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FOURTH INTERNATIONAL WORKSHOP ON AGGLUTINATED FORAMINIFERA

EXCURSION GUIDEBOOK

POLISH FLYSCH CARPATHIANS

Edited by: M. ADAM GASIŃSKI & EWA MALATA

Institute of Geological Sciences, Jagiellonian University
EXCURSION GUIDEBOOK
POLISH FLYSCH CARPATHIANS

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Computer layout: JACEK JAMIŃSKI

INSTITUTE OF GEOLOGICAL SCIENCES, JAGIELLONIAN UNIVERSITY
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geological Setting</td>
<td>1</td>
</tr>
<tr>
<td>Excursion to the Wieliczka Salt Mine</td>
<td>8</td>
</tr>
<tr>
<td><strong>Excursion A</strong></td>
<td></td>
</tr>
<tr>
<td>First Day - Flysch Carpathians, Magura Nappe</td>
<td>10</td>
</tr>
<tr>
<td>Exposure 1. Grybów: Inoceramian Beds (Late Senonian) equivalent of Grzybowski’s microfauna described in 1901</td>
<td>11</td>
</tr>
<tr>
<td>Exposure 2. Szymark: Inoceramian Beds (Late Senonian) - Dylążanka’s locality (1923)</td>
<td>12</td>
</tr>
<tr>
<td>Exposure 3. Ropica: Inoceramian Beds (Late Senonian) - Grzybowski’s locality (1901) Świątkowa Beds (Paleocene), Variegated Shales (Paleocene-Middle Eocene), Sub-Magura Beds (Late Eocene)</td>
<td>13</td>
</tr>
<tr>
<td>Second Day - Flysch Carpathians</td>
<td></td>
</tr>
<tr>
<td>Exposure 4. Trzciana near Dukla: Dukla Nappe - Menilite Beds (Oligocene) - Grzybowski’s locality (1896)</td>
<td>18</td>
</tr>
<tr>
<td>Exposure 5. Krosno: Silesian Nappe - Variegated Shales (Middle Eocene), Green Shales (Late Eocene, Globigerina Marls (Late Eocene/Oligocene), Menilite Beds (Oligocene)</td>
<td>20</td>
</tr>
<tr>
<td>Exposure 6. Węglówka: Subsilesian Nappe - Węglówka Marls (Campanian) - equivalent of Grzybowski’s microfauna described in 1896</td>
<td>24</td>
</tr>
<tr>
<td>Third Day - Flysch Carpathians, Carpathian Foredeep</td>
<td></td>
</tr>
<tr>
<td>Exposure 7. Międzybrodzie: Silesian Nappe - Gaize Beds (Late Albien-Cenomanian), Radiolarian Green Shales (Cenomanian-Turonian), Red Shales (Turonian-Coniacian) and Variegated Marls (Late Senonian)</td>
<td>26</td>
</tr>
<tr>
<td>Exposure 8. Dębna: Skole Nappe - Krosno Beds (Late Oligocene/Early Miocene)</td>
<td>32</td>
</tr>
<tr>
<td>Exposure 9. Zawada: Skole Nappe - Inoceramian Beds (Campanian-Early Maastrichtian - Friedberg’s locality (1901)</td>
<td>32</td>
</tr>
<tr>
<td>Exposure 10. Szczepanowice: Skole Nappe - Spas black Shales (Early Cretaceous), Variegated Shales (Late Cenomanian-Early Turonian), Siliceous and Fucoid Marls (Turonian-Senonian) and Inoceramian Beds (Late Senonian-Paleocene)</td>
<td>34</td>
</tr>
<tr>
<td>Exposure 11. Sulików: Carpathian Foredeep, Middle Miocene deposits</td>
<td>36</td>
</tr>
<tr>
<td><strong>Excursion B</strong></td>
<td></td>
</tr>
<tr>
<td>Exposure 12. Bujaków: Subsilesian Nappe - Variegated Marls (Middle Eocene)</td>
<td>38</td>
</tr>
<tr>
<td>Exposure 13. Lipnik: Silesian Nappe - Upper Cieszyn Shales (Valanginian-Hauterivian), Grodziszce Shales (Hauterivian-Early Barremian) and Verovice Shales (Barremian-Early Albian)</td>
<td>39</td>
</tr>
<tr>
<td>Exposure 15. Goleśzów: Cieszyn Limestone (Late Berriasian)</td>
<td>45</td>
</tr>
<tr>
<td>Exposure 16. Zawadka: Subsilesian Nappe - Variegated Marls and Shales - equivalent of Grzybowski’s microfauna from Wadowice (1896)</td>
<td>48</td>
</tr>
</tbody>
</table>

## Literature
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Title Cover

Photo depicts a group of geologist during the field excursion to the Carpathians of Galicia.
Jaremce, 4 September 1896: Władysław Szajnocha (seated centre, holding map), Józef Grzybowski
(seated right, holding rock) and two unidentified associates. Photo from the collections of
the Institute of Geological Sciences, Jagiellonian University.

Back Cover

Copy of the original plate from the Grzybowski's paper 1896.
GEOLOGICAL SETTING

The Carpathians form a part of the great arc of mountains stretching from near Vienna in Austria to the Iron Gate of Romania on the Danube. Towards the west the Carpathians are linked with the Alps and to the southeast pass into the Balkan mountain chain. The Carpathians consist of two main domains: an older one - Inner Carpathians which were affected by Late Cretaceous tectonic phase, and a younger one - Outer Carpathians, which are also known as the Northern or Flysch Carpathians, where main tectonic phase was during Neogene (Książkiewicz, 1977). These two domains are separated by the narrow, tectonically complex belt - Pieniny Klippen Belt which was affected by Late Cretaceous and Tertiary tectonic phases.

Figure 1
Tectonic sketch map of the central part of the Carpathians

1 Foreland 7 Dukla and Fore-Magura Nappe
2 Miocene 8 Magura Nappe
3 Marginal nappe of flysch zone 9 Pieniny Klippen Belt
4 Skole Nappe of flysch zone 10 Pre-Paleogene
5 Sub-Silesian Nappe 11 Palaeogene
6 Silesian Nappe 12 Tertiary Volcanics
Outer Carpathians

The sedimentary sequence of the Outer Carpathians began in Kimmeridgian / Tithonian time and lasted till Early Miocene and flysch sedimentation predominated during the whole time.

Figure 2

ORIGIN OF VARIEGATED SHALES FROM FLYSCH

During the development of the Outer Carpathian geosyncline, several longitudinal sedimentary basins were created: from the south they were: Magura basin, Fore-Magura-Dukla basins, Silesian basin, Subsilesian basin, Skole basin (Kiążkiewicz, 1962). Flysch sediments were deposited in the deeper parts of these basins. The depth of the basins was relatively great as it is indicated by complete absence of shallow-water sedimentary structures and the total lack of shallow water fauna in the autochthonous sediments. The depth reached probably its

\[1\] As the excursion is taking place in the Outer Carpathians, that part of the Carpathians is described only.
Fig. 3. Northern Carpathians. Paleogeographic domains (basins and ridges) during the Tithonian and the Upper Cretaceous and related stratigraphic columns. The sequences on the ridges are thinner with occasional reef deposits as compared to the sequences in the basins, which are thicker and often terrigenous.

Pescatore & Ślączka, 1984
maximum, about several thousand meters, in the Cenomanian, at the time when radiolarites and radiolaritic shales were deposited (Koszarski & Żytko, 1965). On the basinal slopes and submarine ridges pelitic and marly sediments (red and green marls and shales) prevailed. There was steady and continuous subsidence of the floor of the basins, which permitted the accumulation of flysch sediments of a very great thickness (more than 6000 m in several places). Detrital material which formed a system of deep sea fans was derived both from the margins of the Outer Carpathian geosyncline and from the islands (Cordilleras) which separated individual basins (Książkiewicz, 1965).

Figure 4

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Fig. 4. Northern Carpathians. Source areas and paleocurrent directions in flysch basins.

Pescatore & Ślączka, 1984
**TABLE 6**

<table>
<thead>
<tr>
<th>ALB - ALBIAN</th>
<th>WIEK - AGE</th>
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<tr>
<td>Lgota Beds</td>
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<th>Sample</th>
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<thead>
<tr>
<th>Litostratigrafia</th>
<th>Lithostratigraphy</th>
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</tbody>
</table>

| Foraminifera wepyjne, calcareous (głównie, mainly Lagenidae) |
| Foraminifera agłotynujące, arenaceus (głównie, mainly Litulinidae) |
| Radiolaria (głównie, mainly Canasphaera) |
| Ostracoda |
| Lenticulina münsteri (Roemer) |
| Lenticulina nodosa (Reuss) |
| Astacolus callipolis (Reuss) |
| Astacolus schönbachi (Reuss) |
| Pseudodiadulina humilis (Roemer) |
| Saracenaria bronni (Roemer) |
| Lenticulina subungulates (Reuss) |
| Lenticulina curschmanni (Sigal) |
| Lingulina praelonga (Ten Lam) |
| Globigerina infrasecretacea Giesmner |
| Pseudospirifer cimnicenaz Geroch |
| Trochammina quinqueloba Geroch |
| Verneulinoidea neocostenata (Kjell.) |
| Trochammina vocans Reuss |
| Ammodiscus suhlianus Berthelin |
| Thalamamina neocostenata Geroch |
| Marsouella haueri Reuss |
| Hornemann ovulum (Grypowski) |
| Gaudrynia oblonga Gasp. |
| Hippocrepina decrescens Vašiček |
| Plectorecurvoides irregularis (Geroch) |
| Verneulinoidea subfiliformis Bartenstein |
| Haplophragmoides monticuloides (Reuss) |
| Gaudryinella atherinii Bartenstein |
| Recurvoides aff. contortus Earland |
| Bigenerina variabilis Vašiček |
| Reophax minutus Tappen |
| Haplophragmoides aff. monticuloides /Reuss/ |
| Hyperammina elongata Brady |
| Gaudryina filiformis Berthelin |
| Recurvoides imperfectus Hantliková |
| Plectorecurvoides alternans Noth |
| Gloeapsilla irregulares (Grypowski) |
| Haplophragmoides class minor Neiss |
| Trochammina ex gr. globigeriniformis (J. et F.) |
| ? Canasphaera sp. |
| Canasphaera aff. spherosphaera Riset |
| Hemisphaeropora tuberosa Dimitrić |
| Thamarcha comis /Aliev/ |
| Spathamphora sp. |
| Holocryptocantum japonsicum Nakaseko et al. |
| Dictyonema an multicostata Zittell |
| Stichocapsa oceanica Scornova, Aliev |
| Cenellipida sp. |
| Stichocapsa an beckmanni Riset |

**FLECTORECURVOIDEA ALTERNANS NOTH**

**Lithostratigraphy**

Geroch & Nowak, 1963

*partly modified*
During the development of the Outer Carpathians three mega-cycles can be distinguished (Koszarski, 1963). The first one (Tithonian - Albian) which started with calcareous turbidities was characterized by presence of the black shales and considerable uniformity of sediments within all basins. During the second cycle (Turonian - Late Eocene) there was characteristic appearance of red shales and differentiation of the sediments in the various basins. This cycle ended at the end of the Late Eocene with sedimentation of Globigerina marls. The third, final cycle (Oligocene - Early Miocene) was distinguished on the basis of the lack of red pelitic sediments and prevailing black and grey shales. During this cycle, once more, sediments in all basins became more uniform and there is very distinct migration of depocenters and tectonic movements across the Outer Carpathians.

During the Neogene (Miocene) orogenic phase the sedimentary basins were fully detached from their basement and transformed into separate nappes with a dominant northern direction of thrusting. They are from the south:

Magura Nappe (bounded from the south by Pieniny Klippen Belt),
Dukla and Fore-Magura Complex Nappe,
Silesian Nappe,
Subsilesian Nappe,
Skole Nappe.

The northward-moving flysch nappes caused a downwarping of the southern margin of the North European Platform, forming a tectonic depression being filled with thick Miocene molasse deposits of the Early and Middle Miocene age.

As the Carpathian orogeny proceeded northward, the depocentre of molasse sedimentation advanced with it (Oszczypko & Ślączka, 1989). During the northward movement of the Carpathian orogeny some of the internal elements of the Miocene molasse were folded and detached in front of the flysch nappes, and along the outer margin of the Carpathians a narrow belt of the folded Miocene deposits occurs. The extent of thrusting of nappes reaches 40 km in the western part of the Carpathians and the whole orogene is thrust over the North European platform for a distance over 60 km.
Northern Carpathians. Palaeozoic sections from Upper Cretaceous to Upper Miocene (see text). Until the Oligocene the flysch sedimentation was related to the vertical movements of the ridges (tensile stage), while after the Oligocene the flysch deposition was related to a compressive stage. Diachronism and regressive trends characterize the flysch units during this late stage.

Pescatore & Ślączka, 1984
## Łuczkowska & Rolęwicz, 1990

<table>
<thead>
<tr>
<th>Profile 1 prób.</th>
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<tr>
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<td>Foraminifer taxa</td>
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<td>Eichmüller</td>
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<td>41. Globocystina dehiscens</td>
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<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>42. Ctenostrema sulcatus</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>43. - Mastigopus obesa</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>44. - Mamillaria spinata</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>45. - Tubularia acuta</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>46. - bykowae</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>47. - conica</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Figure 8

Miocene Basin: 1 - actual edge of the Carpathians, 2 - presumably extension of the Miocene below the Carpathians, 3 - northern edge of the Miocene Basin, 4 - Carpathian Foredeep; B - Bydgoszcz, G - Gdańsk, Ka - Katowice, Kr - Kraków, L - Lublin, Ł - Łódź, N - Nysa, O - Opole, P - Poznań, Rz - Rzeszów, W - Wroclaw, Sz - Szczecin
(after Łuczowska)

Figure 9

Hypothetical deep cross section through Carpathians along meridian of Kraków

1- North European Platform
2- Outer Carpathian basements
3- Inner Carpathian basements
4- Neogene to Cenozoic foredeep (molasse)
5- Lower Carpathian Flysch
6- Pleinrey Folded Belt
7- Lower Carpathians
8- Neogene of intermontane basins
9- Molasse
10- Overthrusts

Oszczypko & Sliżewska, 1986
EXCURSIONS
EXCURSION TO THE WIELICZKA SALT MINE
12 September, 1993

Itinerary: Kraków - Wieliczka - Kraków

The Wieliczka halit deposit is a part of a vast area of evaporites connected with the Carpathian Foreland, and belongs to its inner, strongly folded part. The evaporites formed during the salinity crisis which affected the Carpathian Foredeep basin at the beginning of the Serravalian (Middle Miocene, ±15 My). The halite deposits consist of two members: lower - Stratified and upper - Breccia Member. Stratified Member displays sedimentary structures which show that the bulk of the halite layers represent sediments produced by redeposition by gravity mass movements. The Breccia Member representsolistostromes deposited by the submarine debris flow.

Figure 10

![Map showing position of salt bearing deposits in Wieliczka-Bochnia region. 1 — salt deposits in overthrust unit; 2 — northern margin of the Carpathians; 3 — boreholes. (after Garicki, 1975)](image)

It appears that the rocks of the Stratified Member are practically devoid of autochthonous microfauna. In the Breccia Member, rich and well preserved microfauna occurs in redeposited marly claystones. This microfauna represents various environments. The composition of the assemblage is shown in Table 1.

The itinerary of the excursion will cover the galleries and chambers excavated in XVII - XIX c. of the tourist route and the museum. They are situated in the central and western parts of the salt deposits. The galleries usually cross the Stratified Member and chambers which are
excavated in huge salt blocks within the Breccia Member. In a few places a contact between the two members is visible.
1- Inner Pre-Palaeogene Tatra Unit
2- Inner Pre-Palaeogene Sub-Tatra Nappes
3- Inner units post-orogenic cover
4- Pieniny Klippen Belt
5- Magura Nappe
6- Tectonic Windows of Magura Nappe
7- Dukla Nappe
8- Fore-Magura Nappe
9- Silesian Nappe
10- Sub-Silesian Nappe
11- Skole Nappe
12- Andrychow Klippe
13- Stebnik Unit
14- Wieliczka and Bochnia Folds
15- Neogene
16- Autochthon
17- Andesites
18- Overthrust
Figure 7

Kościukiewicz, 1977

Exposures described in Guidebook
EXCURSION A
16 - 18 September, 1993

First Day

Itinerary: Kraków - Nowy Sącz - Szymbark - Siary - Gorlice - Iwonicz Zdrój

Leaving Kraków, the itinerary of the excursion will bring us along the Carpathian Foredieep. The higher hills towards the south mark the northern border of the Carpathians. The part of the Carpathians situated southeast from Kraków is made up of five, well defined nappes all thrust upon each other. From south to north, these are:
The Magura Nappe,
The Dukla-Fore Magura Nappe,
The Silesian Nappe,
The Sub-Silesian Nappe,
The Skole Nappe.

During this day the excursion will visit the exposures within the Magura Nappe.

At the town of Brzesko the route will enter the Carpathians and cross several flat folds of the Silesian Nappe. The bank of the artificial lake supplies several outcrops of the Late Cretaceous thick-bedded sandstones (Lower Istebla Beds). South from Jakubowice the excursion party will pass the northern margin of the Magura Nappe.

The northern part of the Magura Nappe either rests on different units belonging to the Dukla-Fore-Magura Nappe or directly on the Silesian Nappe. It consists of several disharmonic folds. The exposed part of the Magura sequence begins with sediments from the Mid-Cretaceous to the Oligocene. On the basis of lithologic criteria, four facies zones can be distinguished from south to north: the Krynica Subunit which corresponds to the Kochanovice Unit in Slovakia, the Sącz subunit corresponding to the Bystrica Unit, the Gorlice Subunit corresponding to the Raca Subunit and the Siary Subunit.

The excursion will visit mainly the Siary Subunit. It consists of the following beds:
the Inoceramian Beds: Late Senonian - Palaeocene, the Świątkowa Beds: Palaeocene (uppermost part of Inoceramian Beds), the Variegated Shales with intercalations of thick-bedded, glauconitic sandstones: Palaeocene - Late Eocene, the Magura, glauconitic sandstones: Late Eocene - Oligocene.

After crossing the Dunajec river, a quarry in the Oligocene sandstones is seen towards the north. These sandstones belong to the Fore-Magura Nappe system, exposed in the tectonic window. Near the town of Nowy Sącz the route will cross the Miocene piggy-back basin laying on the Magura Nappe. After passing Nowy Sącz the route will run until Grybów along the marginal part of the Magura Nappe. In this part several fragments of the lower tectonic units are tectonically incorporated into the Magura Nappe creating the so called tectonic windows.

Exposure 1. Grybów

In Grybów along Biała river it is possible to observe an exposure of the Late Cretaceous Inoceramian Beds represented by thick- and medium-bedded, laminated sandstones intercalated by grey and green shales and marls. Agglutinated foraminifers from the Inoceramian Beds are: Rhabdammina cylindrica Glaessner, Rh. robusta (Grzybowski), Nothia excelsa (Grzybowski), N. latissima (Grzybowski), Rhizammina indivisa Brady, "Bathysphon" sp., Saccammina placenta (Grzybowski), S. scabrosa Mjatliuk, S. grzybowski (Schubert), Ammodiscus cretaceus (Reuss), A. tenuissimus Grzybowski, Glomospira charoides (J. et P.), G. gordialis (J.et P.), G. serpens (Grzybowski), G. irregularis (Grzybowski), G. grzybowski Jurkiewicz, Reophax cf. pilulifer Brady, R. splendida Grzybowski, Kalamopsis grzybowski (Dylązanka), Hormosina excelsa (Dylązanka) H. ovulum (Grzybowski), H. velascoensis (Cushman), H. gigantea Geroch, Aschemocella div.sp., Recurvoides div. sp., Cystaminella div.sp., Karrerulina div.sp., Rzehakina epigona (Rzehak), Rz. inclusa (Grzybowski).

Microfaunal analysis has displayed distinct vertical differentiation in foraminiferal assemblages in individual shally banks (Table 2).
From Grybów up to Szymbark, the excursion will follow the marginal part of the Magura Nappe.

**Exposure 2. Szymbark**

At Szymbark in the stream-bed of the Ropa river, near the small creek of Bielanka, the Inoceramian Beds are exposed.

**Figure 12**

These are dark-grey and greenish shaly silts and argillaceous shales, alternated with thin- and medium-bedded, fine and medium grained, calcareous laminated, micaceous sandstones. Locally thick-bedded, medium and coarse grained sandstones are developed. This part of the Inoceramian Beds belongs to the Late Senonian and corresponds to the Inoceramian Beds described by Dylążanka in the Szymbark Quarry (Dylążanka, 1923). In the shales, the following species have been found (Table 3).
## TABLE 2

**TYPES OF INTERTURBIDITIC SHALES AND THEIR MICROFOSSILS**

Outcrop of Inoceramian beds /late Senonian/, Magura nappe, in the Biała Dunajcowa river at Grybów, Outer Carpathians

<table>
<thead>
<tr>
<th>Planktonic forams /very rare/</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcareaous benthic forams /v.r./</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>&quot;Cenosphaera&quot; lenticularis</td>
<td></td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Rzehakina inclusa, Rz.epigona</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Hormosina excelsa</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Hormosina ovulum</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Trochamminoides, Recurvoides</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Reophax</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Ammodiscus, Glomospira</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Saccammina placenta, Psammosphaera</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Rhabdammina, Nothia Rhizammina, Hyperammina</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Big &quot;Bathysiphon&quot; Acanthoecella</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Percent of fragments of tubular forams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of specimens of forams pro 100 g of rock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dark-shale</td>
<td>900</td>
<td>40</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>dark-grey sh.</td>
<td>700</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beige-sh.</td>
<td>500</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>grey-sh.</td>
<td>600</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>greenish sh.</td>
<td>100</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>grey sh.</td>
<td>45</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>greenish-grey sh.</td>
<td>35</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;laminated&quot; sandstone</td>
<td>1000</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;corroded&quot; sandstone</td>
<td>300</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of layer</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thicknes of layer /cm/</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>turbidite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelagic autochthonous (—) or partly resembeded by slow bottom currents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Planktic foraminifers in layer 11: Globotruncana cf.arca, G.cf.stuarti, Rugoglobigerina sp.  
*after Geroch*
Exposure 3. Ropica

At Ropica, along the stream-bed of the Sękówka river, near the road bridge, a cross-section made up of the Inoceramian Beds, Świątkowa Beds, Variegated Shales, Sub-Magura Beds and Magura Sandstones will be visited.

The Inoceramian Beds consist of alternating medium- and thin-bedded, laminated calcareous sandstones and grey-green shales. The upper surfaces of the sandstones are covered with numerous organic traces. The abundant microfauna contains the Late Cretaceous assemblages (Table 4).

The Inoceramian Beds are overlain by the Świątkowa Beds, a complex consisting mainly of dark grey and black shales with subordinate intercalations of thin-bedded, laminated sandstones. The foraminiferal assemblages are shown in Table 4.
<table>
<thead>
<tr>
<th>Sample</th>
<th>7.9-12</th>
<th>5.7-12</th>
<th>4-7</th>
<th>2-6</th>
<th>1-0.6</th>
<th>0.6</th>
<th>0.3</th>
<th>0.1-0.15</th>
<th>0.05-0.075</th>
<th>0.025-0.037</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>0.067</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.1</td>
<td>0.1</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**Frequency of fossils in washed residue**

**TABLE 3**
The Świątkowa Beds pass gradually into Variegated, red and green Shales. They contain intercalations of thin-bedded glauconitic sandstones. The red shales have yielded the foraminiferal assemblages of the Palaeocene, Early Eocene and Middle Eocene age (Table 3). The variegated shales are covered by a complex of medium- and thick-bedded, coarse grained,
glaucnitic sandstones of the Late Eocene. They are overlain by a thin layer of dark brown shales. The latter show strong similarity to the Menilitic Shales of the Silesian Unit.

The brown shales are covered by thick complex of the Magura Formation. It consists of thick- to medium-bedded, coarse grained, conglomeratic, glauconitic sandstones with subordinate shales. In this part of the section it is possible to observe various sedimentary structures connected with synsedimentary erosion, load processes and slumps.

From Siary, the excursion party, near the wooden church from the XVI century, will cross the contact of the Magura Nappe and the Silesian Nappe and after passing the town of Gorlice will follow the Gorlice fold. One of the oldest oil fields in the Carpathians is connected with this fold. The production started in the middle part of the XIX century. Farther east the itinerary will cross a tectonic peninsula (the Harklowa peninsula) of the Magura Nappe. East of the village of Folusz the excursion party will again enter the Silesian Nappe. On the right side, the forested range representing the marginal part of the Magura Nappe will be visible. The hills in front are constituted of the southern part of the Silesian Nappe. On passing towards the town of Dukla the excursion will travel along the depressions made up of the Krosno Beds belonging to the Silesian Nappe. In the vicinity of the town of Dukla, towards the south, a steep hill is visible. It marks the northern margin of the Dukla Nappe and is constituted of the Oligocene Cergowa Sandstones.

From Dukla to Iwonicz, the route will run along the southern part of the Central Carpathian Synclinorium made up mainly of the Oligocene Krosno Beds forming several, narrow thrust folds. Small oil fields are connected with these folds and Grzybowski conducted foraminiferal researches of material from bore-holes of some of these fields. In one of them (the Bóbrka-Rogi anticline) the first oil well in Poland was sunk in the year 1853. Mineral waters are connected with the oil fields. Iwonicz is one of the health resorts that have been using these mineral waters since the XVI century.
Second Day


The area that will be visited consists of three tectonic-sedimentary units: The Dukla, Silesian and Subsilesian Nappes.

The Dukla Nappe

The Dukla Nappe is constituted of several imbricated folds which show their maximum elevation in the eastern part and gradually plunge towards the northwest. Towards the west the Dukla Nappe is buried under the Magura Nappe and it or its equivalents are visible in several tectonic windows within the Magura Nappe. Near the town of Dukla, the Dukla Nappe lies flatly on the Silesian Nappe.

The full succession of the Dukla Nappe in the frontal segment (which is the part that will be visited) is as follows:
- the Inoceramian Beds, Senonian - Palaeocene.
- the Hieroglyphic Beds with Variegated Shales, Middle - Early Eocene
- the Green Shales, Late Eocene
- the Globigerina Marls, Late Eocene
- the Mszanka Sandstones
- the Jawornik Marls
- the Cergowa Sandstones
- the Menilite Shales with the Skalnik Limestone horizon
- the Krosno Beds, Oligocene.

The Silesian Nappe

The segment of the Silesian Nappe which will be visited is represented by a vast synclinorium - the Central Carpathian Synclinorium. It plunges towards the southeast where it is composed mainly of the Krosno Beds (Oligocene - Early Miocene). The Central Carpathian Synclinorium is made up of several, long, narrow, imbricated folds which display axial
culminations where strata, older than Oligocene are visible on the surface. The older strata also outcrop along the northern, marginal segment and along the southern uplifted segment (the Fore-Dukla Zone) of the Silesian Nappe.

The sequence of the segment of the Silesian Nappe which will be visited is as follows:
- the Upper Cieszyn Shales, Valanginian - Hauterivian.
- the Verovice Shales, Barremian - Aptian
- the Lgota Beds, Albian
- the Green Shales with radiolarites, Cenomanian
- the Red Shales, Turonian - Early Senonian
- the Istebna Beds, Late Senonian - Paleocene
- the Ciężkowice Sandstones, Paleocene - Early Eocene
- the Variegated Shales and Hieroglyphic Beds, Early - Late Eocene
- the Globigerina Marls, Late Eocene
- the Menilite Beds, Oligocene
- the Krosno Beds, Oligocene - Early Miocene.

The Subsilesian Nappe

This nappe appears from below the Silesian Unit in a tectonic semiwindow, north of the town of Krosno, and it is represented by imbricated folds (the Węgłówka folds). The Subsilesian Nappe is thrust onto the Krosno Beds of the Skole Nappe.

The succession of beds in the Węgłówka zone is as follows:
- the Verovice Shales with lenses of Grodziszcze Sandstone, approx. 220 m, Barremian- Aptian.
- the Lgota Beds, lower part, 180 m, Albian
- the Lgota Gaize Beds, 100 m, Albian - Cenomanian
- the Variegated Shales, 120 m, Cenomanian - Turonian
- the Red and variegated Węgłówka Marls, up to 300 m, Senonian - Middle Eocene.

Between Iwonicz and Dukla the route will run along the same road as on the previous day. From the town of Dukla the excursion party will go to the south, crossing the northern margin.
of the Dukla nappe which is thrust at a low angle onto the Silesian Nappe. In the old quarry the Oligocene Cergowa Sandstones and, farther on, the dark brown Menilite Shales containing intercalations of organodetritic conglomerates lately named Metressa layer, are visible.

Figure 16

![Diagram of lithostratigraphy of the Dukla Unit]

*Figure 16. Composite stratigraphic section of the upper Eocene to Oligocene deposits of the Dukla Unit in the vicinity of Dukla. Arrow indicates the position of the Skalinik limestone, sampled by Crzybowski (1894).*

**Exposure 4. Trzciana near Dukla**

In the village of Trzciana, on the summit of the hill situated on the west side of the road there are old quarries of organodetritic conglomerate. The quarries are grown over and scarcely
visible. The most visible one is situated north from the hermitage of Blessed John of Dukla. The conglomerate comprises fragments of Lithothamnia and Bryozoa and Foraminifera described by Grzybowski (1894). The bed displays gradation and lamination and contains very large carbonate clasts. A thickness of 180 cm is visible. This bed represents a seismoturbidite deposited by a SE-flowing turbidity current from the Silesian Cordillera where shallow-water sediments had been developed. As a result of this redeposition, material containing fauna mainly of the Late Eocene were laid down within the Oligocene sediments (Table 5).

Figure 17


After visiting the quarry, the excursion party will go to the Bóbka Oil Museum crossing the southern segment of the Central Carpathian Synclinorium constituted mainly of the Oligocene
DUKLA. Type locality of Grzybowski's paper /1894/
Sandy limestone layer /Skalnik limestone/

<table>
<thead>
<tr>
<th>Foraminifers acc.to T.Smigielska /1961/</th>
<th>Equivalent in the paper by J.Grzybowski /1894/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiroplectammina sp.</td>
<td>Textularia conica d'O orb.</td>
</tr>
<tr>
<td>Vulvulina haeringensis /Gämbel/</td>
<td>Schizophora haeringensis Gämbel</td>
</tr>
<tr>
<td>Karreriella subglabra /Gämbel/</td>
<td>Tritaxia an tricarinata Reuss</td>
</tr>
<tr>
<td>Keramosphaera sp.</td>
<td>Nodosaria longisulcata Grzyb.</td>
</tr>
<tr>
<td>Nodosaria longisulcata Grzyb.</td>
<td>Robulina arcuato-striata Hantken</td>
</tr>
<tr>
<td>Robulus alato-limbatus /Gämbel/</td>
<td>Polymorphina deflexa Grzyb.</td>
</tr>
<tr>
<td>R.arcuato-striatus /Hantken/</td>
<td>Globulina inflata Reuss</td>
</tr>
<tr>
<td>Dentalina sp.</td>
<td>Polymorphina hamboldtii Bornemann</td>
</tr>
<tr>
<td>Globulina gibba d’Orb.</td>
<td>Bulimina contraria Reuss</td>
</tr>
<tr>
<td>G.deflexa /Grzyb./</td>
<td>Discorbina pusilla Uhlig</td>
</tr>
<tr>
<td>G.inflata Reuss</td>
<td>Pulvinulina concentrica Parker</td>
</tr>
<tr>
<td>Guttilina communis /d’Orb./</td>
<td>Pulvinulina bimammata Gämbel</td>
</tr>
<tr>
<td>G.humboldti /Bornemann/</td>
<td>Pulvinulina rotula Kaufmann</td>
</tr>
<tr>
<td>Discorbis sp.</td>
<td>Truncatulinella livida Grzyb.</td>
</tr>
<tr>
<td>Baggina sp.</td>
<td>Truncatulinella rzhakii Grzyb.</td>
</tr>
<tr>
<td>Eponides pusillus /Uhlig/</td>
<td>Truncatulinella tenella Reuss</td>
</tr>
<tr>
<td>Parea pteromphalia /Gämbel/</td>
<td>Gypsina globulus Reuss</td>
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<tr>
<td>Schlosserina asterites /Gämbel/</td>
<td>Sphaeroidina austriaca d’Orb.</td>
</tr>
<tr>
<td>Ceratobullinina sp.</td>
<td>Rotalia lithothamnica Uhlig</td>
</tr>
<tr>
<td>Asterigerina biammata /Gämbel/</td>
<td>Valvatina umbilicata Bornemann</td>
</tr>
<tr>
<td>A.rotula /Kaufmann/</td>
<td>Discorbina uhligi Grzyb.</td>
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<tr>
<td>Amphistegina sp.</td>
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<tr>
<td>Pseudovalvulineria sp.</td>
<td>Truncatulinella rzhakii Grzyb.</td>
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<td>Cibicides aff.grimsdalei Nuttal</td>
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<tr>
<td>C.lividus /Grzyb./</td>
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<td>C.rzehaki /Grzyb./</td>
<td>Sphaeroidina austriaca d’Orb.</td>
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<tr>
<td>C.sublobatulus /Gämbel/</td>
<td>Rotalia lithothamnica Uhlig</td>
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<td>C.tenellus /Reuss/</td>
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<td>Gypsina globulus Reuss</td>
<td>Discorbina uhligi Grzyb.</td>
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<tr>
<td>Cribragloborotalia sp.</td>
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<td>Rotalia lithothamnica Uhlig</td>
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<tr>
<td>Gyroidina sp.</td>
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<tr>
<td>Rotorbinella uhligi /Grzyb./</td>
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</tr>
<tr>
<td>R.fungiformis /Subbotina/</td>
<td></td>
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<tr>
<td>Rotorbinella sp.</td>
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<tr>
<td>Baculogypsinioides tetraedra/Gämbl./</td>
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</tr>
<tr>
<td>Nummulitess sp.</td>
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<tr>
<td>Grzybowska multifida Bieda</td>
<td>Heterostegina n.sp.ind.</td>
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<tr>
<td>Discocyclina sp.</td>
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<tr>
<td>Asterocyclina sp.</td>
<td></td>
</tr>
<tr>
<td>Elphidium sp.</td>
<td></td>
</tr>
</tbody>
</table>

Explanation of symbols indicating foraminifers frequency:
VR - very rare, R - rare, F - frequent, C - common.

after Geroch
Krosno Beds. At Bóbrka the party will cross the southern limb of the Bóbrka anticline where, in its core, the Ciężkowice Sandstones of the Early Eocene age are visible. One of the oldest oil mines was situated along that fold. After visiting the Bóbrka Museum, the excursion party will cross the morphological depression made up mainly of the Oligocene Krosno Beds and will reach the medieval town of Krosno. On its northern outskirts, in the Ślązka district, the party will reach the core of the Potok-anticline containing Menilite Beds and Eocene strata. Oil has been produced from this anticline for more than one hundred years.

Exposure 5. Krosno

Below the church of St. Adalbertus, a cross section along Wisłok river exposing a southern limb of the anticline will be visited. This is the exposure described by Grzybowski in 1898. The oldest sediments exposed here are represented by red and sporadic green and brown clayey shales (Middle Eocene). They contain abundant manganiferous carbonate micronodules (rhodochrosite up to 96%; pers. com. T. Wieser). These beds pass into green shales (Middle and Late Eocene). Farther down the river the distorted core of a small syncline consisting of the lowermost part of the dark brown Menilite Beds (Subsilex menilite shales and marls) is visible. The southern limb of this syncline is made up of the yellowish-green marls representing the horizon of the Globigerina Marls.

Both red shales complex and green shales complex contain assemblages of agglutinated foraminifers. These faunas display a numerical dominance of tubular agglutinated, lituolids and ammonodiscids, but not of high diversity (ca. 35 species). Characteristic are: Rhabdammina cylindrica Glaessner, Ammodiscus latus Grzyb., Glomospira charoides (J. et P.), G. serpens (Grzyb.), Reophax elongatus Grzyb., Eratides sp. and Reticulophragnium amplexens (Grzyb.), which disappears in the upper part of the green shales complex and Cyclammina rotundidorsata (Hantken), which appears in the uppermost part of the green shales. In this part of the section occur rare calcareous foraminifers, which are abundant in the horizon of the Globigerina Marls (see: J. Grzybowski, 1898, 1969; Jurkiewicz, 1967).
Potok fold at KROSNO. (after Koszarski)

A - general cross-section, B - Grzybowski's outcrop.
Eocene: $E_1$ - variegated shales, mainly red, $E_2$ - Ciez-kowice sandstones, $E_3$ - grey-greenish shales with thin turbidites, $E_4$ - red shales, $E_5$ - green shales,
EO - Globigerina marls.
Oligocene: $O^m$ - Menilite bituminous shales (s- subsilex shales, si- silex), $O^k$ - lower Krosno sandstones,
Q - Quaternary fluvial deposits, ch - old St. Adalbertus church.
Examples of assemblages in Globigerina Marls (after B. Olszewski):

1 - The main components of the assemblage are: Catapsydax scandretti (Blow et Banner), C. perus (Todd), Temuitella liverovskae (Bykova), Globigerina officinalis Subbotina, Chilouemebelina gracillima (Andraee). As single specimens occur: Turbo rotalith cerroazulensis (Cole), T. pomeroli (Toumarkine et Bolli), Globigerina ampliapertura Bolli, Subbotina brevis (Jenkins), S. transdamubica (Samuel). The above mentioned forms suggest for the assemblage the latest Eocene age and correlation with the P 17 zones of Toumarkine & Luterbacher (1985) and Berggren & Miller (1988).

2 - A poorly diversified assemblage is composed predominantly of Catapsydax perus (Todd), with lesser amount of C. scandretti (Blow et Banner), C. unicavus (Bolli et al.). The occurrence of Globoquadrina tapuriensis (Blow et Banner), Globigerina ampliapertura Bolli, Temuitella liverovskae (Bykova) and Subbotina drooger (Mjatliuk) suggests the latest Eocene-earliest Oligocene age for the assemblage. It corresponds to the combined P 18-19 zones of Bolli & Saunders (1985) or to the lower part of the P 18 zone of Berggren & Miller (1988).
3 - The assemblage is typical for the uppermost part of the Sub-Menilite Globigerina Marls or the lowest part of the Menilite Shales (Olszewska, 1983). It is composed of single specimens of so called "large globigerinas" (tropical) and of moderate amounts of minute planktonic and benthic forms. Important for age designation are: *Globoquadra* *nella* Borsetti, *G. tapuriensis* (Blow et Banner), *Subbotina* *vialovi* (Mjatliuk). These species suggest the early Oligocene age for the assemblage, permitting for its correlation with upper part of the combined P 18-19 zones of Bolli & Saunders and the P-18 zone of Berggren & Miller. The benthic assemblage is typical for earliest Oligocene of the Polish Carpathians. It contains such, rather shallow-water species as: *Svatkina perlata* (Andreae), *Brizalina subtilissima* (Mjatliuk), *Globocassidulina globosa* (Hantken), *Anomalinoidea affinis* (Hantken), *Eponides binominatus* Subbotina, *Escornebovina leganyi* (Kenavy et Nyiro), *Rosalina* div. sp., *Asterigerina* sp. Compare also Van Couvering et al. 1981.

North from Krosno the party will traverse the northern part of the Central Carpathian Synclinorium which is bordered at the north by an elevated, frontal segment of the Silesian Nappe. On the tops of the hills picturesque rocky formation are visible. They are made up of Paleocene - Early Eocene Ciężkowice Sandstones. In the upper part, directly below the big tors, they are underlain by Early Eocene red shales (corresponding to the sediments mentioned by Grzybowski, 1897, 1898 in bore-holes from Potok-Krosno anticline). These shales contain characteristic assemblage of agglutinated foraminifers rich in *Glomospira* In the lower part the Ciężkowice Sandstones are intercalated by variegated shales, which contain Palaeocene assemblages of agglutinated foraminifers.

Going down from the hills, the route passes the older strata of the Silesian Nappe: the Istebna Beds (thick-bedded sandstones and black and grey shales of the Late Senonian - Palaeocene age), the red shales (Turonian - Campanian) containing agglutinated foraminifers of *Hormosina gigantea* and *Uvigerinammina jankoi* zones, the Upper Lgota Beds (Late Albian - Cenomanian) and the Upper Cieszyn Beds (Valanginian - Hauterivian). Between red shales and Lgota Beds a thin complex (up to 10 m) of greenish and black shales with thin calcareous turbidites is visible. Some of the shaly layers contain radiolarians and scarce agglutinated foraminifers (tubular and ammodiscids). These sediments correspond to the Cenomanian - Turonian boundary and are developed as radiolarian shales or radiolarites (described by Sujkowski,
1932) in all the nappes of the External Carpathians and also in all the successions of the Pieniny Klippen Belt.

In the marginal zone of the Silesian Nappe, east of Węglówka region, all the Late Cretaceous - Eocene turbiditic formations are wedging out and are replaced gradually by red shales of the same age. Close to the village of Węglówka the excursion will pass the thrust surface of the Silesian Nappe and enter the Subsilesian Nappe.

Exposure 6, Węglówka

At Węglówka, along the stream, a sequence of the Senonian Węglówka Marls may be examined. These are green and pink-red marls with weak fissility. Sporadic burrows are visible. Well exposed Campanian marls contain rich, mainly calcareous microfauna. Red and greenish marls contain well preserved and diverse fauna of planktonic as well as agglutinated and calcareous benthic foraminifers. This fauna displays a high overall diversity and a numerical dominance of planktonic genera such as: *Hedbergella*, *Heterohelix*, *Globigerinelloides* and *Globotruncana* s.l.. Agglutinated forms and calcareous benthic species constitute less than 10% of the assemblages. Green and reddish marls comprise different assemblages; planktonic foraminifers are very rare, diversity is still quite high, but agglutinated species constitute about 50% of the assemblages. The following agglutinated forms are characteristic: *Hormosina ovulum* (Grzybowski), *H. velascoensis* (Cushman), *Kalamopsis grzybowskii* (Dylążanka), *Spiroplectamina aff. dentata* (Alth), *S. costata* Huss, *S. lanceolata* Huss, *Dorothia crassa* (Marsson), *Tritaxia subparisiensis* (Grzyb.). Charateristic benthic calcareous *Reussella szajnochae* (Grzyb.) always occurs. (See: Liszkowa, 1954; Huss, 1957, 1966; Kaminski, 1981).

From Węglówka the excursion party will return to Iwonicz.
Geological map and cross-section of the Czarnorzecki — Węglówka area (after S. Jucha, F. Mitura, H. Świdziński)

Map. Silesian unit: 1 — Upper Cieszyń Shales (Valanginian-Hauterivian), 2 — Verovice Shales (Barremian — Aptian), 3 — Lower Łgota Beds (Albian), 4 — Upper Łgota Beds (Albian), 5 — Siliceous Marls (Conocomphalus), 6 — Variegated Shales (Cenomanian-Turonian), 7 — Lower Isbena Beds (Senonian), 8 — Interbed of grey shales in the Isbena Sandstone, 9 — Fucoidal marls (Upper Senonian), 10 — Upper Isbena Sandstone (Paleocene), 11 — Upper Isbena Shales (Paleocene — Eocene), 12 — Ciebkowice Sandstone (Paleocene — Eocene), 13 — Menillic Beds: white marls, Kliwa Sandstone, Menillic Shales (C-Tertiary), 17 — Passage Beds (Oligocene), 18 — Krosno Beds

Sub-Silesian unit: 19 — Verovice Shales and Grodziszewo Sandstone (Barremian), 20 — Łgota Beds with gaizes (Albian), 22 — Variegated Shales (Cenomanian — Turonian), 21 — Węglówka Marls (Senonian), 24 — Thrust-Line of the isometric nappe, 25 — Lines of tectonic discontinuity, 26 — quarries


Third Day

Itinerary: Iwonicz - Ropczyce - Zawada - Wieliczka - Kraków

On the road from Iwonicz to Zawada the excursion will cross, once more, the marginal part of the Silesian Nappe and will traverse the strongly folded Late Cretaceous, Palaeogene and Early Miocene rocks of the Skole Nappe.

Exposure 7. Międzybrodzie

The outcrop is in the most external zone of the Silesian Nappe, in the valley of the San river, north of Sanok (transition zone to the Subsilesian Nappe). The frontal part of the nappe (named here Grabownica-Zaluž Fold) is build of a few anticlines made up by Early Cretaceous flysch deposits. In these synclines the Turonian-Eocene pelagic variegated (mainly red) shales occur (without turbidites) with an intercalated thin complex of the Late Senonian variegated marls.

In the exposure, at the top of the Gaize Beds (Late Albian-Cenomanian sandstones and dark shales rich in sponge spicules) a thin complex, up to 10 m, of the Cenomanian-Turonian Radiolarian green shales (compare exposure at Węglówka) with black bituminous shales in the lower part, and a few layers of bentonized tuffs (91.4 ±4.7 Ma- see: Van Couvering et al. 1981) can be observed. The shales are rich in montmorillonite and contain barite and celestobarite crystals (see: Wieser, 1982).

The microfauna consists of radiolarians e.g: Praeconocaryomma lipmanae Pessagno, Gongylothorax siphonofer Dumitrica, Orbiculiforma sp., Protostichocapsa stocki (Campbell et Clark), Cryptamphorella sp., Stichomitra communis Squinabol (personal inf. M. Bąk). Radiolarians are common in some layers, but foraminifers are very rare e.g: Rhizammina, Ammodiscus, Glomospira, Recurvoide. In some regions the microfauna of this key horizon (corresponding to CTBE) is more diversified (see: Geroch et al. 1985, Gzik & Koszarski, 1990) and nearly everywhere the presence of ammodiscids is characteristic.

The next member, Red Shales are exposed here in their lower part only (Turonian - Coniacian). These red shales with thin intercalations of the green ones contain rich fauna of small,
Geological map of the frontal part of the Silesian unit and the Sub-Silesian unit in the San Valley


1 — Lower Verovice Shales, 2 — Grodziskie Sandstone, 2a — platy sandstones, 2b — convoluted sandstones and shales, 2c — thick-bedded sandstones, 3 — Upper Verovice Shales, 2p — interbeds of thick-bedded sandstones, 4 — Lower Lgota Sandstone, 4a — lower glauconitic sandstones, 4b — blocky sandstones, 4c — upper glauconitic sandstones, 5 — Middle Lgota Beds, shales, 6 — Gaitze Beds, 6a — dark shales and gales with siliceous marls and spiono- lites, 7 — green radiolarian shales, 8 — red shales (in Upper Cretaceous), 9 — Węglówka Marls, 10 — red shales (in Paleogene), 11 — Green Shales, 12 — Menillic Shales, 13 — Lower Kronko Beds, 13a — Sub-Jasto Kronko Beds, 12b — Supra-Jasto Kronko Beds, 14 — horizon of Jasto Shales, 15 — Upper Kronko Beds, 16 — shales, 17 — convoluted sandstones, 15 — river terraces (sanddived), 16 — slumps, 17 — visited outcrops.

I—II, III—IV, lines of cross-sections in Fig. 20 after L. Koszarski.
Figure 22

Cross-section along the valley of the San north of Sanok.

1-1, II-II — cross-sections of the frontal part of the Silesian unit and of the Sub-Silesian unit

Explanation, see Fig.21. In addition: 10a - Upper Istebska Sandstones (Paleocene), 10b - Hieroglyphic Beds (Middle Eocene), 11a - Globigerina Marls (Late Eocene), 12a - Sub-silex Menilite Shales, 12b - Menilite Silex, 12c - Menilite Shales, 12d - Passage Beds (between Menilite Shales and Krosno Beds).

III-III, IV-IV — Cross-sections of the inner part of the Skole unit (after L. Koszarski and F. Szymakowska). Explanation, see Fig. 24.

after Książkiewicz, 1968
Stratigraphic columns presenting development of the Isteanna Beds and their relation to the variegated shales and marls in the area of Krosno and Sanok (after L. Koszarski; col. 7 compiled after F. Huss)

1 - variegated shales, mainly red (Cenomanian-Senonian), 2 - Węgloówka variegated marls: 2a - W. v. marls (Early Senonian), 2b - W. v. marls, mainly green (Late Senonian); 3 - Godula Sandstone, 4 - Lower Isteanna Beds (Late Senonian): 4a - Sucha Góra Sandstone, 4b - intercalations of the inoceramian - bed - type with fusoid marls, 4c - lower part of Czarnorzeki Sandstone, 5 - Upper Isteanna Beds (latest Senonian - Paleocene), 5a - upper aulurites and shales with exotics, 5b - upper part of Czarnorzeki Sandstone, 5c - upper shales with siderites (= Czarnorzeki Shales); Paleocene-Early Eocene: 6 - variegated shales, 7 - variegated marls and marly-shales

Higher up, in the small creek, Late Senonian greenish, rose and red soft marls contain (after Liszkova In: Koszarski, 1963) rich microfauna, consisting predominantly of agglutinated forms with an admixture of calcareous benthics up to 15%. Characteristic forms are as follows: *H. ovulum* (Grzyb.), *Spiroplectammina dentata* (Alth), *Goesella rugosa* (Hanzlikova), *Dorothy crassa* (Marsson), *Reussella szajnochae* (Grzyb.), *Stensioeina beccariiformis* (White), *Nuttallinella florealis* (White). Planktonic forms are absent or very rare and poorly preserved.

Westwards, near the zone of lateral transition from Variegated Marls to Red Shales (in the same Grabownica Fold), the admixture of calcareous benthics progressively disappears. This transition zone was interpreted as an ancient CCD. In the visited section this occurrence of the Variegated Marls above the Red Shales may be considered as the result of lowering of the CCD close to the Campanian / Maastrichtian boundary.

The Skole Nappe

The Skole Nappe occupies a large area in the eastern part of the Outer Carpathians. It appears near Brzesko, from beneath the Silesian and Subsilesian nappes. To the east, between Tarnów and Pilzno, the Skole Nappe locally disappears beneath the two higher nappes, but farther to the east it becomes broader and along the eastern Polish border it is ca. 40 km wide. The sequence of the Skole Nappe which will be visited is as follows:

the Spas Shales, Barremian - Albian

the Radiolarian Shales (Dolhe shales), Cenomanian

the Red Shales, Cenomanian - Turonian

the Siliceous (Holownia) Marls, Turonian - Coniacian

the Inoceramian (Ropianka) Beds, Coniacian - Paleocene

the Variegated Shales, Paleocene, Early and Middle Eocene

the Green Shales, Middle and Late Eocene
Geological map of the inner part of the Skole unit in the San valley
(after L. Koszarksi and F. Szymakowska)

1 - Eocene, 1a - black shales, 1b - green shales, 2 - Menilite Beds (Eo-Oligocene and Oligocene), 2a - Sub-silex Shales, 2b - Silex, 2c - Menilite Shales, 2d - Kliwa Sandstone, 2e - Jaslo Shales, 2f - interbed of sandstones and shales of Krosno type alternating with Menilite Shales, 3 - Lower Krosno Beds (above the Jaslo Shales), 3a - thick-bedded sandstones, 3b - interbeds of Menilite Shales, 3c - interbeds of silex, 3d - horizon of grey shales with tuffs, 4 - Middle Krosno Beds (Early Miocene?), 4a - submarine mudflow with blocks and pebbles of flysch rocks, 5 - Upper Krosno Beds (Early Miocene), 5a - shales, 5b - interbed of convoluted sandstones, 6 - Silesian unit (Cretaceous undivided), 7 - Sub-Silesian unit (Upper Cretaceous, Paleogene undivided); 8-12 - Quaternary: 8 - upper terrace 45-60 m., 9 - middle terrace 30-35 m., 10 - lower terrace 23-6 m., 11 - lower terrace 1-3 m., 12 - gravels in the stream-bed of San: III-III, IV-IV - cross-sections.

after Książkiewicz, 1968
Fig. 25. Composite lithostratigraphic succession of the Skole Unit in the Rzeszow - Debice area. 1 - Belzwin Sillstones, 2 - Spas Shales, 3 - Variegated Shales, 4 - siliceous marls, 5 - Inoceramian beds, a - Baculites marls.
the Globigerina Marls, Late Eocene
the Menilite Beds, Oligocene
the Krosno Beds, Oligocene - Early Miocene.

Exposure 8. Dębna

Near the village of Dębna, on the western side of the San valley, the Krosno Beds of the internal zone of the Skole Nappe are exposed. The whole section, above Eocene red, green shales and Globigerina Marls comprises black bituminous Menilite Shales (Oligocene) and very thick turbidite sequence (ca. 2500 m) of the Early Miocene Krosno Beds, composed of grey sandstones and shales. The lower Krosno Beds are composed mainly of thick-bedded sandstones with shaly, key complex (Niebylec Shales; see: Nowak et al., 1985, Koszarski et al., 1985) in their top; the middle Krosno Beds are represented mainly by medium-bedded sandstones with shaly intercalations and the upper Krosno Beds are shaly with subordinate thin-bedded sandstones.

In the visited exposure the transition between middle and upper Krosno Beds is visible, which corresponds to NN 3 nannozone (*Helicosphaera ampliaperta* Bramlette et Wilcoxon, *H. carteri* (Wallich) emend. Kamptner, *H. walbersdorfsis* Mueller, *Sphenolithus belemnos* Bramlette et Wilcoxon: according to J. Ślęzak). Shaly intercalations at the top of some turbiditic rhythms contain foraminifers representing the youngest, very poor agglutinated assemblages known from the Carpathian flysch. This fauna displays extremely low diversity, mostly Haplophragmoides sp.

Exposure 9. Zawada

Between the villages of Zawada and Stasiówka small exposures of the middle part (Campanian - Early Maastrichtian) of the Inoceramian Beds are visible. Foraminifera from the shally intercalations were studied by Friedberg (1901). In the village of Zawada marly part of the Inoceramian Beds with a few intercalations of thin-bedded sandstones is exposed.
Between the villages of Zawada and Stobierna the exposure of the green-grey marly and clayey shales with marly and sandy turbidites is visible. In the southern part of the exposure a submarine slump deposit is exposed. It is made up of the light grey marls containing planktonic foraminifers and fragments of the black marly shales of the Early Cretaceous age. In the village of Stasiówka the marly shales intercalated with thin-bedded sandstones are visible. In all the outcrops, visited near Dębica, in the turbiditic marly intercalations calcareous foraminifers (planktonic and benthic) are prevailing eg.: Hedbergella, Globigerinelloides, Globotruncana s.l., Heterohelix, Nodosariidae, Pleurostomella, Osangularia, Reussella szajnochaе (Grzybowski), debris of echinoderms and molluscs and ostracods; with accompanying Dorothia, Arenobulimina, Ataxophragmitium, Spiroplectammina and others.

Figure 26

Geological map of the Skole Nappe in the Dębica region. M - Miocene; P - Eocene variegated shales, KP - Upper Cretaceous - Paleocene Inoceramian beds; W - Upper Senonian Wegierka (Baculites) Marls; K - Upper Cretaceous Inoceramian sandstones; Ply - Turonian Pisarzowice beds.

Jurkiewicz & Woiński, 1986

Shally autochthonous layers in the outcrops at Zawada-Stobierna and Stasiówka contain nearly exclusively agglutinated foraminifers eg.: Rhabdammina cylindrica Glaessner, Nothia excelsa (Grzybowski), Saccammina placenta Grzybowski, Amodiscus cretaceous Reuss, Glomospira charoides (J et P), G. gordialis (J et P), Hormosina ovulum (Grzybowski), H. velascoensis (Cushman), Kalamopsis grzybowski (Dylążanka), Trochamminoides, Recurvoides, Cystaminella, Rzechakina epigona (Rzechak), Rz. inclusa (Grzybowski), Dorothia crassa (Marsson) and "Cenosphaera" lenticularis Grzybowski. The Inoceramian Beds of the Skole Unit in contrast to the equivalent strata of the Magura Unit contain much more calcareous foraminifers. This may be explained by the more shallow-water environment and proximity of shelf and slope.
From Zawada after crossing the frontal part of the Skole Nappe, the route will run towards the west along the Carpathian Foreddeep filled up by the Middle Miocene molasse deposits.

Exposure 10. Szczepanowice

West of Tarnów the excursion will go to the south to the village of Szczepanowice, where the lower part of the Skole Nappe sequence is visible. It is composed of the Spas Black Shales (Early Cretaceous), thin horizon of greenish and red shales (Late Cenomanian - Early Turonian) and a series of calcareous thin-bedded flysch (so called "siliceous and fucoid marls" of Turonian - Senonian) passing into shaly-sandstone flysch of the higher part (Late Senonian - Palaeocene) of the Inoceraman Beds.

Well exposed calcareous turbidites (fine calcarenites-calciulites) are composed of limestone and quartz grains, sponge spicules, calcareous (mainly planktonic) foraminifers, radiolarians etc. Shaly layers contain both calcareous and agglutinated foraminifers. The Inoceraman Beds sequence corresponds to Uvigerinammina jankoi and Hormosina gigantea zones.

From Szczepanowice section we will return to the Carpathian margin.
Sequences in outcrops of the Inoceramian Beds near Dębica

a - hard marl, b - soft marl, c - shale, d - sandstone - shale sequence
e - mudflow, f - slump of marls, g - fragments of early Cretaceous black shales in slump

after L. Koszarski
Skole Nappe near Szczepanowice (after L. Koszarski)

Map. Middle Miocene (Badenian): Ma - autochthonous, Mf - folded and thrust, M - Badenian cover on the Skole Nappe; SL - Skole Nappe; K1 - Early Cretaceous, K2 - Late Cretaceous-Early Paleocene, Pg - Late Paleocene-Oligocene; SS - Silesian and Subsilesian Nappes; x-x line of section

Section. Skole Nappe: oSK - outer zone, cSK - central zone, K1 - Early Cretaceous Spas black Shales, Inoceramian beds (Turonian-Early Paleocene): Km - siliceous marls, Kms - hard marls with shales, Ksm - fusco marls and shales, Kst - sandstones and shales, Ksh - shales and sandstones; M - Badenian cover

I - Tarnów, S - Szczepanowice

Exposure 11. Sułków

At the village of Sułków, near the town of Wieliczka, the Middle Miocene (Badenian) deposits will be visited. The agglutinated foraminifers according to E. Łuczewska are connected with detrital facies of the sea, at the northern and southern borders of the foredeep. They are represented by index species *Cylindroclavulina rudis* (Costa) and *Textulariella lithothamnica* Łuczewska. In the foredeep, the assemblages of agglutinated foraminifers are comprised of numerous *Cyclammina, Haplophragmoides, Protobotellina, Hyperammina, Rhabdammina*. They are developed in the sandy and muddy facies of the central part of the foredeep, while the marly and clayey facies are poor of agglutinated foraminifers (see: Łuczewska, 1990). The distribution of selected foraminiferal species in the Badenian of the Carpathian Foredeep is presented in Fig. 30.
In the small exposure, marls and calcareous mudstones of the Chodenice beds (the Late Badenian) are exposed. They overlie the Wieliczka salt deposits. In the area of Wieliczka only the Late Badenian (Kosovian) sediments are exposed (eg. in Sulków), while westward from Wieliczka the Late Badenian sands, so called "Bogucice Sands" are distributed. In the area of Cracow the Early and Middle Badenian claystones are developed. They represent the deeper facies of the foredeep and contain abundant planktonic foraminifera, but agglutinated forms do not occur in this area.
EXCURSION B
19 September, 1993

Itinerary: Kraków - Wadowice - Bielsko Biała - Gumna (near Cieszyn) - Goleszów

The itinerary of the excursion will run along the margin of the Northern Carpathians. This part of the Carpathians is made up of the Silesian Nappe thrust onto Late Cretaceous and Palaeogene beds, forming the Subsilesian Nappe. This latter nappe appears on the surface in the narrow belt along the Silesian Nappe and in small tectonic windows. Near Wadowice a more external nappe (the External Flysch) is visible. It is made up of the Cretaceous and Palaeogene rocks. According to some theories this represents the western prolongation of the Skole Nappe from the Eastern Carpathians. The frontal part of the Silesian Nappe and the Subsilesian Nappe in the area visited are strongly folded.

In the area of Wadowice the succession of the Subsilesian unit is as follows:
the Red Shales, Turonian.
the Red Shales and Marly Shales, Coniacian - Santonian
the Red and Variegated Marls, Campanian
the Green Marls, Maastrichtian
the Greenish Marls, Variegated Marls and Shales, Paleocene
the Red Marls, Variegated and Green Marly Shales, Early Eocene
the Green Marls, Variegated Marly Shales, Middle Eocene
the Green Marls, Upper Eocene
the Menilite Shales, Oligocene.

The composition of the Silesian Unit in the area which will be visited, between Bielsko and Cieszyn, is as follows:
the Lower Cieszyn Shales, ? Kimmeridgian - Tithonian.
the Cieszyn Limestones, Late Tithonian - Berriasian
the Upper Cieszyn Shales, Valanginian - Hauterivian
the Grodziszcze (Hradiste) Shales, Hauterivian
the Verovice Shales, Barremian - Aptian
the Lgota Beds, Albian
the Mikuszowice Cherts, Albian - Cenomanian
the Lower Godula Sandstones, Turonian - Early Senonian

Exposure 12. Bujaków

Hantkenina marls (after Gasiński, M. A. 1978).
Middle Eocene, Hantkenina, variegated, mainly green marls occur at the village of Bujaków, situated between Bielsko and Kęty (Fig. 31). These sediments belong to the sequence of the Subsilesian Unit. The assemblage of microfossils consists of planktonic foraminifers, ca. 95%, mostly Globigerina, Globorotalia s.l., Globigerapsis, Hastigerina and of benthic ones ca. 5%, mostly calcareous forms. Hantkenina comprises ca. 1% of the total assemblage (Fig. 32). This is the farthest to the north situated outcrop of the Hantkenina marls in the Carpathians.

Exposure 13. Lipnik

At Lipnik, east from the town of Bielsko-Biała, along the small creek the following members of the Silesian Nappe are cropped out: the upper part of the Upper Cieszyn Shales (Valanginian - Hauterivian), the Grodziszcz Shales (Hauterivian - Early Barremian), the Verovice Shales (Barremian - Aptian - Early Albian), the Lgota Beds (Albian - Cenomanian) and the Godula Sandstones (Turonian) (Figs. 33, 34, 35).

Between these members there are transitions with the exception of the boundary between the Lgota and Godula Beds, where there is probably a hiatus caused by intraformational erosion. The Upper Cieszyn and Grodziszcz Shales are characterized by the presence of calcium carbonate. In the younger members (Verovice Shales and Lgota Beds) the pelitic sediments are devoided of calcium carbonate. This bears upon the distribution of microfauna (Table 6).
Figure 31

--- A fragment of the tectonic map of Western Polish Carpathians (Budowa Geologiczna Polski IV, Tektonika cz. 3, fig. 40, 1972). 1 — Sub-Silesian nappe; 2 — Silesian nappe; 3 — Magura nappe; 4 — Andrychów klippen; 5 — Miocene; 6 — Bujaków village

Fragment mapy tectonicznej Polskich Karpat Zachodnich (Budowa Geologiczna Polski IV, Tektonika cz. 3, fig. 40, 1972); 1 — płaszczowina podśląska; 2 — płaszczowina śląska; 3 — płaszczowina magurska; 4 — skalki andrychowskie; 5 — niewy: 6 — Bujaków

Gasiński, 1978

--- Position of marls with Hantkenina in the sequence of beds in the Sub-Silesian series (after W. A. Nowak, in S. Geroch, 1967, fig. 67). 1 — variegated shales (Turonian-Lower Senonian); 2 — variegated marls (Upper Senonian); 3 — dark shales, sandstones and conglomerates of Istebna Beds (Paleocene); 4 — green-brown shales, marls, glauconitic sandstones, variegated marls (Paleocene-Eocene); 5 — variegated marls, partly marls with Hantkenina (Middle and Upper Eocene); 6 — micaceous sandstones and marly shales of Krośnie Beds (Oligocene)

Pozycja margii z Hantkenina w profili jednostki podśląskiej (wg W. A. Nowak, 1968, S. Geroch, 1967, fig. 67). 1 — pastre lupki (turon-senon dolny); 2 — pastre margle (senon górny); 3 — ciemne lupki, piaskowce i slepieńce — warstwy istebnińskie (pałecone); 4 — zielonobrunatne lupki, margle, piaskowce glaukonitowe, pastre margle (pałecone-socone); 5 — pastre margle, częściowo margle z Hantkenina (socone środkowy i górny); 6 — piaskowce mikowce i margliowe lupki — warstwy krośnieńskie (oligocone)
Gasiński, 1978

Foraminiferal assemblage from Hantkenina maris at Bujaków (diagram)
Diagram illustrujący skład ilościowy otwornic w próbie marglu z Bujako-
wa

INCOMPLETE LIST OF SPECIES:

Rhabdammina sp.  
Hyperammina sp.  
Ammodiscus siliceus (Terquem)  
Glomospira charoides (Parker et Jones)  
Reophax pilulifer Brady  
Cribrostomoides subglobosus Sars  
Hoplolaragonoides walteri (Grzybowski)  
Recurvoides sp.  
Trochamminoides coronatus Brady  
Ammobaculites agglutinans (d'Orbigny)  
Vulvulina eocaena Montagne  
Textularia agglutinans d'Orbigny  
Clavulinoides cf. midwayensis Cushman  
Dorothia sp.  
Nodosaria annulifera Cushman et Bermudez  
Nodosaria cf. hochstetteri Schwager  
Chrysozonion tenuicostatum Cushman et Bermudez  
Lagenia crebra Matthes  
Nuttallides trinaspis (Nuttall)  
Hastigerina micro Cole  
Globorotalia brodermanni Cushman et Bermudez  
Globorotalia densa (Cushman)  
Globigerina boweri Bolli  
Globigerina eocaena Gumbel  
Globigerina yeguaensis Weinzierl et Applin  
Subbotina limaperta (Finlay)  
Truncorotaloides topfensis Cushman  
Globigeropsis kugleri Bolli, Loeblich et Tappan  
Globigeropsis mexicana (Cushman)  
Globigeropsis rubiformis (Subbotina)  
Globigerinina corpulenta (Todd)  
Hantkenina mexicana Cushman  
Hantkenina liebensi Shokhina  
Hantkenina dumblei Weinzierl et Applin  
Eponides umbonatus Reuss  
Cibicides cushmani Nuttall  
Pleurostomella sp.  
Aragonia sp.  

Figure 32

R²  
F  
F  
R  
R  
F  
F  
R  
R  
R  
R  
R  
R  
F  
C  
C  
A  
C  
F  
F  
R  
R  
C  
C  
R  

41
LIPNIK SECTION (near Bielsko-Biała) after Geroch & Nowak, 1963

Map of the vicinity of Bielsko-Biała. The rectangle—area included in the geological map fig. 2; the heavy line denotes outcrops of the Lower Cretaceous investigated micropaleontologically.

Geological map of the vicinity of Lipnik. Q - Quaternary; Kg - Lower Godula Beds (Cenomanian-Turonian); Kl, Upper Lgota Beds (Mikuszowice siltex); Kl' - Middle and Lower Lgota Beds; (Kl+Kl') - Albian-Cenomanian?; Kbw-Wierzowice Beds (Barremian-Aptian-Early Albian?); Kv, - Grodziszcze Shales and Upper Cieszyn Shales (Valanginian-Hauterivian); Kv2 - Cieszyn Limestones; Kv1 - Lower Cieszyn Shales (Kv1+Kv2 - Tithonian-Berriasian); - faults; 2 - overthrusts; 3 - strike and dip, position of hieroglyphs; 4 - old outcrops and presumable position with macrofauna described by V. Uhlig (1883, 1901); from Fallaux's and L. Hohenegger's collections (b - Barremian fauna, h - Hauterivian fauna); 5 - outcrops of the Lower Cretaceous investigated micropaleontologically.
Geological map showing a section of the stream with outcrops of the Lower Cretaceous (Fig. 3a) and the localization of samples [C. 1—10, B. 11—14, L. 15—71] taken for microfauna investigations (Fig. 3b); (5) — Lower Godula beds; (4a) — Upper Lgota beds (Mikuszowice silex); (4b) — Middle Lgota beds; (4a) — Lower Lgota beds; (3b) — Upper Wierzowice beds; (3a) — Lower Wierzowice beds; (2) — Grodziszcze shales with marked new position of fossil flora (Weichselia lubricata Stockes et Webb. and Fresnoliopsis hoheneggeri Schenck determined by dr J. Rojman); (1) — Upper Cieszynek shales

after Geroch & Nowak, 1963
Lower Credevous at Lipnik on the basis of outcrops shown on the map (Fig. 29). (a) — Lower Gudula beds; (b) — Upper Gudula beds (Mikulczowiek sile); (c) — Middle Gudula beds; (d) — Lower Lgota beds; (e) — Upper Wierzowice beds; (f) — Lower Wierzowice beds; (g) — Grodiniec shales; (h) — Upper Lota shales; (i) — thin-bedded, coarse-grained sandstones (in 5); (j) — middle-bedded, coarse-grained and conglomeratic sandstones (in 6); (k) — muddy conglomerates (in 7); (l) — fine-grained to coarse-grained sandstones, the thicknesses of the layers variable (in 6, 7, 8, 9); (m) — platy, fine-grained sandstones with calcite-veins (in 7); (n) — thin- to middle-bedded, fine-grained siliciclastic sandstones (in 8); (o) — thin-bedded, fine-grained sandstones with calcite-veins (in 7); (p) — platy, fine-grained sandstones with calcite-veins (in 7); (q) — thin-bedded sandstones (in 7, 8); (r) — thin- and middle-bedded silticlastic sandstones (in 1, 3); (s) — siltstones (in 7, 8, 9, 10); (t) — siltstones (in 4); (u) — hard light-grey marl (in 5, 10); (v) — dark marly shales interbedded with light marly shales (in 8, 9); (w) — dark marly shales with thin interbeddings of sandstones (in 1); (x) — green and gray stained shales (in 3, 4, 5, 6, 7); (y) — black shales (in 3).

after Geroch & Nowak, 1963
FLYSCH CARPATHIANS IN POLAND

Dukla-Grybow | Magura
--- | ---

**Beds**

- 25 Cergowa Beds
- 22 L.K.B.
- 19 G.S.M.
- 19 Sp.M.Sh.
- 18 M.B.
- 14 Ma.B.
- 14 V-G.Sh.
- 14 M.Sh.
- 13 G.M.
- 13 S.M.Sh.
- 13 17 S.M.Sh.
- 12 Variegated Shales
- 12 Green Shales
- 10 Hieroglyphic Beds
- 9 with Przybyzow Sands (locally)
- 8 Variegated Shales
- 8 Maxian Beds (Sh. loc. Sand)
- 8 Gisna Sands
- 8 Lupkows Beds
- 8 Variegated Shales
- 8 Green Sh.
- 8 Radiol
- 8 Black Shales
- 8 Variegated and Green Shales
- 8 Dark Shales and Sands.
- 8 Inoceramian Beds
- 8 (including Szczawina Beds)

**KLIPPEN BELT**

- 3 Calcareous Limestone of the Pieniny Klippen Belt (N)

**DECOLLEMENT**

(after Koszarski, L.)

= Cisowa Member; F.M. = "Fucoides" Marls; Fr.M. = Grey Frydek Marls;
Sub-Grybow Marls; G.S.w.R. = Green Shales with Radiolarians;
one horizon; J.M. = Jastrzebia Marls (with gaizes); Jas.M. = Jasienica
nka Sandstones; M.Sp. = Mikusowice Spongiolites; P.B. = Fisarzowice
R.C. = Rybie Conglomerates and Sandstones; S.C.M. = Sub-Geryowa
S; Sz.S. = Szydlowiec Sandstones; V-G.Sh. = Variegated and/or Green

numbers 1-31 inclusive
indicate tuff horizons
Exposure 14. Gumna

At Gumna, in a road-cutting the Lower Cieszyn Shales (Kimmeridgian-Tithonian) are exposed. These are dark-grey marly shales with a few intercalations of detrital limestones. Noteworthy is the presence of slump structures which suggest that the observed deposits represent a part of the submarine slump. Microfauna in the marls consists mainly of small *Trocholina, Nodosariidae*, radiolarians and ostracods. Agglutinated specimens are rare e.g. *Ammodiscus, Glomospira, Paleogaudryina*. Detrital limestones contain fragments of macrofauna e.g. echinoderms and molluscs. Selected microfossils are indicated in Table 7.

Figure 36

Exposure 15. Goleszów

At Goleszów, a large quarry in Cieszyn Limestone (Late Beriassian) will be visited. In the traverse cutting leading to the main quarry the lower part of the limestones is exposed. The section begins with grey-white, thin-bedded limestones alternating with marly shales. Some of the layers contain tintinnids, mainly *Calpionella alpina* Lorenz. Higher up, the limestone layers become darker in colour. They alternate with grey shales. Graded bedding is discernable in several layers, which are thin- and medium-bedded and often composed of graded and pelitic parts. Different microfaunal associations are connected with different lithology.
Malik, 1986 (after Książkiewicz)

According to Bieda et al. (1963), Geroch et al. (1967), Geroch & Olszewska (1990) the
detrital, turbiditic limestone layers contain calcareous agglutinated and calcareous secreted
foraminifers (Textulariidae, Lituolidae, Ataxophragmiidae, Nodosariidae, Involutinidae),
ostracods, sponge spicules and fragments of echinoderms, molluscs and bryozoans. Pelitic
limestone layers are characterized by radiolarians, calpionellids, stomiosphaerids, Nannoconus
and Globochaete.
Representative detailed logs of the Cieszyń Limestones from Goleszów, Jasieniowa quarry

Detritic limestones: 1 - with grading or massive; 2 - horizontally laminated; 3 - cross-laminated (in cosets or in a single set); 4 - outsized intracrysts. Pelitic deposits: 5 - calcilutites (pelitic limestones); 6 - marlstones; 7 - marly claystones. Sole markings: 8 - extensive scours; 9 - current marks; 10 - bioturbation; 11 - load structures

Malik, 1986

The uppermost part, with thicker, coarse grained and conglomeratic limestones, is seen in the main, abandoned quarry. Their coarse, basal part consists of organic detritus of fragmented shells of lamellibranchs, aptychi, crinoids, urchin spines and algae.

**Exposure 16. Zawadka**

At Zawadka, SE from Wadowice along the creek of Dąbrówka, the Subsilesian marls and shales crop out in several small exposures. 15 metres down from the bridge (on the road from the bus stop) there are red and green marls which represent Early and Middle Eocene. A few metres farther, a contact with turbiditic sandstones is visible. These turbidites represent the
lower tectonic units (External Flysch - ? Skole Unit). Going upstream from the bridge, on the right side of the creek, variegated and green marls of the Campanian and Santonian age are visible.

On the other side of the creek, a succession of the Paleocene variegated marls and yellowish green marls with red intercalations are visible, passing to the right into yellowish-green marls of the Maastrichtian age. After passing several small exposures of Palaeocene and Maastrichtian variegated marls and grey siltstones and shales from the External Flysch Nappe the excursion party will see, in the creek bed the red Turonian shales, variegated Santonian marls, green and red Campanian marls.

The Campanian variegated marls contain microfauna similar to that described by Grzybowski (1896) but scarce. Planktonic specimens are very rare and agglutinated forms comprise more than 50% of the assemblage. Characteristic foraminifers are: Reussella szajnochae (Grzybowski), Tritaxia subparisiensis (Grzybowski), Spiroplectammina subhaeringensis (Grzybowski), Dorothia crassa (Marsson), Hormosina ovulum (Grzybowski).

Maastrichtian green marls display a numerical dominance of planktics and approximately a one to one ratio between agglutinated and calcareous benthic foraminifers. Palaeocene greenish and variegated marls contain less than 15% of planktonic specimens. Characteristic agglutinated species are:
Glomospira grzybowskii Jurkiewicz, Hormosina ovulum (Grzyb.), H. velascensis (Cushman), Rzehakina epigona (Rzehak), Dorothia crassa (Marsson), Remesella varians (Glaessner).

The Early and Middle Eocene assemblages from red and green marls comprise mostly over 90% of planktonic specimens. Characteristic agglutinated species are: Spiroplectammina spectabilis (Grzyb.), Kar rerulina conversa (Grzyb.), Dorothia div. sp., Gaudryina div. sp. and Reticulophragmium amplectens (Grzyb.). Higher up a contact between the Early Campanian red, marly shales and a turbiditic complex from the External Flysch Nappe is visible.
I. Geology south of Wadowice
/compiled by L. Koszarski/

scr1 - Silesian nappe /early Cretaceous flysch/, Ss - Sub-Silesian thrust sheets /pelagites/:
A - Grzybowski's pit /Campanian, Paleocene/
B - Neotype locality at Zawadka /Turonian-

Oligocene

External Flysch /?Skole nappe/:

Owk - Krosno shales and sandstones /late

Oligocene - early Miocene/, O - Menilite

beds /bituminous shales, silex, sandstones

/Oligocene/, Ma-Pa - Maastrichtian - Paleo-

cene flysch /Szydlowiec and Gorzen beds/

II. Part of the section at ZAWADKA

Sk - External Flysch /Paleocene part/,

Ss - Sub-Silesian thrust sheet - variegated

marls and shales /Tu - Turon, Ko - Coniac.

and Santon, Ka Campan, Ma - Maastricht,;

Pal - Paleocene, E1-E2 - early and middle

Eocene/. 

50
LITERATURE


