

Contribution to the knowledge of some small Early Barremian ammonites from the Silesian Unit (Outer Carpathians, Czech Republic)

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Abstract. In the framework of many years' biostratigraphic research of Lower Cretaceous deposits of the Silesian Unit in the Outer (Flysch) Carpathians in the territory of the Czech Republic, a unique ammonite locality has been found at the village of Soběšovice in the Český Těšín area (belonging to the Těšín partial nappe) recently. In grey shaly deposits in the faunistic horizon of a negligible thickness, pyrite steinkerns of ammonites with preserved sutures partly occur in addition to shells deformed prevalingly. About 74 % of collected ammonites represented altogether by 17 species belong to the representatives of the suborder Ancyloceratina. Of them, almost 86 % can be assigned to the subfamily Leptoceratoidinae. The number as well as the variety of the mentioned subfamily in the locality is documented by 5 genera and 6 species, of which *Josticeras wiedmanni* represents a new genus and simultaneously a new species. For Leptoceratoidinae an opportunistic strategy has been suggested. The original environment of the ammonite association under study must have been specific conditions of the area of a deeper shelf. From here, accumulated shells were redeposited into the basinal environment by the turbiditic current. According to the whole spectrum of ammonites, the stratigraphic assignation of the studied horizon into the upper part of the Early Barremian can be considered, namely to the Caillaudianus Zone.

Abstrakt. V rámci mnohaletého výzkumu spodnokřídových uloženin slezské jednotky ve flyšových Karpatech na území České republiky se v uvedené jednotce před nedávnem podařilo najít unikátní amonitovou lokalitu poblíže obce Soběšovice na Těšínsku (náležející k těšínskému dílčímu příkrovu). V šedě zbarvených břidličnatých uloženinách ve faunistickém horizontu nepatrné mocnosti se vedle převážně deformovaných schránek zčásti též vyskytují pyritová jádra amonitů se zachovanými suturami. Nasbíraní amoniti, reprezentovaní celkem 17 druhy, ze 74 % náležejí k zástupcům podřádu Ancyloceratina. Z nich téměř 86 % patří k podčeledi Leptoceratoidinae. Četnost a rozmanitost jmenované podčeledi je na lokalitě dokládána 5 rody a 6 druhy, z nichž *Josticeras wiedmanni* představuje nový rod a současně nový druh. Leptoceratoidinae podle ekologických hledisek bývají řazeni do kategorie oportunistických druhů. Původním životním prostředím studovaného amonitového společenství byly pravděpodobně specifické podmínky oblasti hlubšího šelfu. Odtud byly nahromaděné schránky redeponované do pánevního prostředí turbiditním proudem. Podle zastoupení amonitového spektra lze studovaný horizont zařadit do vyšší části spodního barremu, do amonitové zóny Caillaudianus.

Key words: Barremian, Těšín-Hradiště Formation, ammonites, Outer Carpathians

Introduction

As already stated in the preliminary report by Klajmon et al. (1997), a new Lower Cretaceous ammonite locality in the Těšín-Hradiště Formation at the village of Soběšovice was found in 1996. It was situated in the river cut in the vicinity of the left bank of the Stonávka river (Fig. 1). In July 1997, the outcrop ceased to exist due to a catastrophic flood.

Deposits exposed in a thickness of about 1 m were formed by alternating of very thinly bedded claystones and siltstones. Sporadically, they were interbedded by thick laminae to lenticular intercalations of fine-grained sandstones. A set of those deposits falls, according to lithological features, into the category of distal turbidites. Fossils associated with the only 2-3 cm thick fossiliferous horizon are largely small. Their size usually ranges from 10 to 30 mm. A portion of shells are incomplete, which is partly caused secondarily by imperfect fossilization. Regularly coiled ammonoid shells represent primarily a juvenile stage.

Grey shaly deposits, in addition to original shells, or external moulds deformed up to pressed to the plane of the

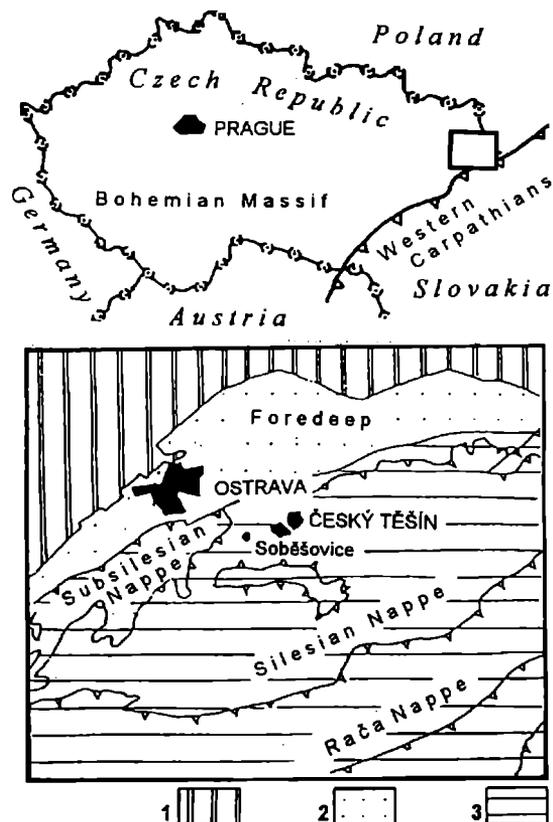


Fig. 1. The geographical position of the studied area and geological situation of the Soběšovice locality. 1 - Bohemian Massif, 2 - Neogene, 3 - Outer Carpathians flysch units.

bedding surface contain, in a lesser degree, also pyritized shells. Pyritization is not frequently perfect. It usually affects only the side or half of the shell that rested on the sediment. The pyritized side then remains non-deformed. What is important is that it often bears at least incompletely preserved sutures.

The studied collection consists of 133 finds of fossils. Only 5 of them (3.76 %) do not belong to ammonites. Three represent floristic remnants (stem of a horsetail, minor leaves of ferns and one small leaf of the group of the genus *Zamites*) and two fragments of the spine of a fish vertebrate. Only twenty of 128 ammonite finds are such imperfectly and unwholly preserved that they could not even be determined on the level of genus.

In the submitted study, stratigraphically significant and systematically interesting species of suborders of Ammonitina and Ancyloceratina are described in detail.

Taxonomy

The basic taxonomy respects Wright et al. (1996) classification. As far as species descriptions are concerned, common abbreviations for dimensions measured (D - diameter of the shell, H - whorl height, B - whorl width, U - umbilical diameter) and for lobes (E - external lobe, L - lateral lobe, U - umbilical lobe, I - internal lobe) are used.

Suborder Ammonitina Hyatt, 1889
Superfamily Perisphinctaceae Steinmann, 1890
Family Holcodiscidae Spath, 1923

Genus *Holcodiscus* Uhlig, 1882

Type species: *Ammonites caillaudianus* d'Orbigny, 1850.

Holcodiscus cf. *angulatus* Tzankov, 1935

Pl. 1, Figs. 1-3

1985 *Holcodiscus angulatus* Tzankov; Tzankov & Breskovski, p. 27, pl. 8, figs. 3-5 (cum syn.)

Material. Three pyritized steinkerns without preserved sutures (To96/19, 43, To97/14). The first, the biggest of them, is smashed into the plane of the bedding surface. The second that is juvenile and the third are preserved much more favourably.

Description. Half-evolute shells with low, arcuated whorls and a quite wide umbilicus. The juvenile shell bears rather thin ribs: six main ribs and unequal secondary ribs. The main ribs are conspicuous by powerful protruding ventrolateral tubercles generated in combination with the bifurcated main rib in the middle of sides. In the top part of the front, they also bear a tiny rib separated by a small furrow. The secondary ribs, being two or three in the interval between the main ribs, are simple or one of

them (just after the main rib) bifurcates in the middle of the flanks. In the point of bifurcation, a lateral tubercle is usually indicated. On the adulter shell, juvenile whorls are unfavourably preserved. On the last half-whorl on the main ribs, ventrolateral tubercles protruding high dominate. Their sides are furrowed because they usually develop from two converging ribs running from lateral tubercles. They seem to be placed on the unequal level of the whorl usually on the main ribs, but also on their subsequent rib. On the last whorl eight main ribs are situated. Inserted ribs are simple or they bifurcate on the uneven level on the sides of the whorl. The bifurcation can be accompanied by a slight lateral tubercle. The secondary ribs pass without any arcuation and interruption into the opposite side. Between the tubercles on the main ribs, a furrow exists. At the end interval of the spec. To97/14, inserted ribs go oblique from the last but one main rib. The final rib is entire with strong tubercles.

Measurement. The juvenile specimen has a diameter of 7.5 mm. On the rather deformed specimen To97/14 with D = 14.5 mm, H = 6.6 (0.455) and U = 4.1 (0.28).

Remarks. The sculpture of our not very well preserved material is characterized by a considerable non-uniformity in the formation of ribs and lateral tubercles on the one side and conspicuously projecting ventrolateral tubercles on the other side. The last feature is also distinctive of *H. nodosus* Karakasch, 1907 and *H. decorus* Avram, 1995. However, both the species differ, among other matters, in the higher number of main ribs with tubercles. With our material, the higher number of ribs inserted between the main ribs is closer to Tzankov's (1935) species. His illustration is not, however, ideal in the Bulgarian literature.

Distribution. Tzankov & Breskovski (1985) state the Lower-Upper Barremian without any further specification.

Holcodiscus ex gr. *diversecostatus latituberculatus* Tzankov & Breskovski, 1985

Pl. 1, Figs. 4, 5

1985 *Holcodiscus diversecostatus latituberculatus* sp. n.; Tzankov & Breskovski, p. 35, pl. 8, figs. 21, 22, 25, pl. 9, figs. 1, 2

Material. The only heavily smashed pyritized steinkern (To97/34).

Description. As a result of deformation this is almost an involute shell. It is conspicuous by dense, slightly goose-necked ribs; main and secondary ribs being distinct. The main ribs bear rather slight lateral tubercles elongated in the direction of ribs. From them, two ribs run in the final half of the whorl which join into high ventrolateral tubercles (fibulation) on the periphery. The ventrolateral tubercles are close to each other. Moreover, a short rib directed forwards usually splits from each lateral tubercle. After the main ribs a markedly stronger inserted

rib appears in the lower half of the whorl. The rib is separated from the main rib with a narrow constriction. On the level of the lateral tubercle, this rib becomes weak and runs as a thin inserted rib to the external side. In the interval between the main ribs, the number of which is seven in the last whorl, 3 - 6 inserted ribs can be found. Often they seem to radiate from one point near the umbilicus. Some of them can bifurcate in the lower half of the whorl height. The deformed shell reaches a diameter of about 27 mm.

Remarks. This single deformed shell is characterized by numerous thin and dense, non-uniformly developed ribs with minor lateral tubercles and marked ventrolateral tubercles and a narrow umbilicus. It is the developed lateral tubercles that differ our shell from the type species *H. diversecostatus* (Coquand, 1880) and, on the contrary, put it into the group of *H. diversecostatus latituberculatus*. However, it is a specimen depicted in pl. 9, figs. 1, 2 in the study by Tzankov & Breskovski (1985), not the holotype of the subspecies given above bearing numerous main ribs, which is the closest. A shell illustrated by Avram (1995, pl. 4, figs. 23 a, b) under the name of *H. cadocerooides* (Karakasch, 1907) is also similar. The type material of the latter mentioned species is probably morphologically different.

Distribution. Tzankov & Breskovski (1985) state the Early Barremian in association with *Crioceratites emerici*, *Acrioceras tabarelli* and *Barremites difficilis*.

Superfamily Pulchelliaceae H. Douvillé, 1890
Family Pulchelliidae H. Douvillé, 1890
Subfamily Psilotissotiinae Vermeulen, 1996

Genus *Kotetishvilia* Vermeulen, 1996

Type species: *Pulchellia changarnieri* Sayn, 1890
(in Vermeulen 1996, p. 118).

Kotetishvilia sp. ind.

Pl. 1, Fig. 9

Material. Four pyritized remnants preserved in poor quality usually with a periphery limited altogether well; however, no side sculpture being preserved (To97/6, 9, 16, To96/80). The latter spec. To97/9 was hollow. At breaking its side in the course of preparation, it turned out that the final half of the last whorl belonged to the body chamber.

Description. Involute shells probably with a point umbilicus and high, slightly arcuated whorls. On the periphery of each shell, conspicuous flat tuberculated elements corresponding to the ends of flat, wide ribs are there. The ventral side bears probably a shallow furrow, on the bottom of which furrows between ribs are clear. Near the outer side of the whorl of spec. To97/9, the short furrows between ribs can be seen. They must have been short at least in this stage of growth.

Measurement. The spec. To97/9 preserved best reaches the maximum diameter of 20 mm. At $D = 17.8$ mm, H is 10.3 (0.58). The largest shell has a diameter of 22 mm.

Remarks. An imperfection in the preservation of shells of a small diameter does not enable any precise determination. The preserved morphology corresponds to the genus *Kotetishvilia* determined recently. The closest species are probably *K. nicklesi* (Hyatt, 1903) and *K. compressissima* (d'Orbigny, 1840). Maybe the point umbilicus and the width of peripheral tubercles indicate the latter mentioned species in a higher degree, but an imperfection in the preservation of material does not allow to name it unambiguously.

Distribution. On the basis of a supposed species classification, the Compressissima Zone in the sense of zonal division proposed by Vermeulen (1995).

Suborder Ancyloceratina Wiedmann, 1966
Superfamily Ancylocerataceae Gill, 1871
Subfamily Crioceratitinae Gill, 1871

Genus *Emericiceras* Sarkar, 1954

Type species: *Crioceratites emerici* Léveillé, 1837.

Emericiceras sp. juv.

Pl. 1, Figs. 6 - 8, Fig. 2

Material. One juvenile, prevailingly pyritized steinkern with a preserved suture (spec. To96/60) and one juvenile shell smashed into the plane of the bedding surface (To97/8). An embryonic beginning is missing in either case.

Description. Shells coiled in a loose criocone spiral. The most juvenile preserved part is smooth. Already at the diameter of about 5 mm, uniform, simple, dense, prorsiradiate ribs appear with indicated lateral and ventrolateral tubercles. With the diameter of the shell of about 7 mm, ribs become less dense and strengthen. In addition, both types of tubercles strengthen and shortly after that one thinner rib without tubercles is inserted between the tubercle-bearing ribs. The ribs pass through the ventral side without any interruption, but they are rather weakened. At the diameter of about 9 mm, slight umbilical tubercles emerge on the main ribs too. At the diameter of about 13 mm, the main ribs are markedly trituberculated. The umbilical tubercles are the weakest, lateral ones are stronger. The ventrolateral tubercles, which are there rather close to the lateral ones, have preserved spines of about 2 mm length arcuated backward.

Measurement. The shell To96/60 reaches a diameter of 15 mm as a maximum. In the non-deformed part of the shell, $H = 2.3$ (0.24), $U = 7.0$ (0.74), $B = 2.4$ (0.25) at $D = 9.5$ mm. Only at the diameter more than 10 mm, the height of the whorl equals the width, otherwise the width exceeds the height.

Suture. The completest suture with all documented

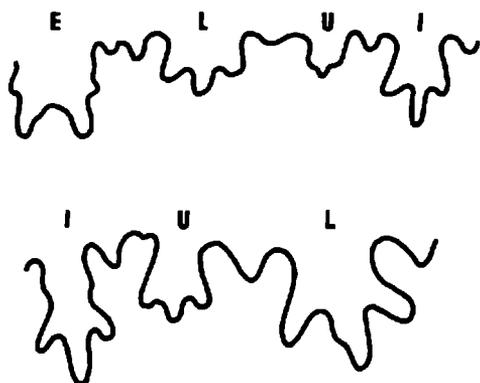


Fig. 2. Complete juvenile suture of *Emericiceras* sp. juv. at H = 1.6 mm and B = 1.9 mm and the incomplete suture at H = 2.0 mm and B = 2.3 mm.

lobes E, L, U, I corresponds to the whorl height of 1.6 mm (Fig. 2). All the lobes with the exception of E are trifid, which is more conspicuous in the last preserved suture corresponding to H = 2.0 mm.

Remarks. A juvenile suture from the range of the genus *Crioceratites* Léveillé (or *Emericiceras*) has been illustrated probably merely by Wiedmann (1963, Fig. 3) so far. The suture of his juvenile Barremian specimen having, at the maximum diameter of about 9 mm, no tubercles developed yet on the ribs is, however, formed in a shape different from our specimen. By its trifid arrangement of the lobes I, U, L and a marked width of the lobes L, U, the suture of the Silesian specimen is close to the suture of the Aptian species *Ammonitoceras wassiliewskyi* Renngarten (Michajlova, 1983 in figs. 36 and 139). However, with the Russian specimen, approximately the same degree of suture articulation is reached only at the whorl width of about 5 mm in comparison with less than 2 mm in our shell.

We suppose that our juvenile specimen belongs to the group of *Emericiceras emerici* (Léveillé, 1837). Uhlig (1883) illustrates under the given name (pl. 27, fig. 3) an imperfectly preserved subadult shell from the Silesian Unit; the shell being morphologically close. There are, however, some doubts about its unambiguous belonging to *E. emerici* in the literature.

Distribution. The species *E. emerici* itself is generally considered to be of Early Barremian age.

Family Ancyloceratidae Gill, 1871

Subfamily Leptoceratoidinae Thieuloy, 1966

Genus *Leptoceratoides* Thieuloy, 1966

Type species: *Leptoceras pumilum* Uhlig, 1883.

In the contribution by Vašíček & Wiedmann (1994), the genus *Leptoceratoides* is believed to be a synonym of the genus *Karsteniceras* Royo y Gómez 1945. The above mentioned genus conception contains shells coiled in a planispiral and trochospiral. On the basis of our new material from the Silesian Unit and, in accordance with the Treatise on Invertebrate Paleontology (Wright et al.

1996), we separate the genus *Karsteniceras* from the planispirally coiled genus *Leptoceratoides*.

An unmarked spatial coiling of shells of the genus *Karsteniceras* is usually hidden in clayey sediments by frequent deformations of shells into the plane of the bedding surface obtaining thus secondarily the planispiral coiling. This fact makes the distinguishing between both the genera considerably difficult. However, the spatial coiling with the completer shells of representatives of the genus *Karsteniceras* can reveal the mutual overlap of whorls.

Leptoceratoides subtile (Uhlig, 1883)

Pl. 1, Figs. 10, 11

1994 *Karsteniceras subtile* (Uhlig); Vašíček & Wiedmann, p. 214, pl. 2, figs. 5-8, text-fig. 3B (cum syn.)

Material. 9 small shells largely with a preserved embryonic first whorl (e.g. spec. To96/62).

Description. Small criocone shells. In the vicinity of the mouth, ribs become thinner and denser. The largest specimen has a diameter of about 20 mm.

Distribution. The species is known with confidence from the Early Barremian of the Mediterranean area, especially in the zone extending from Rumania through the Alpine-Carpathian area to Spain.

Genus *Karsteniceras* Royo y Gómez, 1945

Type species: *Ancyloceras beyrichi* Karsten, 1858.

The genus *Karsteniceras* is characterized by a low helicoid coiling of shells, ventrolateral tubercles and often also by the thinning of ribs in the external side, or by a developed ventral furrow.

Karsteniceras beyrichoide Vašíček & Wiedmann, 1994

Tab. 1, Figs. 12 - 14

1994 *Karsteniceras beyrichoide* sp. nov.; Vašíček & Wiedmann, p. 213, pl. 1, figs. 6-8, text-fig. 3A (cum syn.)

Material. Three pyritized steinkerns (To96/3, 27, 38a), the largest of which (the latter) is most deformed into the plane of the bedding surface. The other four shells deformed heavily into the plane of the bedding surface could belong to the mentioned species too.

Description. Criocone to elliptic shells coiled in a low spatial spiral. The embryonal beginning of the smallest shell is missing. The most juvenile preserved part of the shell is smooth. Shortly, simple, thin, slightly prorsiradial, dense ribs of the uniform type onset that pass without interruption into the external side. After the juvenile ribbing, which covers about one quarter of the whorl, ribs become stronger and less dense. On some of them, rather small ventrolateral tubercles appear irregularly (usually on each second or third rib). After them, on the imper-

fectly preserved siphonal area, the ribs weaken. In the spec. To96/27, the remnant of an incomplete simple leptoceratoid suture exists.

Measurement. Larger shells have a diameter of about 25 mm.

Remarks. The described finds supplement the original diagnosis of *K. beyrichoide* by a knowledge of forming the juvenile shell and the undoubted spatial coiling of whorls. However, the spatial coiling can be suppressed wholly as a result of the non-uniform initial orientation of the shell deposited into the clay sediment at various angles. The deformation is especially conspicuous and varied with non-pyritized shells (similar to that with graptolite rhabdosomes of the genus *Spirograptus* Guerich in graptolite shales).

Distribution. The precise stratigraphic position of the species *K. beyrichoide* was not known. It was supposed that it came from the Late Barremian (Vašíček & Wiedmann 1994). New finds from the Silesian Unit prove the Early Barremian age, but the continuation in the lower part of the Late Barremian cannot be excluded.

Genus *Hamulinites* Paquier, 1901

Type species: *Hamulina munieri* Nickles, 1894.

Vašíček and Wiedmann (1994) considered the species *H. parvulum* (Uhlig, 1883) and *H. munieri* Paquier, 1901 to be synonyms as for the content of the genus *Hamulinites*. To this, Kakabadze & Hoedemaeker (1997) have entered objections on the basis of conception of both the species recently. It is the ptychoceraticone morphology of Paquier's species that leads them to the opinion that the latter species is not a synonym of *H. parvulum*. Thus they simultaneously cast doubt on a wide volume of the genus *Hamulinites* discussed by Vašíček & Wiedmann (1994).

Using three tens of our new finds of *H. parvulum* in the single horizon as a basis, we want to emphasize that our present material as well as that processed in Vašíček & Wiedmann (1994) proves an extraordinary morphological variability. The extreme morphological limits represented in the previous paragraph by the mentioned species, are interconnected with continuous transient types. Among other matters, this is documented by extreme morphological types depicted in pl. 1, when small ancyloceratoid shells with a preserved first whorl (morphotype *parvulum*), ptychoceraticone shells (morphotype *munieri*) with subparallel arms and their transient types occur altogether. Nevertheless, the morphotype *munieri* has not been known in a form of the whole specimen with a preserved embryonic part yet. However, our new finds, and primarily Wiedmann's finds from the locality of La Querola near Cocentaina in Spain (Wiedmann 1963, pl. 1, fig. 3, Vašíček & Wiedmann 1994, pls. 10, 11) rather support than exclude that the final stage of growth of shells of the genus *Hamulinites* need not end in an open hooky shell, but in a shell of the ptychoceraticone type. For these rea-

sons, we continue to adhere to the original genus conception by Vašíček & Wiedmann (1994).

Hamulinites parvulus (Uhlig, 1883)

Pl. 1, Figs. 15 - 18

1994 *Hamulinites parvulus* (Uhlig); Vašíček & Wiedmann, p. 221, pl. 3, figs. 5-9, 11, 12, ?10 (cum syn.)

non 1995 *Hamulinites parvulus parvulus* (Uhlig); Hoedemaeker, p. 240, pl. 8, fig. 10

Material. Altogether 27 shells (To96/30, 42, 51, 52, 57, To97/28 and others) and 5 fragments that are fossilized non-uniformly: non-deformed pyrite steinkerns (with the only well preserved side) with the remnants of sutures up to shells pressed into the plane of the bedding surface and deformed in a various manner.

Description. Small ancyloceratoid to ptychoceraticone shells, whose shafts are either open in a various degree or almost tightly subparallel. Simple ribs, sometimes thinner and denser, sometimes stronger and less dense.

Measurement. The length of shells ranges from 15 to 35 mm.

Remarks. The mentioned species is characterized by a considerable shape and size variability as well as a variability in ribbing. The shell To96/57 with subparallel shafts, which is morphologically in accordance with the type specimen *Hamulina munieri* Nickles, bears remnants of sutures. Those correspond both with the suture of the mentioned type and the suture of Uhlig's *Leptoceras parvulum* with open shafts. As stated earlier, all the studied material comes, in principle, from the same bedding surface. For this reason, we regard neither the extreme morphological members of the association nor the types with differently arcuated provera as representatives of different species and genera. We believe that they are representatives of the only species *H. parvulum*; i.e. in accord with synonymics presented in Vašíček & Wiedmann 1994. (An exception may be only the specimen depicted in pl. 3, fig. 10 in the just cited paper. According to the bifurcated ribs in the area of the hook, this shell could belong more probably to the genus *Anahamulina* Hyatt, 1900). However, it is the shell stated by Hoedemaeker (1995, pl. 8, fig. 10) that does not belong to the species *H. parvulum*, because on the periphery of its provera, short spines have been found.

Distribution. The species has a considerable distribution in area of the Mediterranean region. It probably occurs in all the Early Barremian.

Genus *Eoheteroceras* Vašíček & Wiedmann, 1994

Type species: *Eoheteroceras silesiacum* Vašíček & Wiedmann, 1994.

Eoheteroceras uhligi (Vašíček, 1981)

Pl. 2, Figs. 1 - 6

1994 *Eoheteroceras uhligi* (Vašíček); Vašíček & Wiedmann, p. 227, pl. 4, figs. 6, 7 (cum syn.)

Material. Six differently preserved specimens more or less pyritized on one side and deformed in all cases (To96/35, 38b, 48, 61, 69, To97/5). The spec. To96/69 belongs to an incomplete juvenile helicoid shell with several fragmentary sutures.

Description. Small heteromorph shells. A juvenile part is coiled in a helicoid spiral and is followed with a developed hooky adult part. The low helicoid part, whose whorls are not probably in contact, bears apparent simple ribs, on which small ventrolateral tubercles can occur irregularly. The spiral part uncoils to the arcuated loose shaft (proversum), after which a hooky part (flexus) and the end shaft (retroversum) are situated. The whole retroversum can be longer than the proversum with the juvenile shell altogether. The proversum keeps the style of ribbing of the juvenile shell, i.e. it bears simple ribs, of which some can bear ventrolateral tubercles. In the beginning of the hooky part, the phragmocone probably ends and the body chamber begins. On the retroversum, stronger ribs (sometimes in pairs) begin to change with weaker ribs. In the vicinity of the mouth, ribs fade.

Measurement. The first growth interval from the juvenile end to the periphery of the flexus has a length of about 20-25 mm. The retroversum can be somewhat longer.

Remarks. Our findings bring some new knowledge of the formation of a juvenile helicoid shell, supplement the knowledge on a possible length of the retroversum and on its non-uniform ribbing. On the juvenile shell To96/69 remnants of several small sections of sutures belonging to different septa are apparent. These fragments have a rather complicated structure close to the formation of the suture given in the description of the next species illustrated in Fig. 3.

The shells are deformed and preserved unequally. Despite it seems that they have a considerable variability in the size of initial whorls and the whole shell, or in the detailed formation of the sculpture. Differences of secondary origin are, however, also due to the position of the shell in the plane of deformation and in the plane of the bedding surface.

The close species *E. silesiacum* differs especially in forming the juvenile shell. The adult part is close to the latter described species.

Distribution. Vašíček & Wiedmann (1994) state the Early and Late Barremian. The present finds come from the upper part of the Early Barremian (Caillaudianus Zone).

Eoheteroceras cf. silesiacum Vašíček & Wiedmann, 1994 Pl. 2, Figs. 7, 8, Fig. 3

1994 *Eoheteroceras silesiacum* sp. nov.; Vašíček & Wiedmann, p. 226, pl. 4, figs. 4, 5

Material. The only shell pyritized on one side (originally the bottom) with an imprint (To96/65) and some other imperfectly preserved shells that could, at least partly, belong to the group of the given species.

Description. The small ancylocoid shell with an unknown juvenile part. After the arcuated proversum, a hooky part is located, whose shape is partly influenced by deformation. Just behind the hook, whose end is emphasized with a constriction, the retroversum follows that belongs to the body chamber.

The proversum bears apparent, simple ribs inclined to the mouth. This style of ribbing ends in a constriction combined with a bifurcated rib at the end of the hook. The retroversum bears less apparent ribs that are straight, not inclined. Near the expected mouth, ribs fade.

Suture. Almost the complete suture is, with reference to a small height of the shaft, rather articulated in the areas of the first and the second saddle. The lobe U is conspicuously narrow (Fig. 3).



Fig. 3. Suture of *Eoheteroceras cf. silesiacum* Vašíček & Wiedmann at H = 3.7 mm.

Measurement. The shell has a total length of almost 20 mm. The height in the hook is 5.5 mm.

Remarks. The imprint of a positive lengthens the proversum continuation by about 2 mm at the embryonal end. Its type of curvature indicates the continuation into a narrow whorl of the loose coiled spiral. This should shift (the continuation is not, however, preserved) under the retroversum and passes thus into low spatial coiling. The basic morphology of the juvenile part indicates *E. silesiacum*. However, the proversum of the holotype is sculptured in a rather different way, which can fall into the morphological variability, but identifying the holotype with our specimen is not quite sure.

The well preserved suture in the genus spectrum of sutures of the subfamily Leptoceratoidinae is, in its own manner, close to the genus *Hamulinites*; primarily the articulated suture of *H. assimilis* (Uhlig, 1883) being then the closest. For completeness, it is necessary to state that the suture of the genus *Eoheteroceras* was not known earlier.

Distribution. The authors of the species *E. silesiacum* presupposed the Early Barremian. The present finds prove the upper part of the Early Barremian.

Genus *Josticeras* gen. nov.

Type species: *Josticeras wiedmanni* sp. nov.

Diagnosis. A heteromorph of medium size with simple strong ribs on the phragmocone and with similar,

but unequally strong ribs on the body chamber. Leptoceratoid suture.

Description. A three-part shell with an unknown embryonal beginning. The juvenile part consists of two slightly open shafts. They have simple ribbing. The body chamber forms with the end of the phragmocone an obtuse angle. In contrast with the phragmocone, it bears ribs unequally strong. The simple suture with bipartite saddles and lobes of the goniatitic type.

Remarks. The unpreserved embryonal part makes the comparison with related genera difficult. In comparison with all leptoceratoids, the position of the body chamber represents a different element. The phragmocone itself reminds in shape the genus *Hamulinites* Paquier, 1901, in which the septal part, however, does not reach the other shaft. The suture of the latter mentioned genus is much more complicated. By simplicity of the suture, but not by a size of the shell, the new genus is close to the genera *Orbignyceras* Royo y Gómez, 1945 (= *Velezyceras* Wright, 1957 in Wright et al. 1996, p. 226) and *Karsteniceras* Royo y Gómez, 1945. A certain analogy in the shape of the adult shell can be searched in specimens designated by Stahlecker (1935) as *Heteroceras multicostatum*. This species is probably another representative of the genus *Josticeras*.

Distribution. The new genus is known from the Early Barremian of the Silesian Unit (Czech Republic). Stahlecker's material (1935) comes, in all probability, from the lower part of the Late Barremian of the Cape Verde Islands (Maio Island).

Josticeras wiedmanni sp. nov.

Pl. 2, Figs. 9 - 11, Fig. 4

Holotype. Spec. To96/32 (Pl. 2, Figs. 9, 10). Early Barremian, Těšín-Hradiště Formation, Soběšovice.

Derivatio nominis. A genus and species names are given in honour of my friend Prof. Dr. Jost Wiedmann.

Another material. An incomplete and heavily deformed shell To96/83 from the same locality.

Diagnosis. A medium-size shell having altogether a triangular shape. Sharp and simple ribbing on the whole shell.

Description. A heteromorph with simple and dense prorsiradiate ribs on the first shaft. In the transition from the first shaft to the other, the ribs straighten up and strengthen. The spaces between ribs are larger here than the width of ribs. The transition to the body chamber is accompanied by the diversion of the end shaft at an obtuse angle. The ribs of the body chamber are unequally strong. They are slightly convex towards the mouth. Stronger and weaker ribs change irregularly.

Suture. It is simply articulated (E, L, U, I). The internal lobe is not preserved. Saddles are bipartite, otherwise smooth. The external lobe bears a low and smooth secondary saddle. The other saddles are simple, smooth (Fig. 4).



Fig. 4. Incomplete suture of *Josticeras wiedmanni* n. sp. at H = 3.2 mm.

Measurement. The length of the phragmocone is 20 mm; the total length being 34.5 mm. The height of shaft at the end of the phragmocone is 5 mm.

Remarks. Differences from related genera are included in notes concerning the newly determined genus. The related species *J. multicostatum* (Stahlecker, 1935), which is more robust, is close thanks to its simple ribbing and characteristic curvature of shafts of some adult shells.

Distribution. It corresponds to data in the description of the genus.

Family Heteroceratidae Spath, 1922

Genus ?*Hemibaculites* Hyatt, 1900

Type species: *Toxoceras obliquatum* d'Orbigny, 1842.

?*Hemibaculites* sp.

Pl. 2, Figs. 12, 13

Material. Two imperfectly preserved shells deformed in plane that miss their juvenile parts (To96/47, To97/17). Maybe even the specimen To96/41, 63 can be ranked among them.

Description. The most complete shell is formed by a slightly arcuated, considerably long shaft. A rather smaller final half of the preserved shell that, in all probability, belongs to the body chamber bears weak and denser, simple ribs convex towards the mouth. On the internal side, ribs are inclined more steeply than on the periphery. Fine ribs and their greater density indicate the vicinity of the mouth. The phragmocone of the just described larger shell has no preserved sculpture. In the smaller specimen, thin and dense ribs are, however, apparent. They are arcuated like those on the body chamber of the more complete shell.

Measurement. The shell has a preserved length of about 120 mm. The height of the shaft by the mouth is 13 mm.

Remarks. What obstructs the unambiguous genus classification is ignorance of the suture in the case of *H. obliquatum* (d'Orbigny, 1842) as well as with our material. As stated by Wright et al. (1996), the type specimen of the genus *Hemibaculites* (i.e. *H. obliquatum* d'Orbigny) was lost. According to d'Orbigny's (1842, pl. 120, figs. 1-4) illustration, the typical species is very close to our material in shape, which indicates the same genus assignment. It is primarily its strong ribbing which distinguishes it from the Silesian material. In our opinion, Druščic's specimen designated as *H. obliquatum* (1960, pl. 41, fig. 1), in which a helicoid beginning of the shell is

preserved, does not belong to the genus *Hemibaculites* in any means.

Moreover, shells that are stated by Stahlecker (1935, p. 287, pl. 14, figs. 18-20) under the name *Bochianites hennigi* belong to the range of the given genus. A shape of the shells is similar, simple ribs are weaker than the ribs of *H. obliquatum*, but they are stronger than those with the shells designated here as *?Hemibaculites* sp. In conclusion it cannot be excluded that an imperfectly preserved shell that Rieber (1977, pl. 1, fig. 8) depicts under the name *Anahamulina* aff. *ptychoceratoides* (Uhlig) with a suture preserved partly (text-fig. 5), is close to the Silesian material.

Distribution. The Silesian specimens come from the upper part of the Early Barremian; Stahlecker's species from the lower part of the Late Barremian.

Total composition and stratigraphical position of the ammonite association

The locality is unique thanks to the total composition of ammonites and, above all, thanks to pyritized finds of a part of heteromorph ammonites. The collection under study tops, in a certain way, the macropaleontological and biostratigraphical, probably never completed, investigation of Lower Cretaceous deposits of the Silesian Unit. This investigation was started by Hohenegger (1852, 1855, 1861) and Uhlig (1883, etc.) in the last century, reopened on the initiative of Dr. Z. Roth, DrSc. in the sixties of this century and then it periodically has continued up to now.

In the determinable part of the ammonite collection (108 shells), all suborders of ammonites are represented, although wholly unequally. Of 108 findings, only 2 specimens (1.85%) belong to the suborder Phylloceratina, 14 (12.96%) to the suborder Lytoceratina, 12 (11.1%) to the suborder Ammonitina and 80 (74.07%) to the suborder Ancyloceratina. Of the latter suborder, only 11 shells (13.75%) do not belong to the subfamily Leptoceratoidinae.

The following ammonite species were determined: *Phyllopachyceras infundibulum* (d'Orbigny), *Lytoceras* cf. *densifimbriatum* Uhlig, *Protetragonites crebrisulcatus* (Uhlig), *Holcodiscus* cf. *angulatus* Tzankov, *H.* cf. *diversecostatus latituberculatus* Tzankov & Breskovski, *Spiritidiscus* sp., *Kotetishvilia* sp. ind., *Emericiceras* sp. juv., *?Hemibaculites* sp., *?Hamulina* sp., *??Acrioceras* sp., *Leptoceratoides subtile* (Uhlig), *Karsteniceras beyrichoides* (Vašíček & Wiedmann), *Hamulinites parvulus* (Uhlig), *Eoheteroceras uhligi* (Vašíček), *E.* cf. *silesiacum* Vašíček & Wiedmann, *Josticeras wiedmanni* n. g. and n. sp.

As far as stratigraphy is concerned, pulchelliids and holcodiscids should be regarded as the most important representatives of the mentioned association. Leptoceratoids can be assigned rather to species passing through several ammonite zones or to endemites. The others belong to stratigraphically less important, long-lived speci-

es, or they are not reliably determinable on the species level. Pulchelliid representatives undoubtedly belong to the genus *Kotetishvilia*. From the standpoint of species assignment, it can be rather speculated than documented that more or less juvenile, but especially imperfectly preserved pulchelliid shells could be assigned to the group of *K. compressissima*. According to Vermeulen (1995) and older authors, the above-cited species is of zone importance as a species of the upper part of the Early Barremian.

Similarly, collected small holcodiscids are not determinable unambiguously: *H.* cf. *angulatus* and *H.* cf. *diversecostatus latituberculatus*. Their relatively strong ventrolateral tubercles are the most apparent feature. In virtue of data of Tzankov & Breskovski (1985), the higher Early Barremian can be considered. The Early Barremian is also evidenced with leptoceratoids, mainly *Leptoceratoides subtile* and *Hamulinites parvulus*.

If we take into account all available stratigraphic data, the ammonite Caillaudianus Zone (Hoedemaeker, Company et al. 1993) can be deduced, or the Compressissima Zone according to biozones determined by Vermeulen (1995), i.e. the upper part of the Early Barremian. We arrived at the same conclusion preliminarily in the report by Klajmon et al. (1997), where was our stratigraphic assignment also based upon the association of 17 species of cysts of noncalcareous dinoflagellates. After P. Skupien's determination in the cited report, *Cerbia tabulata* (Davey & Verrier) Below 1981 also occurs in the association. According to Leereveld (1985), in the Río Argos section begins this species its occurrence in the deposits of the Caillaudianus Zone for the first time.

Comments on palaeoecology

As already mentioned, in the collected material ammonites prevail and representatives of other faunas, especially of the benthic fauna are wholly missing. On the other hand, remnants of the land flora and also fragments of fish vertebrates occur. The position in the thick formation of sediments (several hundred meters) indicates the redeposition of organic remnants through a turbidite current from a more or less shelf position to a deep-water environment.

The question remains whether the studied shells got to the poorly aired clay bottom already in the place of the original environment of heteromorphs or after their redeposition. However, the pyrite preservation of a part of ammonite shells evidences, in any case, a decreased oxygen content. Small, more complete shells with preserved sutures have always preserved body chambers. Although the ammonite association in the locality should be a result of transport by the turbiditic flow, when some types of shells could be partly sorted, it is necessary to suppose that, in principle, they are a picture of the original ammonite association and environment.

Associations of small heteromorph ammonites, either

real leptoceratoids or heteromorphs close through their external morphology to leptoceratoids, are quite known from the Barremian stage, or in the last years also from Barremian-Aptian deposits. Their shells can be usually found collectively in dark clay or clay-shale deposits, or also in dark clay intercalations in limestones of the Maiolica type, and others. The shells in some localities of the presented type are often pyritized, which indicates anoxic or dysaerobic conditions at least in the course of fossilization. They are very often without any accompanying benthos. For example, Ooster (1860), Uhlig (1883), Sarasin & Schöndelmayer (1902), Stahlecker (1935), Vašíček (1972, 1990), Rieber (1977), Cecca & Landra (1994), Stöhr (1994), Stöhr & Hippenstiel (1996), and others state them in such sediments.

The locality of Soběšovice is, as for the facies and ammonite composition, very close to the horizon VII in the Maio Island (Stahlecker 1935). In Stahlecker's collection consisting of about 50 ammonites from dark grey shaly deposits of that place, only 14 belong to coiled forms, the other belong to heteromorphs. The presence of fish remnants is interesting. As far as the faunal horizon VII is concerned, Stahlecker (1935) expects justifiably the Barremian age of deposits. He prefers rather the Upper Barremian. With regard to the fact that zone species of ammonites are missing here, the age of deposits can be more probably put to the Early Barremian/ Late Barremian boundary.

Non-uniform opinions on ecology of leptoceratoids are presented in the literature. Rieber (1977) supposes a nektonic way of life above the anoxic bottom. Westermann (1990, 1996) lays cryptocone heteromorphs into the conditions of the distal shelf. Vašíček & Wiedmann (1994) put Silesian occurrences to autochthonous intercalations between turbidites. The latest finds from the locality of Soběšovice in the Silesian Unit, however, enable no autochthonous explanation.

It was primarily Westermann (1996) and Cecca (1997, 1998) who have concerned with the palaeoecology of Cretaceous uncoiled ammonites recently. Above all in the latter mentioned contribution dealing also with the Barremian subfamily Leptoceratoidinae, the whole range of problem is discussed in a very wide spectrum, namely on the basis of the author's own observation and material and in virtue of rich data in the literature. One can prevalently agree with his opinions and conclusions that are partly and as briefly as possible recapitulated in the following paragraph.

The paleogeographic distribution of Barremian ammonite assemblages in the Mediterranean Tethys indicates that their composition is ecologically controlled. A considerable diversification of Barremian ammonites, higher than that in previous stratigraphic stages, reflects the high number of niches and food sources. Environmental changes connected with flowing, fluctuating the sea level, a different terrigenous supply from land, etc., manifest

themselves most in the marginal shelf parts. Those changes induce stress phenomena leading to an explosive development of opportunistic ammonite species. It is representatives of the subfamily Leptoceratoidinae that belong, among others, to opportunistic species in the Barremian. They can be characterized by the fact that their adult shells are small in size, uncoiled, variable as for morphology and species. They are short-lived and occur in considerable numbers.

The studied locality in the Silesian Unit is in accordance with the presented knowledge. As already mentioned, a considerable thickness of non-carbonate, prevailing clayey-silty Barremian deposits and other lithological features of them lead us to the opinion that a horizon at Soběšovice occurs in the zone of distal turbidites, deposited under basinal conditions in the final phasis. The original environment of leptoceratoids was, however, the area of the outer, deeper shelf in the range of terrigenous material and plant remains from land. The given environment must have extended above the anoxic bottom making the life of benthic organisms impossible. Therefore, the animal assemblage, in which ammonites dominate wholly, is supplemented only little by remains of nektonic fish vertebrates. Anoxia enabled especially a favourable preservation of slightly arcuated, bilateral symmetric ammonite shells. Spatially coiled shells or those that did not rest at the bottom level have not preserved those parts that had towered above the level of a zone of hydrogen sulphide contamination having a negligible thickness.

Conclusion

The preservation in a form of pyrite steinkerns supplement some diagnoses of the representatives of subfamily Leptoceratoidinae concerning new substantial diagnostic features. The represented species of this subfamily, which have usually, from the standpoint of detailed stratigraphy till this time, neither precisely known stratigraphic position nor range, are accompanied not only by several species of small stratigraphic significance, but also by representatives of more significant genera *Kotetishvilia* and *Holcodiscus*. However, none of imperfectly preserved specimens of the latter presented ammonite genera belongs to the category of zone species. Nevertheless, according to the determined spectrum of ammonites, the stratigraphic assignation of the studied horizon into the ammonite Caillaudianus Zone can be considered. The spectrum of the 17 species of non-calcareous dinocysts indicates this as well.

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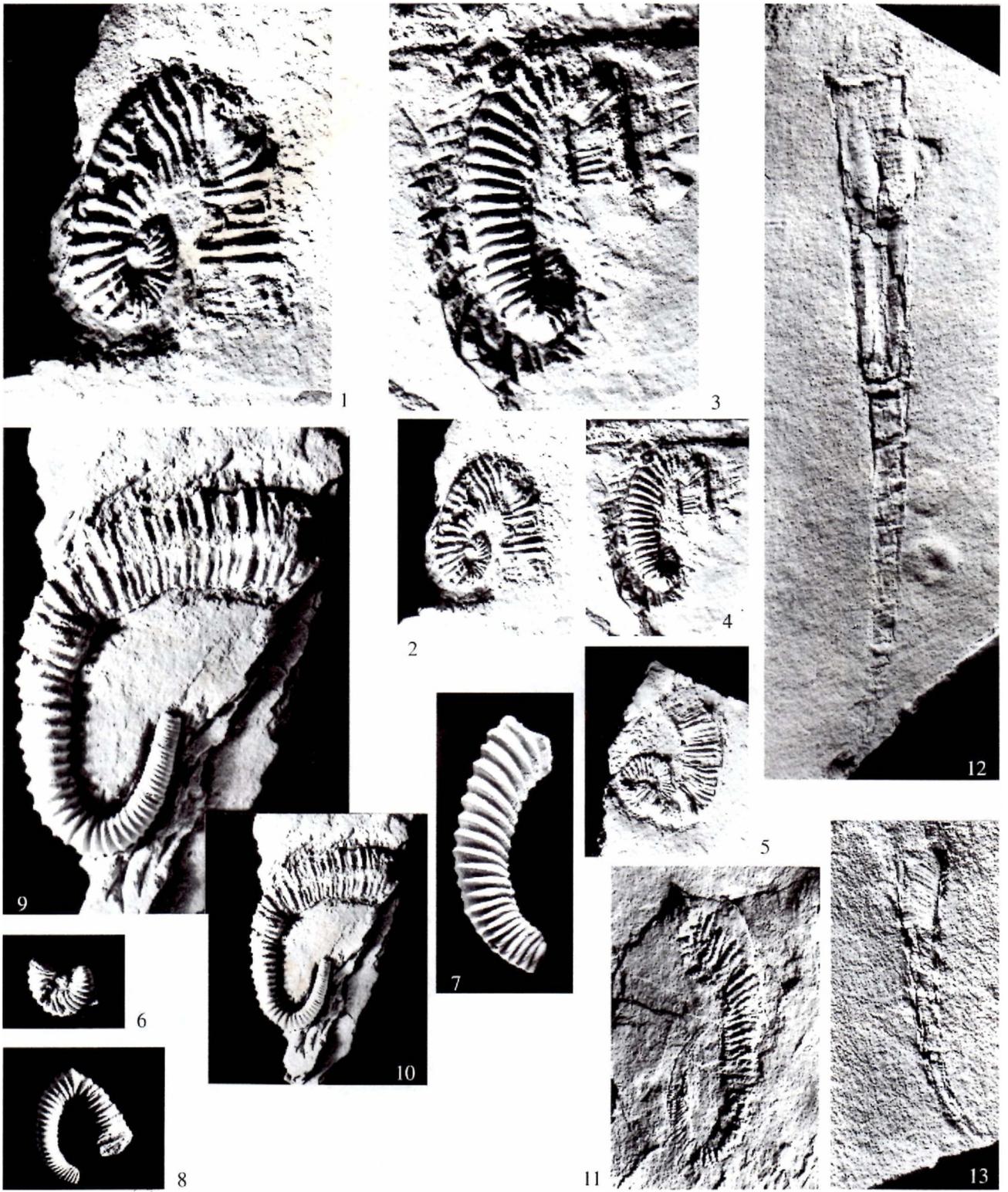


Plate II

Figs. 1-6: *Eoheteroceras uhligi* (Vašíček): 1 to 4, 6 - specimens preserved as pyrite steinkerns, 5 - original shell: 1, 2 - spec. To96/35 (1 - x2, 2 - x1); 3, 4 - spec. To97/5 (3 - x2, 4 - x1); 5 - x1, spec. To96/61; 6 - incomplete, juvenile part, x1, spec. To96/69. Figs. 7, 8: *Eoheteroceras* cf. *silesiacum* Vašíček & Wiedmann: 7 - incomplete pyritized phragmocone with sutures, x3, 8 - almost complete shell with a part of the juvenile continuation apparent in a counter-impression of the original, x1, spec. To96/65. Figs. 9-11: *Josticeras wiedmanni* gen. nov., sp. nov.: 9, 10 - holotype with a pyritized, spatially preserved phragmocone and a deformed body chamber without pyritization. 9 - x2, 10 - x1, spec. To96/32; 11 - deformed, incomplete original shell, spec. To96/83, x1. Figs. 12, 13: *?Hemibaculites* sp.: 12 - nearly complete adult shell with an imperfectly preserved juvenile area, x1, spec. To97/17; 13 - juvenile shell with a marked sculpture, x1, spec. To97/47.

Photos by K. Mezihrádová, Ostrava University. All specimens were bleached with ammonium chloride. The whole processed material will be handed over to the Ostrava Museum to be deposited in its collections.

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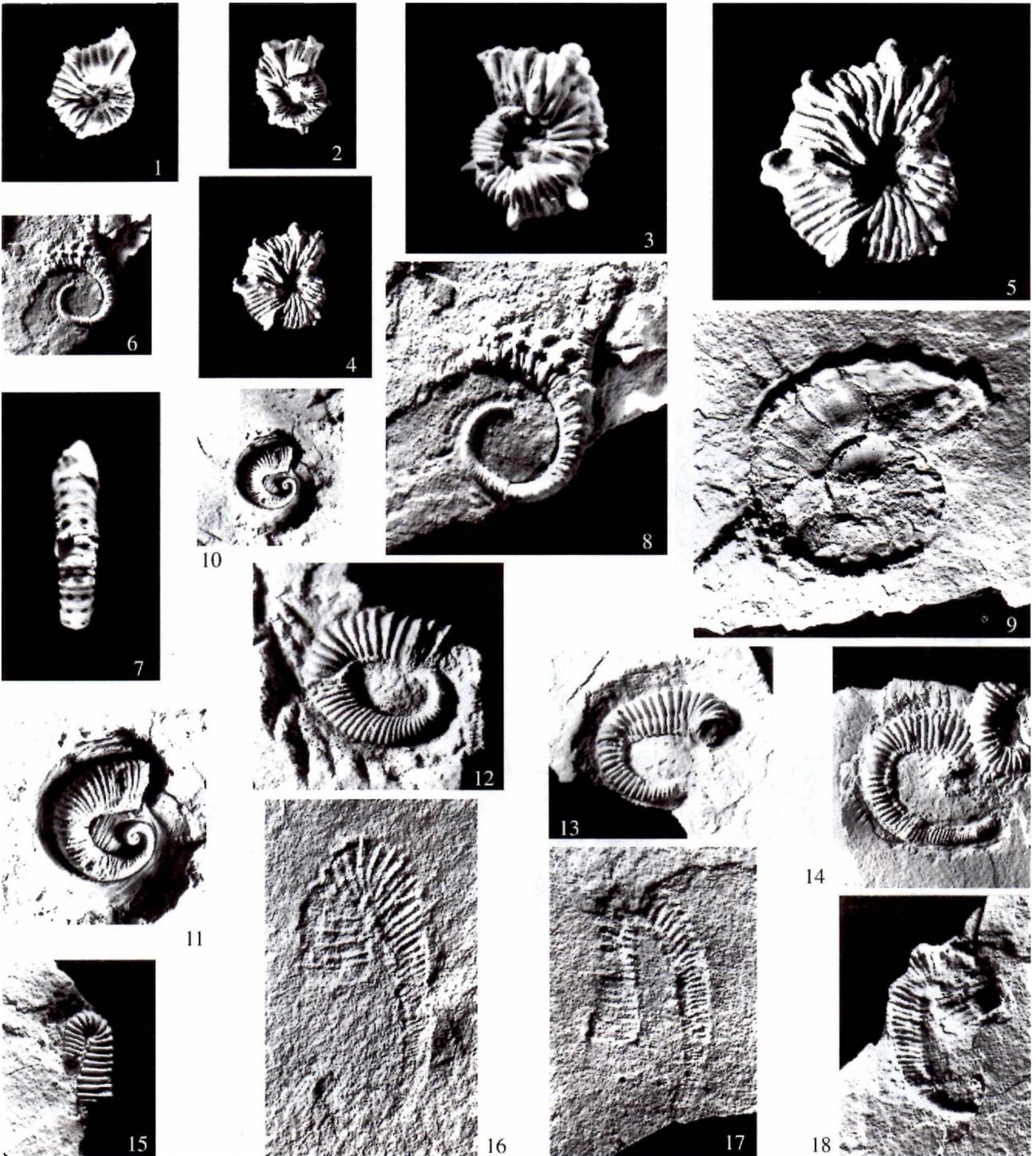


Plate 1

Figs. 1-3: *Holocodiscus cf. angulatus* Tzankov; 1 - juvenile pyrite steinkern, x2, spec. To96/43; 2 - left side of the specimen To97/14, x1; 3 - opposite side of the same specimen, x2.. Figs. 4, 5: *Holocodiscus ex gr. diversecostatus latituberculatus* Tzankov & Breskovski; pyritized side, 4 - x1, 5 - x2, spec. To97/34. Figs. 6-8: *Emericiceras* sp. juv.; 6, 8 - side view, x1 and x2; 7 - view of the external side, x2, spec. To96/60. Fig. 9: *Kotetishvilia* sp. ind.; imperfectly preserved specimen with a body chamber, x2, spec. To97/9. Figs. 10, 11: *Leptoceratoides subtile* (Uhlig); specimen with a preserved embryonic whorl. 10 - x1, 11 - x2, spec. To96/62. Figs. 12-14: *Karsteniceras beyrichoide* Vašíček & Wiedmann; 12 - pyritized juvenile shell, x2, spec. To96/3; 13 - pyritized shell of the middle stage of growth, x1, spec. To96/27; 14 - partly pyritized shell deformed in plane of bedding, x1, spec. To96/38a. Figs. 15-18: *Hamulinites parvulus* (Uhlig); 15 - incomplete pyrite steinkern, x1, spec. To96/57; 16, 17 - usual manner of preservation, x2, spec. To96/51 and To96/52; 18 - almost complete, partly pyritized shell, x2, spec. To96/42.