and later biographies (the latest written by Gába, 2008) expressed their belief that Richard Schubert would have contributed to micropaleontology much more if he had survived the war. His contribution to micropalaeontology is huge, and he keeps inspiring and provoking his followers.

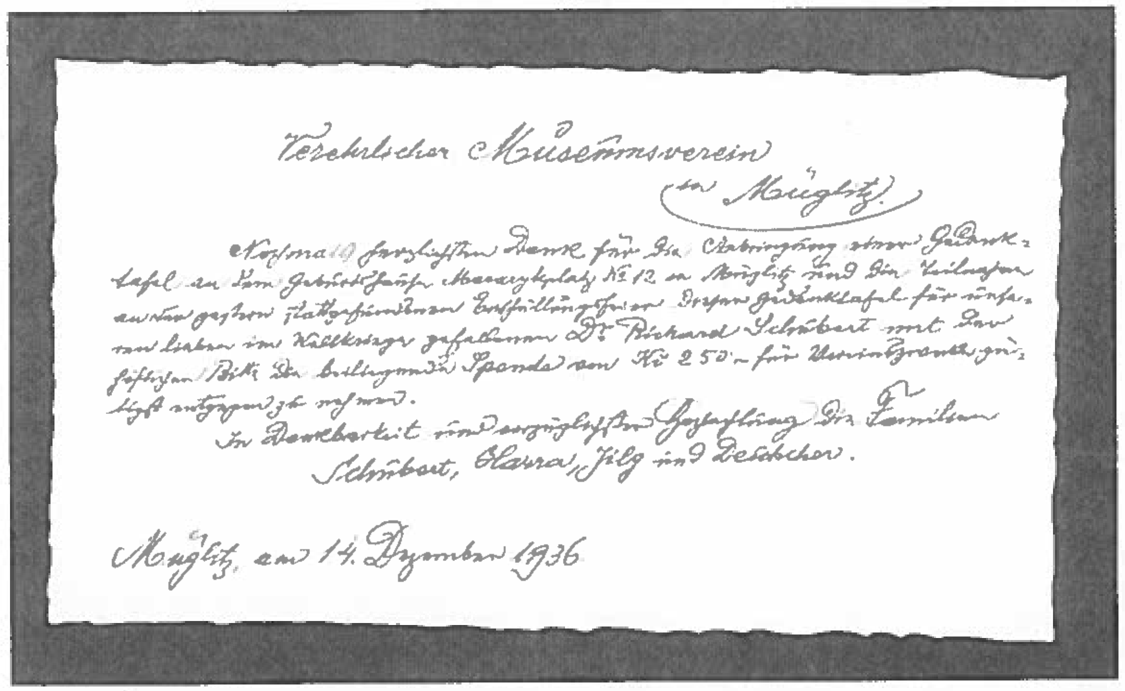

Fig. 9. Card with thanks from Schubert relatives and friend to the Museum Association in Mohelnice for the placement of memorial plaque, Regional Museum Šumperk.

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Part 1. Scientific Contribution

Richard J. Schubert - one of the first cultivators of otolith studies

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Abstract

Richard J. Schubert, Ernst Koken's student, significantly expanded in the early 20th century the systematic approach to the taxonomy of Paleogene and Neogene fish otoliths, mainly of the Central Paratethys. He opened up the use of otoliths for paleogeographic and paleoecological conclusions, and discussed the possible options of using them in stratigraphy. Schubert published 13 original works on fossil otoliths, some of which were of fundamental importance for many decades. He died as an Austrian army officer during World War I at the age of 39.

Key-words: Richard J. Schubert, history, otoliths, Central Paratethys, Paleogene, Neogene

Schubert´s scientific life (otoliths)

Richard J. Schubert was inspired to study bony fish otoliths thanks to the work and personality of Ernst Koken, a professor of paleontology at the Karl Eberhard University of Tübingen, where he in 1899, during one semester residence, completed his university studies.

Fig. 1. Richard J. Schubert (1876-1915)

Prof. Koken was one of the first who recognized the systematic value of otoliths and understood the importance of this group of fossils in understanding the fossil fish fauna in the profiles where skeletal remains of fish are lacking. He published his results in five basic works (Koken, 1884, 1885, 1888, 1891a, b), in which he introduced otoliths to paleontology as a group of fossils that complements the macroscopic study of fish skeletons in micropaleontology level and greatly expanded the possibilities to document history and evolution of Teleostei.

Fig. 2. Prof. E. Koken (1860-1912)

This way of research was still followed at the end of the 19th century in the Paratethys Tertiary by D. Kramberger, A. Rzehak, and most significantly by V.J. Procházka.

Of these, especially Procházka attempted a broader interpretation of otoliths and their use also for palaeogeographic and stratigraphic conclusions. His personal life was, however, very complicated and thus many data remained in his works only in hints or as unsubstantiated, and numerous otoliths findings then formally as nomina nuda (Brzobohatý & Hanzlíková, 1983) - see below.

In the first decade of the 20th century publications associated with the study of otoliths were presented in French and Belgian profiles by M. Leriche and F. Priem, in Hungary by J. Lörenthey and M.E. Vadasz, and especially in the Austrian-Hungarian Tertiary (Central Paratethys in today's palaeogeographical terminology) by R.J. Schubert. Schubert drew on his experience gained at Tübingen and after a one-year fellowship at Prague's German Technological Institute started as a volunteer and later as an assistant at the Geological Survey in Vienna. Besides the works of the field geologist and mapper Schubert deepened, during this time, his knowledge of otoliths of present-day fish by collaboration with the Zoological Institute in Trieste. Significantly, in this respect, he also cooperated with the renowned zoologist and ichthyologist L. Vaillant, who had given him, even until then virtually unknown deepwater fish otoliths obtained from the naval expeditions on board the Travailleur in 1880, 1881 and 1882 and on the Talisman in 1883.

Fig. 3. L.L. Vaillant (1834-1914)

Schubert has also obtained rich present-day material from the malacologist B.B. Woodward (London), dr. Trojan (Prague) and from the collections of the zoological institutions in Frankfurt and Berlin. Deepwater fish otoliths from the Atlantic and Messina regions that Schubert studied in the collections of Prof. Cori of Trieste were especially valuable for advancement of systematic studies of fossil materials. During this time he also processed fossil otoliths from the Austrian-Hungarian Tertiary. In 1906 he received the so called "Schlönbach-Scholarship" from the Director of the Geological Survey E. Tietze, which enabled him to cooperate with G.G. Bassoli of Modena. Bassoli had at that time already rich fossil material from the Mediterranean Miocene (a collection of tens of thousands of otoliths) that he partly processed together with Schubert, which is reflected in the definition of some species. Bassoli (1906) formally held this co-authorship despite the fact that his works were published before Schubert's, as the latter presents himself in a footnote (see Schubert, 1906, p. 624).

A period of intense studies of otoliths at the very beginning of the twentieth century resulted in a three-part publication of "Die Fischotolithen des österr.-ungar. Tertiärs" the essential and most important of Schubert's works on Teleostei otoliths. Its first part is devoted to Sciaenidae (Schubert, 1902). He, as one of the first, compares fossil and Recent otoliths of this group, considers their mutual relations, the stratigraphic range, and using morphological characteristics he pictured, as one of the first, otoliths also from the profile. The second part (Schubert, 1905) is devoted to macrourids and berycids. Concerning the latter he writes "........Otolithen, die ich lediglich aufs Kokens Autorität hin auf Beryciden bezog ...." because he already thinks about majority of them belonging to myctophids. The rich material of such groups studied in the Miocene profiles (especially myctophids) leads him to understanding growth changes of otoliths during ontogeny and to discussion of close species and their possible systematic relationship. In this context, he pointed out the absolute necessity of knowledge of Recent fish otoliths. Similarly as Koken he declined the skepticism of the then ichthyologist towards the taxonomic value of otoliths. Already at this time he also pointed to inconsistencies of purely marine and deep-water species of *Macrouroides kokeni* (Rzehak, 1893) occurrence in sediments near Oslavany (Moravia, now Middle Miocene) and their correlation with brackish Lower Miocene Oncophora Beds

(= Rzehakia Beds). This mistake, based on numerous redeposited brackish fossils into the younger marine sediments of Middle Miocene was not corrected until many years later.

The third part (Schubert, 1906) discusses all other at the time known groups of otoliths and complements or updates data from previous works (Schubert, 1902, 1905). His conclusion (published also in parallel again, 1906b) is dedicated to the first large-scale synthesis of the Tertiary fish fauna of Austrian-Hungarian. Schubert assigns in this work some of so-called "berycids" from older works to mesopelagic "scopelids" (syn. = myctophids), and this allows him to better formulate views on the paleobathymetry of individual sites. [Note: Kalabis (1938-1940) recognized the skeletal remains of myctophids in the Carpathians over 30 years later]. He also notes the contrast between the individual frequencies of certain groups in a present-day Adriatic Sea (e.g., Mugilidae) and their rare occurrence in the Miocene sediments of the studied area. Wherever possible, he discusses also otoliths in situ. He provides an overview of the various kinds of otoliths in individual locations from Oligocene to Pliocene and offers brief characteristics of the sedimentary environment in the relative terminology (shallow-, deep-, etc.), and compares the sites to each other and forms groups of sites based on similar environment. For example: he evaluates the otolith community of the classical site Kienberg (Vienna Basin, Upper Badenian = Langhian) as a purely coastal fauna that can also reflect the environment of freshwater tributaries. Present day studies characterize the sedimentary conditions of the Kienberg profiles as " ...open infralitoral sedimentary conditions without the influence of brackish or freshwater, varying between 30-80 m depth with sandy - muddy / sandy bottom and possibly seagrass beds, in a subtropical climate with gradual upwards cooling ...... " (Brzobohatý *et al.*, 2007).

At the end of his work Schubert created a list of all known Neogene taxa of the studied area based on skeletons and otoliths. He discusses differences in the representation of individual systematic groups of both elements. He stressed that without studying otoliths the groups of primarily deep-water fish (Macrouridae, Myctophidae) in the Central Paratethys would remain almost unknown. This observation is still valid today. Substantial expansion of knowledge of fish fauna using otoliths allowed him to also compare the Neogene fish fauna of the Central Paratethys and the present Mediterranean. There he evaluates taxonomic and individual frequency of individual families of species stemming from the then current knowledge of ichthyology and paleoichthyology in an effort to find identical or different features of fish communities. In summary, he then notes the closeness of Middle Miocene Vienna Basin fish fauna and today's Mediterranean Sea and notes the fundamental difference between the Pliocene fish fauna of the Central Paratethys with high dominance of sciaenids and the fauna of today's European intercontinental waters.

Schubert also had since the beginning of his studies a certain familiarity with the otolith fauna of the Pouzdřany Marl (lowermost Oligocene, NP21-22) including the location of the Moutnice Limestone from the nappe parts of the Outer Carpathians of Moravia. He sensed, however, the need for a deeper insight into this area from the above synthesis. Thus he turned his attention in that direction and processed otoliths from the above mentioned regions (Schubert, 1908). He introduced 19 species from the former region and 4 types of otoliths from the Moutnice Limestone area. He admitted his original erroneous correlation of the Pouzdřany Marl with Neogene rocks that was based on the absence of myctophids in the Oligocene of the North Sea Basin, accepted the Paleogene age of the Pouzdřany Marl, and pointed to problems in the use of otoliths in stratigraphy. The reason for the palaeogeographic absence of myctophids in Oligocene North Sea (e.g., Schwarzhans, 1994) remained at that time still

unknown to him. Unlike Rzehak (1896) who contemplated their sedimentation in very shallow environments, he interpreted the Moutnice Limestone as more deep-water like. The current comprehensive information about the otolith fauna of the Pouzdřany Formation provides for 44 species including paleobathymetric and other environmental interpretations (Brzobohatý & Krhovsky, 1998).

Schubert has, with the aforementioned works, continued in Koken's trend and established otoliths into a wider recognition by micropalaeontologists. In the following years, he acquired larger or smaller collections of otoliths to be processed, along with the following micropaleontological samples: Miocene and Pliocene of northern Italy (Emilia-Romagna, Schubert, 1906c) in which he expands the above cited Bassoli's (1906) systematic processing of the otoliths by including faunal and environmental considerations, the Miocene of Bologne and Sardinia (Schubert, 1907a, b), the Miocene of Panama (Schubert, 1909), New Guinea (Schubert, 1910) and Sardinia (Schubert, 1912a).

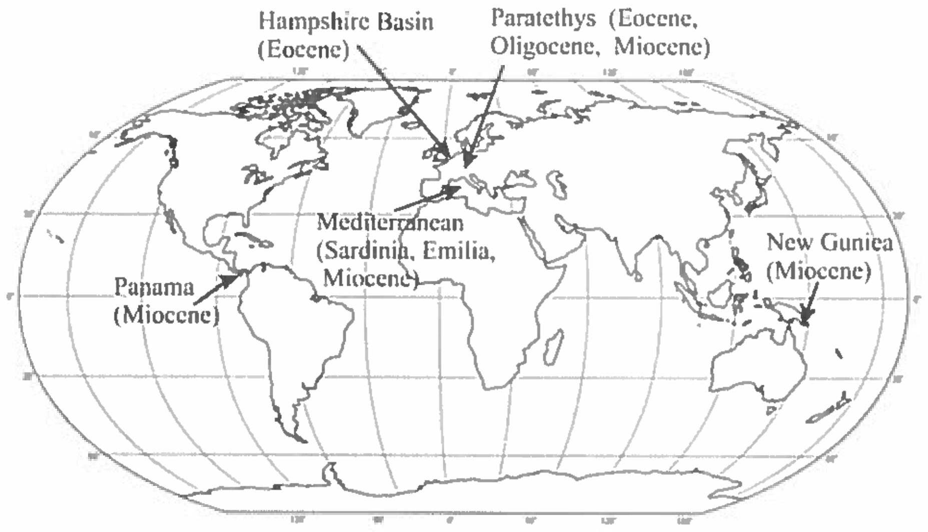

Fig. 4. Place and time locations of Schubert's otolith studies

Schubert then returns to his main publication and complements and expands the view of the otolith fauna from the eastern areas of the Austrian-Hungarian Empire (Schubert, 1912b; also published in the Hungarian version of the quoted magazine). There he presents only sporadic taxa from Paleogene profiles there, compared to numerous lists from Neogene profiles of different localities of the Danube, South Slovakian, and Transylvanian basins. He presents for example 41 taxa from the classic locality of Devinska Nova Ves (German -Theben Neudorf, Hungarian - Deveny Újfalu, Upper Badenian) and 32 taxa from Walbersdorf (Upper Badenian). Where the generic frequency allows, he considers again the conditions of sedimentation.

Schubert's last work (1916) on otoliths was published after his death (3.5.1915, WW1 - battlefield in eastern Galicia). He received, from C.D. Shepherd, a relatively rich sample – a community of 19 species from Eocene profiles at "Barton Cliff" (Christchurch, Hampshire Basin). Their mere descriptions, illustrations, and systematic discussion, without any links to the environmental, paleogeographic or stratigraphic considerations seemed to suggest that the work was influenced by social events at the beginning of World War I and was not written (? completed) in the realm of Schubert's previous professional development.

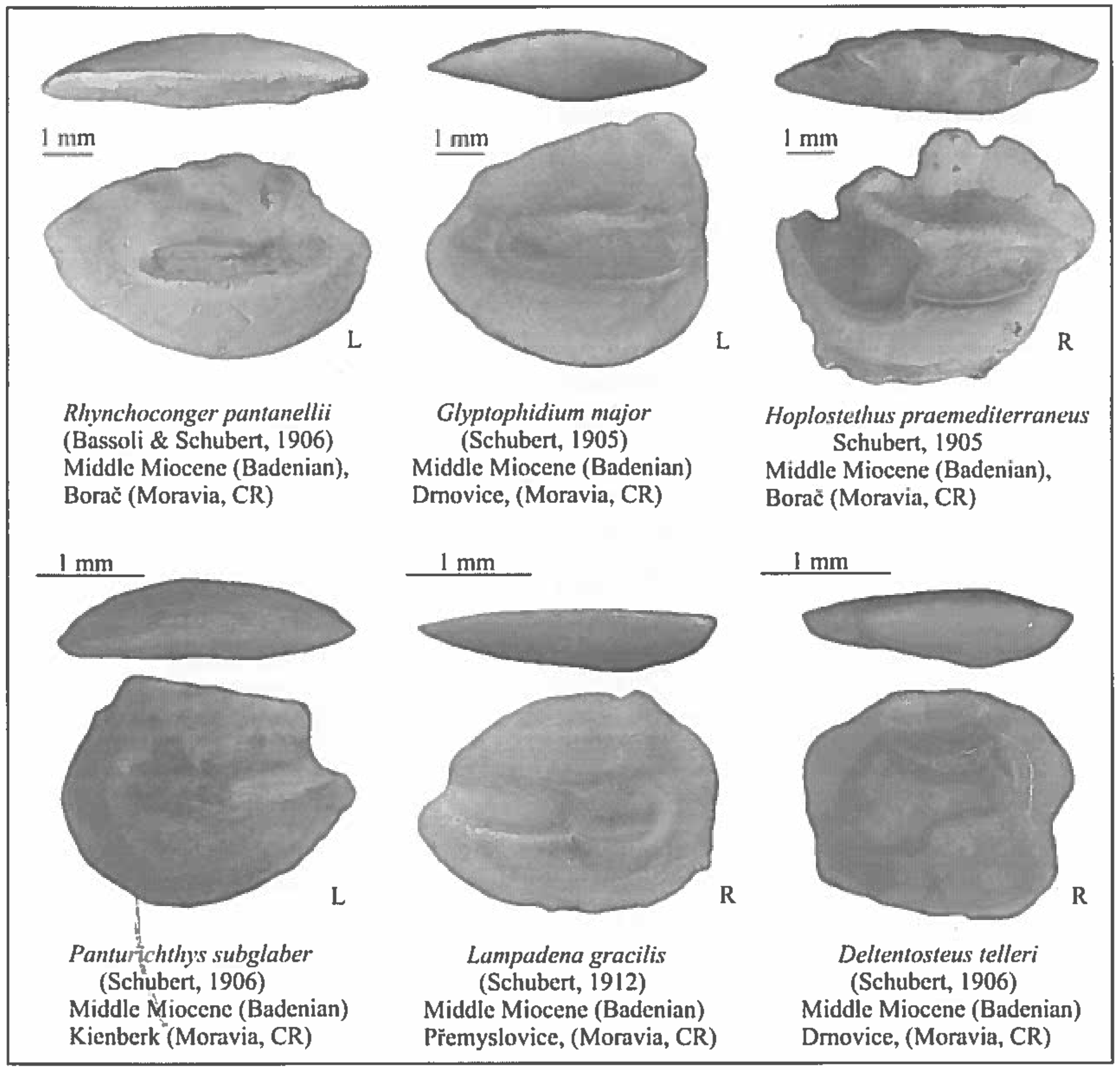

Fig. 5. Important Schubert's species from the Paratethys Miocene [Otoliths from the right (R) and left (L), ventral view/inner face]

One can occasionally encounter an interesting relationship between the older V.J. Procházka (25.9.1862 - 30.10.1913) and younger R.J. Schubert (18.12.1876 - 3.5.1915) in the history of the study Paratethyan otoliths. A careful reader of Schubert's works cannot miss a certain sharper tone associated with quotations from Procházka's data. Schubert (e.g., 1905) points out errors in the texts, for example, *"......Merclucius (konstant so statt Merluccius)", " Merlaugus (!)", " ......der Cranialrand (aber nicht, wie Procházka im deutschen und tschechischen Text* ***mit Vorliebe*** (underlined by R.B.) *zu sagen pflegt, Carinalrand)"*. These are notes that have a touch of certain ridicule. Striking is also the fact that not even one of Schubert's newly described species bears Procházka's name, while 19 of them are dedicated to teachers, colleagues, collection donors, etc. (e.g., *arthaberi, kokeni, bassolii, uhligi, tietzei,* etc.). Other texts also show that Schubert did not know Procházka's material (for example - Schubert, 1906, p. 634, *"........ da mir nicht seine Originalia zugänglich waren ..."*). And here the question arises - did he

not want to know, or was he not given it by Procházka? While the existing collections and also recent and fossil collections of otoliths from practically all over the world were completely available to Schubert for comparative studies, he has not seen the extensive material obtained by Procházka from his home terrain. He had to, most likely, repeat the field and laboratory work from some of the major localities. He could not, however, for factual reasons and time constraints, encompass all of them.

These two researchers, whose birthplace and main residence was less than 70 kilometers (air distance) away (Tišnov-Mohelnice), working in the same scientific field, timeframe and territory, with 14 years age difference, working even for some time concurrently in the year 1900 at universities in Prague (Schubert under prof. V. Uhlig at the German Technical University, Procházka under prof. A. Slavík at the Imperial and Royal Czech Technical University) – without ever having contact with each other. How can we interpret this? The answer is provided by their personal traits and social status and complemented by ethnic emphasis. Mainly the latter could have played in the background of the final period of the Austrian-Hungarian monarchy the most important role.

On the one hand there is Schubert with an excellent family background and social status, high-quality education and academic background, and employment in central institutions of the Austrian monarchy and cooperating on a broad international basis. Contemporaries characterize him as a not very sociable and ill-tempered man incapable of hypocrisy and causing numerous squabbles. He died in the beginning of World War I while fighting for Monarchy as an excellent Austrian officer, a prominent scholar and a hero (Tietze, 1915; Ampferer, 1915).

Fig. 6. V.J. Procházka (1862-1913)

On the other hand there is Procházka *"..... genuine Czech, who found everything Viennese offensive to all Viennese, who lived for a long time in Vienna, but in spirit was always in his beloved Moravia"* (Jahn, 1913), unmarried and insistent solitaire with an university education without the state exam, who during the years 1901-1908 is earning his living as a low paid journalist and translator, and barely surviving in cramped conditions without solid footing in the provincial town Tišnov. His *"....... restless, often bohemian nature and adversity coupled with frequent changes of circumstances prevented him* *from finishing numerous of his works ....."* (Kettner 1962). For these reasons much of his writing often remained only in manuscript. Becoming Associate Professor at the Technical School in Brno, shortly before his death, improved his social status – it did not however fundamentally change the course of his life.

It seems that neither one of them – born in the same region, fellow citizens, and researchers working in a closely related field did not overcome their own ego, and thus the merit of their work has lost itself.

The progress that studying otoliths from Schubert's time went through is reflected in some of the following numbers - see Fig. 7.

Fossilium Catalogus	Number of fossil species (otoliths)		Number of recent species (otoliths) known at that time	
Posthumus (1923)	~ 360		~ 167	
Weiler (1968)	~ 1 000[*1] +100[*2]		~ 1 055	
Nolf (2013, + verbal comm.)	nominal 2 666	~ valid 1 391 +406[*2]	published ~ 5 900	not published (collect. only) ~ 3 000

Fig. 7. Quantitative progress in otolith studies after Schubert's time (*1 - including Recent species known as fossil, *2 - Recent species known as fossil)

Conclusions

Schubert was Prof. Koken's direct disciple and successor. He introduced a total of 115 new species (including collaboration with Bassoli) to the literature of which 44 are now recognized as valid (see Appendix). All others are younger synonyms, doubtful, or rejected, or cannot be evaluated on the basis of the iconography (see Nolf, 1981, 2013). A relatively high number of the last two groups is influenced by a significant number of eroded types.

At the beginning of the 20th century, Schubert significantly advanced the knowledge about fossil otoliths from the Paleogene and Neogene particularly in the Central Paratethys and Mediterranean, and became a leading specialist in this regard. Besides the systematics that logically reflects the level of knowledge about Recent species, his work was targeted to cover the widest possible palaeogeographic and palaeoecologic conclusions within the methods of his time. His work remained for almost 50 years the basic source of information about the otolith fish fauna in the Paratethys.

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Appendix:
List of Schubert´s species now recognised as valid (after Nolf, 2013)
Name Iconography
(Nolf, 2013)

Panturichthys subglaber (Schubert, 1906) Pl. 17
Rhynchoconger pantanellii (Bassoli & Schubert, 1906) Pl. 25
Lamapadena gracilis (Schubert, 1912) Pl. 77
Bregmaceros catulus (Schubert, 1908) Pl. 86
Coelorincus arthaberi (Schubert, 1905) Pl. 93
Coryphaenoides hansfuchsi (Schubert, 1905) Pl. 96
Merluccius shepherdi Schubert, 1916 Pl. 101
Gadiculus labiatus (Schubert, 1905) Pl. 113
Micromesistius planatus (Bassoli & Schubert, 1906) Pl. 116
"Ophidiida" *rzehaki* (Schubert, 1906) Pl. 124

Ampheristus waltoni (Schubert, 1916) Pl. 130
Glyptophidium major (Schubert, 1905) Pl. 131
"*Neobythitina*" *bartonensis* (Schubert, 1916) Pl. 135
"*Neobythitina*" *dimidiata* (Schubert, 1916) Pl. 136
"*Neobythitina*" *subregularis* (Schubert, 1916) Pl. 138
"*Bythitina*" *occultoides* (Schubert, 1906) Pl. 140
"aff. *Dermatopsis*" *boratschensis* (Schubert, 1906) Pl. 141
Chaunax niederleisensis (Schubert, 1906) Pl. 146
Atherina austriaca Schubert, 1906 Pl. 151
"*Hemiramphida*" *minora* (Schubert, 1906) Pl. 155
Hoplostethus praemediterraneus Schubert, 1905 Pl. 165
"*Myripristina*" *priemi* (Schubert, 1916) Pl. 172
Chelidonichthys asperoides (Schubert, 1906) Pl. 184
"*Percoideus*" *tietzei* (Schubert, 1906) Pl. 197
Dapalis hungaricus (Schubert, 1912) Pl. 200
"*Ambassida*" *lapugyensis* (Schubert, 1912) Pl. 202
Serranus integer (Schubert, 1906) Pl. 215
"*Percida*" *ocsensis* Schubert, 1912 Pl. 224
Pristigenys rhombica (Schubert, 1906) Pl. 226
"*Priacanthida*" *lerichei* (Schubert, 1916) Pl. 227
"*Apogonida*" *kosdensis* (Schubert, 1912) Pl. 232
Lithognathus steinabrunnensis (Schubert, 1906) Pl. 261
"*Sparida*" *doderleini* (Bassoli & Schubert, 1906) Pl. 263
Umbrina cirrhosoides (Schubert, 1902) Pl. 279
aff. "*Umbrina*" *kokeni* (Schubert, 1902) Pl. 279
Umbrina subcirrhosa Schubert, 1902 Pl. 279
Cepola bartonensis Schubert, 1916 Pl. 294
"*Cepolida*" *vadaszi* (Schubert, 1912) Pl. 294
Deltentosteus telleri (Schubert, 1906) Pl. 319
" aff. *Phrynorhombus*" *bassolii* Schubert, 1906 Pl. 343
Hyppoglossoides splendens (Schubert, 1906) Pl. 347
Arnoglossus kokeni (Bassoli & Schubert, 1906) Pl. 348
Dicologlossa subvulgaris (Schubert, 1906) Pl. 353
Solea patens Bassoli & Schubert, 1906 Pl. 354

Part 2. Abstracts

Redeposited sponge spicules into deep-water environment of the Silesian Basin during Middle–Late Cenomanian – an environmental implications

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A composition and features of numerous bioclasts found in sandy/silty fraction of turbidite layers in the Middle–Upper Cenomanian deep-water sediments of the Silesian Nappe in the Outer Carpathians, dominated by sponge spicules, suggest that they originated from the growth and destruction of sponge assemblages formed on shelves of the northern margin of the Silesian Basin. These assemblages were built of rigid skeletons of sponges mostly of Tetracladina group, accompanied by other benthic fauna like calcareous foraminifers and echinoid oscicles. Many spicules have been calcified in their primary environment before their redeposition by turbiditic flows. Favourable conditions for the development of sponge assemblages took place on the northern margin of the Carpathian basins during the Cenomanian transgressions, being related to balanced delivery of sediment particles trapped by sponges and waters enriched with nutrients. The nutrients consumed by sponges were related to dissolved silica content that originated from two sources: terrestrial chemical weathering on low gradient plains on the northern margin of the Carpathian basins, and opal grains such as siliceous plankton, suspended in the water column during the periods of blooms forced by seasonal upwelling.

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Intraspecific variability of the genus *Acanthocircus* (Radiolaria) in relations to environmental changes around the Cenomanian-Turonian Oceanic Anoxic Event (OAE2)

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Planktonic foraminifera have been a subject of many previous biometric investigations, but information about size variation within living and fossil radiolarian species is rather scarce. Some of the studies relate to radiolarians inhabiting cold water, which tend to develop thicker-walled skeletons, sometimes with additional secondary external ornamentation, in comparison to members of the same species living in warmer waters (e.g., Hays, 1965; Kellogg, 1975a; Schmidt *et al.*, 2006). Therefore, radiolarian test sizes are usually interpreted as fairly constant regardless of the environment and do not show a systematic change of size with changing environmental conditions. Only a few examples of radiolarian size gradients have been recognised (Bjørklund, 1977; Cortese & Bjørklund, 1997), but not fully interpreted as yet. Recent studies of radiolarian skeleton size based on selected species from the Upper Cenomanian – lower Turonian deposits from the Umbria-Marche and Tatra basins show that intraspecific size variability is a common feature in fossil radiolarian assemblage, and can be used for ecological interpretation.

Herein we summarise data on intraspecific size variability of species belong to the radiolarian genus *Acanthocircus* from the Upper Cenomanian through lower Turonian deposits from two settings in the Western Tethys. Two distant basins: the Umbria-Marche and the Tatra basins were chosen for analysis, represents 1.8 Ma time interval, including a distinctive sedimentation of black shales associated with OAE 2. Radiolarian size variability was analyzed on a background of changes of planktonic foraminifera tests size obtained from microfacies analysis.

Radiolarians are much more diverse than planktonic foraminifers and may inhabit a much greater range of water depths. Skeletons of adult forms differ in size among radiolarian species in one assemblage by at least an order of magnitude.

Plankton morphological variability and size can be influenced directly by several physical and chemical properties of the sea water, such as temperature, nutrient availability, carbonate and silica saturation, and oxygen availability (e.g., Berger, 1969; Bé & Tolderlund, 1971; Hecht, 1976; Caron *et al.*, 1981, 1987a; Bijma *et al.*, 1992; Ortiz *et al.*, 1995; Naidu & Malmgren, 1996; Schiebel *et al.*, 2001; Schmidt *et al.*, 2004a). Each of these physical and chemical factors may influence also indirectly on plankton habitats. These provide more niches and minimise interspecific competition in planktonic assemblages influenced indirectly on their test size (Schmidt et al. 2004a).

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Micropalaeontological and palynological analysis of the uppermost Maastrichtian deposits recorded in the Magura Unit (Polish, Outer Carpathians)

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Microfaunal (radiolarians and foraminifers) and palynological assemblages have been studied within the Inoceramian beds in the Magura Unit Rača subunit) located near Szymbark settlement in the Beskid Niski Mts.

The radiolarian assemblage consists of well preserved, pyritised specimens, which have been found in the dark-grey silty claystones. The nassellarians dominate in numbers of specimens and taxa. They consist of 90 percent of all specimens found. The most characteristic genera are *Amphipyndax*, *Dictyomitra* and *Theocapsomma*. The spumellarians are represented predominantly by species belonging to the family Pseudoaulophacidae (genera: *Pseudoaulophacus* and *Patellula*). The fauna described has a character of low latitude radiolarian association. The age of the radiolarian assemblage has been assigned based on correlation with the radiolarian zonal schemes of previous authors (Foreman, 1975, 1977; Riedel & Sanfilippo, 1974; Pessagno, 1976; Hollis, 1997). The assemblage investigated can be correlated with the upper Campanian to Maastrichtian *Amphipyndax tylotus* radiolarian Zone of Foreman (1977), described also by Foreman (1968) from upper Maastrichtian deposits in California.

Among foraminifers deep-water agglutinated forms dominate, represent nearly 100%. The most frequent are tubular-shaped forms of genera *Rhabdammina*, *Bathysiphon* and *Nothia*. They are accompanied by siliceous-walled *Hormosina excelsa, Rzehakina epigona, R. inclusa, R. minima, Ammodiscus cretaceus* and *Glomospira diffundens*. Less frequent are *Subreophax splendidus, Pseudonodosinella parvula, Reophax* spp., *Recurvoides* spp., *Saccammina placenta*. Moreover, there have been found *Paratrochamminoides heteromorphus, Trochamminoides* spp., *Spiroplectammina* cf. *spectabilis* and *Remesella varians*. Planktic foraminifera occur only as single specimens in five samples. Some agglutinated foraminifera, occuring in the section, such as *Remesella varians*, rzehakinids and *Spiroplectammina spectabilis* could confirm this suggestion. The FAD of *Remesella varians* is known from the middle-upper Maastrichtian (e.g., Kuhnt & Moullade, 1991; Kuhnt & Kaminski, 1997). Numerous small rzehakinids are also described from the Maastrichtian flysch deposits (e.g., Malata *et al.*, 1996). First appearance of *Spiroplectammina spectabilis* was documented from the latest Maastrichtian, near the Cretaceous-Tertiary boundary (Kaminski *et al.*, 1988; Peryt *et al.*, 1997). On the other hand, the lack of small Early Paleocene globigerinids and truly Paleocene deep-water agglutinated foraminifer, *Rzehakina fissistomata* (Geroch & Nowak, 1984), have excluded the Paleocene age of the studied deposits.

The planktic foraminifera include single specimens of *Pseudotextularia elegans, Heterohelix striata, Racemiguembelina fructicosa, Pseudoguembelina palpebra, Globotruncanita stuartiformis, Globotruncana arca* and *Gansserina gansseri*. Taking into account the stratigraphic ranges of these taxa (e.g., Caron, 1985), it could be speculated the age of the deposits, as not older than the *Gansserina gansseri* Zone (middle Maastrichtian). The late Maastrichtian *Abathomphalus mayaroensis* has not been found.

In the present study we identified a Late Campanian to Maastrichtian dinoflagellate cysts assemblage, dominated by species such as: *Spiniferites ramosus, Hystrichosphaeridium* sp., *Palaeotetradinium silicorum, Oligosphaeridium complex* and *Cerodinium diebelii. Oligosphaeridium complex, Hystrichosphaeridium* sp., and *Spiniferites ramosus* are not relevant stratigraphically. The only important form extinct between Maastrichtian and Early Paleocene (Danian) is *Cerodinium diebelii*

(70.6 to 66.043 Ma) however, the species marked environmental changes at the Cretaceous/Tertiary boundary have not been observed.

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Organic-walled microfossils from the Middle Cambrian sediments of the Pepper Mountains, Poland – palaeoenvironmental implications

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An association of organic-walled microfossils consisting of filamentous cyanobacteria, algal coenobia and acanthomorphic acritarch have been documented from non-calcareous mudstones and claystones in a new surface outcrop of the Pepper (Pieprzowe) Shale Formation, located in its stratotype area in the Pepper (Pieprzowe) Mountains, Southern Poland. Organic-walled, filamentous microfossils are in form of ribbon-like and thread-like trichomes, which are usually 10–30 μm long and 2–3 μm thick. According to their morphological features, they show similarities to cyanobacteria from family Nostocaceae. Thirty to forty percent of acritarchs visible in thin sections of the rock consist of cells assembled in rounded to irregular clusters of coccoids represent multicellular algal coenobia attributed to Chlorophyta from the family Hydrodictyaceae. Sphaeromorphic and acanthomorphic acritarchs include forms as: *Celtiberium dedalinum* Fombella, *Cristallinium ovillense* (Cramer & Diez), *Dictyotidium* sp., *Eliasum llaniscum* Fombella, *Estiastra minima* Volkova, *Granomarginata squamacea* Volkova, *Multiplicisphaeridium xianum* Fombella, *Multiplicisphaeridium* sp., *Stelliferidium robustum* Moczydlowska, and *Trunculumarium revinium* Vanguestaine.

Filamentous cyanobacteria might represent planktonic, free-floating forms, possibly living in shallow marine environments influenced by freshwater input. They could create periodic blooms during the increased supply of nutrients. Green algae coenobia represent possibly freshwater species, which could be periodically delivered to shallow marine environment by river input.

The interpretation of deposition environment is reinforced by the preservation of the organic-walled microfossil group, which differ in degree of thermal maturation visible as their different colouration. Filamentous cyanobacteria possess lighter colours, which correspond to a degree of thermal maturation of organic matter adequate to heat flow effected the whole tectonic unit. The algal coenobia and acanthomorphic acritarchs from the same sample are darker, caused by earlier humification preceded final deposition in environment where cyanobacteria could live. These data indicate additionally, on possibly freshwater input into this shelf environment, what is interpreted on the basis of co-occurrence of algal coenobia and filamentous cyanobacteria in the heteroliths.

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Fauna assemblages from the Lower Cenomanian phosphorite layer of Podillya (Western Ukraine)

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The stratigraphic position of the basal phosphorite layer of the Cretaceous from Podillya is still perceived as controversial. While some attributed it to the Middle (Gavrylyshyn *et al.*, 1991; Pasternak *et al.*, 1987) or Upper Albian (Ivanik *et al.*, 2013), the other – to the Lower Cenomanian (Bakayeva, 2011; Kokoszyńska, 1931). Such differences in the views of the time of the layer forming are caused by the features of its occurrence and distribution, and by the fossils preservation that are contained in it.

The deposits of the Lower Cenomanian phosphorite layer crop out in the Middle Transdniester, in Melnytsya-Podilska district (Ternopil region), namely in the outcrops on the left bank of the Dnister River near to village Hudykivtsi, where the richest fauna complexes have been found out. The same deposits occur at the other outcrop near to village Pylypche, but less diverse fauna assemblage and smaller sizes of specimens have been established there (Pasternak *et al.*, 1987). Near to village Hudykivtsi the phosphorite layer is lying on the eroded Devonian surface and is composed by a low-power layer of the basal conglomerate, which consists of the phosphorite agglomerates, gravel and pebble of Devonian rocks, quartzes, flints and numerous phosphorite congestions. Also there are casts with mollusc shells, needles of sea urchins, phosphorite sponges, shark teeth, coprolites and numerous fragments of the phosphorite wood. Conglomerate is cemented by a phosphatic substance, sandy limestone or sandstone. The thickness is 5-30 cm. The layer has a distinctive bitumen smell and dark brown colour.

Remains of the fauna in the layer are preserved as dark brown phosphorite casts, some of which are damaged and rounded. Often on the casts surface there are traces of drilling and shell fragments. Whereas shells of gastropods are rare, bivalves with shells occur frequently. In the phosphorite congestion very small molds of probably juvenile molluscs that are unsuitable for determination were found too. Moreover, there were found fragments of mollusc shells filled with sand, which have been buried in situ. Foraminifers are not numerous and are represented by casts and phosphorite shells that could be determined only to genus.

In the phosphorite layer have been determined 27 bivalve species, one scaphopod species, 8 cephalopod species (Pasternak *et al.*, 1987) and 23 gastropod species (Bakayeva, 2004). While some of them are typical in the Albian (*Lucina downesi* Woods, *Cardium proboscideum* (Sowerby), *Ampullina cosnensis*

(Loriol), *Proscala gaultina* (d'Orbigny), *Hoplites dentatus* (d'Orbigny), *Hoplites baylei* Spath, *Anahoplites planus* (Mantell)), the other are common in the Cenomanian (*Leda baueri* Noetling, *Cucullaea mailleana* (d'Orbigny), *Limopsis mulleri* Holzapfel, *Mimachlamys robinaldina* (d'Orbigny), *Lopha carinata* (Lamarck), *Amphidonta canaliculata* (Sowerby), *Cyprina ligeriensis* d'Orbigny, *Conotomaria ewaldi* (Tiessen), *Pleurotomaria tourtiae* Tiessen, *Tessarolax marginata* (d'Orbigny), *Avellana cassis* d'Orbigny). Species with a wider stratigraphic distribution that occur in the Albian and Cenomanian (*Nucula pectinata* Sowerby, *Cyprimeria faba* (Sowerby), *Fustiaria strehlensis* (Geinitz), *Puzosia mayoriana* (d'Orbigny), *Gyrodes gaultina* (d'Orbigny), *Confusiscala dupiniana* (d'Orbigny)) and in the older or younger deposits (*Barbatia marullensis* (d'Orbigny), *Cucullaea glabra* Parkinson, *Grammatodon carinatus* (Sowerby), *Glycymeris sublaevis* (Sowerby), *Entolium orbiculare* (Sowerby), *Plicatula gurgitis* Pictet et Roux, *Torquesia granulata* (Sowerby)) have been established too.

Thus, revealed in the phosphorite layer fauna complex belongs to a mixed type. According to stratigraphic distribution of species, preservation of fossils and degree of skeletons diagenetic transformation there were detected two fauna assemblages of different ages. The first, Albian assemblage is represented by phosphorite casts, which are damaged and rounded with drilling traces. *Hoplites dentatus* occurrence indicates its Middle Albian age. Foraminifers are preserved by a quartz translucent and phosphorite casts that have been rounded and their skeletal parts have been wiped away. The benthic forms *Haplophragmoides*, *Lenticulina*, *Trochogaudryina*, *Gyroidinoides*, *Lingulogavelina*, *Gavelinella*, *Hedbergella*, *Pseudonodosaria*, *Lagena* have been determined. While an important feature of quartz casts is the size of individuals that is almost 1 mm, the phosphorite casts are small. It is possible that the assemblage consists of Middle and Late Albian complexes, but for their separation are not enough arguments yet. The second, Cenomanian assemblage is represented by calcite mollusc shells with a weak degree of phosphorization that have been buried in situ. Foraminifers are preserved by calcite translucent casts of small planktonic forms *Globotruncana* and ?*Rotalipora*.

Therefore, conducted analysis of fossils, selection and comparison of the main features of the phosphorite layer allow to relate these deposits to the Cenomanian.

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Fig. 1. Upper part of Cooksonia sp. with sporangia (Lodĕnice – Čemidla, Motol Formation, Wenlock), specimen D 550, National Museum, Prague.

Fig. 2. Upper part of Cooksonia sp. (Lodĕnice – Čemidla, Motol Formation, Wenlock), specimen D 551, National Museum, Prague.

Gogiid eocrinoids from the Cambrian of the Barrandian Area (Czech Republic)

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The class Eocrinoidea is ranked among one of the main echinoderm groups in Cambrian associations (Sprinkle, 1973). This extinct group of Palaeozoic invertebrates represents a paraphyletic class of basal blastozoans (Sprinkle, 1973; Smith, 1984). Eocrinoids echinoderms are known from the Cambrian to the Silurian (Sprinkle, 1973; Zhao *et al.*, 2008).

Studied material is housed in the Paleontological Department of National Museum Prague and in the Czech Geological Survey Prague. Studied specimens have been collected from diverse outcrops and sections in the Jince Formation of the Příbram-Jince Basin, and from several outcrops and one section in the Buchava Formation of the Skryje-Týřovice Basin. All studied material appears in siliciclastic sediments, that based on the trilobite and agnostid content are considered Drumian in age. Gogiid eocrinoids are usually preserved disarticulated in the Barrandian area (Prokop, 1960; Chlupáč *et al.*, 1998). Articulated specimens are rare and restricted to very specific strata (Fatka *et al.*, 2004). Some of studied specimens are excellently preserved and provide the opportunity to study even the finest morphological details, like internal and external surface of thecal plates.

Gogiid eocrinoids are the most diverse group of Cambrian echinoderms in the Barrandian area. Three genera have been described from this area: *Acanthocystites* Barrande, 1887; *Akadocrinus* Prokop, 1962 and *Luhocrinus* Prokop & Fatka, 1985. Named genera (*Acanthocystites*, *Akadocrinus*, *Luhocrinus*) share common features as they bear non-branched brachioles with biserial plating pattern; their theca is bottle-shaped and composed of numerous, irregularly arranged plates with or without epispires. Thecal plates are variable in size. The theca grades into proximal part of the stem. The stem ended with attachment disc composed of polygonal plates.

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Preliminary micropalaeontological data from the Late Cretaceous Santa Marta Formation at James Ross Island, Antarctica

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James Ross Island, in its northern deglaciated part, has extensive exposures of marine Upper Cretaceous sediments well accessible to stratigraphical and palaeontological research. Early studies of the biostratigraphy focused primarily on the well-preserved molluscan faunas. Consecutive studies of microfossils from the James Ross Island region have clearly shown the potential for establishing biostratigraphic frameworks using foraminifers, diatoms, silicoflagellates and palynomorphs (e.g., Huber 1988; Harwood 1988; Askin 1988). Other preliminary studies on James Ross and surrounding islands have also shown the potential of palynomorphs for local and regional biostratigraphical correlation (Riding *et al.*, 1992). However, foraminifers from the Santa Marta Formation remain understudied. Huber (1988) deals with Campanian to Paleocene foraminifers of the James Ross Island region and described several new benthic taxa. Hradecká *et al.* (2012) in their preliminary report reported foraminifers including planktonics from Turonian to Campanian strata of the northern James Ross Island. Another study focused to microfossils of Coniacian-Santonian part of the Santa Marta Fm. including systematic description of benthic foraminifers (Santos Florisbal *et al.*, 2013). Concheyro *et al.* (2014) brought descriptions of some interesting Cretaceous benthic foraminifers reworked in the Cenozoic diamictites.

The main aim of our current study is to bring more detailed information on foraminifers in the basal Santa Marta Formation (lower part of the Lachman Crags Member), which is uppermost Coniacian to Santonian in age. Samples come from the A90 section, that is situated about 1 km west of Panorama Pass and 2 km SSE of Johann Gregor Mendel station, northern James Ross Island. The Lachman Crags Member exposed in the A90 section is characterised 86 m thick sequence of massive, very fine- to medium grained volcaniclastic sandstones and silty sandstones. Moreover, pebbly sandstones, accretionary lapilli beds and calcareous concretionary horizons occur in the section. Concretionary horizons are rich in fossil phytodetrite, fossil tree trunks and a rich variety of marine invertebrate fossils (inoceramid bivalves, decapods, ammonites etc.). Microfossils were retrieved by washing of soft lithotypes and by acetolysis of calcareous concretions.

The microfossil content of studied samples comprises, besides foraminifers, rare radiolarians, planktonic diatoms, very rare ostracods, prasinophyte cysts (*Tasmanites*, *Leiosphaera*?), calcispheres and characeans. Macrofaunal groups are in washing residues represented by sponge spicules, echinoid elements, fish bones and locally mass occurrences of inoceramid prisms. All samples contain abundant coalified or mineralised plant tissues that are in many cases the only fossil remains. Foraminifer assemblages are of low diversity (up to 10 species) and low density (usually 2 to 3 specimens per 1 g of rock). Poor samples allowed retrieving up to few tens of specimens per sample even after extensive picking. Agglutinated benthic taxa prevail over calcareous - planktonics are missing. The composition of assemblages is in many cases affected by dissolution and calcareous taxa are often preserved as cores. Among agglutinated taxa several species of *Haplophragmoides* and *Spiroplectammina* are the most abundant, followed by *Tritaxia, Karrerulina, Recurvoides, Cribrostomoides*? and *Marssonella*. Calcareous taxa are represented by genera *Lenticulina, Cibicidoides, Quadrimorphina, Allomorphina, Gyroidinoides, Hemirobulina*, and rarely *Siphonodosaria, Conorbina, Pyrulina* and *Gavelinella*. The finds of moderately preserved radiolarians and well preserved diatoms of "*Coscinodiscus*" type are also very interesting.

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Lithological and micropalaeontological data of the Pasierbiec Sandstone Formation in the Rača Subunit of the Magura Nappe (Outer Carpathians, Poland)

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The Outer Carpathians consists of several nappes northwardly thrust one upon another. The southernmost is the Magura Nappe. It is divided to four subunits. One of the inner subunits is the Rača Subunit. Within the Paleogene part of section of its sedimentary succession the Eocene Pasierbiec Sandstone Formation is especially well developed in the Osielec village and surrounding area. It consists of thick-bedded sandstones, conglomeratic sandstones and conglomerates interbedded within thin-intercalation of shaly-sandstone flysch and some marly mudstone beds. There, in Osielec, occur olistostrome deposits that consist of pebbles, cobbles and boulders of different exotic rocks which reside within sandy-pebbly matrix or sandy-shaly debris. Between others, especially interesting are large blocks of gabbro and occasional boulders of organogenic Paleogene limestones with larger foraminifera. The Osielec Sandstone Formation is underlain by Eocene oceanic red beds of the Łabowa Shale Formation and overlain by the Beloveža Formation. The deposits of the Pasierbiec Sandstone were sampled for biostratigraphical determinations. The microfossil assemblages were usually very poor and contain foraminifers, radiolarians, and fish teeth. Preliminary data indicate the occurrence of Eocene species of foraminifera. *Reticulophramium amplectens* (Grzybowski), *Haplophragmoides parvulus* Bleicher, *Eggerelloides propinqus* (Brady) as well *Haplophragmoides nauticus* Kender, Kaminski et Jones occurred as single specimens among other cosmopolitan agglutinated species. A sample including the monospecific assemblage with *Praespherammina subgaleata* (Vasicek) was found, which is typical for Middle Eocene. Sporadic planktonic foraminifera are represented by *Acarinina bullbrooki* (Bolli) and *Subbotina gortanii* (Borsetti).

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Silicification of coccolithophores in fossil faecal pellets (Tylawa Limestones, Lower Oligocene, Outer Carpathians)

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Perfectly preserved, silicified coccolithophores have been found in the Tylawa Limestones, laid down in the Central Paratethys Sea during Early Oligocene (NP 23 nannoplankton zone). The limestones consist of alternating dark and light submillimetric laminae (e.g., Ciurej & Haczewski, 2012). The dark laminae are mostly composed of clay and organic matter with addition of diatoms, preserved mostly as voids and rarely as frustules. The light laminae are composed of the coccolithophores, mostly well-preserved with many intact coccospheres. The coccolithophore material is mostly packed in pellets (interpreted as zooplankton fecal pellets), which are the main components of the light laminae. The pellets are mostly lithified by calcareous cement. A small portion of cement is siliceous. The pellets from the light laminae were studied in ten samples of the Tylawa Limestones collected in five outcrops in Polish Outer Carpathians, in thin sections under SEM, using the method described by Ciurej (2010).

Three types of pellets preservation in respect of siliceous cement and its relation to coccolithophore preservation state, their frequency and position within laminae are as follows:

(1) Pellets with chalcedony and/or microquartz and single quartz crystals, located within inner parts of intact or partially dismembered coccospheres whose morphological structures are well-preserved without replacement of calcareous components. These were observed in all studied samples and occur within all light lamiae, often near their bottoms or tops, but sometimes in both location.

(2) Pellets with siliceous cement, occurred in the form of microquartz which partially or totally replaces calcite in coccolith plates within intact or partially dismembered coccospheres whose morphological structures are not obliterated. Such pellets are present in samples including portions of limestone completely silicified to black chert, especially in the light laminae adjacent to chert.

(3) Pellets with siliceous cement in the form of microquartz obliterating, often totally replacing calcite in coccolith plates, which are often recognizable only as fragmentary imprints. These pellets are present only in the light laminae replaced by cherts, visible locally in some samples with a naked eye.

The excellent preservation has been caused by special coincidence of high sedimentation rate and environmental conditions in water column which stimulate successive blooms of coccolithophores and diatoms in semi-closed basin with limited circulation, where delivery of aluminosilicates to surface waters from coastal areas are much higher than in open ocean. In such conditions biogenic silica as marine snow is delivered into water column. Aluminium lowering biogenic silica dissolution and is easily bind by diatoms during frustules formation. Dissolution and crystallization of silica in the deeper part of the water column or near the bottom/water interface is related to water temperature, disintegration of pellets with diatoms and change in the solubility attributed to adsorption of cations or clay mineral formation.

Three above mentioned type of laminae reveal adjacent steps of silicification caused formation of excellent preserved, silicified coccospheres in one of them. Timing of silicification is hard to estimate, but it would be on a timescale of months or even days.

The details of processes responsible for excellent preservation of silicified coccospheres are interpreted as follows: water saturated in relation to silica could very early infiltrate into pellets built with abundant coccolithophores which were strongly porous, and the first generation of siliceous cement could precipitate into free space of complete coccospheres just after decomposition of cytoplasm. Lowering of the pH initiates dissolution of calcareous plates, leaving their casts in the first generation of siliceous cement. During this time, crystallization of a second siliceous cement continued in empty spaces after the coccoliths dissolution. After complete disintegration of pellets, recrystallization of siliceous cements continued, leaving biogenic structures obliterated and making them finally unrecognizable.

Fluctuations of silica dissolution could have broken the silicification processes at any stage leaving completely or incompletely replaced coccospheres by siliceous cement.

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The Miocene oysters from the Moravian part of the Carpathian Foredeep: systematics, taphonomy and morphometry

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We present the study of the Badenian oyster collections from 24 localities of the Carpathian Foredeep in Moravia (Czech Republic), deposited in Vlastivědné Muzeum in Olomouc and Muzeum Prostějovska in Prostějov. The localities are as follows: Bedřichovice, Blažovice, Borač, Brno, Čelechovice, Černá Hora, Drysice, Hluchov, Kelčice, Kobeřice, Kroužek, Laškov, Lomnička, Luleč, Myslejovice, Olomouc-Neředin, Opatov, Práče, Přemyslovice, Slatinky, Služín, Terezské údolí, Újezd, and Vinohrady (Fig. 1).

The old determinations (22 species) have been revised into 4 species: *Crassostrea gryphoides* (Schlotheim, 1813), *Hyotissa hyotis* (Linné, 1758), *Neopycnodonte navicularis* (Brocchi, 1814), and *Ostrea digitalina* (Dubois, 1831). Generally, *Crassostrea gryphoides* is represented by ~38%, *Neopycnodonte navicularis* by ~14%, *Ostrea digitalina* by ~36% and *Hyotissa hyotis* by ~12%.

A large number of analyzed specimens exhibit bioerosion traces both on the external and internal valve surfaces, typically caused by barnacles, sponges, bryozoans, worms, gastropods and bivalves. There have been ascertained reticular, channel shaped and punctuate structures, referable to the ichnogenera *Entobia* Bronn, 1838, *Caulostrepsis* Clarke, 1908, *Gastrochaenolites* Leymerie, 1842 and *Meandropolydora* Voigt, 1965 (Domichnia). Their positions are not random; they reflect both the palaeoecological conditions during the oysters′ life, and the processes following after their death and connected generally with the phases of their decay, transport, sedimentation and the later burial. It can be concluded that a substantial part of the boring organisms activities occurred after the death of the oyster specimens, because of the abundant boring traces on the inner parts of disarticulated valves.

Finally, there have been performed the morphometric analyses concerning the following parameters: valve height (H), valve maximum length (W), ligamental area length (W1), distance between resilifer area and upper part of the muscle scar (H1), ventral length (W2), distance between lower part of the muscle scar and ventral margin (H2), and opening angle of the muscle scar (α). We compared the W/H, W1/H1 and W2/H2 ratios in order to verify, through a regression analysis, if there was a correlation among these parameters. Polynomial curves and the relative confidence ellipses for each of the four species have been ascertained.

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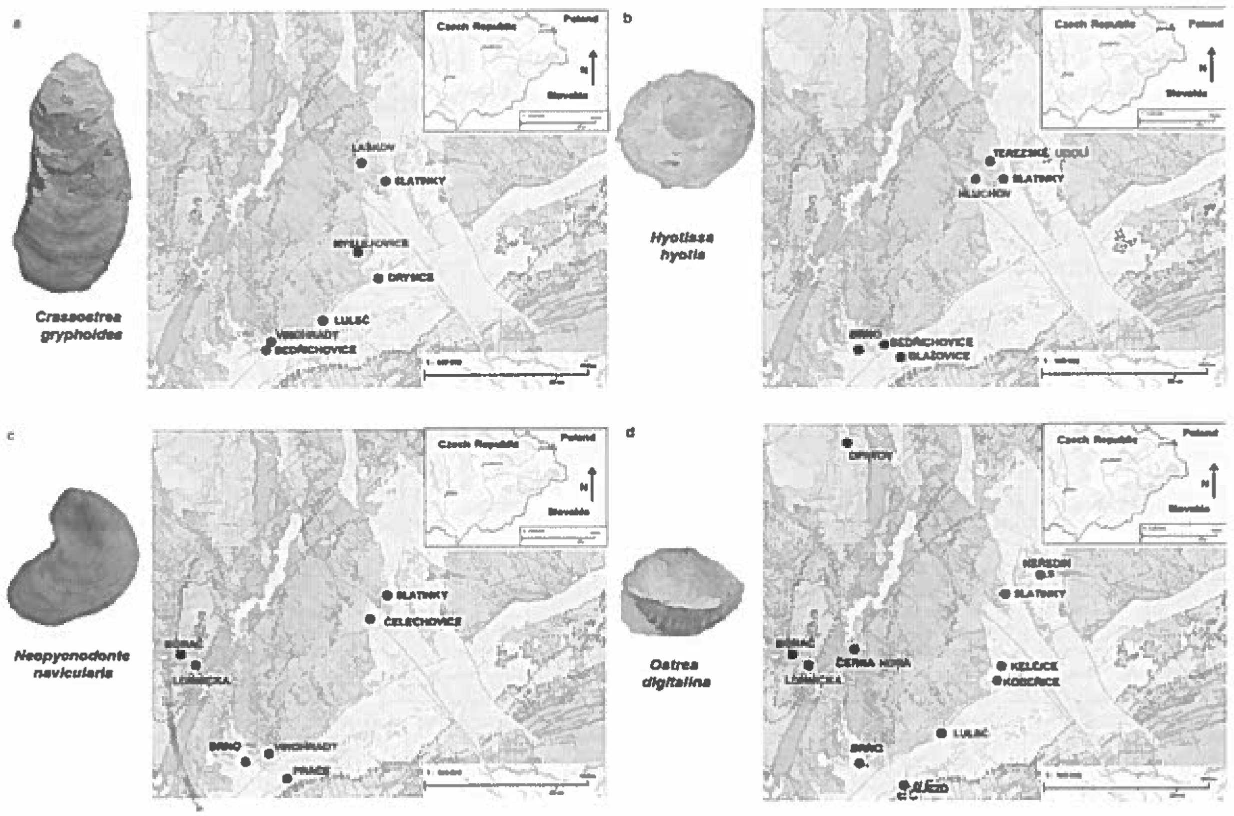

Fig. 1. Distribution of oyster localities and species (a: *Crassostrea gryphoides*, b: *Hyotissa hyotis*, c: *Neopycnodonte navicularis* and d: *Ostrea digitalina*).

Bolivinoides (benthic foraminifera) from the Upper Cretaceous of Poland and western Ukraine: taxonomy, evolutionary changes and stratigraphic significance

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The Upper Cretaceous–Lower Paleocene foraminiferal genus *Bolivinoides* Cushman is a unique group of benthic foraminifera as, in contrast to most other benthic foraminifera, it has a very broad, near-global distribution in shelf sediments. Representatives of *Bolivinoides* have been reported from, for example, northwestern, England, Poland, Belarus, Ukraine, Kazakhstan, Libya, Israel, Egypt, Texas, Mexico, Trinidad), southern Chile, western Australia and New Zealand.

The evolution and speciation of *Bolivinoides* was relatively rapid, and the stratigraphical ranges of many species seem to be very similar around the world. Accordingly they have been widely used as a biostratigraphical tool for almost worldwide correlation of Santonian–Maastrichtian strata. A series of important studies on *Bolivinoides*, presenting many aspects of its evolution and stratigraphical value, were published mainly during the 50s, 60s and 70s. Many authors successfully correlated *Bolivinoides* species ranges with standard planktonic foraminiferal and macrofossil zonations. However, difficulties in correlating local stratigraphic schemes with more standard zonations, poor definition of stage boundaries or generally poor stratigraphic data from the investigated regions, or different interpretations and nomenclature of particular bolivinoidid taxa, has led to some differences and deficiencies in the *Bolivinoides* stratigraphy.

The present paper provides taxonomic descriptions, illustration, evolutionary interpretation and stratigraphic range data for the Upper Cretaceous *Bolivinoides* from The Polish Lowlands and western Ukraine. The analysis is based on newly collected material from an almost complete stratigraphic interval from the Upper Santonian to the end of the Maastrichtian, that is, the interval that corresponds with the total range of Cretaceous *Bolivinoides*. The studied successions are well-documented stratigraphically, mainly by macrofossils, which allowed for the estimation of the precise stratigraphic positions of evolutionary changes within *Bolivinoides* lineages and ranges of particular *Bolivinoides* species, as well as their correlation with those from remote regions of the world.

Palynological analysis of the youngest sediments of the High-Tatric units, Central Western Carpathians

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The Tatra Mountains are built of two main rock systems: a Paleozoic crystalline core and a Mesozoic (Early Triassic–Late Cretaceous) sedimentary sequence which belongs to several tectonic units, including the High-Tatric autochthonous cover and overthrusted High-Tatric and Sub-Tatric nappes (e.g.. Andrusov 1965, Froitzheim *et al.*, 2008 and references herein). The youngest part of the sedimentary sequence is referred to the Zabijak Formation (Krajewski, 2003), dated as late Albian through the late Cenomanian (Bąk K & Bąk M., 2013) or middle Turonian (Cúlová & Andrusov, 1964).
Palynological analysis of the Zabijak Formation has been carried out in two sections from the Polish part of the Tatra Mts. All samples processed following standard palynological procedure yielded palynological organic matter (POM). The palynofacies in each sample are characterised by the dominance of various phytoclasts: black, opaque, woody parts with non-translucent, sharp edges. Rare

cuticle remains, amorphic organic matter and hyphnae fragments occur only in few of the samples. Palynomorphs are absent; no occurrence of recognizable dinoflagellate cysts and sporomorphs or zoomorphs were observed.

The black phytoclasts represent oxidised or carbonised woody particles (Tyson, 1995). Opaqueness and darkening of POM can also be result of secondary effects, such as staining by migrating fluids within the sediment (Whitaker *et al.*, 1992).

Using the distribution diagram related to types of phytoclasts vs. type of environment (e.g., Van der Zwan *et al.*, 1993), the phytoclasts from the material studied are medium in size, mostly with sharp edges, being medium sorted, and poorly diversified. It suggests that energy of environment was not high and the transportation time was not long. The occurrence of black opaque phytoclasts with fragments of cuticles suggests terrestrial environments for the redeposited organic matter.

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System of preventative conservation of fossils containing Fe-disulphides (pyrite, marcasite)

Systém preventivní konzervace fosilií obsahujících Fe-disulfidy (pyrit, markazit)

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Fe-disulphides contained in fossils produce serious problems due to gradual oxidation and hydratation resulting in degradation of specimens. Despite this preventive treatment is rarely performed and action is taken when degradation products appear on the specimen's surface. This presentation introduces some procedures of preventative care methods.

Obsah Fe-disulfidů ve fosiliích a okolní hornině s sebou přináší složitý komplex problémů, které často vedou k degradaci sbírkového předmětu. Příčinou je v první řadě oxidace FeS_2 a další následná oxidace a hydratace degradačních produktů. Proces je provázen dalšími negativními jevy, především vývinem agresivní a hygroskopické kyseliny sírové, nebo expanze degradačních produktů, která způsobí dezintegraci exempláře.

Ve většině paleontologických kolekcí se problém buď vůbec neřeší, nebo pozdě, kdy jsou na povrchu vzorku již zjevné projevy degradace. Poměrně rozšířenou metodou preventivní „konzervace" nových exemplářů je jejich rychlé vysušeni a napouštění syntetickými pryskyřicemi. Tento postup však problém neřeší, pouze oddálí a přináší problémy při nasazení dalších konzervačních postupů.

V příspěvku je prezentován řetězec univerzálních postupů, které se nejvíce osvědčily v praxi a jsou nejméně invazivní. Pro zachování fosilií jsou obzvláště významné kroky doprovázející sběr a následující těsně po něm, tedy činnosti, které se týkají všech v terénu pracujících paleontologů.

1. Při sběru je výhodné se zaměřit na exempláře, které jsou z hlubších partií skalního masivu, které obsahují vodu (skalní vlhkost). Podle místních podmínek a petrologické povahy matečné horniny je vhodné zhodnotit, jestli zde nedocházelo k opakovanému vysoušení a vlhnutí. Trvale vlhký vzorek znamená menší riziko difúze kyslíku do vzorku a tudíž nižší riziko iniciace rozkladných procesů.
2. Při transportu je nutné zajistit, aby vzorek nevysychal a byl k němu omezen přísun kyslíku (např. PET zip sáček) a aby nebyl vystaven vysokým teplotám.
3. Mytí vzorku a vyloužení rozpustných degradačních produktů je nutno provést brzy po transportu. Pokud jsou degradační produkty viditelné na povrchu vzorku, omyjí se v odplyněné destilované vodě a očistí mechanicky kartáčkem nebo štětcem vhodné tvrdosti. Poté se vzorek uloží na 24 hodin do odplyněné destilované vody a zamezí se přístupu kyslíku. Dle stavu vzorku se může proces opakovat v čerstvé lázni.
4. Pro sušení je nejvhodnější použít metodu lyofilizace. Vzorek se zamrazí v laboratorním mrazáku nebo chladiči lyofilizátoru na teplotu pod -50 °C a voda ve vzorku se nechá mrazově sublimovat ve vakuové komoře lyofilizátoru. Doba vysoušení je velice rozdílná a závisí na typu horniny. Pro následující proceduru je vhodné, aby vzorek nebyl dosušen zcela.
5. Stabilizaci degradačních produktů v pórech vzorku je nejlépe provádět plynným NH_3. Dostatečná doba bývá 24 hodin v závislosti na použité metodě.
6. Pro bezpečné uložení vzorku se osvědčily hermeticky uzavíratelné nádoby naplněné ochrannou atmosférou (vhodný je např. dusík). Pro úplnou eliminaci kyslíku lze do nádoby vložit O2-scavenger.

Příprava komplexní metodiky včetně základního výzkumu probíhá s podporou MKČR v rámci projektu NAKI 12-DF-031 „Metodika preventivní i akutní konzervace sbírkových předmětů z oblasti paleontologie a mineralogie ohrožených produkty degradace sulfidů". Výsledná metodika bude zahrnovat více alternativních postupů rozdělených podle efektivity, dostupnosti a ekonomické náročnosti.

New data from palaeoecology and taphonomy of the Early Miocene site Ahníkov (Merkur-North; Nástup Tušimice mine)
Nové poznatky z paleoekologie a tafonomie raněmiocénní lokality Ahníkov (Merkur-sever; Doly Nástup Tušimice)

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The origin of Ahníkov site is connected with a time period immediately preceding the depositing of the main brown coal seam in the North Bohemian Basin. The first detailed research started in the 80's at the locality Ahníkov I (= Merkur-North), which was destroyed in 2002. New fossil-bearing area (Ahníkov II) was discovered in 2011 ca. 1 km SE from the former site. The results obtained until 2015 yielded new data for palaeoecological and taphonomical interpretations of the locality. The detailed evaluation of a rather large area allows us to recognise various fossiliferous patches. Based on the geological sections, sedimentological history and diversity at the locality and in its underlaying rocks were preliminary reconstructed. The stratigraphical range of terrestrial vertebrates record was extended and specified for the North Bohemian Basin.

Vznik lokality Ahníkov je spojen s časovým úsekem krátce předcházejícím vzniku hlavní uhelné sloje v severočeské hnědouhelné pánvi. První plošné výzkumy probíhaly od 80. let na lokalitě Ahníkov I (= Merkur-sever), která v roce 2002 zanikla sesuvem. V roce 2011 byla zhruba 1km JV odtud objeveny nové fosiliferné plochy (Ahníkov II). Poznatky získané do roku 2015 přinesly některé nové pohledy také na paleoekologii a tafonomii. Detailní výzkum na velké ploše umožnil rozpoznání rozdílných tafonomických enkláv. Na základě studia geologických řezů byl předběžně zmapován sedimentologický vývoj a diverzita lokality a jejího podloží z čehož vycházejí některé nové poznatky o paleoprostředí. Byl rozšířen stratigrafický rozsah výskytu terestrických obratlovců v rámci spodnomiocénní výplně pánve.
Výzkum je podporován interním vědeckým projektem NM pro rok 2014-2015 „Paleoekologická a tafonomická charakteristika spodnomiocénní lokality Ahníkov" a částečně výzkumným plánem Geologického ústavu AV ČR (RVO67985831).

Microfacies analysis of the Lower Cretaceous Nižná Limestone Fm (the Pieniny Klippen Belt, Western Carpathians)

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The Pieniny Klippen Belt is a tectonic melange representing the boundary between the Outer and Central Western Carpathians. Within this melange, Jurassic and Cretaceous sedimentary rocks from deep-water (Kysuca Basin) to shallow-water environments (Czorsztyn Unit) occur. The Nižná Unit was originally distinguished by Scheibner (1967) as being a particular subunit of the Kysuca Unit of the Pieniny Klippen Belt. The Jurassic/Lower Cretaceous sequences of both units is approximately similar (Czajakowa, Czorstyn and Pieniny limestone formations) but instead of dark grey marls of Koňhora Fm which are typical for the Kysuca Unit, organodetritic limestones termed as the Nižná Limestone (Scheibner, 1967) are present in the Nižná Unit. This Urgonian-like limestone was originally mapped as Middle Jurassic crinoidal limestone (Andrusov, 1931). The limestone is mostly of talus to distal allodapic origin, with detritus coming from a shallow-water platform. The further lithostratigraphic concept presented by Scheibner (1967) supposed that the Nižná Limestone is directly overlain by Albian-Cenomanian exotic flysch, later followed by higher Cenomanian-Senonian marly sediments. Detailed microfacies analysis of the limestone was carried out by Mišík (1990). According to the planktonic foraminiferal assemblages, the age of the Nižná Limestone Formation is mostly Aptian (Scheibner, 1967; Mišík, 1990). Repeated submersion of the unit occurred in this time, as in the Czorsztyn Unit. The processes that led to the emergence of the Nižná Unit had most likely already commenced in the Hauterivian, as shown by some occurrences of coarse-grained turbidites and mass-flow deposits in Hauterivian marls of the Kysuca Unit. These data imply that the Nižná Unit can be placed in the Kysuca sedimentary area on the northern side of the Kysuca Trough, closer to the Czorsztyn Swell (Józsa & Aubrecht, 2008). Klippens with Nižná Limestone can be traced in the Orava territory between the Dlhá nad Oravou village and the town of Tvrdošín.
This limestone is thick-bedded to massive, often forming cliffs. It represents a spectrum of facies from the shallow-water coarse-grained and reef facies, with erosional features on the base, as far as the distal detrital fan. Basal breccia member distinguished by Józsa & Aubrecht (2008) - the Tvrdošín Breccia Member consists of chaotically arranged, poorly sorted clasts and larger blocks of radiolarites, red limestones, white Calpionella limestones and their black chert nodules. The breccia matrix is organodetritic with organic detritus of bivalves, coralline algae, benthic and occasionally of planktonic foraminifers and rudists.
Microfacies of the Nižná Limestone Fm is represented mainly by biodetritic, relatively coarse-grained, poorly sorted packstone, grainstone to rudstone. Boundstones with selectively silicified corals were also found. The bioclasts are commonly rounded, micritised or silicified and consist of echinoderm particles (crinoid ossicles, echinoid spines, fragments of bryozoans, bivalve (mostly oysters and rudists), gastropod and brachiopod shells and rare fragments of dasycladaceans and coralline algae. *Cyclagelosphaera. brezae, Rucinolithus wisei* and *Watznauria barnease* are most common in calcareous nannoplankton assemblage. Foraminifers are also present, mainly as fragments of orbitolinid foraminifers without preserved embryonic aparatus (*Orbitolina sp.*), to a more extent there are miliolids, lagenids, textularids (*Sabaudia minuta* (Hofker) and agglutinated biserial forms, and rarely also planktonic forms. The grainstone varieties also contain fragments of calcareous sponges and oncoids. The bioclasts are often partly silicified.

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Hlavina Beds - stratigraphical assignment, fauna and palaeoenvironment
Hlavinské vrstvy - stratigrafické zaradenie, fauna a paleoprostredie

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Abstract: The Hlavina Member consists mostly of the freshwater limestone, travertine and lacustrine chalk. Age determination of the sediments was based on molluscs as the Upper Pannonian - zone H and on the base of small mammals as the Turolian (MN11). From lithostratigraphic terms they have been incorporated into the Volkovce Formation. Sediments of the Hlavina Member were created in the environment characterised by the presence of alluvial rivers, ephemeral lakes and marshes.

Hlavinské vrstvy (Fordinál & Nagy, 1997) reprezentujú plytkovodné prevažne karbonátové sedimenty Dunajskej panvy vrchnopanónského veku. V minulosti boli zaraďované do „pestrej série" panónu (Janoschek, 1943). V súčasnosti sú začlenené do volkovského súvrstvia (Kováč *et al.*, 2011) a stratigraficky do zóny H panónu (Papp, 1951).

Hlavinské vrstvy sa vyskytujú pri okrajoch severných zálivov Dunajskej panvy (blatnianska a rišňovská priehlbina) a v Bánovskej kotline. Tvorené sú sladkovodnými vápencami bielej, svetložltej okrovožltej a krémovej farby, jazernou kriedou a travertínmi, ktoré sa vo vrstevnom slede vo väčšine prípadoch striedajú s tenkými vrstvami ílov, pieskov a ojedinele i štrkov. Sladkovodné vápence patria k ílovitým mikrokryštalickým vápencom, v menšej miere sú zastúpené onkolitové vápence.

V sedimentoch hlavinských vrstiev bola na viacerých lokalitách zistená fauna ulitníkov, sladkovodných lastúrničiek, krabov, rýb (Orešany-vrt PID-1, Čeľadince, Turčianky, Malé Kršteňany) a suchozemských stavovcov (Krásno, Čeľadince a Šalgovce).

Bohaté a divezifikované spoločenstvá sladkovodných a suchozemských ulitníkov boli zistené v sedimentov hlavinských vrstiev vo vrte PID-1 v Orešanoch (Fordinál, 1994). Prítomnosť suchozemských ulitníkov druhu *Klikia goniostoma*, *Tropidomphalus doderleini*, *Acicula edlaueri* a sladkovodných ulitníkov *Anisus krambergeri*, *Gyraulus subptychphorus* a *Planorbis confusus* umožnila uvedené sedimenty zaradiť do zóny H panónu. Kvalitatívné zloženie spoločenstva suchozemských ulitníkov z hlavinských vrstiev vrtu PID-1 je porovnateľné so spoločenstvom lokality Eichkogel-stratotypu zóny H panónu vo Viedenskej panve v Rakúsku. Z ekologického hľadiska boli v spoločenstvách suchozemských ulitníkov zastúpené vlhkomilné (*Carychium pachychilus*, *C. berthae*, *Vertigo callosa*, *Succinea oblonga*), lesné (*Aegopinella orbicularis*, *Leucochroopsis kleini*) a druhy otvorenej krajiny (*Strobilops pappi*, *S. pappi* a *Vallonia subpulchella*).

V sedimentoch hlavinských vrstiev boli vo vrte PID-1 nájdené i bohaté spoločenstvá sladkovodných lastúrničiek s druhmi *Fabaeformiscandona balatonica*, *Microdarwinula zimmeri*, *Cyclocypris ovum*, *Cryptocandona* sp., *Scotia* aff. *pseudobrowniana* etc.

Na lokalitách Krásno, Šalgovce a Čeľadince boli nájdené aj fosílne zvyšky drobných cicavcov. Prítomnosť druhu *Parapodemus lugdunensis* spolu s druhom *Kowalskia skofleki*, a zároveň absencia zástupcov rodu *Progonomys*, ktorý bol nahradený modernejším rodom *Parapodemus* ako aj prítomnosť glirida (plcha) *Graphiurops austriacus*, ktorého stratigrafický rozsah je v strednej Európe limitovaný na zóny MN10 a MN11 nám umožňila začleniť sedimenty hlavinských vrstiev do turolu, zóny MN 11 (Joniak, 2013). Kvalitatívne zloženie tanatocenóz drobných cicavcov nájdených v sedimentoch hlavinských vrstiev je veľmi podobné spoločenstvu z lokality Eichkogel.

Okrem vyššie uvedených fosílnych skupín organizmov boli v sedimentoch hlavinských vrstiev nájdené i klepietka sladkovodných krabov druhu *Potamon hegauense*, otolitov rýb *Palaeoesox* cf. *praekrameri* (vrt PID-1, Fordinál, 1994) a fosílne zvyšky zástupcov rodu *Hippotherium* na lokalitách Sádok (Schafarzik, 1900) a Čeľadince (Čerňanský *et al.*, 2012).

Sedimenty hlavinských vrstiev vznikli v aluviálnom prostredí s prítomnosťou riek, efemérnych jazier a maršov. Na pobreží jazier sa nachádzali mokrade a riedke lesy striedajúce sa otvorenými plochami.

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Paleozoic Palaeobiogeography of the East European Platform in Poland

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Baltica consisted of a major part of northern Europe. It was bound on the west by the Iapetus suture, on the east by the Ural suture, on the south by the Variscan/Hercynian suture, and on the southwest by a suture located close, but not quite along the Teisseyre-Tornquist line. Baltica included part of Poland and adjacent areas northeast of line, which ran from Scania through Western Pomerania, Łódź, Holy Cross Mountains Fault to the Black Sea. This line separate the East European Platform and element sutured to Baltica. The present authors attempted to provide maps of the Eastern European Platform in Poland during Paleozoic times. These maps were constructed using a plate tectonic model based on PLATES, GPLATES and PALEOMAP software. The plate tectonic reconstruction programs takes tectonic features in the form of digitised data files, assembles those features in accordance with user specified rotation criteria The rotation file contains a list of finite rotations between pairs of tectonic elements, at different episodes of time, with brief bibliographic notes or general comments for each individual rotation. Information derived from global and regional papers followed by the authors own research were posted on the maps and the general palaeoenvironment zones were distinguished within the platforms, basins and ridges. The position of plates was based on palaeomagnetic data and geological observation. It was also augmented by palaeontological data, which included several groups of benthos and plankton, mainly trilobites, brachiopods, corals, graptolites, foraminifers and others. This augmentation is a subject of palaeobiogeography. Fossils became an important factor in our understanding of the distribution of plates since the birth of plate tectonics. The palaeobiogeographic studies contributed to understanding that present day Poland was built as a mosaic of plates sutured together during Phanerozoic times.

Baltica originated as a result of disintegration of supercontinent Pannotia, which occurred during Early Cambrian. Early Ordovician was the time of maximum dispersion of continents during the Paleozoic. The benthic fauna of Baltica became endemic showing that large oceans separated this palaeocontinent from Gondwana and other plates. Avalonia probably started to drift from Gondwana and move towards Baltica in the late Tremadocian and was in a drift stage by the Llanvirnian. Between Gondwana, Baltica, Avalonia and Laurentia, a large longitudinal oceanic unit, known as the Rheic Ocean was formed. Avalonia was probably sutured to Baltica by the end of Ordovician or in the Early Silurian. This process was dominated by a strike-slip suturing of the two continents, rather than by full-scale continent-continent collision. Silurian was a time of Caledonian orogeny, closing of Early Paleozoic oceans, collision of Baltica with Avalonia and Laurentia and origin of supercontinent Laurussia. The Variscan Orogeny was caused by the collision of Bohemian Massif plates and Protocarpathian terrane with Laurussia. The Protocarpathian terrane acted as an indentor, which caused thrust tectonics of the Eastern

European Platform in Holy Cross Mountains and Lublin areas. Baltica lost its identity during Late Paleozoic times. The Eastern European Platform became part of Laurussia and later of Pangea.

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Dermal bone histology in *Metoposaurus krasiejowensis* (Amphibia, Temnospondyli) from the Upper Triassic of Poland

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Recent histological studies on the Metoposauridae, the Late Triassic temnospondyls, have focused mainly on the microstructural characteristics of postcranial skeletons, such as femurs, ribs and vertebrae. The histological diversity among dermal bones in Temnospondyli is still poorly understood, except for a few unidentified isolated bones of *Metoposaurus diagnosticus*.

In this study, results from the histological analysis of the dermal bones of *Metoposaurus krasiejowensis* from the Upper Triassic of Poland are presented. Histological thin sections were accuired from the skull, three mandibles, a clavicle and an interclavicle. These bones represent the dermal bones in Temnospondyli. The dermal bones are created on the metaplastic ground, without the chondral stage. They exhibit a diploë structure. The central part of the dermal bone includes the spongy middle region which is surrounded by layers of compact external and internal cortex. The external cortex consists of well vascularised parallel-fibered bone. In the area of the sculptural ridges, dense clumps Sharpey's fibers and growth marks are present. The spongy central region is highly eroded and possesses extremely large and numerous erosion cavities. The secondary osteons are numerous as well, and in some regions, they make up Haversian tissue. The internal cortex is thinner than the external cortex and is almost avascular. The only exception is the interclavicle, where the internal cortex shows a high amount of vascularization and a clear thickening of the parallel-fibered bone. These differences in vascularization in both cortices of the dermal bones, may indicate a thermoregulation function. The well-developed vascular network of the external cortex may possibly foster the exchange of heat between the body and the aquatic environment.

New fossils related to the Ericales from Klikov Formation, Late Cretaceous, Czech Republic

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Ericales reproductive structures, fruits and seeds preserved as charcoalified mesofossils are described from the Klikov Formation. The material was collected in the Zliv Řídká–Blana Quarry north of České Budějovice. The Klikov Formation (upper Turonian- Santonian) is the most basal part of the South Bohemian Basins, consisting of two elongated depressions: the Třeboň Basin and the Budějovice Basin. Deposits of the Klikov Formation are present in both of the sub-basins, and represent the most widely distributed stratigraphic unit in the South Bohemian Basins. Three sediments types occur repeatedly and irregularly in the Klikov Formation: (1) light gray or yellow conglomeratic, coarse- to medium-grain sandstone beds, (2) mainly fine-grained red beds and (3) gray mudstone beds.

The mesofossils were extracted from gray claystones by bulk maceration. They are preserved as three-dimensional charcoal fossils. Sorting and preliminary studies were done using a binocular microscope. Specimens for SEM observations were mounted on aluminium stubs and studied using field emission scanning electron microscopes. Specimens for MicroCT were studied using a SkyScan 1172.

Currently 10 taxa have been identified as possibly related to the Ericales. Additional taxa may be added as the research continues. The fossils are mainly capsular fruits, all derived from flowers with a superior, trimerous, tetramerous, or pentamerous ovary, and persistent calyx. There are several pentacarpelate fruits; the most common is cf. *Epacridicarpum cretaceum*. The fruit of cf. *Epacridicarpum cretaceum* is a locular capsular, formed from five carpels and ellipsoidal in outline. Remains of the calyx are preserved surrounding the basal part of the fruit, documenting a hypogynous organisation of the perianth. In a few cases, several small projections, probably the remains of styles, occur on top of the fruit. There are several tri- and tetra-carpelate fruits in the material. The material consists of several taxa of seeds that may be assigned to Ericales, such as *Visnea* sp. and *Eurya crassitesta* (Pentaphylaceae). Seeds of *Visnea* are rounded with micropyle and hilum, closely spaced on both sides of the bow-shaped condyles. The seed surface is covered by large cells, except over the condylus, where the cells are smaller. The seeds of *Eurya crassitesta* are almost circular in outline, with slightly curved raphe and outer epidermis of the seed formed from palisade cells. Lumens of the palisade cells gradually narrow to the base to form the characteristic cavities on the surface. Cell walls of the palisade cells are finely pitted.

Knobloch and Mai described a large number of taxa related to Ericales from the Klikov Formation. However, some of them will require revision in light of our new observations.

New finds and analyses of Miocene molluscs at the Gravettian archaeological sites of Pavlovian Hills (Southern Moravia, Czech Republic)

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Within the last 20 years, detailed studies of Miocene fossils, predominantly molluscs, discovered in varying amounts at the Gravettian archaeological sites of the Pavlovian Hills (Dolní Věstonice, Pavlov, Milovice), and used mostly as decorative objects, became an integral constituent of the complex research of these localities. At the 9th Paleontological Conference in Warsaw (2008) the results from the sites Pavlov I (excavation seasons 1952-58), Pavlov VI, Milovice, and Dolní Věstonice I have been presented (Hladilová 2008, Svoboda *et al.*, 2009). In the meantime, new results from two sites, namely from Milovice IV, and Dolní Věstonice I, appeared (Svoboda *et al.*, 2011, 2015).

The Milovice IV sample (Svoboda *et al.*, 2011) included more or less complete shells of *Dentalium badense, Pirenella picta picta, Pirenella picta mitralis, Pirenella nodosoplicata nodosoplicata, Astraea meynardi, Conus vindobonensis, Melanopsis vindobonensis vindobonensis, Zonaria sp., Alaba costellata anomala, Glycymeris pilosa deshayesi, Cardites partschi* ssp., and some undeterminable fragments. The shells were typically weathered, indicating collection at outcrops; some of them were perforated, or with traces of red ochre or a black coal mass on the surface. Besides the dominating scaphopods, most other species are represented by only a single specimen.

At the Dolní Věstonice II site (Svoboda *et al.*, 2015), there were studied 377 specimens of Miocene molluscs - 157 gastropods, 215 scaphopods and 5 bivalves. In addition, 1 Miocene worm tube fragment and 4 specimens of brachiopods most probably of Mesozoic (Jurassic) age were uncovered. Among the molluscs, the most numerous (sub)species are *Dentalium badense*, *Melanopsis impressa posterior*, *Melanopsis vindobonensis vindobonensis*, *Pirenella picta picta*, *Terebralia lignitarum lignitarum*, and *Melanopsis* cf. *fossilis*. The Pannonian elements (melanopsids) at this site are represented by the highest percentage ascertained up to now at all the studied Gravettian sites from the area of the Pavlovian Hills. Moreover, Dolní Věstonice II, with its 382 specimens of fossils, represents the second richest site after Pavlov I, and, to date, it is the first site where scaphopods unambiguously dominate among fossil molluscs. On the other hand, the total species number is much lower in comparison with Pavlov I or Pavlov VI. The shells are intensively weathered, rolled, eroded or corroded, and with frequent secondary human adaptations.

The Miocene molluscs from all the hitherto analysed Gravettian sites were intentionally collected at surficial outcrops, and their source areas can be interpreted as the Miocene sediments of the Carpathian Foredeep and of the Vienna Basin. At the same time, both quantitative and qualitative differences among individual sites are evident. We can only speculate about their reasons: in addition to the probable spatiotemporal accessibility changes of the particular fossiliferous Miocene sediments field outcrops, hypothetically even some differences in real activities of the inhabitants at individual sites could play a role (shorter/longer or single/repeated activities at one place, more/less intensive or active searching of fossils in the field, greater/lower individual mobility into various directions, etc.). Nevertheless, as the data sets are increasing, we made the first attempt to calculate the similarities/differences among individual sites using the STATISTICA programme.

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Foraminiferal biostratigraphy and bathymetry of Maastrichtian-lowermost Oligocene deposits of the Vezhany Nappe (Ukrainian Inner Carpathians)

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The Vezhany Nappe (=Marmarosh Klippen Zone) are placed in the inner part of the Ukrainian Carpathians to the northwest of the Marmarosh Crystalline Massif. The calcareous deposits of this nappe contain abundant planktonic foraminifers and as such provides a unique opportunity to construct a biozonation of the Ukrainian Carpathians. The foraminiferal biostratigraphy and bathymetry of the Maastrichtian-lowermost Oligocene Jarmuta and Metova formations of the Vezhany Nappe are considered in the work.

Micropalaeontological studies were carried out on samples collected from the outcrops along the Tereblya River and its tributaries as well as the Metova Stream (Borzhava River basin) in the Transcarpathian Region. Foraminiferal zonation (Berggren *et al.*, 1995; Geroch & Nowak, 1984) and foraminiferal zonation of the Ukrainian Carpathians (Fig. 1) were used.

The Jarmuta Fm. (of a thickness 45 m) conformably covers the red marls of the Puchov Formation and pass upwards into the Metova Fm. It is represented by thin-bedded flysch with intercalations of the red marls. The Metova Fm. (of a thickness 190 m) is composed of both clastic sediments (siltstones, sandstones) and (hemi)pelagic deposits (grey, green and red marls).

The Caudammina gigantea Zone and Abathomphalus mayaroensis Zone (Upper Maastrichtian) were identified in the Jarmuta Fm. The Parvularugoglobigerina Zone (Lower Danian) was found in the lowermost part of Metova Fm. The Morozovella subbotinae Zone, Morozovella aragonensis Zone, Acarinina bullbrooki Zone, Acarinina rotundimarginata Zone (Upresian-Lutetian) and an assemblage of the Globigerapsis tropicalis Zone were identified in the upper part of the Metova Fm. The Subbotina corpulenta Zone and Subbotina vialovi Zone (Upper Priabonian-lowermost Oligocene) were found in the Globigerina marls of the top part of the Metova Fm. (Fig. 1).

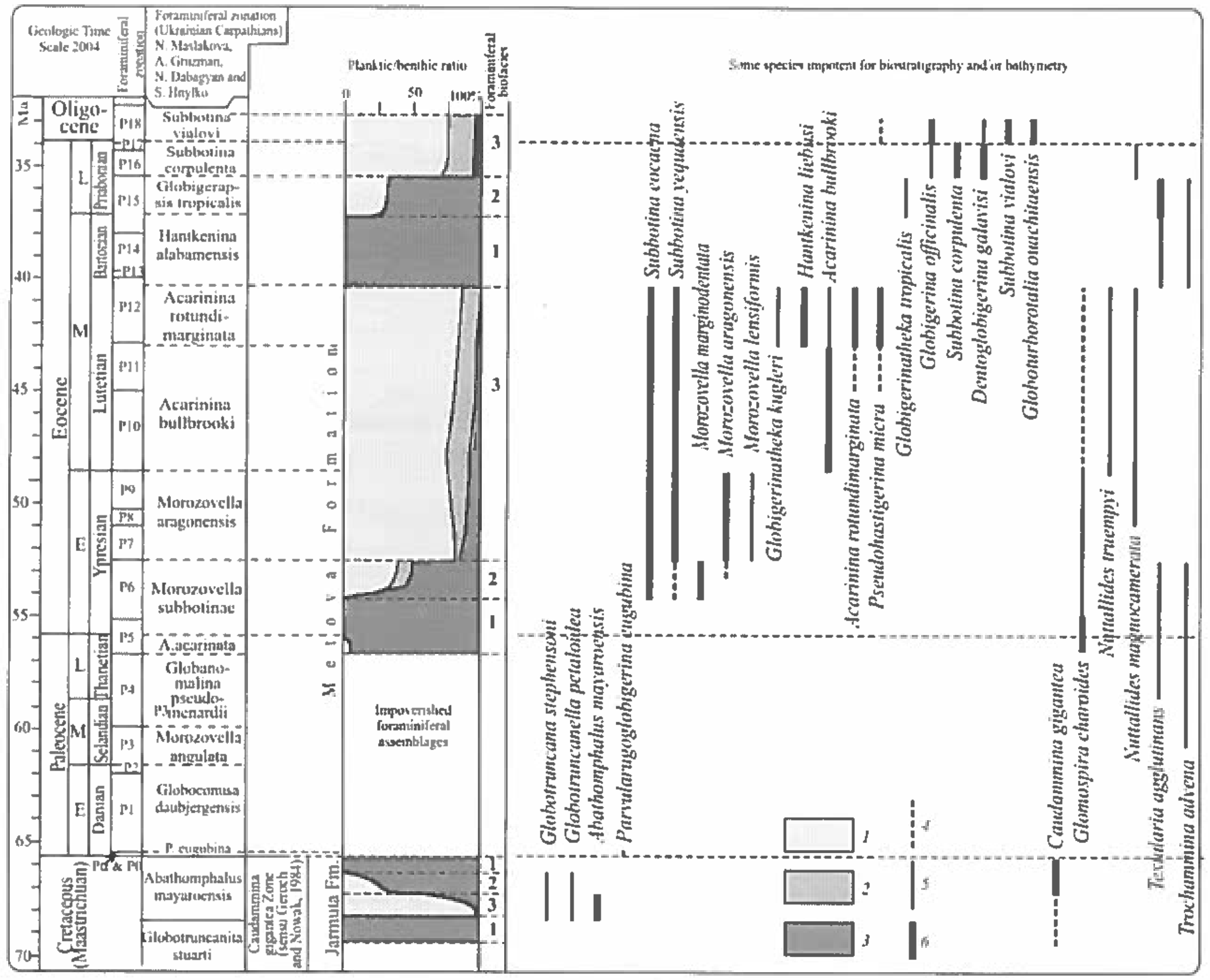

Fig. 1. The features of the distribution of foraminifers. *1-3* – ecological Groups: *1*- plankton; *2* – calcareous benthos; *3* – agglutinated benthos. *4-6* – the quantity of specimens: *4* – rare; *5* – moderate; *6* – abundant.

Biofacies of agglutinated foraminifera (1), mixed planktonic-benthic biofacies (2) and plankton-dominated biofacies (3) were determined in the studied deposits (see Fig. 1). Biofacies (1) is represented by both the " *Rhabdammina*" assemblage (sensu Kuhnt & Kaminski, 1989) in the flysch deposits of the Jarmuta Fm. and the "*Textularia-Trochammina*" assemblage in the Metova Fm. Biofacies (3) consists of the fauna that corresponds to the "Scaglia-type" assemblage (sensu Kuhnt & Kaminski, 1989) in the red marl intercalations among the turbidite deposits of the Jarmuta Fm. as well as the bathyal assemblage (sensu Murray, 1976) in the marls of the Metova Fm. The fauna of smaller foraminifera suggests a lower bathyal environment in the Maastrichtian and bathyal depths above the CCD in the Eocene-earliest Oligocene.

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The species and genus categories in biological systematic reconsidered

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Biological systematics has been established by Linné as a hierarchical system of classes. This hierarchy is inclusive, because one class includes classes of higher connectivity. Thus, the grade of connectivity is a measure for constructing a hierarchical system.

Homogeneity in characters is the scale for connectivity, thus decreasing homogeneity in class building rate leads to fusion of classes. Continuous class building rates make distinct levels (= categories) within the class building system artificial. Only discontinuous class building rates mark these discontinuities as natural categories (Fig. 1). The main criterion for finding natural classes is consistency of the classification criterion, meaning that the classification criterion must not change during the complete classification process.

In phylograms and cladograms, where the connection points (levels) mark phylogenetic relationships, discontinuities are difficult to determine. This is the reason for failing the Linnean hierarchical system in phylogenetic systematics based on morphology or molecular genetics. Phylogenetic trees are excluded from hierarchical classification based on heterogeneities, because they represent excluding hierarchies where fusion points are objects (species), not heterogeneity levels.

All biological classification systems are based on the biological species. As the basic object species must be homogeneous groups based on consistent classification criteria. Therefore, they must follow a general concept including all organisms. Since Darwin's work on the origin of species, intensive efforts have been mounted to find a criterion for biological species. This has led to numerous species concepts, but none have met the requirement of universal application. Additionally, many concepts are based on

criteria that can be used only for recognizing species (operational criteria), not defining the 'being' or make-up of the species (explanatory criteria). In an explanatory definition represented here species are groups of organisms sharing a pool of genotypes with the potential to transfer genomes to the succeeding generation, perpetuating transferability. Splitting up/off the pool of genotypes without further transfer potential between pools gives rise to new species.

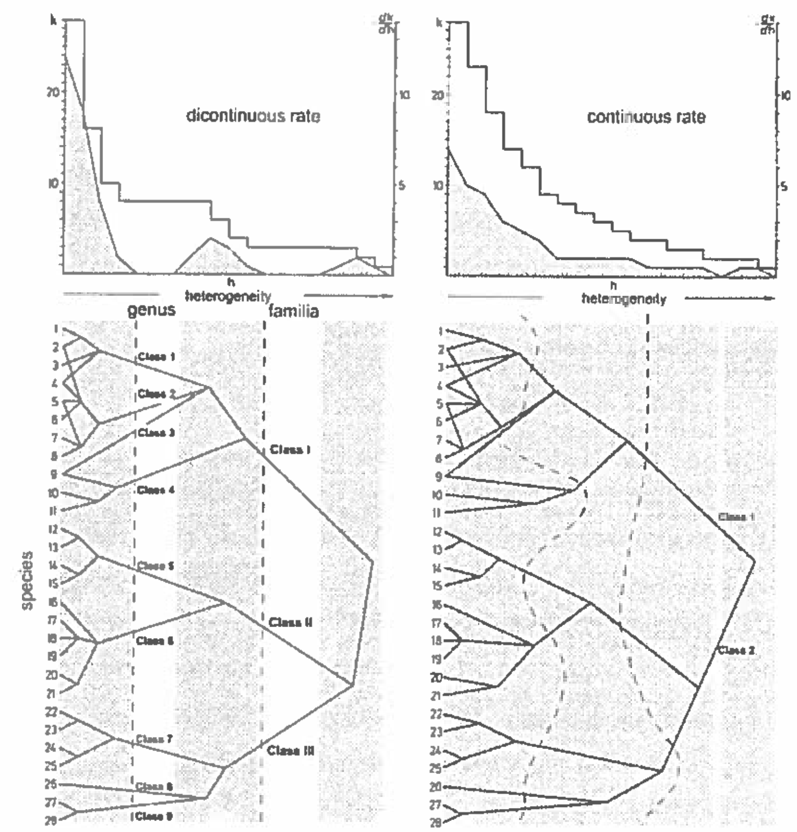

Fig. 1. Differences between natural and artificial categories based on dendrograms with the same topologies.

Operative methods try to approximate the explanatory species, but fails in delimiting closely related species from subspecies. Methods for species recognition and delimitation are based on morphological or molecular genetic characters or both together. Species described as pools of contemporarily interconnected genotypes possessing their own history lead to evolutionary lines. The proof of interconnection by phenotypic homogeneity must be based on the four criteria 'shape homogeneity', 'ontogenetic cohesion', 'homogeneous ecological niches' and 'evolutionary continuity'. While in all eukaryonts three of the four – homogeneities in shape and ecological niches, ontogenetic cohesion – can be checked both in living individuals and fossil forms, the detection of birth (speciation), lifetime and death (ending) of a species, factors that determine an evolutionary line, is only possible in organisms with a fossil record. Speciation can be grouped in split-off and split-up processes. Split-off processes where a daughter species derives from a mother species are easier to recognise than split-up processes where several species originate more or less contemporaneously within a geological time interval. This makes it difficult to delimitate species when they are in a reticulate speciation process in which hybridization between subspecies is a common feature. In contrast to evolutionary continuity, homogeneities in shape and ecological niches as well as ontogenetic cohesion are more difficult to recognise in fossil species due to low specimen numbers, incomplete preservation caused by taphonomic processes and the fragmentary representation of fossil environments in the sedimentary strata, hindering the acquisition of gradients.

The genus category grouping similar species into classes cannot be based on phylogenetic classifications neither using (apomorphic) morphological nor molecular genetic characters. They can only be based on phenetic criteria using morphological characters indicative for the species group as defined above. This means that the classification criteria must be consistent for all species to be grouped into higher categories. Now, discontinuities in class building rates can be investigated allowing grouping into natural categories. The first natural category with the highest grade of homogeneity can be regarded as the genus category. Higher natural categories in the specific classification system must not be labelled (families, orders etc.), because comparison with other classifications are impossible since they are based on quite different classification criteria (e.g. families in foraminifera versus families in mammalia).

Foraminiferal assemblages of the Badenian isle Devínska Kobyla

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Middle Miocene strata exposed at the Devínska Kobyla hill (Malé Karpaty Mts., Slovakia) very well document changes in the marginal environments of the Vienna Basin during that time.

Altogether 14 studied localities at the Devínska Kobyla with the Middle Miocene strata exposed have yielded rich associations of micro- and macrofauna, as well as nannoflora. Localities can be divided into the three groups, both sedimentologically and faunistically: Devín area, Dúbravka area, and Devínska Nová Ves. On the basis of foraminifers the localities of Dúbravka area (Dúbravská Hlavica, Pektenová lavica, Starý lom, partly Fuchsov lom) can be assigned to the lower Sarmatian, whereas the localities in the Devín (Šibeničný vrch, Zárez cesty, Terasy, Lomnická, Lingulová lavica, Glosusová lavica) and the Devínska Nová Ves (Sandberg 1–3, Waitov lom) are predominantly of the Upper Badenian age. Locality Zelené terasy shows Upper Badenian and Sarmatian foraminifera. Sarmatian ones were also reworked in the younger, fluvial sediment. Sarmatian age of the sediments from the upper part of the localities Fuchsov Lom and Sandberg is also proved by calcareous nannofossils. Nevertheless, mollusks from the mentioned localities refer the Upper Badenian age. Discrepancies in estimating of the stratigraphic age counted on the basis of molluscs vs. foraminifers can be explained by the nature of the Vienna Basin as a marginal part of the Central Paratethys Sea during the Middle Miocene; the lack of planktonic foraminifers in the Sarmatian sediments of the Vienna Basin can lead to the inequality in the stratigraphic control. Generally foraminiferal assemblages mirror three main types of marine environment: deep water rich in organic matter (Glosusová lavica, partly Zelené terasy), shallow water with bottom covered by sea grasses (Dúbravská Hlavica, Pekténová lavica, Starý Lom) and shallow water linked to the harder substrate or patch reefs (Sandberg, partly Lingulová lavica and Starý lom).

Concerning the palaeoecological and stratigraphical implications, this contribution should be considered as preliminary and more detailed sampling is needed to solve the relationships between distinct areas as presented herein. However it can be said that both the sedimentological and palaeoecological history of the Devínska Kobyla area during the Middle Miocene is more complex than previously thought. Thus, we aim for the more detail correlation between studied sedimentary sequences as the next step in new studies of the Miocene strata exposed in the Devínska Kobyla area.

Acknowledgements.The work has been supported by research grants APVV 0099-11 DANUBE and APVV-14-0118.

A shallow-water *Ammobaculoides* assemblage from the Middle Jurassic (Bajocian) Lower Dhruma Formation of Central Saudi Arabia

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We report the occurrence of an *Ammobaculoides*-dominated assemblage in green shales from the Lower Dhruma Formation exposed in a roadcut west of the Dhibi Limestone quarries, west of Riyadh. The section is located along a minor road that connects Highway 30 with national road 5395 (N24°09'45"; E46°07'41"). The Lower D1, or Balum member of the Dhruma Formation is assigned a Bajocian age based on ammonites, and was deposited during the Middle Jurassic transgression (Vaslet *et al.*, 1983). The basal member of the Dhruma Formation contains vuggy collapse breccias that were formed as a result of dissolution of evaporates, and therefore the depositional palaeoenvironment is interpreted to be very shallow marine, with hypersaline pools or lagoons.

The foraminiferal assemblage recovered from the green shales of the Lower Dhruma Formation consist entirely of small agglutinated forms dominated by *Ammobaculoides*, with subordinate *Ammobacilites* and trochamminids. Such an *Ammobaculoides*-dominated assemblage has not been previously reported from the Jurassic of Saudi Arabia.

The species of *Ammobaculoides*, which most closely resembles *A. primoris* Komissarenko, is described as follows:

Test free, minute, elongate, slightly compressed. Early chambers planispirally enrolled, consisting of two whorls with 6 chambers in the final whorl; later with two pairs of biserial to loosely biserial chambers, becoming lax-uniserial, and finally uniserial. Wall agglutinated, silicified, insoluble in acid, surface smooth. Aperture terminal, central, on a produced neck in the final rectilinear chambers.

Our new finding constitutes the oldest reported occurrence of this genus. The oldest previously published report of *Ammobaculoides* is from the Callovian of Western Siberia (Azbel *et al.*, 1991).

Pleistocene Agglutinated Foraminifera from Core PS87/030-1-KAL, Lomonosov Ridge, Arctic Ocean

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We present a new record of deep-water agglutinated foraminifera (DWAF) from a >6m long kastenlot core collected at 1276 m water depth on the Lomonosov Ridge (88° 39.72' N; 61° 32.52' W). In the uppermost 350 cm of the core, calcareous foraminifers including benthic and planktic taxa show a very high diversity of species and a generally good preservation.

In the lower part of the core below 215 cm, the calcareous foraminifera progressively disappear, and agglutinated benthic foraminifers are found in relatively high numbers. The DWAF dominate the biogenic content of the sediment below 350 cm. Given their abundance and their potential use for biostratigraphy, special attention has been paid in agglutinated foraminifer assemblages from 215 cm to 621 cm. In this interval, 25 samples were picked quantitatively to describe the DWAF assemblages.

The DWAF consist of a mixture of cosmopolitan species such as *Reticulophragmium pusillum* and Arctic endemics such as *Alveolophragmium polarensis*. The dominant species throughout the core are *Reticulophragmium pusillum, Trochammina lomonosovensis, Haplophragmoides* sp. 1, and *Psammosphaera fusca*. The small, fragile tests of *Haplophragmoides* sp. 1 are common in the core, but this taxon has not been previously reported to occur in the Arctic. It most closely resembles the species *Haplophragmoides trullisatus*, but a detailed comparison and a differential description needs to be carried out. There appears to be two forms of this species always occurring together: a microspheric form that often has darker agglutinated grains along its sutures, and a larger, more lobate megalospheric variety with a visibly larger proloculus.

At 215 cm, the agglutinated assemblages are sparse and dominated by *R. pusillum*. Below this level, the diversity of agglutinated foraminifers progressively increases downcore. The relative proportions of *Haplophragmoides* sp. 1 and *Trochammina lomonosovensis* also increase downcore, and species diversity reaches a maximum between 395 and 457 cm. Two intervals containing *Alveolophragmium polarensis* are observed: an upper one between 404 and 457 cm, and a second one between 606 cm and the bottom of the core. The occurrence of *Trochammina quadriloba* and *Cribrostomoides subglobosus* in the core is restricted to the upper *A. polarensis* interval. The species *Psammosphaera bowmani* is fairly common between 395 and 583 cm. This species first described from the North Sea has not been previously reported from the Pleistocene of the Arctic. Because of its small dimensions it was most likely overlooked in previous studies. At 510 cm, the assemblage is dominated by *Haplophragmoides* sp. 1 and *Trochammina lomonosovensis*, with subordinate *R. pusillum* and *Psammosphaera*.

A total of 27 DWAF species were recorded in the core, among which many are reported for the first time from Pleistocene sediments in the Arctic Ocean (for comparison see Evans and Kaminski, 1998). The agglutinated foraminifers thus show the potential to produce a stratigraphically meaningful record. Moreover, overlaps with calcareous benthic foraminiferal assemblages should enable cross-correlation

between the DWAF and the calcareous benthic assemblages.

Big Pleistocene mammals from Sand Mine 'Kotlarnia' (POLAND)

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Presented here remains of big Pleistocene mammals were found by employees from sand mine 'Kotlarnia' over maintenance work and given to research in Paleobiology Institute in Opole University, in 2011. This seat is in Opolskie voivodeship, in Bierawa; borough, near the road which connect Kędzierzyn- Koźle with Gliwice. All the bones came from glacio-fluvial sands ang gravels embedded over recession Of the Riss glaciation. Their more specific statigraphic position is unknown, because they were elicited by excavator below the water surface. Delivered material involved fragmented remaining and abraded remains of mammals, among which recognised are woolly mammoth (*Mammuthus primigenius* (Blumenbach, 1799)), woolly rhinoceros (*Coelodonta antiquitatis* (Blumenbach, 1807)), wild horse (*Equus ferus* Boddaert, 1785), steppie bison (*Bison priscus* Bojanus, 1827) and four unmarked ribs.

Remains of woolly mammoth are represented by one incomplete mandible fragment. Only three diaphyses (right 64 mm length and left 65 mm) were kept. Beard part and mandible branches were not kept. Further legacy of mammoth's skeleton are a tusk fragment and a fragment of cementum with enamel. Found further unevenly broken part of tusk, namely tip - 305 mm length which was measured by outer curvature. Cementum detritus with enamel have a maximum length of approximately 155 mm and a maximum width of about 72 mm. Instead, the enamel thickness is approximately 0,77 mm. The last ossiferous element which belongs to woolly mammoth is a partly remaining molar. The found fragment contains plagues, tooth root, enamel and tooth pulp. Length and width of the dental crown are approximately 65 mm. Minimal crown height is about 45 mm and maximum about 80 mm. Tooth root has a length of about 25 mm and a width of about 16 mm.

Found fragment of woolly rhinoceros skeleton consist of the left pubic bone, left elbow bone, cervical vertebrae and left shoulder blade. The pubic bone fragment has a length of 246 mm. Visible is top branch together with top surface, front and back limbus. Elbow bone consists of a proximal radix fragment and a diaphysis fragment. Total elbow bone length is 210 mm. Dimensions of near radix are: length about 107mm, height 94mm, and width 136,3 mm. Next found specimen is a part of cervical vertebrae. Probably, this is 5th, 6th and 7th cervical vertebrae. Total lenght of vertebra is 118 mm. Diaphysis is transversely oval, and its dimensions are: height 55,6 mm, width 59,1 mm and length 62,5 mm. In connate materialis partly kept the spinous process, lower and upper appendix pond, and vertebra diaphysis. The last specimen which belongs to rhinoceros is a part of left shoulder blade. Their total lenght and height are 160 mm, and 127,2 mm. Recognised the articular cavity which is separated by the neck of shoulder blade.

Founded bones of wild horse are: metacarpal bone, shinbone, lumbar, two metatarsal bones and radius. The metacarpal bone is almost complete. This status enable to mark the diaphysis of metacarpal bone, basis and its head. This specimen has 185 mm length, diaphysis has 27x20 mm, basis 41x26 mm, and head 39x25 mm. The next specimen is a shinbone. Despite the fact that the examined shank fragment is in bad condition, outside of further part (end) and diaphysis, visible is front limbus, so-called front crest. Preserved shinbone fragment has 252 mm length. Remaining part of near end has dimensions: width 64 mm, height 59 mm, and final slice 51x32 mm. Horse lumbar surrendered significant destruction. Well preserved are lumbar diaphysis, the radix of bow circle. Also visible is complete vertebral foreman. Described specimen has 61 mm height, in the widest place has 48 mm, and its maximum length is 50mm. Metatarsal A was found only in part- only front part is preserved. This status enable to assess the diaphysis, basis and head of metatarsal. Total length is about 230 mm. Diameter of the metatarsal basis is approximately 44 mm, and diameter of head about 36 mm. Bone diaphysis dimension in the widest place is approximately 32 mm. Metatarsal B has destroyed only the basis. The head and diaphysis of metatarsal are well preserved. Total length is about 270 mm. The diameter of bones on different segments are: by the trochlea of radius approximately 40 mm, in widest diaphysis place also 40 mm, and by the base 46 mm. The radius is also strongly abraded. The best preserved is the diaphysis of the bone. The proximal radix, namely the head of radius, and also distal radix are strongly destroyed.
Bone which belongs to steppe bison is little skull fragment, probably part of occipital bone. Total bone length is approximately 210 mm. Minimal width is about 11 mm, and maximum 19 mm. The height is following: minimum approximately 13 mm, in mesial part about 25 mm and max. 43 mm. Excavated were also four ribs fragments. Because of their status, it is hard to assess to which animal it belonged. On diagnosed specimen we can single out: diaphysis, but vertebral end, and neck rib are not preserved.
Radiocarbon dating was also conducted. The sample (sample No. Poz54851) was delivered to 'Radiocarbon' Laboratory in Poznań. On the basis of delivered sample obtained the following result: 29270+280 BP 31288-32666 calBC (calibrated age).

The Late Bathonian – Valanginian foraminifers of the Northen West Siberia

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This study is based on original materials from sections of Upper Bathonian – Valanginian situated in northern regions of West Siberia (well Medvezhiya 316, Severo-Vologochanskaya 18 of the Ust-Yenisei region and Novoportovskaya 137, Arkticheskaya 16 of the Yamal region). The research of variations of foraminiferal communities gave an insight into main regularities of microbenthos distribution depending on changes in palaeoenvironments and transgressive – regressive episodes. Most diverse assemblages have been revealed during transgressive and beginning regressive stages.

Late Bathonian – Callovian. *Transgressive event.* Microbenthic communities are characterised by high diversity and high abundance of taxa. Dominant taxa are agglutinated foraminifers, which belong to the genera *Trochammina* and *Recurvoides*. Common taxa are *Saccammina, Ammodiscus, Glomospira, Reophax, Haplophragmoides, Ammobaculites, Kutsevella, Dorothia, Lenticulina, Saracenella, Astacolus, Pseudonodosaria, Geinitzinita, Ichtyolaria, Dentalina, Globulina,* and *Eoguttulina.*

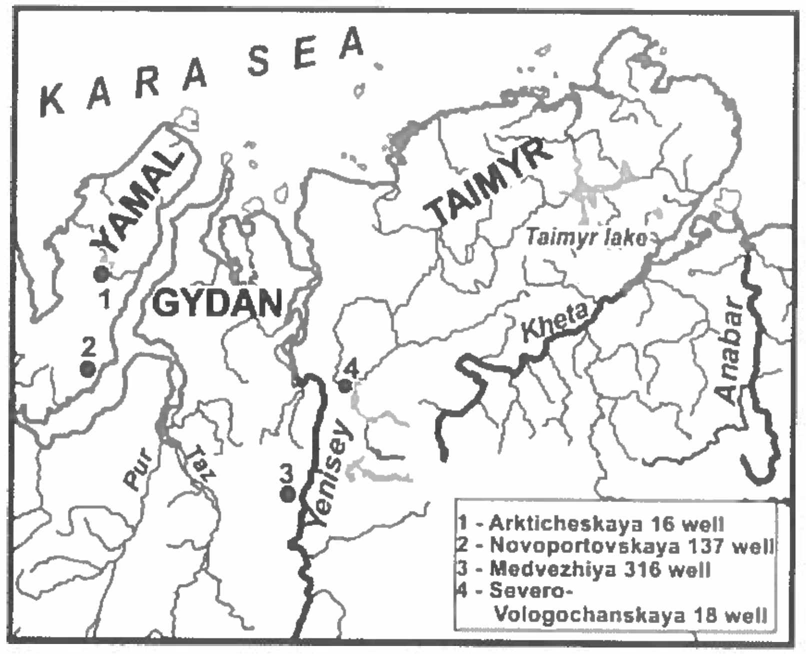

Fig. 1. Location of the studied sections.

Late Callovian – Early Oxfordian. *Regressive event.* Microbenthic communities are characterised by low diversity and dominance of the agglutinated foraminiferal genera *Recurvoides, Trochammina, Dorothia,* and *Eomarssonella.* Accessory taxa are the calcareous *Saracenella. Transgressive event.* Microbenthic communities are characterised by high taxonomic diversity. They are represented mostly by calcareous foraminiferal genera *Lenticulina, Planularia, Saracenaria, Astacolus, Marginulinopsis, Pseudonodosaria, Geinitzinita, Anmarginulina, Globulina, Pseudolamarckina* and others. Agglutinated taxa are *Trochammina, Recurvoides.*
Late Oxfordian – Kimmeridgian. *Regressive event.* Microbenthic communities are characterised by high taxonomic diversity of calcareous foraminifers from *Lenticulina, Citharinella, Saracenaria, Planularia, Ceratolamarckina, Marginulina, Glandulopleurostomella, Quinqueloculina* genera. The agglutinated taxa is *Tolypammina. Transgressive event.* Microbenthic communities are characterised by high taxonomic diversity. The agglutinated foraminiferal genus *Recurvoides* and calcareous genera *Pseudolamarckina, Lenticulina, Globulina* are dominant. Common taxa are *Evolutinella, Ammobaculites, Saracenaria, Astacolus, Dainitella, Planularia, Marginulinopsis, Vaginulina, Citharinella, Pseudonodosaria, Geinitzinita* and others.
Middle Volgian. *Transgressive event.* Microbenthic communities are characterised by high diversity and high abundance of taxa consisting of agglutinated and calcareous foraminiferal genera. Dominant taxa are *Dorothia, Lenticulina, Spiroplectammina.* Common taxa are *Ammodiscus, Evolutinella, Kutsevella, Trochammina, Saccammina, Saracenaria, Marginulinopsis, Marginulina, Marginulinita.*
Late Volgian – beginning of boreal Berriasian. *Regressive event.* Microbenthic communities are characterised by low diversity and are dominant by agglutinated foraminiferal genera *Glomospirella, Evolutinella.* Accessory taxa are *Trochammina* and *Ammodiscus.*

Middle path of boreal Berriasian. *Regressive event.* Microbenthic communities are characterised by low diversity and low frequency of taxa. Dominant taxa are represented by agglutinated foraminiferal genera *Hyperammina, Ammodiscus, Glomospirella, Evolutinella, Trochammina, Gaudryina*. *Transgressive event.* Microbenthic communities are characterised by an increase of taxonomic diversity consisting to foraminiferal genera *Saccammina, Ammodiscus, Recurvoides, Ammobaculites, Bulbobaculites, Kutsevella, Trochammina, Marginulina, Marginulinopsis*.

End of boreal Berriasian – Early Valanginian. *Regressive event.* Microbenthic communities are characterised by low diversity and low frequency of taxa. Dominant taxa are *Ammodiscus, Trochammina, Cribrostomoides, Recurvoides*. Accessory taxa including calcareous foraminiferal genera are *Lenticulina, Marginulina, Globulina* and others. *Transgressive event.* Microbenthic communities are characterised by very high diversity and high abundance of taxa. Calcareous Foraminifera are dominant. They are represented by *Lenticulina, Marginulina, Marginulinopsis, Citharinella, Saracenaria, Epistomina, Valanginella* and others. Common taxa of agglutinated foraminiferal genera are *Ammodiscus, Glomospirella, Recurvoides, Bulbobaculites, Cribrostomoides, Trochammina* and others.

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Life strategies of benthic, endobenthic and semibenthic fossil organisms of the Drahany Culm Basin (Lower Carboniferous sediments of the Myslejovice Formation, Moravosilesian Unit of the Bohemian Massif)

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The Myslejovice Formation is one of the lithostratigraphical units in the Lower Carboniferous sequences of the Drahany Culm Basin, which belongs to the large area of Rhenohercynian Zone of the Variscan orogenetic flysch belt. In the Moravosilesian Unit are developed two main basins, the Nízký Jeseník Mts. basin and the Drahany Upland Culm Basin. The flysch deposits were formed in the synorogenetic succession in the interval of Lower Viséan – Lower Namurian from siliciclastic turbidite fills of Variscan flysch (Culmian facies) in the remnant and foreland basins. From the oldest (Lower Viséan) to the youngest are sediments in the Drahany Culm Basin filled by Protivanov, Rozstání and Myslejovice Fm. (Late Viséan, Goα to Goγ zone). The Myslejovice Fm. contains in its southeastern part very rich associations of fossil flora, fauna and ichnofauna. These are mostly bonded on fine-grained greywackes, siltstones and claystones. The fossil fauna and trace fossils can be generally compared with other associations in the Rhenohercynian Culm facies. Most of the organisms were benthic and occupied miscellaneous types of the environment. Due to turbidite sedimentation, the ecological stress lead benthic inhabitants to develop various types of life strategies. In the Regional museum in Olomouc is stored a large collection of fossils from the Myslejovice Fm. Now we are able to study life-strategies, palaeoecology, and on this basis conclude the palaeoenvironment reconstruction and interaction of organisms with the environment of Culmian turbidite flysch deposits. Studied material comes from localites situated near Vyškov. From these sites are known the following benthic fossil organisms: Anthozoa: *Zaphrentidarum* sp. ind., Trilobita: *Archegonus moravicus*, Gastropoda: *Bellerophon* cf. *moravicus*, *Pleurotomaria* (*Ptychomphalus*) cf. *perstriata*, Polyplacophora: *Rhombichiton laterodepressus*, Brachiopoda: *Dalmanella* cf. *pauciplicata*, *Chonetes (Plicochonetes)* cf. *cromfordensis*, *Rhynchonella*? *Contraria*, Crinoidea: *Lophocrinus minutus*, Bivalvia genera: *Posidonia, Septimyalina, Paralellodon, Dunbarella, Streblochondria, Sanguinolites, Edmondia, Janeia, Polidevcia, Anthraconeilo* and *Palaeoneilo*. Trace fossils: *Cosmorhaphe* isp., ?*Helminthorhaphe* isp., *Dictyodora liebeana*, *Diplocraterion parallelum*, *Gordia* isp., *Chondrites* cf. *intricatus*, *Chondrites* isp., *Nereites missouriensis*, *Nereites* isp., *Phycosiphon incertum*, *Planolites beverlleyensis*, *Planolites* isp. and *Rhizocorallium* isp.. For the palaeoenvironmental analysis were used especially species of bivalves and trace fossils also due to their stratigraphic and environmental importance. Most of fossil bivalves from the Myslejovice Fm. were filter feeders, suspension feeders or deposit feeders. The deposit feeders (burrowing forms) actively consume organic material within the sediment. The palaeoecology of bivalves can be also described by their relation to substrate, namely: infaunal, semi-infaunal and epifaunal. Endobenthic and semi-endobenthic species of bivalves, especially siphon using species were representatives of the genera *Anthraconeilo* and *Palaeoneilo*. The family Nuculanidae was apparently suspension feeders tolerant to dysoxic conditions of substrate. The most abundant strategy developed epifaunal Pteriomorhia subclass. Species of the *Posidonia* and *Septimyalina* genera used byssal threads to attach for the sea bed or use stelae of *Laminariaceae* algae which could be practically rich of organic particles. In some sites near Opatovice, Pístovice and Olšany can be found evidence in the form of numerous specimens of Posidonia beds. Infaunal and facultatively infaunal mobile species of bivalves (*Sanguinolites*, *Polidevcia*, *Edmondia* and *Janeia*) could on the other site suffer from the lack of nutrients due to extensive vegetation of algae. The species of *Posidonia becheri* and *Septimyalina sublamellosa* are very abundant due to specific adaptations to adverse conditions. The epiplanktonic (pseudoplanktonic) life strategy is also a reason of intercontinental expansion of the *Posidonia becheri* species. They are often found attached to floating objects, in particular to driftwood or algae with others analogous thin shelled bivalves e.g., myalinids (*Septimyalina sublamellosa*, *S. minor*). With a gradual transition to upper part of Myslejovice Fm., they are endemic communities suppressed by uniform associations of epiplanktonic and epibyssate species. For the palaeocological analysis especially trace fossils are very useful as autochtonous inhabitants of the substrate. Fossil ichnofauna contains traces of the Nereites ichnofacies. Life strategies in these conditions focused on maximum utilization of the surface in the case of deposit feeders. This type of environment was inhabited by graphoglyptids e.g., *Cosmorhaphe* isp., *Dictyodora liebeana* and *Helminthorhaphe* isp. These ichnospecies represents a fossil behaviour of superficial and shallow infaunal deposit feeders or suspension feeders using meandering and grazing types of movement that are mostly common in the sediment-water interface. In comparsion with the Nízký Jeseník Mt. are distal parts of turbidite sequences of Myslejovice Fm. impoverished of graphoglyptid networks e.g., *Protopaleodictyon* or spiral forms e.g., *Spirodesmos*. Post-deposit colonisers from proximal parts of the turbidite slope are represented by ichnospecies of *Diplocraterion* isp., *Rhizocorallium* isp. and *Planolites beverlleyensis*. These ichnospecies form not very stable associations and represent also dwelling traces. Unique examples of food supply are fodinichnia of *Chondrites* cf. *intricatus*, *Chondrites* isp. and *Planolites* isp. Producers of a Chondrites group traces are known as a chemosymbiosis organism inhabiting the intermediate sediment levels. Suspension feeders tend to be dominant in high-energy settings where organic particles are kept in suspension by waves or currents. In contrast, organic particles accumulate in the sediment in tranquil waters and organisms tend to develop deposit and detritus feeding strategies. The highest amount of organic matter is near the sediment-water interface. The life styles of benthic fossil organisms of Myslejovice Formation sites are are in accordance with our previous sedimentological studies.

Microproblematica and other disputable microfossils as an important component of the "Štramberk-type" limestones (Tithonian-Berriasian) of the Polish Outer Carpathians

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The "Štramberk-type" limestones in the Polish Outer Carpathians occur mostly as boulders and pebbles among the younger, mainly siliciclastic deposits of the Silesian, Sub-Silesian and Skole series. These exotic rocks are remnants of carbonate platforms, which were developed along the margins of the Proto-Silesian Basin in the Latest Jurassic and the Earliest Cretaceous. Much larger fragments of such kind of platform are known from the vicinity of Štramberk (Moravia, Czech Republic), and they represent diversified deposits of the fore-reef, platform-margin reefs, and inner platform (e.g., Eliáš & Eliášová, 1984).

Microscopic study of numerous exotic rocks from over 30 localities in the western part of the Silesian and Sub-Silesian nappes provides abundant data about microfossils, and allows to enrich the current state of knowledge. Among such micro- and macroorganisms like corals, sponges, echinoderms, bivalves, brachiopods, bryozoans, algae, and foraminifera, so-called microproblematica frequently occur. Nowadays the nature of part of them is explained, some of them are still under discussion, and some belong to *incertae sedis* all the time.

Part of these microfossils is microencrusters, which could locally constitute an important component of the reef framework (see also: Hoffmann *et al.*, 2008). *Koskinobullina socialis* Cherchi et Schroeder – *incertae sedis* microfossil – belongs to the most common forms which encrusted corals and sponges. The origin of another one – *Iberopora bodeuri* Granier et Berthou – is also problematic, whereas *Perturbatacrusta lein* Schlagintweit et Gawlick probably had sponge nature (Pleş & Schlagintweit, 2013).

"Bacinellid" fabric and variously interpreted *Lithocodium aggregatum* (sensu lato) are common components of studied limestones. They often occur as microencrusters, but also as oncoidal structures, or even as dominant components of some samples.

Microfossils interpreted as polychaetes: *Mercierella? dacica* Dragastan and *Terebella lapilloides* Münster belong to another group. *M.? dacica* is typical for shallow facies of the carbonate platform, when *T. lapilloides* is mostly connected with slightly deeper environment – reefs constructed by siliceous sponges. *Carpathiella triangulata* Mišík, Soták et Ziegler was originally described as tubes of serpulid worms (Mišík *et al.*, 1999), but Schlagintweit *et al.*, (2007) reinterpreted it as remnants of decapod crustacean, and they proposed name *Carpathocancer triangulatus*. Nature of another similar microfossil *Carpathiella plassenensis* Schlagintweit et Gawlick (*Carpathocancer? plassenensis*) is still disputable.

Crescentiella morronensis (Crecenti) and *Globochaete alpina* Lombard are the most common microfossils in studied samples. *C. morronensis* occurs in diversified deposits of the platform and the slope of platform, and recently this microfossil was interpreted as the association of cyanobacteria and nubecularid foraminifera (Senowbari-Daryan, 2008). *G. alpina* was explained as planktonic, unicellular, green alga (Skompski, 1982). Among deposits of the inner platform another microfossil with algal nature can be observed – *Thaumatoporella parvovesiculifera* (Raineri). Moreover, problematic structure *Labes atramentosa* Eliášová (known also as "Tubiphytes-structure") is noticed, mainly among sediments of coral reefs.

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The conifer *Tritaenia linkii* - reinterpreted

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The narrow leaves of *Tritaenia linkii* from the German Lower Cretaceous (Berriasian) have attracted and puzzled palaeobotanists for a long time. It was originally described as a conifer of unknown affinity. Studies based on sterile foliage were not able to resolve this issue. Due to this, bulk maceration of a large amount of material from the locality Hils-Duingen was performed. Coaly claystone full of leaves and other organic material forming monodominated taphocoenoses provided a number of associated organs: beside leaves, there were shoots, seeds, cupules, male reproductive structures and pollen. Based on the monodomination, it is assumed that all the material comes from one fossil plant. *Tritaenia linkii* (Roemer) Maegdefrau et Rudolf - leaves with resin bodies are very variable in length, and in number of veins per leaf. The leaves are hypostomatic, with very thick cuticle, bearing stomata in two to five stomatal bands; external surface shows papillae, forming star-like structures. *Sulcatocladus robustus* Watson et Harrison - shoots always associated with leaves *T. linkii* in the Wealden of Germany and England. The shoots are covered with helically arranged leaf bases, each subtending one or two types of scars. Ovuliferous organs representing ovate seeds of *Allicospermum* type are born on simple pedicelate collars. Seeds consist of two membranes, interpreted here as sarcotesta and sclerotesta. Seeds are filled with numerous resin bodies forming large bulging structures, sometimes prominent on the seed surface. Male reproductive structures form strobili, consisting of helically arranged bracts subtending microsporangiophores containing monosulcate pollen of *Cycadopites* type. The pollen is smooth, broadly elongate, monocolpate 30 x 40 µm. Ovuliferous organs associated with *Tritaenia linkii* resemble the organs described as female reproductive structures of Cretaceous Ginkgoales, *Nehvizdyella* J. Kvaček et al. from the Cenomanian of the Czech Republic. Collars associated with *Tritaenia linkii* resemble structures of the genus *Nagrenia* Nosova from the Jurassic of Uzbekistan. The only difference between *Nehvizdyella, Nagrenia* and the studied organ is that both of the earlier published organs have bifurcated pedicles, while the studied organ is attached singly. However, the same construction of seeds (*Allicospermum* type) born in characteristic collar clearly argue for ginkgoalean origin of the structure. Associated monosulcate pollen of *Cycadopites* type, as well as that found *in situ* underpins this assumption. Coniferous origin of the *Tritaenia* plant is supported only by presence of needle-like leaves similar to *Sciadopitys*, and shoots covered by large persistent leaf bases.

Morphology and ecology of paradoxidid protaspides

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Trilobites of the family Paradoxididae belong to important and widely distributed faunal components of Cambrian Series 3 strata; paradoxidids have been commonly used as biostratigraphic tools. Although paradoxidid ontogeny has been studied by numerous authors (e.g., Raymond, 1914; Raw, 1925; Šuf, 1926; Westergård, 1936; Růžička, 1943; Šnajdr, 1958; Sdzuy, 1961), we still have poor knowledge about paradoxidid protaspid development as well as about their ecology and possible phylogenetic relationships.

Currently, protaspides are known in four genera (*Acadoparadoxides*, *Eccaparadoxides*, *Hydrocephalus* and *Paradoxides*) of the family Paradoxididae. Protaspides of *Acadoparadoxides* and *Paradoxides* show a rather narrow glabella with a quite distinct sagittal furrow. On the other side, protaspides of *Eccaparadoxides* and *Hydrocephalus* are characterised by a large sub-circular glabella. Comparison of the corresponding stages of the all above mentioned taxa shows a significant difference in their dimension. Whereas the earliest known stages of *Acadoparadoxides*, *Paradoxides* and *Eccaparadoxides* are approximately 1 mm long, the earliest stages of *Hydrocephalus* are almost twice larger. Such difference in size can be explained by a possible lecitotrophy of *Hydrocephalus*.

Morphology of paradoxidid protaspides may be useful for understanding of phylogenetic relationships within the family Paradoxididae. *Hydrocephalus* and *Eccaparadoxides* share highly advanced protaspid morphology comparing to *Acadoparadoxides* and *Paradoxides*. The latter genera share numerous characters with early ontogenetic stages of the superfamily Redlichioidea and thus represent most likely the plesiomorphic state.

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The oldest higher plants with in-situ spores from the Wenlock of the Bohemian Massif

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The studied plant remains originate from the Wenlock (*Monograptus beelophorus* zone) of the Barrandian Lower Palaeozoic in Central Europe. Thirty specimens from the locality Loděnice – Černidla were found in the original Barrande collection. Ten other specimens were collected recently in the same locality. The specimens are preserved in dark, finely laminated limestone, and brown, calcareous, tufitic siltstone (Silurian, Lower Wenlock, Motol Formation). The palaeoenvironment of this part of the Barrandian is interpreted as a volcanic archipelago. Beside the rare remains of fossil plants, the marine sediments contain typical assemblage with trilobite *Miraspis mira*.
The fossil plant remains of *Cooksonia* display central and terminal parts of sporophytes, up to 80 mm long, 1-4 mm in diameter, 1–5 times isotomously branched. Completely preserved axes are terminated with sporangia. Each sporangium is trumpet shaped, 3–5 mm in diameter. Several specimens were macerated, first in HF, then in Schulze's solution. These materials are very bad preserved and therefore structure elements not found. Two sporangias was studied in SEM and discovered *in situ* spores. Circular trilete miospores; 10(12)14 microns in diameter. Proximal surface is laevigate. A small equatorial thickening up to 1 microns is developed. Rays of the trilete mark equal to the diameter, sometimes are elevated. Miospores correspond are of the Ambitisporites avitus-type but due to their very small diameter can be classified as Ambitisporites cf. avitus.
The genus *Cooksonia* was described by Lang from the Devonian of Wales. The characters observed in our material match the diagnosis of *Cooksonia* emended by Gonez & Gerrienne. Within already described species of *Cooksonia*, our material is most similar to *Coooksonia pertonii*, but our fossil remains are older and larger. Organic remains of similar age were found in Ireland, but their plant structure is not completely understood.
Good stratigraphical context provided by well-documented biostratigraphy of the classical Barrandian area make this material the oldest known *Cooksonia*. The large size of the megafossils is also noteworthy in context of other mid-Silurian *Cooksonia* material.

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20 families and 31 genera. Dominant families in the collection are Nerineidae, Cerithiidae, Pleurotomariidae and Tylostomatidae, the most frequent genera are *Cerithium*, *Ditretus*, *Tylostoma* and *Leptomaria*.
About half of the studied gastropods from the collection of Regional museum in Olomouc can be noticed at other European localities, mainly at Romanian Csáklya, Mont Salève in the French Prealps and Polish Inwałd. *Endoplocus staszycii*, *Ptygmatis pseudobruntrutana* and *Ptygmatis carpathica* belong to the most cosmopolitan species.
Based on the identified families and genera, we can say that most of gastropods can be considered to be representatives of epifauna inhabiting or soft substrates or rocks in the littoral zone of shallow, slightly warm to tropical seas.

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Eocene planktonic foraminifers of *Hantkeninidae* CUSHMAN, 1924 from the Western Carpathians: species diversity, functional morphology and palaeoecology

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The digitate planktonic foraminifers of the genus *Hantkenina* include clavate forms with tubulospinose chambers, which were orginated as morphological adaptation for enhanced metabolic effectivity and dwelling in near-surface waters (Coxall *et al.*, 2000). The cladogenesis of *Hantkenina* is related to ancestral species of *Clavigerinella* (Coxall *et al.*, 2003) or to smooth-walled species of *Pseudohastigerina* (Banner & Blow, 1960).
The digitate planktonic foraminifera are considered to represent warm-water habitats of marine microfauna. In the Middle Eocene they are represented by hantkeninids, which disappeared with climatic cooling on the Eocene/Oligocene boundary. The LAD of *Hantkeninidae* marked the E/O boundary in the GSSP section at Massignano (Premoli Silva & Jenkins, 1993).
Eocene formations of the North Peri-Tethyan basins, are not very rich in *Hantkeninidae*. The presence of *Hantkenina* species was recorded in the Transdanubian Mts. (Majzon, 1960), Ždánice – Sub-Silesian unit (Vašíček, 1951, Gasiński 1978) and very scarcely in the Central Western Carpathians (e.g., Samuel, 1990).

New localities with rich occurrences of *Hantkeninidae* has been found in the Liptov-Orava and Turiec basins. *Hantkenina*-bearing marlstones overlain the Nummulitic limestones or carbonate breccias of the Borové Fm. The hantkeninids are diversified to five different species, comprising of *Hantkenina australis, H.dublei, H. mexicana, H. compressa and H. liebusi* (Fig. 1). They are associated with large-sized muricate species (*Acarinina topilensis, A. rohri*), keeled forms (*Morozovella subbotinae, Morozovelloides spinulosa*), smooth forms (*Pseudohastigerina micra, P. wilcoxensis*), bullae-like forms (*Globigerinatheka subconglobata, G. kugleri*) and spinose cancellate forms (*Subbotina eoceana, S. corpulenta*). These species provide the biostratigraphic evidences for the E13 zone, which corresponds to a Middle Bartonian age.

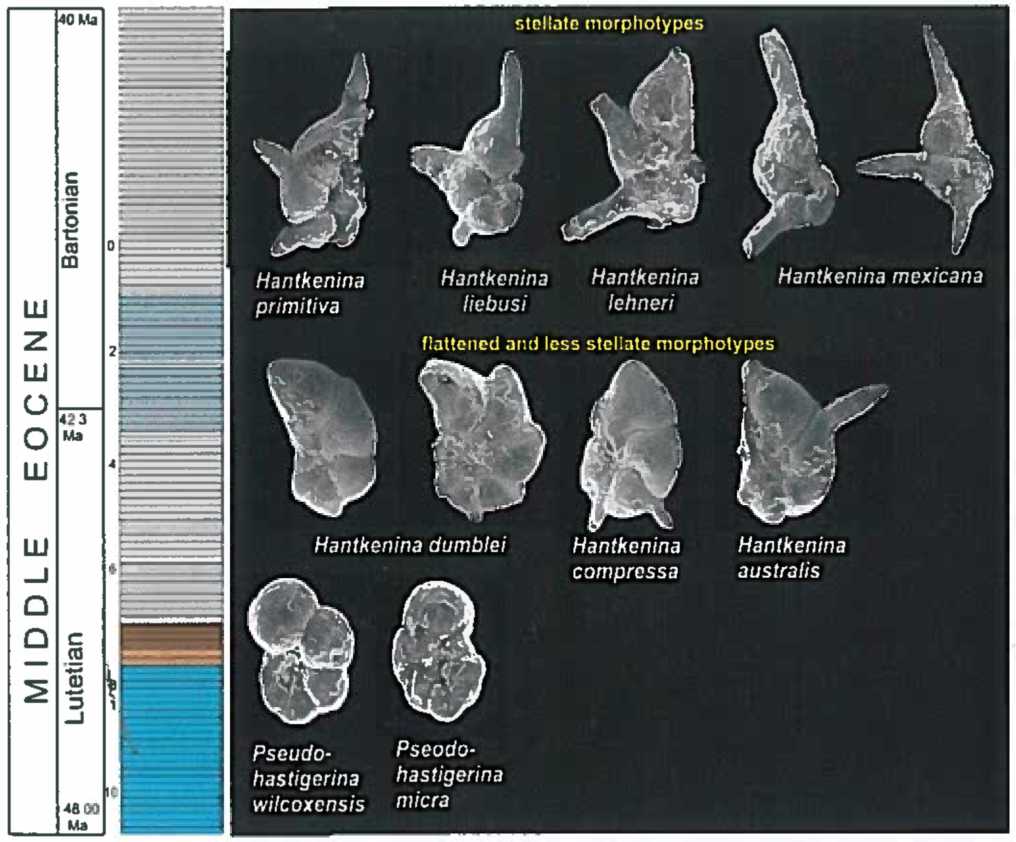

Fig. 1. Phylogenetic diversification of hankeninid species and their relations to ancestral species of *Pseudohastigerina.*

Associations with hantkeninids, acarininids, morozovellids, large-sized pseudohastigerinids and *globigerinathekids* proliferated in warm-water conditions, which changed with climatic colling during the Priabonian. This is manifested by disappearance of hantkeninids and muricate species in higher formations of the Central-Carpathian Paleogene basin, which after the Bartonian/Priabonian boundary were replaced by temperate-water and eutrophic forms of globigerinathekids and subbotinids, and after the terminal Eocene cooling by dwarfing forms of globigerinids, tenuitellids, pseudohasteriginids, catapsydracids and chiloquembelinids (Soták, 2010). The research has been supported by VEGA project 2/0042/12 and project APVV-14-0118.

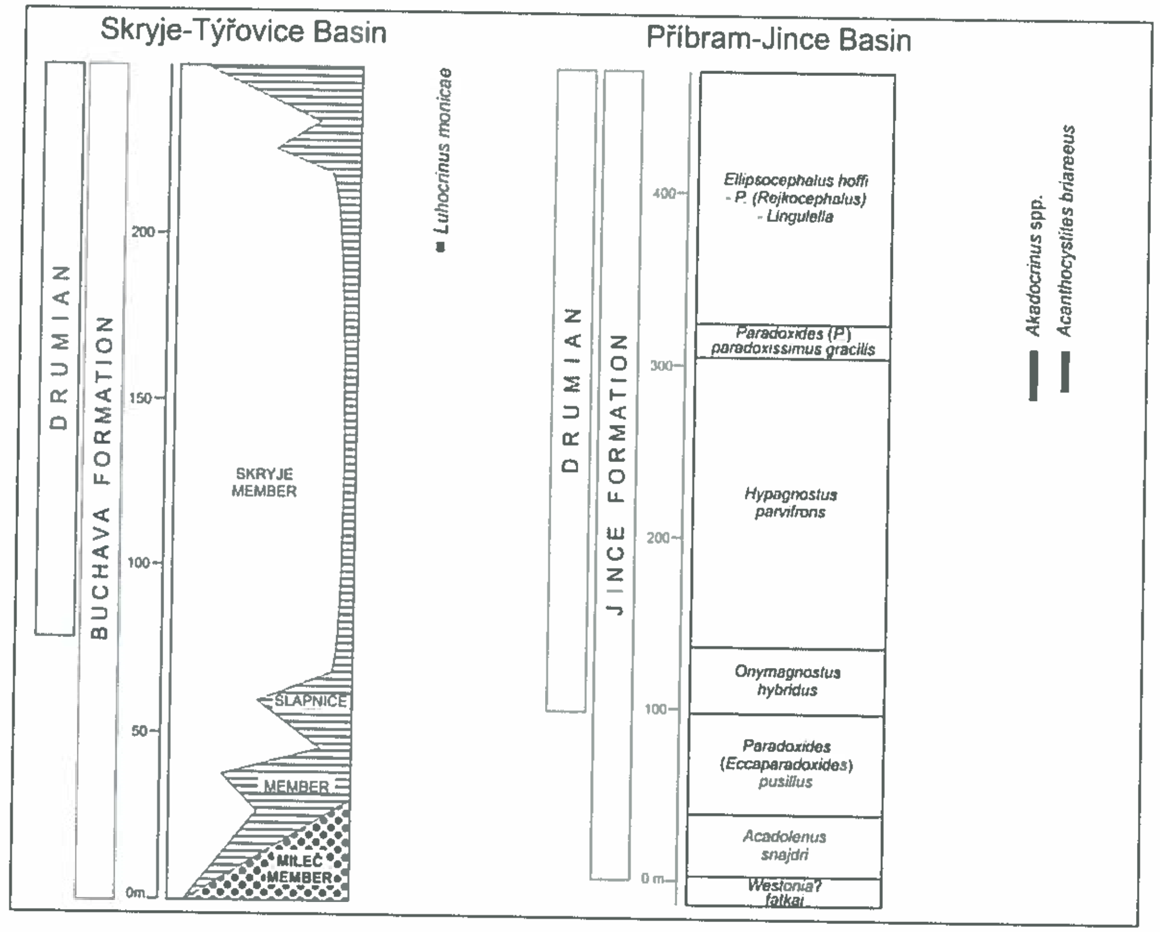

Fig. 1. Lithostratigraphic subdivision of Cambrian rocks in the Skryje–Týřovice Basin (modified after Fatka et al., 2011) and biostratigraphy of the Jince Formation of the Příbram–Jince Basin (after Fatka and Szabad, 2014), with stratigraphic ranges of gogiid echinoderms.

New data on the stratigraphy of Miocene deposits in the Carpathian Foredeep (Kraków Area, Poland)

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The results of micropalaeontological studies on the Miocene deposits of the western part of the Carpathian Foredeep from southern Poland (Kraków area) are presented. These deposits are represented by four lithostratigraphical units: the Kłodnica, Skawina, Krzyżanowice and Machów formations. The study was carried out on samples collected from four boreholes (Pasternik, Węgrzce, Kraków-Nowy Kleparz, Kraków-Plac Inwalidów) and one outcrop – Wola Justowska (Pilarz, 2012). The stratigraphic scheme based on the variability of foraminiferal assemblages from the Upper Silesia area (see Alexandrowicz, 1963) has been used.The analysis of the foraminiferal assemblages allowed to determine the precise stratigraphic position of the Miocene sediments, as Middle and Upper Badenian (*sensu* Hohenegger *et al.*, 2014).

The Kłodnica Formation consists of a diversified complex of clay-sandy deposits formed in terrestrial, freshwater and brackish environments and locally of marine oyster limestones. In these deposits (Pasternik borehole, Wola Justowska outcrop) index foraminifera – *Orbulina suturalis* and *Uvigerina macrocarinata* have been found, which suggest *Orbulina suturalis* Zone (Cicha *et al.*, 1975), Middle Badenian in age (*sensu* Hohenegger et al., 2014). The foraminiferal assemblages from Skawina Formation are typical for Middle and Upper Badenian (IIAB, IIC and IID assemblage zones, *sensu* Alexandrowicz, 1963), which correspond to *Orbulina suturalis* Zone, *Globigerina decoraperta - G. druryi* Zone (Cicha *et al.*, 1975). The Krzyżanowice Formation are developed as claystones with gypsum crystals, generally without fossils. The Machów Formation's deposits were found only in the Pasternik and Węgrzce boreholes. This lithostratigraphic unit is represented by claystones and clays with mudstones. The foraminiferal assemblage (IIIA – op cit.) is typical for Upper Badenian, and corresponds to *Globigerina decoraperta - G. druryi* Zone (Cicha *et al.*, 1975). Moreover, the radiolarian assemblages are characteristic for these deposits.

The detected boundary of foraminiferal zones IIB/IIC or IIAB/IIC (Alexandrowicz, 1963) = *Orbulina suturalis/G. decoraperta - G. druryi* zones (Cicha *et al.*, 1975), was correlated with the boundary of the nannoplankton zones NN5/NN6 (Tab. 1), based on nannoplankton additionally analyzed in this project (Garecka M., 2012). Such correlation has been observed in the stratotype of the Moravian/Wielician boundary (Brestenská, E., 1978), which corresponds to the Middle/Upper Badenian boundary (*sensu* Hohenegger *et al.*, 2014; Tab. 1). The obtained correlation of the foraminiferal and nannoplankton zones lowered the Middle/Upper Badenian boundary, in the studied area, and which is located within the Skawina Formation (Tab. 1). Miocene marine sediments older than Middle Badenian (*sensu* Hohenegger *et al.*, 2014) – *Orbulina suturalis* Zone (Cicha *et al.*, 1975) have not been detected in the Kraków area (Tab. 1).

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Chrono-stratigraphy (Hohenegger *et al.*, 2014)	**Foraminiferal Zones** (Cicha *et al.*, 1975)	**Assemblage Foraminiferal Zones** (Alexandrowicz 1958, 1963, 1969b; Pilarz 2012)	**Nannoplankton Zones** (Martini 1971)	**Litho-stratigraphy** (Alexandrowicz *et al.*, 1982)	**Lithology (Kraków Area)**
Late Badenian	*Globigerina druryi* - *Globigerina decoraperta*	**IIIA**, IIIα	NN6	**Machów** Formation	Grey, light-grey claystones, clays with mudstones
		IID/IIIA		**Krzyżanowice** Formation	Clays, claystones with gypsum, gypsum
		IID, IIC/D **IIC**, IIB/C, IIAB/C	NN5/6, NN6	**Skawina** Formation	Grey, light-grey marly clays, light-grey clays with glaukonite, tuffites
Middle Badenian	*Orbulina suturalis*	**IIB**; **IIA**; **IIAB**; Iα, Iγ, Iβ, Iα; IC	NN5	**Kłodnica** Formation	Sandy claystones, grey and green-grey clays, green clays, oyster limestones, playa, vadoids, caliche, white sands, calcareous marls, tuffites, glaukonitic sandstones

Tab. 1. Stratigraphic scheme of Miocene deposits in the Kraków area

New anatomical data on Oligocene morid fish *Eophycis* (Gadiformes) from the Central Paratethys (Poland)

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The current representatives of the family Moridae (Gadiformes) are mainly marine deep water fish (rarely found also in the brackish waters) well characterised by otophysic connection, horizontal septum of the gas bladder, specific morphology of otoliths, and unique architecture of the caudal skeleton (e.g., Fitch & Barker, 1972, Paulin, 1983, 1988, 1989). Although some fossils were historically classified within this group, only very few of them can be undoubtedly assigned to this family and their skeletal fossil record can be classified as very poor. The earliest representative (based on articulated fossil) is genus *Eophycis* and its affinity to morid fish was confirmed by otoliths *in situ* (Rozenberg & Prokofiev,

2004). Until now, three species of the genus *Eophycis* were described from Oligocene strata of different parts of the Paratethys basins: *E. jamnensis* from the central Paratethys (Jerzmańska, 1968); *E. froidefontainensis* from western Paratethys (Pharisat, 1991); and *E. pshekhiensis* from the eastern Paratethys (Rozenberg & Prokofiev, 2004).
The fossil fish fauna of the Hermanowa site (Rupelian; Polish Carpathians) is represented by different types of teleosts (Přikryl *et al.*, 2011, 2014, Přikryl accepted) and include also numerous individuals of the species *E. jamnensis*. These specimens show numerous previously unknown (or uncertain) important characters that allow compare this extinct group with recent morids in detail.

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Depth distribution of benthic foraminifera in the sublittoral around Okinawa, Japan

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Water depth is a composite factor that controls the associations of biological, chemical and physical properties in the marine environment. It correlates with species distribution and also sediment depositions. Benthic foraminifera inhabit the seafloor by attaching their reticulopodia in the sediment grains. Depth distribution of larger benthic foraminifera species have been extensively studied in Okinawa, hence this study aims to extend the scope to the smaller benthic foraminifera species. Samples of different depth were grouped according to canonical correspondence analysis (CCA); based on this analysis, environmental factors (e.g., water depth and mean grain size) responsible for this grouping were determined. Then, the dependencies between foraminifera species and these factors were also established. Lastly, depth distribution of the foraminifera species were elucidated. Based on canonical correspondence analysis, the species distribution is correlated to depth, inclination and sedimentological parameters. The composition of larger benthic foraminifera species in this area is influenced by the nearby coral reef. The position of larger benthic foraminifera species in the CCA ordination fit the range and mode that have been reported before (personal communication with Hohenegger), although there are several shallow water species located out of their depth range. The composition of smaller benthic foraminifera species is related to sedimentological parameters and this indicate future work for this study.

Detailed carbon and oxygen isotopic analysis of the foraminiferal tests from the Lomnice borehole (Badenian, Carpathian Foredeep)

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The (Lomnice) LOM-1 borehole records a nutrient-rich quiet environment of the outer shelf to upper bathyal in the Moravian (substage of the Badenian) of the Carpathian Foredeep. The LOM-1 borehole is rich of a fossil content with a relatively good preservation. The studied section can be correlated with the interval from 14.6 Ma (the FO of *Orbulina* spp.) to 13.42 Ma (the LO of *Sphenolithus heteromorphus*), which agrees with the beginning of the "Middle Miocene Climate Transition".
The foraminifera for the carbon and oxygen stable isotope analysis were picked from the fraction 0.063-2 mm. The suitability for the stable isotope analysis was carefully evaluated based on the inner wall preservation. The isotopic analysis was done for fifteen samples (4.5 m; 8.5 m; 9 m; 10 m; 11 m; 11.3 m; 11.7 m; 12.6 m; 14.25 m; 14.5 m; 16.5 m; 16.75 m; 18 m; 19.2 m; 19.25 m) with total 373 tests analyzed. Each analysis was performed from exactly one test. The following foraminiferal genera from different palaeobiotops were used for the isotope analysis: *Globigerina bulloides*; *Orbulina universa, Praeorbulina glomerosa*; *Globigerinoides* spp.; *Uvigerina* spp.; *Heterolepa dutemplei*; *Cibicidoides* spp.; *Gyroidinoides* spp. and *Melonis pompilioides* to document the isotopic signal for the superficial, bottom and sediment water. The oxygen and carbon isotope analysis from foraminiferal tests were used for the verification of the palaeoecologic interpretations by Holcová *et al.* (submitted).
The isotopic analysis results were used for a detailed interpretation of the palaeoenvironment in each sample. The interpretation documents the large variability and rapid changing of the palaeoecological parameters, throughout the LOM-1 borehole.
The lowermost part of the LOM-1 borehole (the samples 19.25 m and 19.20 m) represents an environment with an apparent seasonality with presence of at least two different seasons. No significant oscillations of palaeoecological parameters are present. The sample 18.00 m indicates no apparent seasonality. The mixed water column and nutrient oscillations at the sea floor point to rather cooler conditions. This change of palaeoecological parameters is followed by the possible seasonal upwelling regime, documented in the sample 16.75 m, and increasing in seasonality and nutrient oscillations at the sea floor as represented by the samples 16.75 m and 16.5 m. The following samples 14.50 m and 14.25 m represent no apparent seasonality with the oscillations of nutrient conditions at the sea floor. It points to cooler conditions and increasing the instability of the palaeoecological parameters.
Throughout the interval of 19.25 m – 14.25 m (with exceptions) a certain period with high rainfall occurs in remarkably regular pattern. The upper part of the LOM-1 borehole is characterised by rapid changing of the palaeoecological conditions. The sample 12.60 m documents the seasonality characterised by warm, more saline upper water layer throughout the summer season. The following samples 11.70 m and 11.30 m also reflect seasonality, however, the oscillations of nutrient conditions during the seasons are present. The sample 11.00 m reflects an apparent seasonality with relatively

stable conditions at the sea floor and the sample 10.00 m represents different seasons with no major oscillations of nutrient conditions. A catastrophic event of a high rainfall and freshwater input is reflected here. The sample 9.00 m documents different seasons with oscillations of nutrient conditions at the sea floor. Finally, the uppermost part of the LOM-1 borehole represented by the sample 4.50 m points to the seasonality with major oscillations of a nutrient input within the water column and at the sea floor. The proposed beginning of the basin shallowing and seasonal changes with major oscillations of the palaeoecological parameters, are indicating an increase of instability within the environment.

The isotopic values show no global trends as reported by Báldi (2006) and Peryt (2013). These global isotopic shifts cannot be traced in such high variable environment which the LOM-1 borehole represents. However, Báldi (2006) and Peryt (2013) studied a longer interval and based their observations on small isotopic datasets.

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Jurassic gastropods from Štramberk – systematic analysis of the collection of Regional museum in Olomouc

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Worldwide famous Štramberk-type limestones (Tithonian - Lower Berriasian) are distinguished by a very abundant fossil fauna, in which almost all groups of Mesozoic invertebrates are represented. In the 19th century plenty of monographs dealing with individual groups of invertebrates was already written and with many of them nobody followed up with newer studies. Gastropods also are among the neglected group, at the end of 19th century Zittel (1873) engaged in them, later Remeš (1909) and Blaschke (1911) followed him with less extensive studies and recently also Lehotský (2012) mentioned them.

A collection of gastropods from Štramberk-type limestones deposited in the Regional museum in Olomouc served as a modern systematic processing. It numbers 141 specimens, from which only 109 better preserved pieces allowed closer identification. They were described, documented and classified to

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Oligocene - Early Miocene foraminiferal microfauna from the South Slovakian Basin (Lučenec and Rimava Depressions): implications for microbiostratigraphy and palaeoenvironments

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Foraminiferal studies have been performed on two borehole sections of the Číž and Lučenec formations in the Lučenec and Rimava Depressions (GTL-2 Rapovce and GOR-1 Gortva boreholes). Planktonic foraminifera reached a great abundance already on the base of the Číž Formation, comprising large-sized forms of globigerinids, turborotaliids and paragloborotaliids. Planktonic associations are diversified to following species: *Turborotalia ampliapertura*, *Paragloborotalia nana*, *Subbotina gortanii*, *Globigerina praebulloides*, *Globigerina officinalis* and *Globigerina leroi*. These foraminiferal species make possible to determine the O2 Zone, belonging to the Middle Rupelian age (O- series of foraminiferal biozones *sensu* Berggren & Pearson, 2005). Microfaunistic assemblages of the Číž Formation changed in the upper Rupelian sediments by the appearance of minute forms of tenuitellids, cassigerinellids, globorotaloids and catapsydracids. The taxonomic diversity of planktonic foraminifers decreases to several species: *Tenuitella gemma*, *Cassigerinella globulosa*, *Globorotaloides hexagonus* and *Catapsydrax martini*. Dwarfing of planktonic foraminifers implies stress-induced conditions, like the influence of hyposaline waters on the morphogenesis of *Cassigerinella chipolensis* or cool-water preferences of tunuitellids.

The transitional beds between the Číž and Lučenec Formations contain the Kiscellian-Egerian associations of foraminiferal microfauna. The character of the microfauna implies the restoration of fully-marine conditions, which is manifested by blooming of planktonic foraminifers and recolonization of the benthic biota. The abundance of planktonic foraminifera increased abruptly during the Egerian transgression, marked by the appearance of *Globoturborotalita ouachitaensis*, *G. angulisuturalis*, *G. woodi* and *G. labiacrassata*. Those foraminifers are associated with *Paragloborotalia opima*, *P. bella*, *Globigerina praebulloides*, and *Globigerinella obesa*. The common occurrence of species from the *Globoturborotalita* – group with *G. angulisuturalis* (LO in O4 Zone) and *P. opima* (HO in O5 Zone) indicates the Late Rupelian - Early Chattian biozones (O4-O5 Zones). Benthic foraminifers are represented by euryoxibiont and low-oxygen tolerant species like *Sphaeroidina bulloides, Pullenia bulloides, Eggerella bradyi, Uvigerina vickburgensis, Bulimina cf. altasica, Bulimina schischkinskayae, Cassidulinoides tenuis, Karreriella quadrinoides, Stilostomella consobrina* and *Stilostomella adolphina*).

The base of the Lučenec Formation is marked by the HO of *Paragloborotalia opima*. At the same horizon, the LO of *Globigerinoides primordius* was recorded. This species appeared together with other primitive specimens of the genus *Globigerinoides* such as transitional forms to *G. altiaperturus* and *G. immaturus*. Change to the new globigerinid forms with secondary appertures on the spiral side appeared in response of Late Oligocene warming (Jenkins, 1973). Planktonic foraminifers of the Lučenec Formation also comprise *Globoturborotalita ouachitaensis*, *G. connecta*, *Globigerina wagneri*, *Paragloborotalia pseudokugleri* (LO in Zone O6), *"Dentoglobigerina"* cf. *venezuelana* and *Globigerinella obesa*. The benthic foraminiferal microfauna of the Lučenec Formation is enriched in epifaunal habitats with plano-convex trochospiral, biconvex trochospiral, rounded planispiral, spherical and uniserial morphotypes. Predominance of epifaunal and shallow infaunal benthic foraminifers in the Lučenec Formation implies improved conditions in bottom water oxygenation. The foraminiferal microfauna changes in the upper part of the Lučenec Formation, where agglutinated species became dominant. Associations involve species like *Trochammina squamata, T. inflata, T. globigeriniformis, Textularia gramen abbreviata* and *Haplophragmoides sp.* This assemblage suggests a deep-water association of agglutinated foraminifera with a reduced amount of dissolved oxygen. The occurrence of trochamminid species and bathyal benthic foraminifers in the upper part of the Lučenec Formation indicates a deepening-upward tendency and sea-level rising during the late Egerian.

Planktonic foraminifers in the uppermost part of the Lučenec Formation are developed mostly as five-chambered species belonging to *Globigerina ottnangiensis*. The appearance of this species is possible to use as a biostratigraphic marker of the Oligocene/Miocene boundary (Rögl, 1994). Early Miocene associations of planktonic foraminifera are completed by *Cassigerinella globulosa*, *Paragloborotalia semivera*, *"Dentoglobigerina" venezuelana* and *Globigerina praebulloides*. Benthic associations are formed mostly by epifaunal forms with rounded planispiral, plano-convex and biconvex trochospiral, and spherical morphotypes. They belong to species of *Angulogerina angulosa*, *Lenticulina arcuatostriata, L. cultrata, L. meznericsae, L. vortex, Cibicidoides ungerianus, C. lopjanicus, Lobatula lobatula, Almaena osnabrugensis, Hanzawia boueana, Melonis affinis* and *Pullenia bulloides*. The Eggenburgian index species of *Uvigerina posthantkeni* appeared in the uppermost part of the Lučenec

Formation (GOR-1, 31.08-31.11 m, Szécsény Schlier). The research has been supported by VEGA project 2/0042/12 and project APVV-14-0118.

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Nannofossil correlation across the Cenomanian to Coniacian interval, Bohemian Cretaceous Basin and Waschberg-Ždánice-Subsilesian Unit, Outer Western Carpathians

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Nannofossil correllation was suggested for the Bohemian Cretaceous Basin (BCB) and units deposited on the SE slopes of the West European Platform, nowadays the Waschberg-Ždánice-Subsilesian Unit, Outer Western Carpathians (OWC). The depocentre of the BCB was part of a seaway developed along the reactivated Elbe Fault System and connected through the epicontinental basins of the NW European Platform and the deep-sea basins of NW Tethys during the latest Cenomanian–Coniacian (Uličný et al. 2009).

To put together the first (FO) and last (LO) occurrences of marker species across the Cenomanian–Coniacian interval and to demonstrate nannofossil events, significant sections were chosen both in the Bohemian Cretaceous and Waschberg-Ždánice-Subsilesian Unit (Švábenická, 2012; Švábenicka & Bubík, 2014, Uličný *et al.*, 2014). Nannofossil events were compared with UC nannoplankton zones (Burnett 1998) and with inoceramid and ammonite macrofauna (Uličný *et al.*, 2014, Svobodová *et al.*, 2014). Special attention was paid to fluctuating numbers of the genera *Biscutum, Lucianorhabdus, Braarudosphaera, Helicolithus* and *Marthasterites* that may reflect sea-level changes, nutrient input, and other palaeoenvironmental events.

Cenomanian: In the BCB, marine ingression goes with the UC3d Zone. Deposits contain poorly preserved nannofossils with *Corollithion kennedyi*. The overlying strata of the UC4b-UC5a zone interval provide *Lithraphidites acutus*, *Axopodorhabdus albianus*, large and broadly elliptical specimens of *Manivitella pemmatoidea*, abundant *Biscutum ellipticum*, and higher numbers of *Broinsonia signata* and *Watznaueria barnesiae*. Sediments are suddenly interrupted by a short interval with poor nannofossil content. The uppermost Cenomanian, the Cenomanian–Turonian boundary and the lowermost Turonian are marked by an omission surface, associated with a distinct hiatus spanning probably the UC5a–b zone.

Sediments of the Waschberg-Ždánice-Subsilesian Unit did not provide any significant Cenomanian nannofossils.

Turonian: An influx of nannoflora into the BCB reflects the deepening of the basin. The FOs of *Eprolithus octopetalus*, UC5c–UC6a followed by the FO of *E. moratus* (UC6b) indicate the lowermost part of stage. The next succession of the FOs of nannomarkers appears during the Lower–Middle Turonian: *Lucianorhabdus* sp., *Eiffellithus perch-nielseniae, Octolithus multiplus, Quadrum gartneri* (UC7), *Eiffellithus eximius* (UC8), *Kamptnerius magnificus, Lithastrinus septenarius* (UC9), *Watznaueria quadriradiata*, *Liliasterites angularis*, and *Marthasterites furcatus*. The base of acme of *Braarudosphaera bigelowii* is approximately the same as the LO of *L. angularis*. Above the first discovery of the inoceramid species *Inoceramus perplexus*, the base of the Upper Turonian follows the FOs of *Ottavianus giannus, Zeugrhabdothus biperforatus* (UC9b), and *Broinsonia parca expansa* (UC9c). The base of the acme *Marthasterites furcatus* coincides with the *Didymotis* Event I. Some of the above mentioned nannofossil events are of a local importance (Švábenická 2012). Similar nannofossil correlation can be applied to the OWC.

Coniacian: In both regions, the stage is recognised with the FO of the inoceramid *Cremnoceramus deformis erectus*. Above, the FOs of *Micula adumbrata* and the top of the acme *M. furcatus* were recorded. The short interval of the *Cremnoceramus deformis erectus* Zone marks the uppermost Lower Coniacian. The FOs of *M. staurophora* (UC10) and *Uniplanarius gothicus* in the overlying strata give evidence for the lower Middle Coniacian. The upper Middle Coniacian is marked by the FO of *Lithastrinus grillii* (UC11) followed by *Lucianorhabdus arcuatus*. The youngest deposits contain *Lucianorhabdus cayeuxii* (UC11c), *Micula swastica*, a bloom of *Biscutum* div.spec., and common *Helicolithus trabeculatus*, and they are correlated within the *Paratexanites serratomarginatus* Zone. Fossil macrofauna in flysch sediments of OWC occurs rarely.

Nannofossil pulses in abundance: Abundance and acme intervals may coincide with significant palaeoenvironmental events including sea-level fluctuation and nutrient input. Nannofossil preservation and abundances strongly depend on the lithological character of deposits. Data inform about nannofossil thaphocoenoses, they do not reflect the original nannoflora qualitative and quantitative spectra.

Helicolithus trabeculatus: *H. trabeculatus* pulses in abundance are observed repeatedly during the Turonian and Coniacian. Hampton *et al.* (2007) highlight the utility of common *H. trabeculatus* as a marker event of Early Santonian age close to the top of the inoceramid *Cladoceramus undulatoplicatus* Zone.

Braarudosphaera bigelowii: Common *B. bigelowii* was probably triggered by nutrient input. It is observed within the Upper Turonian, UC9a Zone between the LO of *Liliasterites angularis* and FO of *Zeugrhabdothus biperforatus*. *B. bigelowii* abundance increases above the interval with common *H. trabeculatus*. Species occurs scarcely or it is absent in other stratigraphic horizons.

Marthasterites furcatus: Acme *M. furcatus* is evident in the Turonian- Coniacian boundary interval. The base is usually observed between the FO of *B. p. expansa* and the FO of inoceramid species *Cremnoceramus deformis erectus* and/or *C. walbersdorfensis*. Acme is observed both in the BCB and Waschberg-Ždánice-Subsilesian Unit.

Indications for the Coniacian-Santonian boundary interval, BCB: Nannofossil assemblages contain both species their FO is mentioned from Santonian (Burnett 1998, Hampton et al. 2007) and some taxa they were described from the Coniacian-Santonian stage boundary (Blair & Watkins, 2009).

The boundary interval may indicate the following phenomena:

- *Micula concava:* Burnett (1998) correlates the FO with the uppermost Coniacian within the ammonite Zone *Paratexanites serratomarginatus*.
- Scarce specimens of *Gartnerago clarusora, G. margaritatus, Prediscosphaera* cf. *desiderograndis, Tortolithus dodekachelyon*: the FO is mentioned close below the FO of *Inoceramus undulatoplicatus* (Blair and Watkins 2009).
- Abundance of *Helicolithus trabeculatus* (up to 3-4% of assemblage) in association with *L. cayeuxii*. Hampton *et al.* (2007) proposes the horizon with common *H. trabeculatus* as a marker event for the Santonian.
- Acme *Biscutum* div. spec. (from nearly 9% of assemblage, minute specimens of *B. ellipticum* prevail).

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Calcareous nannofossils of the Jurassic-Cretaceous boundary strata in the Puerto Escaño section (southern Spain) - biostratigraphy and palaeoecology

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We obtained material from the Puerto Escaño section (southern Spain) to study the Jurassic-Cretaceous (J/K) boundary interval. The same samples had already been processed for magnetostratigraphic studies and biostratigraphic zonation based on calpionellids and ammonites (Pruner *et al.*, 2010), but not for calcareous nannofossils.

The aim of this study was to process the samples using micropalaeontological analysis and to compare and calibrate results for calcareous nannofossils with existing magnetostratigraphic and other biostratigraphic data.

The calcareous nannofossil assemblage was dominated by the genera *Watznaueria*, *Cyclagelosphaera*, *Nannoconus* and *Conusphaera*. Several nannofossil bioevents were recorded on the basis of the distribution of stratigraphically important taxa. Based on the first occurrences of *Microstaurus chiastius*, *Nannoconus infans*, *N. globulus minor*, *N. wintereri*, *N. steinmannii minor*, *N. steinmannii steinmanni*, *N. kamptneri minor* and *N. kampteri kamptneri*, five nannofossil subzones (NJT 15b, NJT 16a, NJT 16b, NJT 17a, NJT 17b) and two nannofossil zones (NKT, NK-1) were recognised. The J/K boundary interval was identified approximately in the middle part of the M19n magnetozone, corresponding to the *Calpionella alpina* 'acme zone'. New palaeoecological data are introduced, based on geochemical analysis and macrofauna occurrences.

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Upper Famenian foraminiferal assemblage from the Dębnik Anticline (Southern Poland) - preliminary results

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The Upper Famenian limestone, containing a foraminiferid assemblage has been sampled in an outcrop called "Skałka przy Mostku" located near the entrance to the Racławka Valley (8 km east to Krzeszowice town). The studied deposits belong to the tectonic structure called the Dębnik Anticline, part of the Dębnik–Siewierz fold belt (Żelaźniewicz *et al.*, 2011), which creates an eastern part of the Upper Silesian Block (Buła *et al.*, 2008; Fig. 1B), and contains Devonian–Carboniferous folded sediments. Deposits from the outcrop in Racławka Valley are developed as limestones, mainly light grey to greyish peloidal wackstones and locally packstones with bioclasts, which are numerous calcispheres, foraminifers, crushed trilobites, stromatoporoids, as well as single ostracods, crynoids and spiriferids remains. In the lower part of the section stromatoporoids dominate while foraminifers are absent. The upper part of the section reveals an increasing trend of foraminiferal presence and a decreasing amount of other above mentioned organisms.

The studied foraminiferal assemblage contains taxa such as: *Bisphaera malevkensis* Birina, *Earlandia elegans* (Rauser-Chernusova et Reitlinger), *Rectoseptaglomospiranella* sp. *Septaglomospiranella primaeva* (Rauser-Chernusova), *Quasiendothyra bella* (N. Chernyshera), *Quasiendothyra communis* (Rauser-Chernusova), *Quasiendothyra dentata* (Durkina, 1959) and *Quasiendothyra konensis glomiformis* Reitlinger.

The studied assemblage indicate a Late Famenian age based on comparison with foraminifers described from the Southern Urals (e.g., Kulagina, 2013)

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Foraminiferal and calcareous nannoplankton assemblages from klippen series at Zaskale: implication for tectonic and sedimentary deformations in the Zlatne unit (Pieniny Klippen Belt, Poland)

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Micropalaeontological and geological data from the klippen series at Zaskale in Poland has allowed to recognise breccias in the Zlatne unit located in the SW part of the Pieniny Klippen Belt bordering to the south with the Inner (Podhale Basin). From the Jurassic-Cretaceous transition this tectonic-facial unit was developed as the marginal and narrow zone that was related with pelagic sedimentation during the Jurassic and flysch deposition from the Albian to the Oligocene. In this area the Middle Triassic-Lower Cretaceous (Aptian) limestones and dolomites segmented into blocks and tectonic slides (Haligovice Klippes) are surrounded by Albian-Oligocene flysch-type deposits, which are similar to the Outer Carpathian series. The studied deposits are represented by shales and marls forming lithological units or intercalations in conglomerates and olistostromes corresponding with periods of tectonic activity in the Zlatne zone. These deposits are recognised as breccias including broken and crushed fragments of carbonate rocks and packages of sediments, which are cemented together by a fine-grained matrix. The matrix is similar to or different from the composition of the fragments and packages.

The material for the study was taken from matrix and also from fragments of rocks in breccias outcropping in the Mały Rogoźnik stream at Zaskale. In most cases, collected samples contain fossil assemblages of the same age while mixed forms of various age (i.e., the lower and upper part of the Late Cretaceous) are noted in some of them. In studied samples micro- and nannofossils of Jurassic, Cretaceous (Albian-Cenomanian, Turonian-Santonian, Campanian-Maastrichtian) and also Paleogene (Paleocene and Eocene) age were found. Part of them (mainly agglutinated and sometimes calcareous forms) are well-preserved and abundant in forms (i.e., Albian-Cenomanian, Turonian, Senonian). In most cases the skeletal elements of calcareous micro- and nannofossils had been subjected to mechanical crushing processes and often corrosion, dissolution, and also mineralization. Forms that are resistant to mechanical destruction and dissolution predominated in foraminiferal and nannofossil assemblages. Among them, massive forms of calcareous nannoplankton (*Watznaueria* and *Micula*) and foraminifera (Globotruncanidae) were noted. In addition, the latter microfossils were sometimes deformed to a high degree.

The micropalaeontological data from the studied area suggest that processes forming breccias may have already been intensified during the Cretaceous and then continued during the Eocene. In addition, the presence of Eocene forms indicates that the formation of the breccias could have been finished probably at the Eocene/Oligocene boundary. In general, lithological and sedimentological features of breccias were reflected in the numbers, diversity, and preservation of micro- and nannofossils. Integrated micropalaeontological and geological data show that the breccias may be correlated with syn- and post-tectonic sedimentation controlled by local tectonic activity during Cretaceous to Paleogene time.

Microfossils from the Istebna beds: implications for stratigraphy and depositional environment

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Microfossils including foraminifers, spores, pollen grains and also phytoplankton from the Istebna beds (Istebna Fm.) outcropping in the Silesian Beskids, located in the western part of the Polish Outer Carpathians, were recognised as useful tools for stratigraphy and environmental reconstruction. In

researches the stratigraphic position of the studied deposits and environmental conditions during the debris and turbidite deposition in the Silesian Basin from the Campanian to Paleocene were discussed. The outcrops from the vicinity of the Zywiec Lake and Sola River mainly consist of sandstones and also conglomerates occurring as local bodies and shales forming intercalations of various thickness from a few to several tens of centimetres. The clay rich sedimentary rocks form some levels, which are distinguished as the Istebna shales occurring in the Campanian-Maastrichtian (variegated shales) and the Paleocene (brown shales). The first of them contain mainly agglutinated foraminifers including numerous species of *Rzehakina inclusa*, *Rz. epigona* and *Caudammina gigantea*. Planktonic and calcareous benthic forms, which are known from these series (Geroch *et al.*, 1967) were not found in studied material. In the Paleocene series two levels of the Istebna shales were described. In both cases the studied samples contained agglutinated foraminiferal assemblages including the index taxa: *Glomospirella grzybowskii*, *Glomospira diffundens* or *Rz. fissistomata*, which are dated as Maastrichtian-Paleocene and the Paleocene. Apart from agglutinated foraminifera, calcareous forms belonging to plankton and benthos were found in the lower Istebna shales. In the studied samples very rare and poorly preserved species of the *Globigerina* group and more diversified assemblages including also other index taxa of genera: *Chiloguembelina* (*Ch. crinita, Ch. morsei*), *Subbotina* (*S. triloculinoides*, *S. trivialis*), *Parasubbotina* (*P. pseudobulloides*), *Acarinina* (*A. mckannai*), *Globanomalina* (*M. pseudomenardii*) and *Morozovella* (*M. velascoensis*) were noted. Forms belonging to the genus *Acarinina* and *Morozovella* indicate a Late Paleocene age. Occasionally, *Nuttalides trumpyi*, *Remesella varians* and *Rz. epigona* accompanied them.

From a biostratigraphic point of view this boundary is located in the lower level of the Istebna shales. Agglutinated foraminiferal assemblages yielded by them are characteristic for the Maastrichtian-Paleocene transition (*G. grzybowskii*, *G. diffundens*) and the Paleocene (*Rz. fissistomata*). In addition, calcareous foraminifera, which are dated as Paleocene sometimes occur at the top of the lower Istebna shales. Spore and pollen assemblages and also phytoplankton also shows the Cretaceous-Paleogene transition in the studied material.

In that time the sedimentation of the studied deposits took place in a mixed hemipelagic environment under influence of input of coarse-grained material, which were transported down slope by sediment gravity flows. During these processes fossil material was partly eroded from deposits accumulated on shelf and slope and also taken from surface waters. The terrestrial material including spores, pollen rain, and other plant debris were easily transported by rivers and marine currents from the surrounding land. However only selected organic and calcareous material including individual planktonic and benthic forms were transported to greater depths. It is suggested that sedimentary materials in final stage were dispersed and driven by turbidite (suspension) currents into areas of deep-water deposition located close to the CCD. In this area the high and long-term concentration of organic matter, which led to acidification of waters could be also the main cause of elimination of calcareous forms. Under these conditions agglutinated foraminifers, which were represented by herbivores and active deposit feeders living near the surface of the sediment were dominant. These epifaunal and opportunistic mobile infaunal forms coexisted with scarce deep water infaunal forms preferring more oxygenated sediments.

Response of micro- and nannofossils to facies changes in the Silesian Basin from the Campanian to Paleocene (Silesian-Subsilesian zone, Polish Outer Carpathians)

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Micro- and nannofossils from Campanian-Paleocene deposits forming the Silesian-Subsilesian zone in the Polish Outer Carpathians were discussed with respect to relation to depositional conditions. The deposits described in the outcrops located in the Beskid Zywiecki, Lanckorona and Wisnicz Foothills, and also Beskid Wyspowy and Beskid Sredni accumulated in the Silesian Basin, which was divided into two tectonic-facial zones differing in depth and distance from land. In consequence of these settings the studied deposits represent proximal (Subsilesian zone) and more distal facies (Silesian zone), which are characterised by distinctive sedimentological, palaeoecological and micropalaeontological features. The limits between these facies are marked by transitional zones, which define changes in lithofacies and sometimes in fossil assemblages. In the tectonic-facial zones calcareous and clastic deposits occur in different ratio. In the Subsilesian zone the variegated shales and Frydek-type marls dominate, which formed in final stage submarine slumps at the boundary of the shelf and slope. This environment received periodically an input of fine and coarse-grained terrigenous material including fragments of plants (wood, leaves) and coal. Shallow-water and terrestrial material was found in the Campanian-Maastrichtian marls and variegated shales, which persisted until the Paleocene, and also in sandstone bodies (Rybie sandstones), which occurred locally in the Campanian. At that time coarse sandstones belonging to the Istebna beds also accumulated in some parts of the Silesian zone. In this more distal zone turbidite sedimentation of the sandstones series (Istebna beds) were continuously deposited into the Paleocene whereas the Frydek-type marls were formed only in the Maastrichtian. Additionally, variegated shales, which constitute a separate lithological unit in the Subsilesian zone occurred as intercalations in the Istebna beds of the Silesian zone.

Micro- and nannofossils from the proximal Subsilesian zone mainly correspond with hemipelagic and pelagic sedimentation in the transition zone between shelf and slope areas, while those from the more distal Silesian zone document turbidite deposition on slope. Generally, the Campanian-Maastrichtian marls contain assemblages of smaller foraminifers dominated by planktonic (*Globotruncana, Globotruncanita, Globotruncanella, Contusotruncana, Rugoglobigerina, Heterohelixa, Pseudotextularia, Pseudoguembelina, Racemiguembelina*) and calcareous benthic forms coexisted with other microfauna (large foraminifera, ostracodes) and fragments of macrofauna (bivalves, echinoids, crinoids, sponges). The youngest foraminiferal plankton (*G. havanensis* and *A. mayaroensis* zones) and calcareous nannoplankton (*R. levis* and *N. frequens* zones) indicate that marls may have formed by gravity flows in the Early and Late Maastrichtian. The formation of marls at the boundary of the shelf and slope zone was documented by calcareous (*Preabulimina, Bolivina, Bolivinoiodes, Reusella, Chilostomella, Nonionella, Gavelinella, Stensioeina*) and agglutinated benthic foraminifers (*Rzehakina, Spiroplectammina, Bolivinopsis, Dorothia, Caudammina, Rhabdammina*) belonging to deep and mobile infauna, and sometimes semi-infauna or epifauna, which are derived from slope environments. The part of them was found in variegated shales intercalated with the Istebna sandstones, which were transported by turbidite currents.

Clastic material includes shallow-water (algae) and terrestrial elements (carbonised plant debris, pieces of coal) were transported from adjacent lands by rivers and then by submarine flows which partly eroded deposits accumulated on shelf or slope. The flooding of neighbouring lands and the input of nutrients led to increased productivity and acidification and also depletion of oxygen in the marine environments. Under these depositional conditions, which were influenced by sea-level fluctuations micro- and nannofossils changed in variability and preservation and also have been removed and reworked during the Cretaceous-Paleogene transition. In this time calcareous benthic foraminifers were usually replaced by agglutinated taxa (*Rz. fissistomata, G. diffunfens, G. grzybowskii*), which became the dominant elements of the assemblages whereas calcareous nanno- and microplankton were often eliminated. Locally planktonic foraminifers survived in the Subsilesian zone. In this area, the deep-dwelling forms with massive tests (globotruncanids) inhabiting more oligotrophic waters during the deposition of the Campanian-Maastrichtian Frydek-type marls were replaced by shallower-dwelling opportunistic species of small-sized globigerinids and chiloguembelinids preferring a euthrophic environment, in which variegated shales were deposited. Single specimens of other surface water dwellers (morozovellids, acarininids, subbotinids) coexisted with them. However, in the sandstone series calcareous foraminifers including planktonic and benthic forms known from the marls and variegated shales appeared quite frequently in the Campanian-Maastrichtian and also occasionally in the Late Paleocene.

Changes in foraminiferal assemblages and the extinction of calcareous nannoplankton, and also supplies of shallow water phytoplankton and terrestrial organic matter into calcareous and clastic series corresponding with erosive type of lithological boundary and sedimentary gaps in the deposits confirm sea-level fluctuations and changes in depositional conditions in the Silesian-Subsilesian zone during the Cretaceous-Paleogene transition.

Ontogeny in ribbing of some of perisphinctid macroconchs (Ammonitina) from the Štramberk Limestone

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In museums in the Moravian-Silesian Region and also in Vienna and Munich, a rather small number of large shells of ammonites from the Štramberk Limestone are preserved. It is a case of shells with a diameter of more than 20 cm that are designated as macroconchs.

The shells are coiled semi-evolutely to semi-involutely. During their growth, the style of their ribbing changes three times as a minimum – on juvenile whorls, in the middle stage and on the living chamber. Shells are not deformed, but specimens are preserved differently.

In the fossilization of the shells that remained lying on the bottom, the following pattern can be traced: Into the chambers of phragmocone, fine calcareous mud penetrated through a siphonal canal in a limited degree. The supply did not last long, and thus the majority of the chambers are only partly filled with fine micritic limestone on the side that lay in the sediment. The other half of the phragmocone chambers on the opposite side have remained unfilled. Later, in the empty space of the chambers, secondary calcite crystallised; it could fill the whole remaining space in the chamber or crystallised only on the wall of the shell and septa. In this way structures designated as geopetal structures were formed. The living chamber and the vicinity of the shell are filled and surrounded with an organodetritic calcareous material. The original aragonite shell recrystallised into calcite or dissolved. In the latter case, the result of preservation is imperfect steinkerns with the remains of sutures.

Shells have usually better preserved or preparable that side that did not lie in the sediment at the beginning of fossilization. On the other hand, this side was more susceptible to corrosion and dissolution even much later after the fossilization, especially in the area of the living chamber.

Macroconchs can have, but more frequently do not have, preserved juvenile whorls or have whorls overlain with sediment. If juvenile ribbing is preserved, only the lower part of it, which is not overlain by the subsequent whorl, is visible. Thus neither ribbing on the higher part of the whorl nor the venter is observable. The venter bears one significant taxonomic feature that is not usually available. This is a siphonal furrow or smooth band or the fact that ribs pass through the venter without interruption.

Tithonian macroconchs usually have more than three stages in ribbing development. Nevertheless, all juvenile stages are characterised by simple dichotomous branching in the higher part of whorl in the form of biplicate ribs (stage 1). Previous uniform thin and dense biplicate ribbing may change gradually. The visible parts of the ribs strengthen and between the ribs, spaces increase. To the biplicate ribbing, triplicate (or polygyrate) ribs are added (stage 2). The subsequent ribbing becomes stronger and spaces between the ribs further increase. At the base of the ribs, bullate umbilical tubercles appear. Ribs on the outer side of the whorl take on a bundle or fascipartite form. Between the bundles of ribs, intercalatory ribs of the same length are inserted (stage 3). At the end of the phragmocone, ribs still strengthen more and more and become more widely spaced. At the base, blunt umbilical tubercles occur (stage 4). In the final part, ribs in bundle fade out on the living chamber. Only widely spaced bulged ribs remain (stage 5).

I demonstrate changes in ribbing, its variants and effects on it due to different ways of preservation by *Pseudosubplanites grandis* (Mazenot, 1939), belonging to the category of simply shaped, by *Pseudosubplanites senex* (Oppel, 1865), *Ernstbrunnia bachmayeri* Zeiss, 2001 and *E. toriseri* Zeiss, 2001. Representatives of the genus *Ernstbrunnia* have not been stated from the Štramberk Limestone yet.

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Concentrations of tourmalines within the agglutianted tests of deep-water foraminifera from Carpathian Basin

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The tests of the agglutinated foraminifera are built from grains which occur on the sea floor. As the building material are used mineral or organic grains collected in the environment of the foraminifera's life. The mineral composition of the agglutinated foraminiferal tests from the deep-water Carpathian Basin was studied. The microfossils from the Eocene Hieroglyphic beds of the Silesian Nappe were chosen for this purpose.

Quartz grains were the predominant material used for test building. Several foraminiferal specimens were constructed only from quartz. The feldspars, muscovite, and heavy minerals grains were used as accessory components. The heavy minerals were most popular from this group of components. They are represented only by tourmalines (dravites and schorls).

The tourmalines grains were incorporated into several percent of foraminiferal tests in the assemblage, its amount exceptionally reaches up to 30%. As a rule, they are single components, one up to four tourmaline grains were noticed in a single test.

Within deep-water deposits of the Carpathians, the tourmalines constitute allochtonous material. The amount of tourmalines is marginal in the sediment, ranging from 0.4% to 0.001% in the Hieroglyphic beds. The number of the tourmaline grains built into foraminiferal test reaches from a few up to 1250 grains per sample. The most numerous tourmaline-bearing forms were concentrated in bioturbated shales. The other groups of heavy minerals (like zircons or garnets) were not used for building the tests by foraminifera, however their proportion in the Carpathian deposits is similar and sometimes even higher and they are equally accessible like tourmalines. Their size and shape are comparable with tourmaline grains, too. Other mineral grains like feldspars or muscovite occur very rarely as single components of the foraminiferal tests.

The agglutinated foraminifera living in the Eocene, during the Hieroglyphic beds sedimentation, had a tendency to select tourmaline from the sediment.

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Biostratigraphy of the organic rich deposits within the Hieroglyphic beds of the Silesian Nappe (Outer Carpathians)

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The Hieroglyphic beds belong to an informal lithostratigraphic division within the Silesian Nappe. In general, they are built of thin-bedded, shale-dominated deposits. In the area of the Szczyrzyc Depression, the Hieroglyphic beds contain a 20 meter thick shaly complex dominated by dark deposits. Brown shales occur alternatively with grey-green shales, creating fine- and medium-laminated packets. Thin layers of clay bentonites are characteristic for this interval. The hard brown siltstones, massive or parallel-laminated with muscovite and very thin-bedded, very fine grained quartzite sandstones also occur there as rare intercalations. Within the Hieroglyphic beds, these deposits belong to the rocks richest in organic carbon. The amount of TOC is 1–2%. This complex is situated in the upper part of the Hieroglyphic beds.

The foraminifera were studied from the organic-rich deposits and their surroundings. In dark deposits, the foraminiferal assemblages are less diversified and less numerous in comparison with other parts of Hieroglyphic beds. Poor foraminiferal assemblages from organic-rich deposits are not very reliable for age estimations. The assemblages from under- and overlying deposits were used for this purpose. The taxonomic composition of these assemblages is typical for the Bartonian Ammodiscus latus biozone (zone after Olszewska, 1997). The index taxon is common, however it is represented by single specimens per sample; in some samples it is more frequent, but does not exceed 1% of all foraminifera. *Reticulophragmium amplectens* (Grzybowski) is numerous and constitutes up to 20% of all foraminifera in the assemblage. The first specimens of *Ammodicus (Dolgenia) latus* (Grzybowski) were found 15 metres below the black deposits. In turn, *Reticulophragmium gerochi* Neagu et al., whose occurrence in deep water assemblages defines the younger Priabonian zone, appears 20 metres above the organic-rich complex. *Haplophragmmoides parvulus* Blaicher, characteristic of Middle and Upper Eocene in the Carpathians, is an accessory component of the assemblages. *Buzasina pacifica* (Krasheninnikov), *Ammomarginulina aubertae* Gradstein et Kaminski, *Eggerelloides propinqus* (Brady), and *Insculptarenula* cf. *subvesicularis* (Hanzlikova) occur in the assemblages. Above the organic-rich deposits *Spirosigmoilinella compressa* Matsunaga appears.

The uppermost Eocene and Lower Oligocene organic-rich deposits are widely distributed within the Outer Carpathian basins. They are known from the Silesian and Skole nappes as well as from the Foremagura group of nappes and they are distinguished as the Menilitic beds (or the Menilite Formation). In the section of the Szczyrzyc Depression the Bartonian organic-rich deposits are clearly separated from the Menilite beds by a 40 metres thick series of Bartonian-Priabonian thin-bedded flysch dominated by gray shales, which are typical for the Hieroglyphic beds. Thus, the local episode of dark deposits sedimentation was clearly marked within the Silesian Basin in the Middle Eocene. It could be correlated with dark deposits called the "Black Eocene" described from the Foremagura group of nappes. The interpretation of organic rich deposits lithology indicates conditions necessary to provide the concentration and preservation of organic matter.

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The Latest Devonian conodonts from Kowala Quarry (Holy Cross Mts.) and biofacies changes in the interval between Hangenberg and Kowala Black Shale

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The investigated area is located in the southern part of the Kielce region of Poland. Beds of the Devonian/Carboniferous boundary interval have been recognised by Czarnocki (1989). He recognised the presence of the shales with *Imitoceras* lying on marly limestones of *Wocklumeria* Genozone. The first conodonts from this interval were studied from the Kowala 1 borehole by Nehring-Lefeld (1990) and later by Malec (1995, 2014) in exploratory trench dug in vicinity of Kowala and by Dzik (2006) in Kowala Quarry. Malec (1995) subdivided the D/C transition into 5 informal lithological complexes from A to E.

Deposits included in complex A (Malec, 1995), i.e., the Uppermost Famennian interval between Hangenberg and Kowala Black Shale (Marynowski & Filipiak, 2007) from Kowała Quarry were studied using conodonts and co-occurring agglutinated foraminifers. The investigated interval, is approximately 8 m thick, consists of rhythmic succession of nodular marly limestones and shales. In the lower part of succession the rocks are cherry red, but in the upper part – olive-green. *Wocklumeria sphaeroides* and *Epiwocklumeria applanata* occur here (Woroncowa-Marcinowska, 2011). Bioturbation surfaces at the bottom of the cherry red limestones are present and display various type channels. The succession is limited by two black shale horizons. A lower black shale horizon (KBS) is 25 cm thick, an upper (HBS) – is about 100 cm and occurs about 8 m above the lower shales.

The studied interval, represented by *Wocklumeria* Genozone limestones and shales yields a conodont assemblage, which indicates the so-called the Upper *expansa* and Lower-Middle *praesulcata* zones (Ziegler & Sandberg, 1984). Eleven samples provide sufficient conodont faunas, clearly dominated by *Bispathodus*. About 25 pectiniform form-taxa are determined (genera *Bispathodus*, *Branmehla*, *Mehlina*, *Polygnathus*, *Neopolygnathus*, *Palmatholepis*= *Tripodellus*, *Pseudopolygnathus* and "*Siphonodella*"=*Eosiphonodella*). The zonal sequence proposed by Becker *et al.* (2013) is presently tested also.

The conodont biofacies focused on the relative distribution of eight genera. A palmatolepid-bispathodid-branmehlid biofacies characterises the interval between the Upper *expansa* and Middle *praesulcata* zones. *Branmehla* and "*Polygnathus*" are highly abundant in the higher Upper *expansa* Zone.

Bispathodus decreases in abundance in the middle of this interval, while the *Branmehla suprema* Group predominates and has its maximum in the lower Middle *praesulcata* Zone. In the Kowala section the change of the conodont biofacies is strikingly similar to contemporary ones from the Rhenish Massif and Carnic Alps (Kajser *et al.*, 2008).
The studied samples include not only conodonts but lots of agglutinated foraminifers and fish remains. The material under study includes such genera as *Hyperammina*, *Tolypammina*, *Thurammina* and *Paratikhinella*.

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Pleistocene mammal assemblages from fluvial, aeolian and cave sediments of Poland (Geological Museum PGI-NRI collections, Warsaw)

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Fifteen collections of mammal remains (16 sites, 357 specimens) from the Geological Museum of the Polish Geological Institute-National Research Institute, collected during the first half of the 20th century have been taxonomically and morphologically studied. The oldest of collections were gathered by J. Samsonowicz, J. Czarnocki, L. Horwitz, S. Sokołowski and L. Sawicki. Apart from two partly studied collections (Mus. PGI 40.II. and Pyskowice) the rest of them were examined for the first time. The remains are Pleistocene in age.
The investigated collections were obtained from fluvial sediments (where remains of woolly mammoth and rhinoceros predominate), aeolian (only remains of mammoth) and cave sediments (taxonomically rich mammal remains with predomination of predators).
Collections from the fluvial sediments come from 7 sites, which are located along the Vistula River and its tributaries [Jeziorko Szczęśliwickie Lake (Mus. PGI 1451.II.), Żyrardów-Stężyca (Mus. PGI 705.II.1,3), Góra Puławska (Mus. PGI 1460.II.)], in the southern part of Poland (Outer Carpathians, Mus. PGI 1454.II.), along the Niemen River in Belarus (Grodno, Mus. PGI 1453.II.) and in Upper Silesia (Pyskowice). Among the mammal remains, the woolly mammoths (*Mammuthus primigenius*) and rhinoceros (*Coelodonta antiquitatis*) dominate.
Collections from the cave sediments show the taxonomic diversity of mammals with predomination of predators and come from 5 sites: Wiercica Cave (Mus. PGI 335.II.), „Grota Magurska" (Jaskinia Magurska Cave, Mus. PGI 1455.II.), Wojcieszów quarry (Mus. PIG 430.II.), Kadzielnia quarry (Mus. PGI 39.II.) and Sitkówka quarry (Mus. PGI 157.II.). Bones and teeth from the Jaskinia Magurska Cave and Wojcieszów belong to predators only, such as bear and the Eurasian cave lion (*Panthera leo spelaea*). The collection from Wiercica Cave is represented by remains of Rhinocerotidae, Suidae, Cervidae, Ursidae and Bovidae. Among the studied bones from Kadzielnia the majority are predators (*Ursus* sp. and some of Mustelidae), the rest belong to woolly rhinoceros, *Bos/Bison*, aurochs – *Bos primigenius taurus*, wild boar – *Sus scrofa* and *Lepus* sp. Similar in taxonomic diversity is the Sitkówka site, where cave hyena, reindeer, European badger, beaver, and the most remarkable *Cervalces latifrons* (Stefaniak et al., 2014) are also recognised. The typical Pleistocene sediments in Kadzielnia occur only in the Jeleniowska Cave and Schronisko nad Przepaścią Cave opened in this quarry. In the other study sites at the Kadzielnia and Sitkówka quarries only Neogene sediments were found.
Two old collections from sediments without geological context (Garwolin site and Ossówko site near Szydłów) were studied and registered for the first time in 2012.
The analysis of the literature (Czarnocki, 1932, 1935, 1948; Maruszczak, 1991; Żarski, 1996; Żarski *et al.*, 2014; Nowicki, 2002; Wójcik & Rączkowski, 2009; Nadachowski *et al.*, 2011; Urban *et al.*, 2011) suggests, that the majority of bones representing all collections originated in the period of the Vistulian Glaciation, mainly the Grudziądz Interstadial.

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Fig. 1. Map of Poland with palaeontological sites in the sediments of fluvial genesis (1), aeolian genesis (2), cave sediments (3) and in sediments without geological context (4)

New biostratigraphic data from the Biely Potok Formation in the intramontane depressions of the Central Western Carpathians: age constraints based on foraminifera

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The Paleogene sediments of the Horná Nitra (Handlová), Bánovce and Žilina-Rajec Depressions exhibit a different facial character in comparison to the Podtatranská skupina Group and the Buda Basin. In the Handlová Depression, the Biely Potok Fm. is developed as the massive sandstones and conglomerates of the Chrenovec Beds and coarse-grained to boulder conglomerates of the Sub-Remata Beds (Gross, 2008). The sediments of the Chrenovec-type litofacies are known also from the Rajec Depression under the name of Konská Sandstones (Andrusov & Köhler, 1963). Lithofacial equivalents of the Chrenovec Beds occurred also in the Bánovce Depression near Vysočany village.

The biostratigraphic age of these sediments has been dated for the first time at the stratotype locality in the sand-pit near Chrenovec-Brusno village (Zlinská, 2013). The intercalations of non-calcareous claystones of the Chrenovec Beds provide a poor association of small planktonic foraminifers, some large foraminifers (*Operculina* sp., *Planostegina costata*), bryozoans (*Hornera subangulata*), echinoid spines and molluscan fragments. The planktic foraminifers belong to the species *Paragloborotalia opima*, *Tenuitella munda*, *Chiloguembelina gracillima* and *Globigerinoides trilobus*. These foraminifers provide the biostratigraphic data for the age of the Chrenovec Beds, which was established based on the highest occurrences of *Ch. gracillima* and *P. opima* in the Late Kiscellian and Early Egerian and the lowest occurrence of *G. trilobus* in the Early Egerian. The age of the Chrenovec Beds corresponds to the O5-O6 Zone (*sensu* Berggren & Pearson, 2005). The foraminifers are well preserved, they are not corroded and sorted, only some of globular forms exhibit traces of bioerosion. Therefore, it is not possible to exclude their redeposition, and in that case accept the Late Egerian age of the Chrenovec Beds.

The Chrenovec Beds in the area of Malá Čausa (ČH-1 borehole) contain a not-fully marine foraminiferal association with *Ammonia beccari*, *Heterolepa dutemplei*, *Cibicidoides sp.*, *Elphidium sp.*, *Spiroplectinella carinata*, only with rare planktonic species (*Globigerina praebulloides*, *G. officinalis*).

Sandstones of the Chrenovec Beds in the Bánovce Depression contain claystone intercalations with richer planktic foraminifers. Their association comprises the species *Globoturborotalita ouachitaensis*, *Globoturborotalita labiacrassata*, *Turborotalita quinqueloba*, *Globigerinoides cf. primordius*, *Tenuitella munda*, *T. neoclemenciae*, *Pseudohastigerina praemicra*, *Paragloborotalia opima*, *P. siakensis*, *Globorotaloides hexagonus*, *Cassigerinella cf. chipolensis*, *Chiloguembelina cubensis*, *Ch. ototara*, etc. Benthic foraminifers are less frequent, consisting of the species *Heterolepa dutemplei*, *Almaena osnabrugensis*, *Planulina cryptomphala*, *Elphidium sp.*, etc. The stratigraphic age is dated by the HO of *Pseudohastigerina sp.* and *Chiloguembelina cubensis*, and by the appearance of *Globigerinoides primordius*, which provides the LO in the Early Egerian.

The Konská Sandstones of the Rajec Depression were studied in the Kľače section. Their poor microfauna is composed mostly by some agglutinated foraminifers, such as *Reophax scalaria*, *Glomospirella gibbosa*, *Kalamopsis cf. grzybowskii*, *Rhabdammina sp.*, *Bathysiphon sp.*, etc. Planktonic foraminifers are very scarce, represented by small-sized tenuitellids (*T. munda*), pseudohastigerinids (*P. naguewichiensis*), globigerinids (*G. officinalis*), globoturborotalids (*G. ouachitaensis*, *G. labiacrassata*), dentoglobigerinids (*D. globularis*) and paragloborotaliids (*Paragloborotalia aff. pseudokugleri*). These foraminiferal data provide an evidence of a mid Kiscellian – Early Egerian age of the Konská Sandstones. The research has been supported by VEGA project 2/0042/12 and project APVV-14-0118.

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New findings from the biostratigraphic research of the Lupkov Formation in the Malý Bukovec anticlinorial zone (Dukla unit)

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The Lupkov Formation is the oldest lithostratigraphic unit of the Dukla unit. The wide stratigraphic range (?Albian-?Paleocene) and ambiguous definition of this formation have initiated the detailed study of this formation in the Malý Bukovec anticlinorial zone in the framework of the project "Update of the Geological Setting of Problematic area in the Slovak Republic at scale 1:50,000" (the theme Lupkov Formation - Mesozoic-Paleogene - of the Dukla unit - lithostratigraphy, biostratigraphy and cartographic affiliation).

The biostratigraphic investigation took into account two groups of microorganisms – calcareous nannofossils and microfossils. Based on the results of new geological research, sedimentological and biostratigraphic studies, we have found that sedimentation of the Lupkov Formation in the Malý Bukovec anticlinorial zone took place during the Upper Campanian to Maastrichtian. The obtained knowledge has allowed to firstly define the Topoľa Formation in the studied area, the sedimentation of which took place in the late Maastrichtian. The study was focused also on the lower part of the overlying Cisna Formation, deposited from the late Maastrichtian to ?Paleocene, regarding to the thick complex of sediments in the upper part of this formation.

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Part 3. Exursion

Tracking Richard Johann Schubert in Moravia: field-trip guide

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Abstract

The fieldtrip in tracks of Richard J. Schubert guides from Mohelnice – his native city – to city surroundings where he conducted his investigations of Middle Miocene foraminifera. At Mohelnice it can be seen Schubert's family house, school that he visited and place of his last rest. At Jevíčko ("Gewitsch") and Vlčice ("Wolfsdorf") original historical localities the Miocene clays rich in microfauna can be visited and sampled.

Field trip itinerary.

0 km Mohelnice – Náměstí Svobody square (Stop 1);
1,4 Mohelnice – cemetery (Stop 2);
40,5 Jevíčko - "Gewitsch" (Stop 3);
65 Vlčice – "Wolfsdorf" (Stop 4);
68 Loštice;
70 Mohelnice – highway exit.

Whole round trip is 70 km long and will take 1:30 hour of drive. When the trip starts in Olomouc, it is necessary count with extra 35 km (one way distance) drive on highway which takes about 30 minutes.

Stop 1. Mohelnice

Mohelnice (Müglitz in German) is a native city of Richard J. Schubert. You can find there several places connected with his life. The main square in centre of city (náměstí Svobody) still looks like at times around the break of 19th and 20th century. Right at the square you can see still a house where R.J. Schubert was growing up. It is a house at western corner of Olomoucká street (GPS: N49 46 35.9 E16 55 06.2). Comparing with historical appearance of the house (see this volume), it may be difficult to believe that it is the same building. From those times, the house was completely rebuilt and lost its old-fashioned charm.

When you walk down the Olomoucká Street, after 300 m you will see large grey school building on the right (GPS: N49 46 26.9 E16 55 03.9). It is now the Electrical Industrial School but at the last decades of 19th century it was elementary school that was visited by R.J. Schubert undoubtedly.

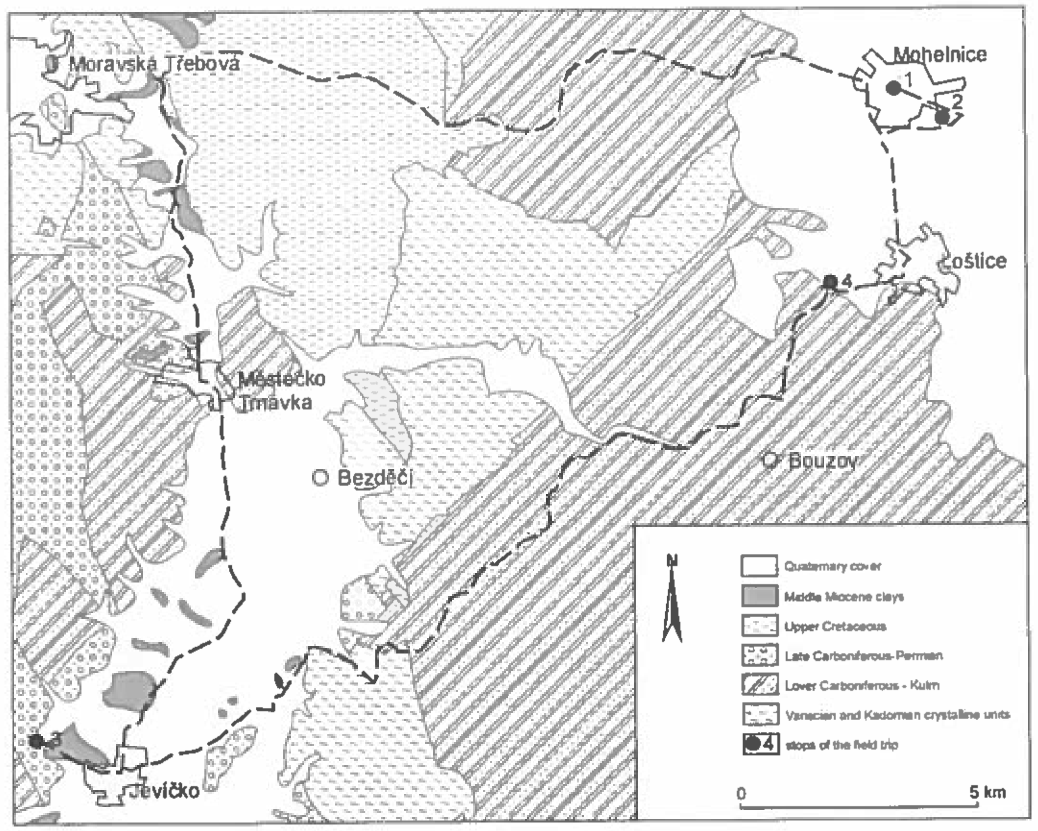

Fig. 1. Overview geological map of western surroundings of Mohelnice with field trip route.

Fig. 2. Náměstí Svobody square in centre of Mohelnice comparing with view at postcard from 1902.

Fig. 3. Current look of Schubert's family house at Mohelnice.

Fig. 4. Former elementary school at Mohelnice.

Stop 2. Mohelnice cemetery (GPS: N49 46 23.3 E16 56 10.8)

At the eastern periphery of the Mohelnice, there is city cemetery surrounded by industrial zone. This is the cemetery where R.J. Schubert body was buried after its exhumation and repatriation from the military cemetery in Galicia. The position of grave is unfortunately not known. After the World War Two German citizens of Mohelnice were transferred and the cemetery experienced many changes including removal of tombstones. In case you enter the cemetery, it is anyway very interesting to look at one prominent family tomb from black gabbro along the eastern cemetery wall. At the tombstone is engraved name E. Josef Schubert – "Fürst Salmscher Bergingeniueur" (1825-1915) and Adele Schubert (1835-1925). The dates of birth and dates deceased may suggest that these Schubert's are grandparents of R.J. Schubert. This is anyway task for historians.

Roadside sights. *After leaving Mohelnice towards the West, the trip route crosses the Devonian?-Lower Carboniferous shales of Moravo-Silesian Culm and Cenomanian-Turonian sandstones, marlstones and limestones of the eastern extension of the Bohemian Cretaceous Basin (Fig. 1). The route then turns to the South following the Valley of Třebůvka River with remnants of Middle Miocene clays covered usually by Quaternary deposits. The valley sides are built of the crystalline units, shale-greywacke Culm strata and by Late Carboniferous-Permian continental siltstones, sandstones and conglomerates.*
At Městečko Trnávka you will pass ruins of Cimburk castle from the end of 13th century. It served as stronghold to Hussites in 15th century and since the Thirty Years' War gradually went to ruin.
At the western margin of the Městečko Trnávka (Türnau in German) Schubert (1900a) studied the foraminifer fauna from greenish grey clay ("Tegel") and listed 67 taxa of foraminifers. The locality was studied already by Reuss (1854). At the present time no exposures of clays were found. Their position is anyway displayed in current geological maps (Fig. 1).
South of Městečko Trnávka is Bezděčí village (Mitterdorf in German) where Schubert (1900a) sampled Miocene clays from drainage channels and listed 48 foraminifer taxa. New search for this locality was without success. Sandy clays near Bezděčí contained just frequent sponge spicules and rare Cenomanian-Turonian foraminifera Pernerina depressa *and* Arenobulimina *sp. derived from the marine Upper Cretaceous nearby (see Fig. 1).*

Stop 3. Gewitsch, =Jevíčko (GPS: N49 38 15.6 E16 41 13.3)
From Jevíčko we will follow road to to the West and stop at the crossroads Křenov - Bělá u Jevíčka. From road trench at this crossroads already Reuss (1854) observed Miocene clays ("Tegels") and studied their foraminifer fauna. Schubert (1900a) revisited Reuss's locality and restudied its microfauna. While Reuss reported 9 foraminifer taxa, Schubert completed the faunenlist to 23 taxa.
The locality fortunately still exists. During the Spring 2015 the road trenches were cleaned and under reddish slope loam, coloured by weathered Permian rocks, Miocene brownish grey clays were exposed (Fig. 5). Washing residue contains abundant sand admixture coming from the slope creep. Microfossils are anyhow abundant and fairly well preserved. Preliminary determination of foraminifers revealed 74 benthics and 7 planktonics. Extensive picking will surely higher this number considerably. Except the foraminifers, few ostracods, echinoid spines and rare *Bolboforma* cysts can be found.
Agglutinated foraminifers are minor component of benthic assemblage. *Spirorutilus carinatus* (Orb.), *Martinottiella karreri* (Cush.) and *Semivulvulina pectinata* (Reuss) are the most common of them. Calcareous benthics are slightly dominated by genus *Bolivina* (*B. hebes* Macf., *B. antiqua* Orb. etc.).

Fig. 5. Historical Reuss's locality Gewitsch near the Jevíčko – Křenov – Bělá u Jevíčka crossroads.

Uniserial forms *Amphimorphina haueriana* Neugeb., *Amphicoryna*, *Laevidentalina*, *Scallopostoma*, *Grigelis*, *Pseudonodosaria*, *Siphonodosaria* are common. Among other calcareous benthics can be found large *Lenticulina* spp., *Hemirobulina* sp., *Fissurina* spp., *Ceratocancris haueri* (Orb.), *Bitubulogenerina reticulata* Cush., *Lapugyina schmidi* Pop., *Reussella spinulosa* Reuss, *Angulogerina angulosa* (Will.), *Uvigerina macrocarinata* P. et T., *Pappina compressa* (Cush.), *Bulimina subulata* (Cush. et P.), *Bulimina striata* Orb., *Praeglobobulimina pyrula* (Orb.), *Cassidulina laevigata* Orb., *Globocassidulina oblonga* (Reuss), *Cassidulinoides* sp., *Asterigerinata planorbis* (Orb.), *Valvulineria* sp., *Melonis pompilioides* (F. et M.), *Cibicidoides ungerianus* (Orb.), *Nonion commune* (Orb.), *Astrononion* sp., *Pullenia bulloides* (orb.), *Epistominella* sp., *Gyroidinoides* spp., *Nonionella* spp., *Ammonia vienensis* (Orb.) etc. Planktonic foraminifers are frequent but mostly very small forms. The most common are: *Tenuitella* spp., *Globigerinita uvula* (Ehrenb.), *Globigerina bulloides* Orb., *Paragloborotalia mayeri* (Cush. et E.), *Obandyella bykovae* (Aisenst.), "*Globigerina*" *tarchanensis* S. et Ch. and *Globigerinoides immaturus* Le Roy.
When you will follow the road to Křenov, you will come to waterworks at the right side. The roadcut at the left side exposes blocks of fresh greenish grey calcareous clay ("Tegel") in slope loam. It is perhaps material digged out of waterworks fundaments during construction. The clay is richly fossiliferous and free of contamination by Quaternary slope processes. The taphocoenosis of microfossils is similar to that of historical locality but less affected by weathering and more suitable for quantitative analysis (Fig. 8). The foraminifer benthic density in the clay is estimated to more than 1000 specimens per 1g of rock. Both benthic and planktonic specimens are mostly small sized. Most common are *Bolivina* spp. (*B. hebes* Macf., *B. dilatata* Orb. etc.), *Siphonodosaria* spp., *Angulogerina angulosa* (Will.), *Cibicidoides* spp., *Epistomenella* sp., *Uvigerina* sp. etc.
Presence of *Melonis pompilioides* (F. et M.) and some agglutinated taxa indicate bathyal depth of Miocene palaeohabitat. Abundant planktonics are evidence of relatively open-marine conditions (Fig.

8). The remnants of the Miocene clays near Jevíčko are a part of originally much more continuous sedimentary cover of the area and visible hills around Jevíčko were flooded by sea during the early Middle Miocene (early Badenian).

Roadside sights. *The road to the West from Jevíčko crosses so called "Hitler" highway. The highway was designed in 1938 by German authorities to connect Vienna with Bresslau (Wroclav) but never finished. Here near Jevíčko abandoned earthworks and bridge are preserved.*
Driving to the next stop, you can see from Doly village a silhouette of castle with several pointed towers. It is Bouzov – originally gothic castle from end of 13th century, completely rebuilt around 1900 by the Teutonic Order that owned the castle from 17th century till 1939.

Stop 4. Wolfsdorf, =Vlčice (GPS: N49 44 20.6 E16 54 20.4)
After passing the Vlčice village, road makes 180° turn to right. Stright in the curve, local road turns-off and climbs to the slope towards Žádlovice village. At the foot of the slope near the curve there is abandoned sand pit overgrown by tall trees (Fig.6). This is the famous locality "Wolfsdorf" first mentioned by Tietze (1893) and studied in detail by Schubert (1900a, b).

Fig. 6. Historical Schubert's locality "Wolfsdorf" near Loštice.

At the end of 19th century pottery clays were exploited from several clay pits in this area under relatively thick cover of clastic sediments and loess. Schubert (1900a) described them as bluish grey plastic clays and compared them with "Badenian Tegels". Tietze reported occurrence of 9 mollusc species. Schubert (1900b) completed the faunenlist by 35 taxa of molluscs: bivalves, scaphopod and mainly diverse gastropods. In another paper Schubert (1900a) described from Wolfsdorf 149 foraminifer taxa including 7 new. Overlying clastic sediments are also worth of note and they do not comprise just ordinary Quaternary cover. Barth et al. (1971) characterized the strata as sandy clays and gravels of variegated

colouration (white, grey yellow, brown, brick red and violet) with cross bedding. Although the age is unclear due lack of useful leading fossils, it can be assumed that these are fluvio-lacustrine sediments of Neogene age (Badenian?, Pliocene?).
At the present time there are just small remains of exposures in sand pit walls. No marks after the old clay pits are left here. Fortunately, at the bottom of sand pit just at the entrance part, there are piles of clays covered just by thin layer of soil. Especially in the spring, you can find relatively fine clay material in the piles produced by moles (molehills) or dig a shallow pit. All these clays contain sandy and pebbly admixture coming from overlying clastics. These may be piles digged from former clay pits rather than real exposure. Clays anyway contain abundant foraminifer fauna and some molluscs.
Denzity of benthic foraminifera in the clay can be estimated to more than 1200 specimens per 1 g of rock. Quantitative analysis of benthic assemblage based on statistic count of 300 specimens shows high equitability/low dominance (Fig. 7). Number of species in this statistical set was about 46 what illustrates fairly high diversity. The most frequent taxa are representatives of genera *Bolivina* and *Epistomina* followed by cassidulinids, uvigerinids and *Gyroidinoides*.

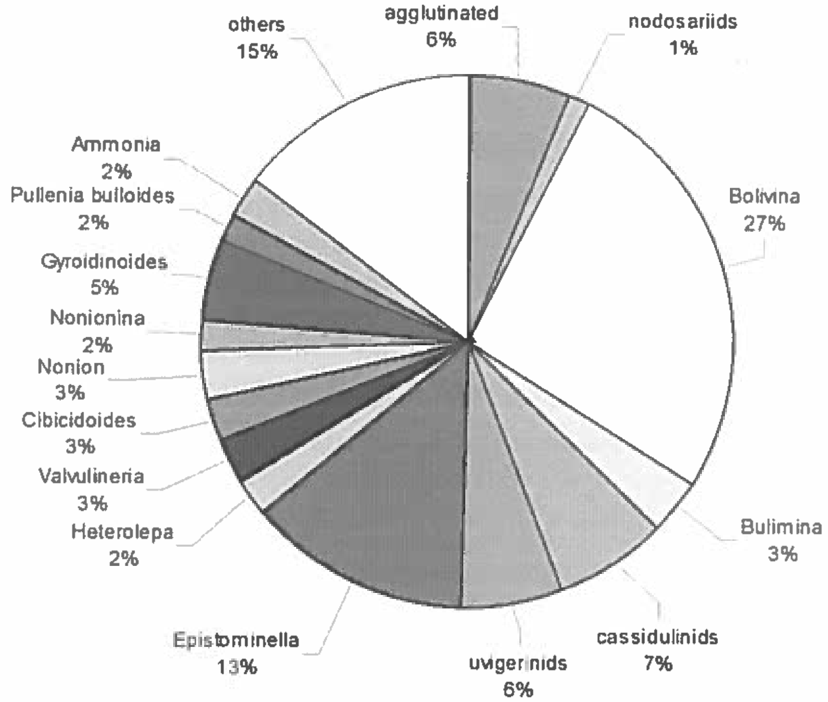

Fig. 7. Quantitative structure of benthic foraminifer assemblage from statistical pick of 300 specimens; "Wolfsdorf" locality.

Preliminary picking of foraminifers from newly collected material confirmed over 90 benthic taxa. More extensive picking will result in much higher number of taxa for sure because some of them occur very rarely. "Wolfsdorf" locality may be considered the type locality of following taxa described by Schubert: *Dentalina communis* var. *inflata, Dentalina catenulata* var. *continuicosta, Dentalina globularis, Dentalina adolphina* var. *armata, Bulimina andreaei, Miliolina rodolphina* var. *striatula* and *Nonionina turgida* var. *inflata.* Not all of them were recovered from the new samples. Some may be very rare. It is clear that Schubert's taxa needs careful taxonomic revision because at least a part seems to be younger synonyms. Uniserial taxa are often broken and for revision are necessary complete specimens with well preserved apertural details that will enable correct assignment to new genera erected by Hayward.

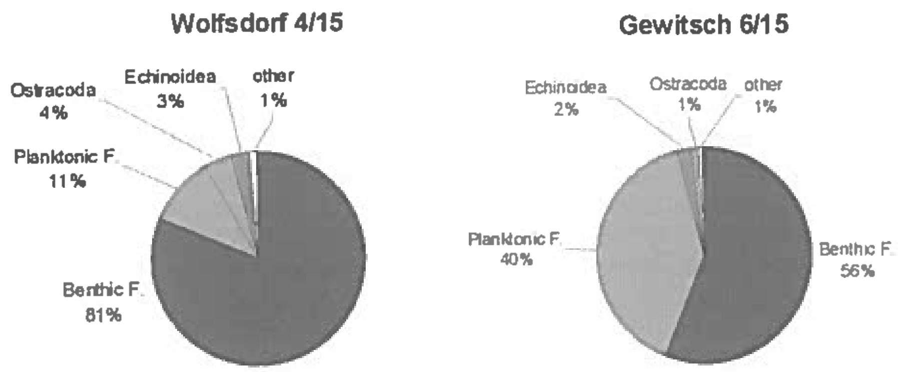

Fig. 8. Quantitative analysis of taphocoenoses from historical localities of Schubert.

Planktonic foraminifers are much less frequent then at the "Gewitsch" locality (Fig. 8) and up to now *Tenuitella* sp., *Turborotalita quinqueloba* (Natl.), *Globigerina* cf. *bulloides* Orb., *G. concinna* Reuss, *Globigerinoides quadrilobatus* (Orb) and *Obandyella bykovae* (Aisenst.) were identified. Besides foraminifers, ostracods are relatively frequent and diversified. Highly ornamented *Henryhowella* representatives are conspicuous.

Quantitative analysis of taphocoenosis revealed that "Wolfsdorf" fauna has aparently shallower character. Small proportion of planktonic foraminifers indicates restricted conditions that may be related to proximity of shore or islands. Also the frequent mollusc fauna and ostracods support this interpretation. Finally, representatives of *Elphidium, Amphistegina* and *Quinqueloculina* are typical for inner-shelf habitats although their redeposition is very probable.

Preliminary list of benthic foraminifera newly recovered from "Wolfsdorf" in alphabetical order:

Adelosina sp.
Alabamina spp. (2 species)
Allomorphina trigona Reuss
Ammonia viennensis Orb.
Amphicoryna? *hispida* (Soldani)
Amphicoryna sp.
Amphistegina lessonii Orb.
Angulogerina angulosa (Will.)
Asterigerinata planorbis (Orb.)
Asterigerinoides sp.
Astrononion sp.
Bitubulogenerina reticulata Cush.
Bolivina dilatata Reuss
Bolivina spp. (4 species)
Bulimina striata Orb.

Bulimina subulata Cush. et P.
Cancris sp.
Cassidulina laevigata Orb.
Cassidulinoides sp.
Ceratocancris haueri (Orb.)
Cibicidoides sp.
Cribroelphidium porosum (Orb.)
Dentalina acuta Orb.
Dentalina spp.
Elphidium crispum (L.)
Elphidium fichtellianum (Orb.)
Elphidium flexuosum (Orb.)
Favulina hexagona (Will.)
Fissurina sp.
Fursenkoina acuta (Orb.)
Fursenkoina sp.
Glandulina sp.
Globocassidulina globosa (Hant.)
Globocassidulina oblonga (Reuss)
Gyroidinoides sp.
Hemirobulina sp.
Hoeglundina elegans (Orb.)
Laevidentalina sp.
Lagena sp.
Lapugyina schmidi Popescu
Lenticulina calcar (L.)
Lenticulina convergens (Born.)
Lenticulina inornata (Orb.)
Lenticulina vortex (F. et M.)
Lenticulina spp.
Lobatula sp.
Marginulina hirsuta Orb.
Martinottiella karreri (Cush.)
Melonis pompilioides (F. et M.)
Nonion commune (Orb.)
Nonion? sp.
Oridorsalis umbonatus (Reuss)
Oridorsalis sp.
Pappina compressa (Cush.)
Plectofrondicularia sp.
Praeglobobulimina pyrula (Orb.)
Praeglobobulimina pupoides (Orb.)
Pseudonodosaria sp.

Pullenia bulloides (Orb.)
Quinqueloculina sp.
Reussella spinulosa (Reuss)
Reussella sp.
Robertina sp.
Saracenaria sp.
Scallopostoma ovicula (Orb.)
Semivulvulina pectinata (Reuss)
Sigmoilinita tenuis (Czjzek)
Sigmoilopsis sp.
Siphonina reticulata (Czjzek)
Siphonodosaria? *armata* (Schubert)
Siphonodosaria? *globularis* (Schubert)
Siphotextularia concava (Karrer)
Spirorutilus carinatus (Orb.)
Stainforthia? sp.
Textularia gramen Orb.
Textularia laevigata Orb.
Uvigerina macrocarinata P. et T.
Vaginulinopsis pedum (Orb.)
Valvulineria complanata (Orb.)
Virgulinella pertusa (Reuss)
Virgulopsis sp.

Roadside sights. *On your journey back to Mohelnice you can make a stop in Loštice at Náměstí Míru square* (GPS: N49 44 41.1 E16 55 41.2) *and taste "Olomoucké tvarůžky" - local cheese with harsh smell but delicious taste. Beginning of "tvarůžky" tradition fell into oblivion but records from 15th century mentioned them as common regional product. At Loštice you can find "Museum of tvarůžky" and "tvarůžky cake shop" you can visit just here and maybe in Olomouc.*

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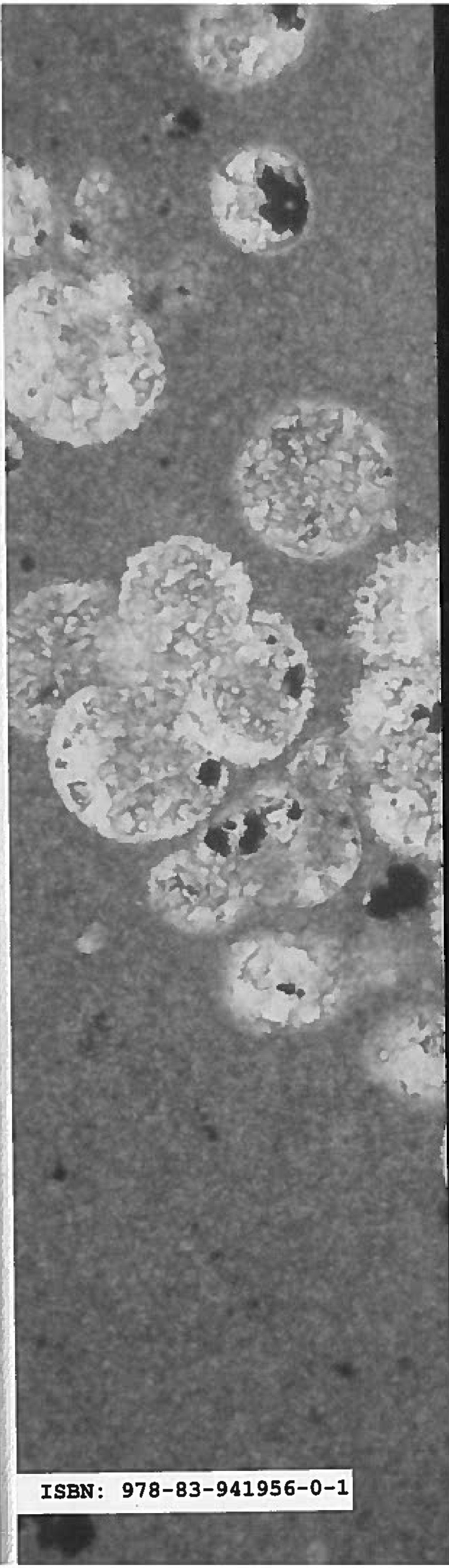

16th Czech - Slovak - Polish Palaeontological Conference

10th Polish Micropalaeontological Workshop MIKRO-2015

The 10th Polish Micropalaeontological Workshop MIKRO-2015 provides a venue for Polish-speaking Micropalaeontologists to network and present current research topics. For the second time, the MIKRO – meeting is held in conjunction with the annual joint meeting of Czech - Slovak - Polish Palaeontological Conference. Both meetings are held in Olomouc and consist of three days of technical sessions and a joint field excursion.

This conference is dedicated to the memory of Dr. Richard J. Schubert, an outstanding Biologist, Micropalaeontologist, Geologist, who was born in Mohelnice not far from Olomouc. It is commemorates the 100[th] anniversary of his tragic death on the eastern front on May, 3, 1915.

This volume includes collections of abstracts summarizing the contributions presented at both meetings, Richard J. Schubert's Curriculum Vitae and an article that provides background information on Richard J. Schubert's scientific investigations, and a field guide that focuses on the traces of Richard J. Schubert's activities visited during the field excursion.

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