Early Berriasian ammonites from the Štramberk Limestone of Kotouč quarry (Outer Carpathians, Silesian Unit, Štramberk, Czech Republic)

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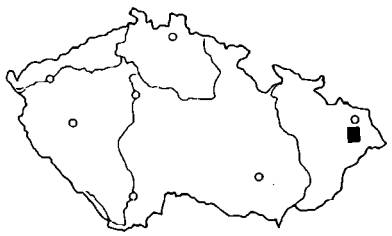
Abstract. Several favourably preserved ammonites were found in a limestone clast redeposited to a layer of limestone breccia, in the middle of the western, at present already removed, part of the Kotouč Hill massif near Štramberk composed of Štramberk Limestone (Outer Carpathians, Silesian Unit). Among these ammonites, *Neocosmoceras cf. bruni* Mazenot, *Dalmasiceras kiliani* Djanélidzé and *Micracanthoceras microcanthum* (Oppel) were determined. The first two listed species had not been known from the Štramberk Limestone so far. According to the present knowledge, these species do not indicate the Tithonian but the Berriasian, most probably Lower Berriasian. The Berriasian age is suggested for a part of the Štramberk Limestone also by some other species of Zittel (1868) listed in the final part of this contribution and by other data by the same author on non-existing localities outside Štramberk area where slightly different limestones were exploited, though considered identical with the Štramberk Limestone. Redeposition and accumulation of Štramberk type limestones of the Tithonian and Berriasian age took place in different tectonofacies segments of the Silesian Unit and at different stratigraphic levels from the end of the Jurassic on, mostly during the Lower Cretaceous.

Abstrakt. Uprostřed západní, dnes už odtěžené části masívu Kotouče u Štramberka budovaného štramberskými vápenci (Vnější Karpaty, slezská jednotka) v klastu vápence redeponovaného do polohy vápencové brekcie se podařilo nalézt několik příznivě zachovaných amonitů, mezi kterými se podařilo určit *Neocosmoceras* cf. *bruni* Mazenot, *Dalmasiceras kiliani* Djanélidzé a *Micracanthoceras microcanthum* (Oppel). Prvně dva uvedené druhy nebyly dosud ze štramberských vápenců známy. Podle dnešních vědomostí tito představitelé neodpovídají tithonu, ale berriasu, s největší pravděpodobností spodnímu. Berriaskému stáří části štramberských vápenců též nasvědčují některé další druhy zpracované Zittelem (1868), uvedené v závěrečné části našeho příspěvku, podobně jako jeho další údaje z dnes už zaniklých lokalit mimo oblast Štramberka, na kterých se těžily poněkud odlišné vápence, považované za vápence štramberské. K redepozici a akumulacím vápenců štramberského typu tithonského a berriaského stáří docházelo v různých tektonofaciálních úsecích slezské jednotky a v rozdílných stratigrafických úrovních od konce jury především v průběhu spodní křídy.

Key words: Outer Carpathians, Silesian Unit, Štramberk Limestone, Berriasian ammonites.



Introduction

After blasting on August 19, 1978, H. Eliášová and M. Eliáš found several ammonites of the family Berriasellidae in the road cut between the 4th and 5th levels of the Kotouč quarry near Štramberk, in the typical Štramberk Limestone. These were passed to the latter mentioned author for determination. However, the absence of modern ammonite literature with precise stratigraphic data hindered their systematic description then. Also the ambiguous definition of the Jurassic/Cretaceous boundary posed a problem.

Only later did we return to the indetermined specimens and examine the Zittel's collection of ammonites from Štramberk (1868). As a result of re-granting the Humboldt scholarship to one of us, we were able to examine the Barthel's et al. (1966) collection in Munich. Thereafter, two new ammonite species, not reported from the Štramberk Limestone yet, could be determined in the presented collection. Their systematic description is given in the following section.

Geological setting

The ammonites were found in a part of the quarry now completely removed, at the altitude of ca. 400 m a.s.l., i.e. in about the middle part of the Kotouč Hill massif (Pl. I, Fig. 1). According to the stratigraphic division of V. Houša, the location of the find lies either in the "Calpionella-free limestone" or in the Chitinoidella Zone.

The finds of the ammonites come from the clasts of the "Štramberk-type" limestone which were exposed in a 149-cm interval of coarse limestone breccia intercalated in the continuous sequence of the Štramberk Limestone accumulations. The breccia interval was simply indistinctly positively graded. It comprised clasts of light greyish-brown, fine-grained limestone and organic remains (ammonites, sponges, *Ellipsactinia* and other indeterminable fragments) in the matrix of coarse- to fine-grained detrital limestone. The limestone interval is massive as a whole, with irregular lump jointing. It passed upwards into a 109-cm interval of grey to greyish-brown fine- to

coarse-grained limestone with irregular lump jointing. In the whole thickness of this interval, alternating irregularly bounded streaks of coarse- and fine-grained limestone occur, 2 to 10 cm thick. The sequence is terminated by a 7-cm interval of dark brownish-grey fine- to very fine-grained micritic limestone with lighter and darker brownish-grey laminae. From the sedimentological point of view, the whole succession of these three intervals can be interpreted as fluxoturbidite.

The described fluxoturbidite succession was lying conformably in the Štramberk Limestone sequence. This sequence is exposed in reversed order (dip 55° to 120°) and comprises 200 to 500 cm-thick intervals of fine- to coarse-grained breccias with clasts of greyish-brown fine- to coarse-grained limestone and matrix of coarse- to medium-grained detrital limestone showing thickly tabular to sheet bedding. Breccia intervals display signs of pressure solution of varying intensity.

According to the sedimentological evaluation, the finds of ammonites are derived from a limestone clast redeposited to the breccia interval which has the character of slump to grainflow. This type of sedimentation is typical of the described part of the section through the Štramberk Limestone accumulation. Intervals of coarse detrital sediments up to over 500 cm thick alternating with 5 to 30 cm thick intervals of greyish-brown fine- to very fine-grained limestone, laminated in places, representing thin pelagites or even hemipelagites, could be observed in a profile up to 25 m long.

Systematic paleontology

In the description of ammonite species the following abbreviations are used: D - shell diameter, H - whorl height, B - whorl breadth (width), U - umbilical diameter. Values in parentheses are the proportion of the shell diameter. The suture terminology of Wedekind (1916) reviewed by Kullmann and Wiedmann (1970) is followed here: E - external lobe, L - lateral lobe, U - umbilical lobe.

Superfamily Perisphinctaceae Steinmann, 1890

Family Berriasellidae Spath, 1922

Subfamily Berriasellinae Spath, 1922

Genus *Neocosmoceras* Blanchet, 1922

Neocosmoceras cf. *bruni* Mazenot, 1939

Pl. I, Fig. 2, Text-fig. 1

1939 *Neocosmoceras Bruni* n. sp.; Mazenot, p. 195, pl. 32, figs. 15 a-c

1982 *Neocosmoceras bruni* Mazenot; Nikolov, p. 219, pl. 80, figs. 1-3 (cum syn.)

1985 *Neocosmoceras bruni* Mazenot; Tavera, p. 279, pl. 41, fig. 1, text-fig. 21 F

Material. Steinkern with 3 preserved whorls, partly with corroded external suture-line. The terminal part of the last whorl belongs to body chamber (spec. B 13665).

Description. Semievolute shell of medium dimensions. The flanks of whorls are flat, passing on obliquely to the umbilical wall. On opposite end the whorls are slowly converging to external side. The external side is flat, sufficiently narrow, distinctly limited towards the flanks. The height of whorls exceeds their width.

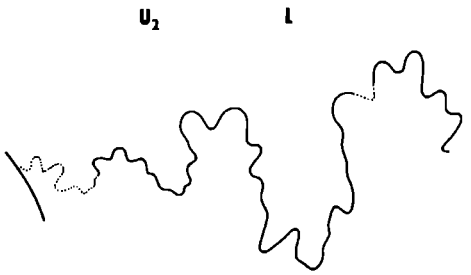


Fig. 1. Incomplete suture line of *Neocosmoceras* cf. *bruni* at H = 15.- mm.

On the earliest preserved part of shell, simple prorsiradiate ribs are apparent, on which weak umbilical tubercles (near umbilical seam) and branching of ribs in them are evident. At the end of the second to last whorl (at a diameter of about 50 mm) umbilical and lateral tubercles on the ribs (some of which are branching near umbilicus) are already clearly seen, in which the branching of ribs continues.

At the end of phragmocone (above the umbilical seam) the simple ribs slowly begin to join and bear marked conical tubercles on the transition of umbilical wall into flanks. The ribs continue as simple approximately up to 2/3 of the height of whorl where lateral tubercles appear on them. The shape and strength of this second row of tubercles is roughly of the same form and strength as of the umbilical one. In lateral tubercles the branching of ribs continues, the ribs in the peripheral section are slightly concave towards the peristome. Between branched ribs, scarcely intercalatory ribs appear, dissappearing at the level of lateral tubercles. On the edge between the flanks and external side all uniform strong ribs end in weak ventrolateral tubercles. The siphonal area is smooth.

On the body chamber, in the lower part of the whorl, marked rare simple ribs with two rows of distinct tubercles are dominate. From lateral tubercles 2-3 peripheral ribs are run out. Between the bundles of mentioned ribs 1 to 2 intercalatory ribs are inserted, disappearing at the latest at the level of lateral tubercles. On all ribs, weak ventrolateral tubercles are present. The siphonal area continues smooth within the band, about 2 mm wide.

Suture-line. Lobe E is not preserved. Lobe L is relatively narrow, deep, gently articulated, asymmetrically trifide. Umbilical lobes are shallow. The first two lateral saddles are narrow and asymmetrical. Whole suture-line is only slightly articulated.

Measurement. At D = 62.- mm, H = 23.- (0.37) and U = 23.- (0.37). At D_{max} = 70.- mm, H = 25.6 (0.36), U = 26.- (0.37), B/2 = 7.5 (B = 15.- mm, B/D = 0.21). On the last whorl (at D_{max}) 24 ribs near umbilicus are present. At D = 50.- mm on a half whorl fall on 13 umbilical (main) ribs and approximately 35 peripheral ones.

On the Holotype of *N. bruni* figured by Mazenot (1939, pl. 32, fig. 15 a) at smallest measurable D = 78.- mm, H = 29.- (0.37) and U = 28.- (0.36).

Discussion. In solving the generic affinity, basic information is supplied by the suture-line, which is slightly articulated and may be considered to be of non-berriaselitid type (cf. Mazenot, pl. 32, fig. 15 c).In contrast to typical representatives of most of the species of the genus *Neocosmoceras, N. bruni* and also the Štramberk specimen lack distinct peripheral tubercles, so some analogically formed species (with the same type of suture-line) are ranked with genus or subgenus *Mazenoticeras* Nikolov, 1966. According to the compilation of including species cited by Nikolov (1982), *Mazenoticeras* appears however to be polyphyletic, since on the one hand it comprises the species with complicated suture-line (see e.g. the type-species *Mazenoticeras broussei* Mazenot, 1939, pl. 11, fig. 4) and on the other hand species with simple suture-line of genus *Neocosmoceras* (e.g. *Hoplites curelensis* Kilian, 1888 - in Mazenot, 1939, pl. 30, figs. 1 c, 2 c).

Neocosmoceras bruni and *N. curelense* (Kilian) have the closest affinities to our Štramberk specimen. However, both the species differ in a lower number of primary ribs. Moreover, *N. curelense* lacks interrupted ribs in the siphonal area. Therefore, we incline more to the affinity with *N. bruni. Protacanthodiscus andreaei* (Kilian) also shows a certain resemblance. It has, however, lateral tubercles distinctly stronger than the umbilical ones, bears another type of intercalatory ribs between the ribs which run out from lateral tubercles, and manifests differences in strength of main and intercalatory ribs at the periphery and the wider whorls, as well.

Distribution. Typical representatives of *N. bruni* are recorded from non-uniform stratigraphical level, but always from the Berriasian. Le Hegarat (1973) and Nikolov (1982) state relatively high Paramimouna Subzone (base of Upper Berriasian), Tavera (1985) the Andrussowi Zone (higher Lower Berriasian).

Genus *Dalmasiceras* Djanélidzé, 1921

Dalmasiceras kiliani Djanélidzé, 1921

Pl. I, Fig. 3

1921 *Hoplites (Dalmasiceras) Kiliani* n. sp.; Djanélidzé, p. 271, pl. 14, fig. 1, non pl. 12, fig. 6 (= *D. gevrei* Jacob)

1985 *Dalmasiceras kiliani* (Djanelidze); Tavera, p. 324, pl. 48, fig. 1, pl. 49, fig. 1, text-fig. 24 D (cum syn.)

Material. Incomplete shell, from prevailing part with recrystalized calcareous mass of test (spec. B 13666).

Description. Semievolute shell of medium dimensions. The whorls are distinctly higher than wide. The whorls are widest near to umbilicus. Not too high flanks of whorls are flat. From umbilical wall, which is not high and relatively steeply passes on to the umbilicus, the flanks are sharply separated. In the peripheral one third of the height, the whorls are slowly converging towards the external side. This side is rounded and narrow.

The sculpture of juvenile whorls, which are poorly preserved, is formed up to the diameter of about 30 mm by thin and dense ribs, being subradial to gently concave towards the peristome. On last but one whorl a greater part of ribs branch near to umbilicus. On the terminal part of the mentioned whorl the bullae are already apparent.

On the last whorl (on the part which still belongs to phragmocone), the sculpture is formed by regularly alternating ribs of two types, i.e. biplicate and triplicate. Both types begin near umbilical seam by indistinct tubercles. In the first type the branching of ribs occurs about a half up to markedly over a half of the height of whorl. In the second type, from the highest part of umbilical tubercles a weaker secondary rib runs out along the back side of primary rib, which remains a simple rib. From half the height of whorl, even higher, the primary ribs branch once more non-uniformly, which results in a set of triplicate ribs. On the transition of flanks into relatively flat external side, on all ribs ventrolateral tubercles are slightly indicated and weakening of ribs occurs in the siphonal area.

On body chamber, which with the exception of external side bears the recrystallized test, the ribs begin by marked umbilical tubercles, which are only gently radially elongated. From these tubercles more often two ribs than one rib run out. In general course the ribs are slightly sigmoid. In the upper 2/3 of the height of whorl, weak lateral tubercles are present on some ribs, in which probably the biplication of ribs occur. Besides them intercalatory ribs are still present, so the vaulted external side is tightly covered towards the peristome by inclined ribs, passing through external side in arch. The ribs in siphonal area are weakened.

Measurement. The shell reaches the maximum diameter of about 80 mm. At D = 61.5 mm, H = 24.5 (0.40) and U = 21.- (0.34); B (estimate) = 12 mm (0.20). On body chamber (at D_{max}) 17 umbilical tubercles are present on a half of whorl fall .

Discussion. The related type of ribbing with distinct umbilical tubercles and weaker lateral tubercles, besides the genus *Dalmasiceras*, occurs more often in genus *Subalpinites* Mazenot, 1939. The latter genus, however, differs in higher whorls and narrower umbilicus.

From the species point of view, the Štramberk specimen corresponds to a medium growth stage of *D. kiliani.* In related species *D. gevreyi* (Jacob), which reaches smaller dimensions, lateral tubercles appear already in an earlier growth stage.

Distribution. *D. kiliani* is known from France and Spain. Le Hegarat (1973) and Tavera (1985) state it conformably from the Jacobi Zone (Lower Berriasian).

Along with the above described species, the same locality also provided shells of the ammonite *Micracanthoceras microcanthum* (Oppel) which is the Upper Tithonian index species (Pl. I, Figs. 4 - 5).

Conclusion

The problems of unambiguous age determination, or, of the whole stratigraphic range of the Štramberk Limestone, have been discussed for many years already by Czech and Slovak (Houša, 1961, 1964 a,b, 1975, 1978, 1983 a,b, 1989, 1990; Soták, 1987) as well as foreign biostratigraphers (more recently Le Hegarat, 1971, 1973; Oloriz and Tavera, 1982), including the questions on possible Cretaceous presence in the Štramberk Limestone. Stratigraphical controversy is closely linked with the complicated geological setting of the area thus also with the different ideas of the origin and present position of the Štramberk Limestone and/or the doubtlessly younger Lower Cretaceous deposits near Štramberk.

As shown by numerous data from Czech geological literature (e.g. Eliáš and Stráník, 1963; Eliáš, 1983; Hladíková et al., 1987), stratification of the massive Štramberk Limestone in the Kotouč quarry is difficult to determine. The body of the Štramberk Limestone is situated in a tectonically complicated zone close to the thrust plane of the Silesian nappe. According to the above cited studies (as opposed to the opinion of V.Houša), the Štramberk Limestone occupies a secondary position, as it represents a slump-derived block conglomerate or breccia incorporating different segments of the original reef, associated with turbidite and fluxoturbidite beds.

If we consider that the Jurassic/Cretaceous boundary lies - according to the presently accepted concept for the Mediterranean region - around the base of the calpionellid zone B (first occurrence of *Calpionella alpina*) which parallels the base of the ammonite Jacobi Zone (Remane et al., 1986; Remane, 1986, 1990; Hoedemaeker and Bulot, 1990; Hoedemaeker, Company et al., 1993), then some of the stratigraphically important ammonite species from the Štramberk Limestone (mostly of the family Berriasellidae) restricted to the Berriasian only according to the present concept, have been reported by Zittel (1868) already. Nevertheless, the number of those species which definitely come from the Štramberk Limestone from Štramberk is not very high (only the figured specimens can be directly validated at present). These are *Pseudoargentiniceras abscissum* (Oppel), *Dalmasiceras progenitor* (Oppel) or *"Corongoceras" koellikeri* (Oppel). Besides these species, also *Berriasella (B.) oppeli* (Kilian) and some representatives of the genus *Spiticeras* s.l. are reported from Štramberk by Zittel (but not figured from the Štramberk locality). *Dalmasiceras kiliani* Djanélidzé and *Neocosmoceras* cf. *bruni* Mazenot can be newly added to the species above. If we ignore the last mentioned species, which could not be decisively identified with any species known from the literature, then all the above cited ammonite species are bound to the Jacobi Zone (Lower Berriasian) according to the present knowledge.

Other berriasellid ammonites (including the stratigraphically less important representants of the superfamilies Phylloceratáceae, Lytoceratáceae and Haploceratáceae) are listed and figured by Zittel (1868) in his monograph from the now non-existing localities of Koňákov (Koniakau) and Tichá (Tychau) which are usually considered identical with the Štramberk locality and the Štramberk Limestone in the literature. These include *Berriasella (B.) oppeli* (Kilian), *Berriasella (Pseudosubplanites) lorioli* (Zittel), *Fauriella carpathica* (Zittel) and also more numerous representatives of the genus *Spiticeras* Djanélidzé. Stratigraphically, this type material mostly also refers to the Jacobi Zone.

It is necessary to note that all the localities of Koňákov, Tichá or Chlebovice, a.o., cited by Zittel in context with the Štramberk Limestone, lie on the territory of the present Czech Republic - in the Silesian Unit of the Outer (Flysch) Carpathians. This limestone occurs at the above localities indisputably in a secondary position. In the last century, localities with sufficiently thick accumulations of blocks, fragments and pebbles of Mesozoic limestones were exploited in quarries in order to meet the demands for lime in the region dominated by non-calcareous flysch. Most of these limestones were entirely removed by quarrying; hence, the above given occurrences belong to the category of non-existing localities today. As evidenced by the original samples of ammonite-containing limestones from these localities deposited now in Munich, they differ from the true Štramberk Limestone by their darker colour (they are grey to brownish-grey). This fact was actually noted by Zittel (1868) already.

The redeposited limestones, which should be more properly designated as Štramberk-type limestones only, were accumulated in different tectonofacies segments and at different stratigraphic levels of the Silesian Unit sequence (from the end of the Jurassic on and during the early Lower Cretaceous). For example, the famous Koňákov locality located almost 35 km NE of the Štramberk locality, lies in the particular Těšín nappe of the Silesian Unit.

Another category of localities with pebbles and fragments of the Štramberk-type limestone is typified by the area of the conglomerates of the Chlebovice Member which belongs to the Baška development of the Silesian Unit (Upper Aptian to Albian). For example, historical localities of Tichá and Chlebovice lie in this area. Rostra of the belemnite *Neohibolites* ex gr. *minimus* (Miller) documenting late Albian age (Vašíček, 1978) were found in a clay matrix containing also Štramberk-type limestones at the Tichavská hůrka locality (which, however, may not exactly coincide with the ammonite occurrences from the last

century). Also the upper parts of the Kotouč Hill massif near Štramberk are equivalent to the conglomerates of the Chlebovice Member.

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Explanations of Plate I

Pl. I ⇨

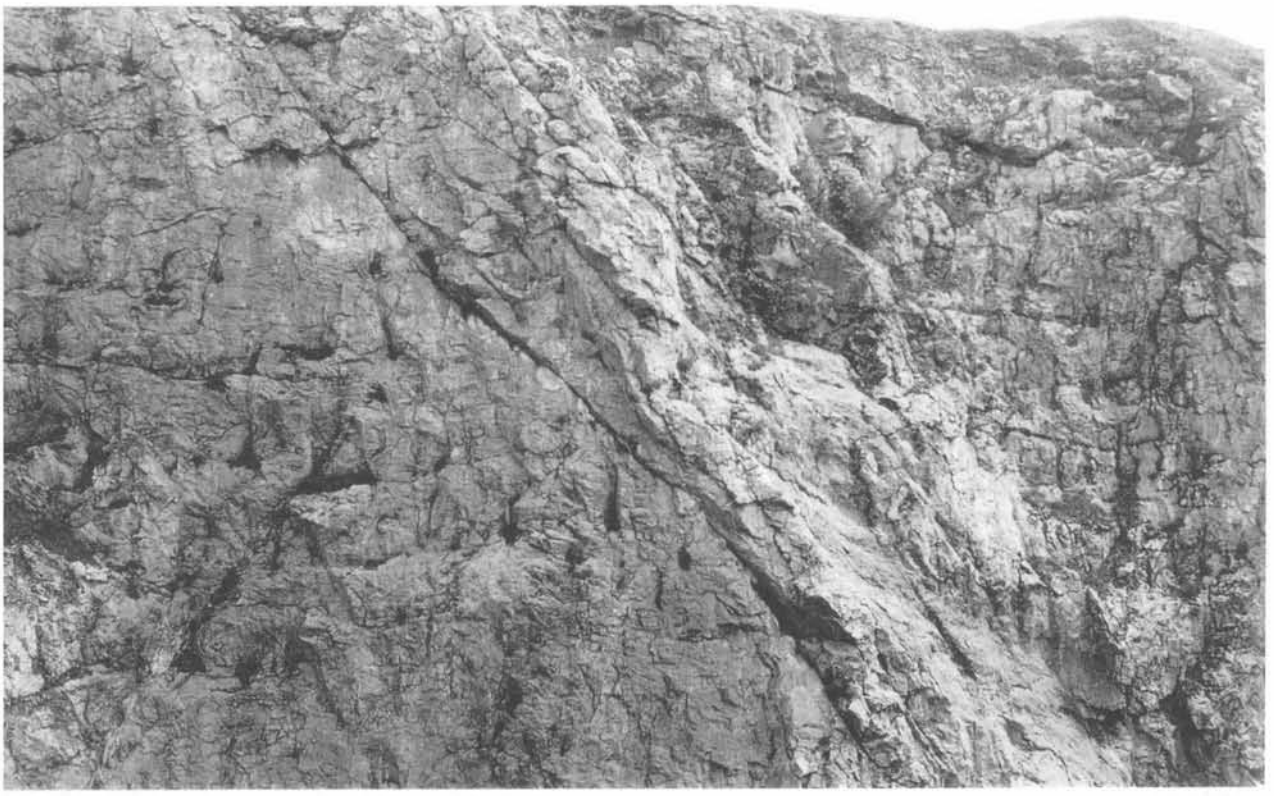
1. The typical example of the structure of the accumulation of the Štramberk Limestone. The wall of the 3rd level of the Kotouč quarry near Štramberk in 1963.

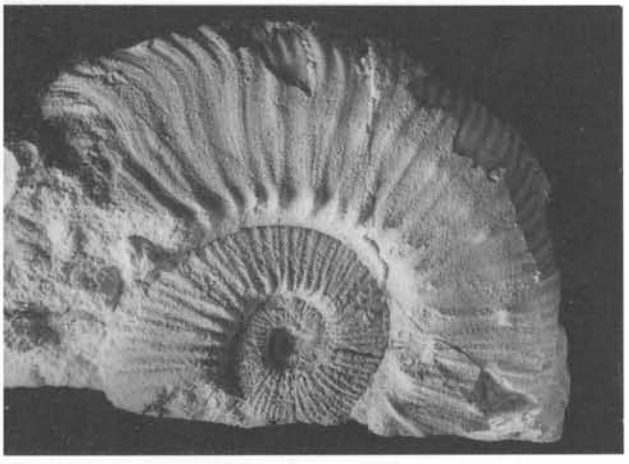
2. *Neocosmoceras* cf. *bruni* Mazenot. Spec. B 13665 preserved in the form of a slightly corroded steinkern.

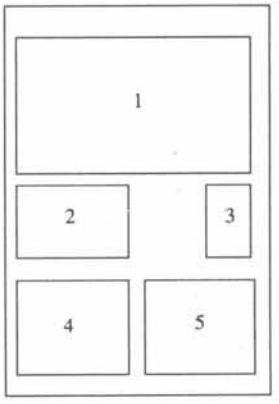
3. *Dalmasiceras kiliani* Djanélidzé. Spec. B 13666 with recrystallized original shell.

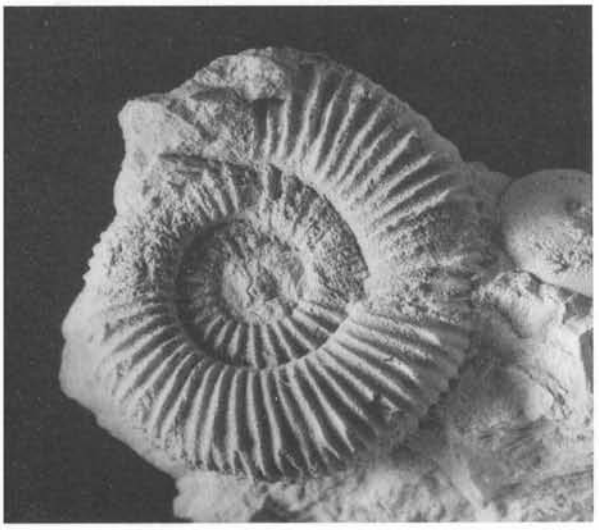
4. *Micracanthoceras microcanthum* (Oppel). Spec. B 13667. Close to the narrow siphonal furrow on ventral side (Fig. 5), the ribs are terminated by weak tubercles.

Field photo by M. Eliáš. Photos of ammonites were taken by K. Mezihoráková, University of Ostrava, and D.Korn, University of Tübingen (Fig. 2). All photos of ammonites in natural size except for Fig. 4 (1.43x). The shells are deposited in the collections of the Ostrava Museum in Ostrava under the numbers cited.









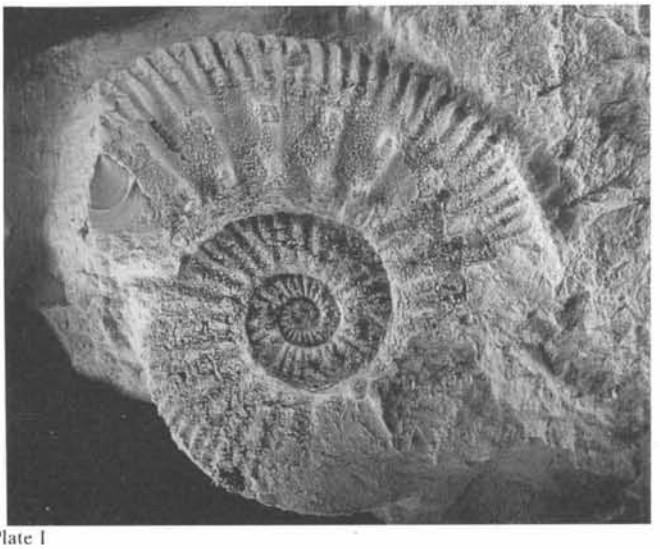


Plate I