



Lower Liassic (Hettangian) Ammonites from Zlambach Graben near Bad Goisern, Upper Austria

MILOŠ RAKÚS

12 Text-Figures and 4 Plates

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*Northern Calcareous Alps
Salzkammergut
Zlambach Graben
Stratigraphy
Hettangian Ammonites*

Contents

Abstract	329
Zusammenfassung	329
1. Introduction	329
2. Systematic part	330
3. Stratigraphic range of cephalopod fauna	341
Acknowledgements	341
References	341

Abstract

The author described Lower Liassic – Hettangian ammonites from the Zlambach Graben locality. The ammonite fauna comes from lithologically indistinguished marlstone from the Zlambach Formation. The collection is deposited at the GBA (Vienna) and it was collected by several geologists. We have determined 15 species of ammonites and one *Nautilus*. Described species indicate undoubtedly the Hettangian age of the uppermost part of the Zlambach Formation Planorbis to Angulata zones.

Eine Ammonitenfauna des unteren Lias (Hettang) von der Lokalität Zlambachgraben bei Bad Goisern, Oberösterreich

Zusammenfassung

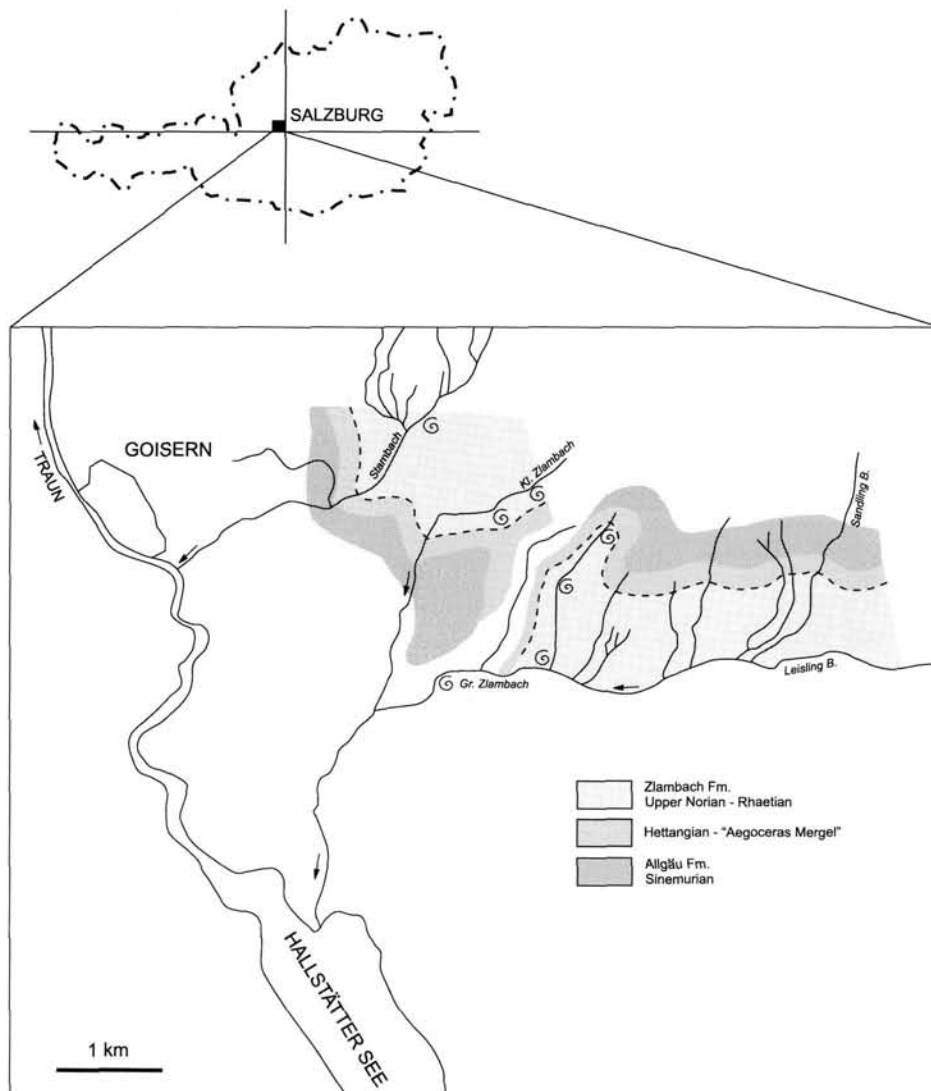
Es wird eine Ammonitenfauna des unteren Lias (Hettang) von der Lokalität Zlambachgraben beschrieben. Die Fauna umfaßt 15 Ammoniten-Arten und einen *Nautilus* und stammt aus grauen Mergeln, die die norisch/rhätischen Zlambachschiechten konkordant überlagern. Die Ammoniten-Vergesellschaftung spricht eindeutig für ein Hettang-Alter (Planorbis bis Angulata Ammonitenzonen).

1. Introduction

The idea of the study of the Lower Liassic ammonites from the Zlambach Graben near Bad Goisern was born in the 90s when I was studying the phylloceratid ammonites from the Late Triassic up to the early Lias of the Northern Calcareous Alps. Then I came across an ammonite collection deposited at GBA, which originally was not horizoned but it contained a lar-

ge number of genera and species of Hettangian ammonites. Furthermore, these ammonites occur in pale grey marlstones, which are impossible to differentiate (by colour and by lithology either) from the true Zlambach marlstones of Upper Norian and Rhaetian ages! This fact was quite exciting for me and so I decided to study them further.

The presence of the Lower Liassic ammonites in the "Grosser Zlambach Graben" had been indicated long ago, in



Text-Fig. 1.

Geological sketch map of Goisern surroundings (Compiled after MEDWENITSCH 1957); dashed line indicates approximate boundary between the Rhaetian and Hettangian.

the past century, when NEUMAYR (1879) described several new species of Hettangian ammonites from there. The fauna described by NEUMAYR descended mainly from the collections of Mr. RASTEL (see NEUMAYR, 1879: 6), who at the beginning of the 70s of the past century mailed a large number of lower liassic fossils to Mr. MOJSISOVICS for determination. On the basis of the rock similarity as well as the mode of fossilization the collector RASTEL ranged them to the "Zlambach Schichten". NEUMAYR himself, who got the RASTEL'S collection from MOJSISOVICS, resumed (l.c.: 6) that some of his new species of Phylloceratids were found together with "Aegoceras" and in the rock which is lithologically impossible to differ from the marlstones of the Zlambach formation. Nevertheless, at that time NEUMAYR already separated two distinct faunas: one of the true Norian - Rhaetian character, the other of the Liassic type. For this part of the Zlambach facies in which the liassic ammonites occurred he used the term "Aegoceras Mergel" and situated it on the top of the Upper Norian/Rhaetian part of the Zlambach formation and below the "Fleckenmergeln" of the Allgäu Formation. From the above mentioned we can conclude that lithologically and also stratigraphically the Zlambach Fm. extends up to the early Jurassic - Hettangian.

The authors of the Alpine literature and Alpine geologists use the term Zlambach Formation exclusively for the Upper Norian, but mainly for the Rhaetian stage (MEDWENITSCH 1975, KRISTAN-TOLLMANN 1964, ZAPPE 1967, PISTOTNIK 1972, WIEDMANN 1972, TOLLMANN 1978, MATZNER 1986 and KRYSSTYN 1987). In the basinal development, to which the Zlambach Formation undoubtedly belongs, only the Kendelbach and Allgäu Formations are ranged to the Liassic. But NEUMAYR'S information and also results of our investigation differ from the above mentioned opinion.

2. Systematic part

Note: with respect to the fact that phylloceratoid ammonites from the Zlambach locality have been described by RAKÚS, (1993), in this work we will only restrict to supplements to so far undescribed species. *The Scale bar in text-figures 2-11 equals 5 mm.*

NAUTILIDAE de BLAINVILLE, 1825

Cenoceras HYATT, 1883

Cenoceras (Cenoceras) schlumbergeri
(TERQUEM, 1855)
Pl.1, Fig. 7

- 1855 *Nautilus Schlumbergeri*, TQM. – TERQUEM: 242, Pl. 12, Fig. 4
1984 CENOCERAS (CENOCERAS) SCHLUMBERGERI (TERQ.) – TINTANT: 39, Text.–Fig. 4
1999 *Cenoceras schlumbergeri* (TERQUEM, 1855) – RAKÚS: in BÖHM et al.: 185, Pl. 24, Fig. 3

Material: one laterally compressed and crushed specimen with its body chamber and peristome partly preserved

Dimensions:	D	Wh	Wb	O
	114,0	55,3	–	17,7

Remark: This rare species of *Cenoceras* is characterised by trapezoidal whorl section, flattened venter as well as by rounded ventral shoulders. The umbilic is relatively open and the umbilical wall is more or less perpendicular to the plan of symmetry. The shell has a very typical reticular structure. The peristome is simple.

Although our specimen is partly deformed we can see that the umbilical wall is not oblique as it was depicted by TERQUEM (1855, Pl. 12, Fig. 4). If we compare his own figure num. 4 with figure 4a, it is clear that figure 4 was incorrectly drawn by the designer.

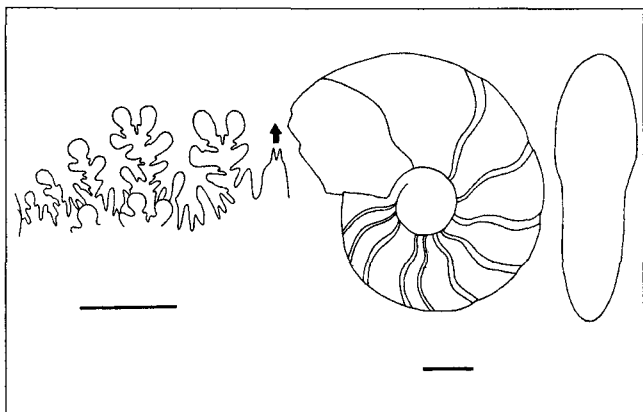
Occurrence: Zlambach Graben near Goisern, Austria, Middle Hettangian, Liasicus zone.

Juraphyllitidae ARKELL, 1950

***Togaticeras* RAKÚS, 1993**

Togaticeras togatum
(MOJSISOVICS m. s. in NEUMAYR, 1879)
Text–Fig. 2, Pl. 1, Fig. 2, 3, 4, 5

- 1879 *Phylloceras togatum* MOJSISOVICS in lit. – NEUMAYR: 21, Pl. 1, Fig. 16, 17
1993 *Togaticeras togatum* (NEUMAYR, 1879) – RAKÚS: 946, Text.–Fig. 15, Pl. 3, Fig. 6, 7



Text–Fig. 2.
Cross section, lateral view and suture line of *Togaticeras togatum* (NEUM.).

Material: nine relatively well preserved phragmocons, one specimen with its body chamber

Dimensions:	D	Wh	Wb	O
	13,8	6,0	–	2,0
	17,3	7,0	–	4,5
	19,2	8,5	–	4,8
	23,4	11,2	–	4,8
	26,8	12,0	8,4	6,4
	34,7	17,0	9,8	6,6

Remark: These specimens were not long ago described in detail by the author himself (1993). Now we give only some complementary observations. Up to 5 mm of diameter, the coiling is almost evolute and the whorl section is circular. However the whorl height is gradually prevailing and the section of the whorls is elliptic. The cross section of the body chamber has the same morphology Text–Fig. 2)

From the diameter of 10 mm the coiling is more involute and the shape of the specimen is convolute to rather involute (adult stage). The juvenile stages are without constrictions. On the phragmocone of subadult and adult stages we observe 7 to 10 prorsiradiate or slightly sigmoidal constrictions, which are a short ventral projection (Text–Fig. 2)

The suture line is typical Juraphyllitid (Text–Fig. 2) with relatively robust stems of S1 and S2 and well spatulated foliioles.

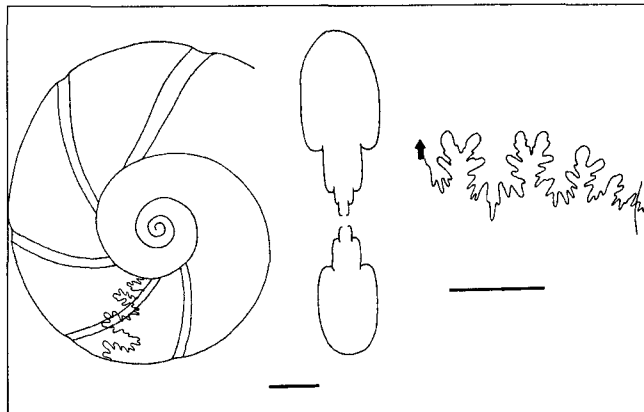
Occurrence: Zlambach Graben near Goisern, light-grey marlstones, Lower, Middle Hettangian, Planorbis to Liasicus Zones

***Togaticeras goisernense* n. sp.**
Text–Fig. 3, Pl. 1, Fig. 1

Etymology: after the classic locality of Zlambach formation Goisern in Austria

Holotype: specimen figured here on the Plate 1, Fig. 1, Text–Fig. 3

Material: one well preserved nearly complete specimen with body chamber



Text–Fig. 3.
Lateral view, cross section and suture line of *Togaticeras goisernense* n. sp., Holotype.

Dimensions:	D	Wh	Wb	O
GBA	31,3	11,3	–	12,6

Diagnosis: A little evolute form of *Togaticeras* with very expressive prorsiradiate constrictions on the last whorl

Description: The small species of *Togaticeras* is mainly characterised by a laterally compressed whorl section with parallel flanks. The whorl section (Text-Fig. 3) is sub rectangular with a rounded ventrum smoothly passing to the flanks. The umbilic is open with rounded but distinct umbilical edge. The umbilical wall is rounded too.

On the last whorl we observe five prominent, prorsiradiate constrictions without ventral projection. The suture line (Text-Fig. 3) has typical Juraphyllitid shape with robust stems of the two first lateral saddles, which are diphylic.

Remark: Small size, tendency of uncoiling of the last whorl as well as the strongly marked constrictions on the body chamber allow us to suppose that our new species is a microconch. Our new species differs from *T. togatum* by more evolute coiling and by flat and parallel flanks.

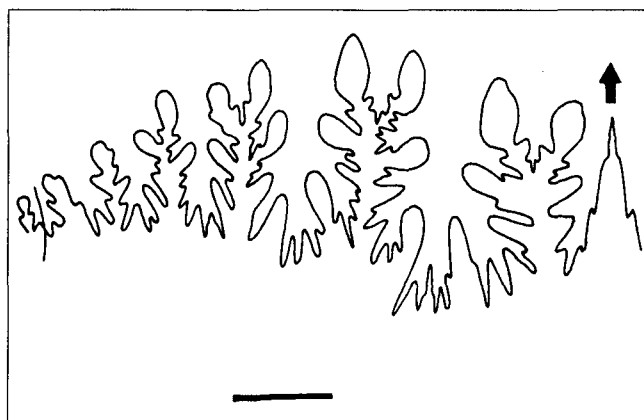
Occurrence: Zlambach Graben near Goisern, Austria, Lower to Middle Hettangian

Nevadaphyllites GÜEX, 1982

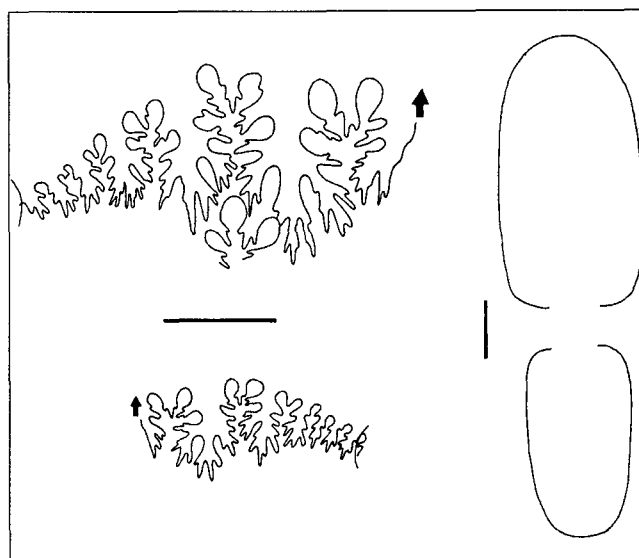
Nevadaphyllites aff. *glaberrimus* (NEUMAYR, 1879)

Text-Fig. 4, Pl. 2, Fig. 4

Material: two fragments of body chamber



Text-Fig. 4.
Suture line of *Nevadaphyllites* aff. *glaberrimus* (Neum.).



Text-Fig. 5.
Cross section and suture lines of *Phylloceras occiduale* CANAVARI.

Remark: in the previous study I distinguished from typical species an adult specimen which is without doubt a *Nevadaphyllites*. This specimen differs from the typical form in a greater diameter and more elongated foliioles on the saddles (Text-Fig. 4).

Occurrence: Zlambach Graben near Goisern, Austria, Lower to Middle Hettangian

PHYLLOCERATIDAE HYATT, 1867

Phylloceras SUESS, 1865

Phylloceras occiduale CANAVARI, 1882

Text-Fig. 5, Pl. 1, Fig. 2a, 6

1882 *Phylloceras occiduale* n. sp. – CANAVARI: 149, Pl. 2, Fig. 13

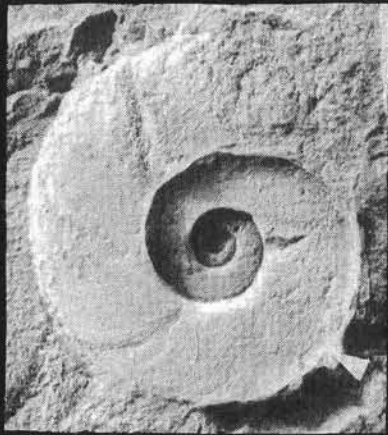
1889 *Phylloceras occiduale* CAN. – CANAVARI: 108, Pl. 2, Fig. 13

Material: three relatively well preserved specimens with relicts of the calcite shell. One specimen has a body chamber preserved.

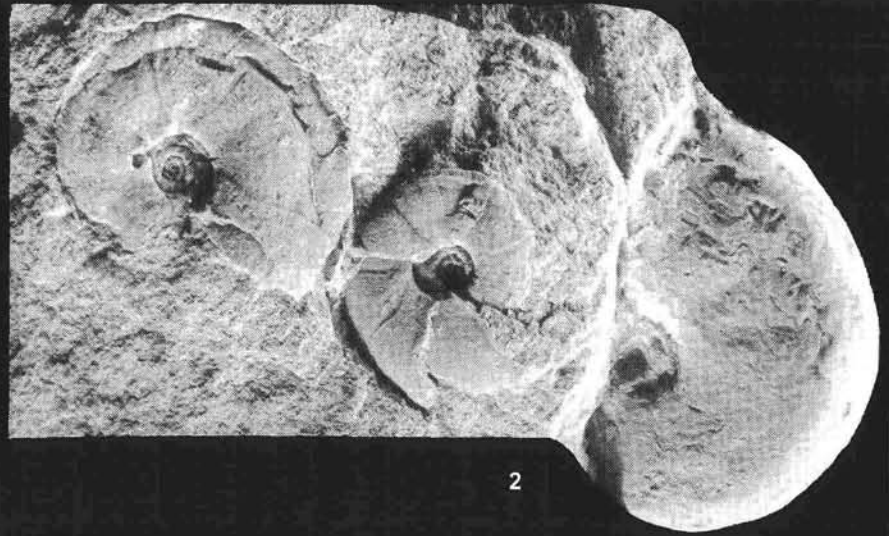
Dimensions:	D	Wh	Wb	O
	18,8	9,4	6,0	3,4
	29,5	15,0	–	4,8
	46,0	22,0	–	5,0

Plate 1

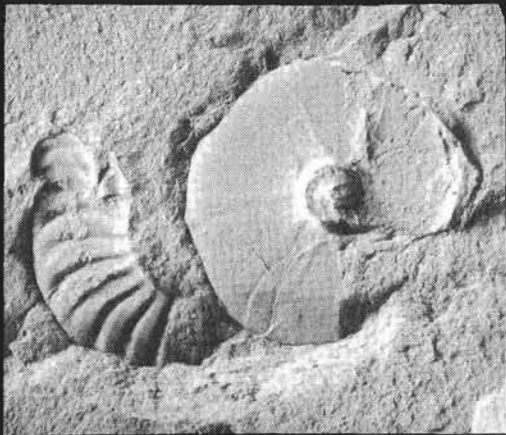
- Fig. 1: *Togaticeras goisernense* n. sp., Holotype, GBA adult specimen with body chamber which shows a tendency of uncoiling, Lower – Middle Hettangian, Loc. Zlambach Graben near Goisern, Austria, 1,5x.
- Fig. 2: *Togaticeras togatum* (Moj. m. s. in NEUMAYR, 1879) and *Phylloceras occiduale* CANAVARI, 1882, Lower – Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,6x.
- Fig. 3: *Togaticeras togatum* (Moj. m. s. in NEUMAYR, 1879) and *Kammerkarites* sp., Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,8x.
- Fig. 4, 5: *Togaticeras togatum* (Moj. m. s. in NEUMAYR, 1879), specimen in Fig. 4 is an adult specimen with body chamber, 1,6x, Fig. 5 shows a subadult stage, 1,9x, Lower – Middle Hettangian, loc. Zlambach Graben near Goisern, Austria.
- Fig. 6: *Phylloceras occiduale* CANAVARI, 1882, an adult specimen with body chamber partly preserved, Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,4x.
- Fig. 7: *Cenoceras (Cenoceras) schlumbergeri* (TERQUEM, 1855), specimen with body chamber, Lower - Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, slightly diminished.



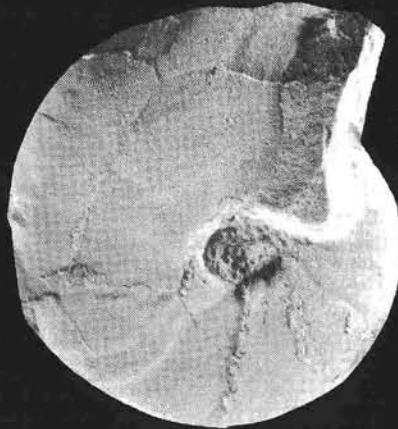
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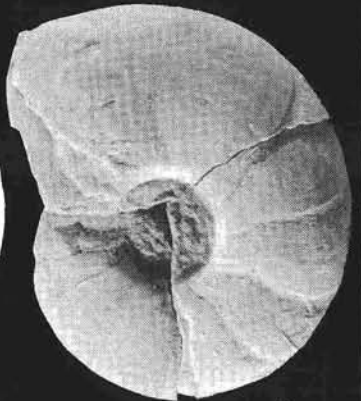
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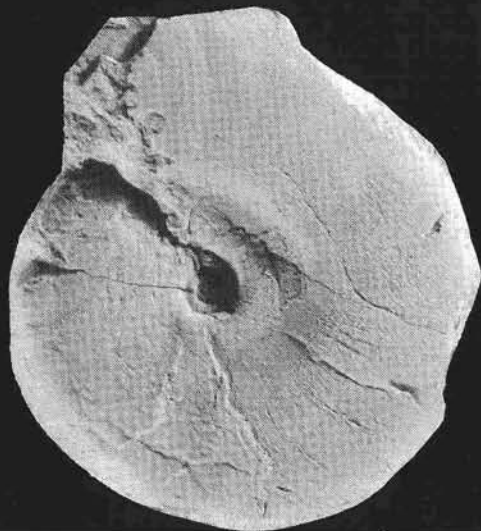
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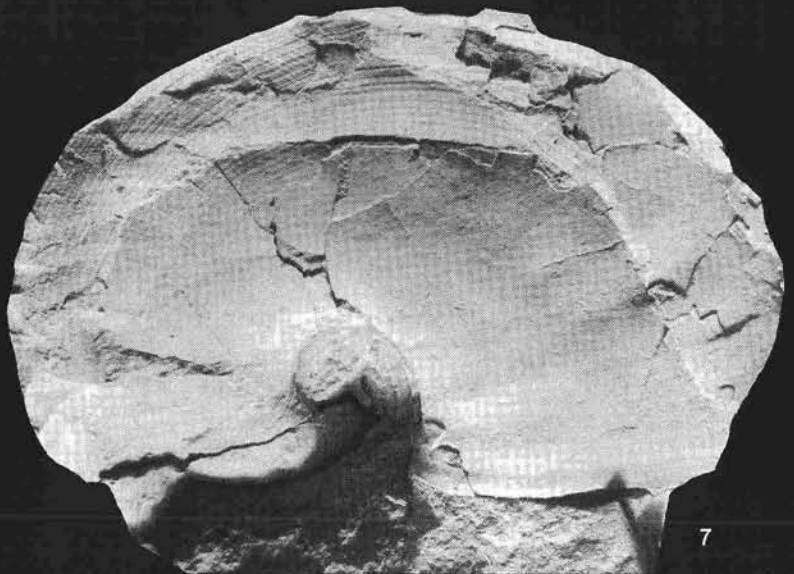
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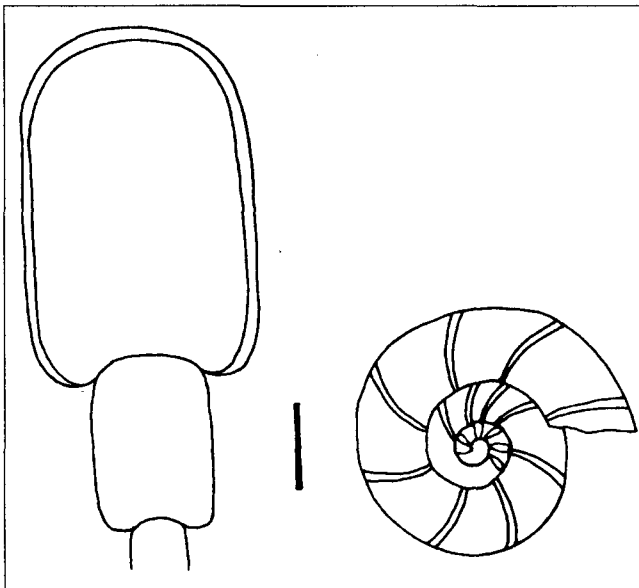
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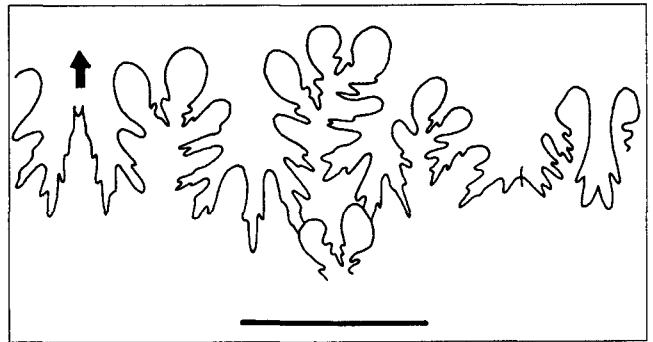
6



7



Text-Fig. 6.
Juvenile stage and cross section of *Euphyllites struckmanni* (NEUM.).



Text-Fig. 7.
Suture line of *Euphyllites struckmanni* (NEUM.).

Text-Fig. 6, 7, Pl. 2, Fig. 1, 2, 6

- 1879 *Aegoceras struckmanni* n. f. – NEUMAYR: 36, Pl. 6, Fig. 5
 1897 *Euphyllites struckmanni* NEUM. – WÄHNER: 170, Pl. 22, Fig. 4–8, ? Pl. 23, Fig. 1
 1952 *Euphyllites struckmanni* (NEUMAYR). – LANGE: 92, Pl. 11, Fig. 2, Text-Fig. 7

Material: three incomplete laterally compressed specimens from Zlambach Graben and two specimens from Pfonsjoch (original material of WÄHNER)

Dimensions:	D	Wh	Wb	O
GBA	27,0	11,0	–	10,0
GBA	66,5	23,3	–	27,0
NHM Vienna, coll.				
WÄHNER, 1897, Pl. 22, Fig. 8	24,6	8,5	–	10,2
1897, Pl. 22, Fig. 4	65,0	22,0	15,4	29,6
1897, Pl. 22, Fig. 3	67,0	25,0	15,0	28,0

Remark: This species was described in detail long ago by CANAVARI (1882). It is characterised by a laterally compressed whorl section, relatively opened umbilicus and very fine and regular ribbing. The whorl section (Text-Fig. 5) shows flat and nearly parallel flanks, which gradually merge with rounded venter. The umbilical "edge" and wall form one arc. This type of section persists during the whole adult stage up to diameter about 100–120 mm (we can observe it on a fragment of body chamber). On the last preserved whorl we can see fine sigmoid "ribs" or riblets, which probably correspond to growth lines.

The suture line (Text-Fig. 5) is typical phylloceratid, with slender stems of external saddles. The saddles S1 and S2 are more or less triphyllitic with prominent spatulation.

Our species is close to *Phylloceras psilomorphum* NEUMAYR, 1879 from which it differs in cross section.

Occurrence: Coregna near Spezia (Italy) and Zlambach Graben near Goisern, Austria, Hettangian to lowermost Sinemurian.

PSILO CERATIDAE HYATT, 1867

Euphyllites WÄHNER, 1897

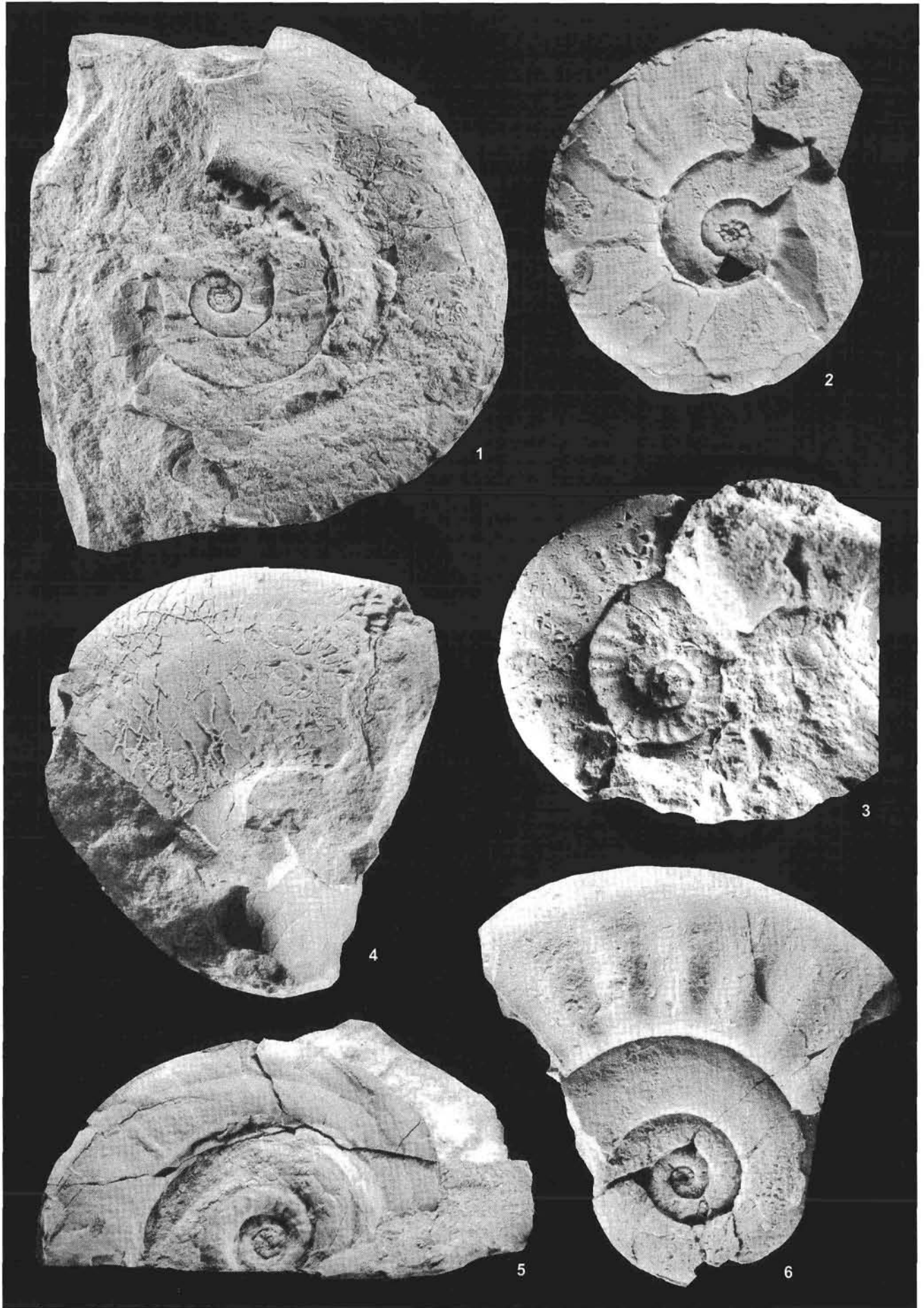
Euphyllites struckmanni (NEUMAYR, 1879)

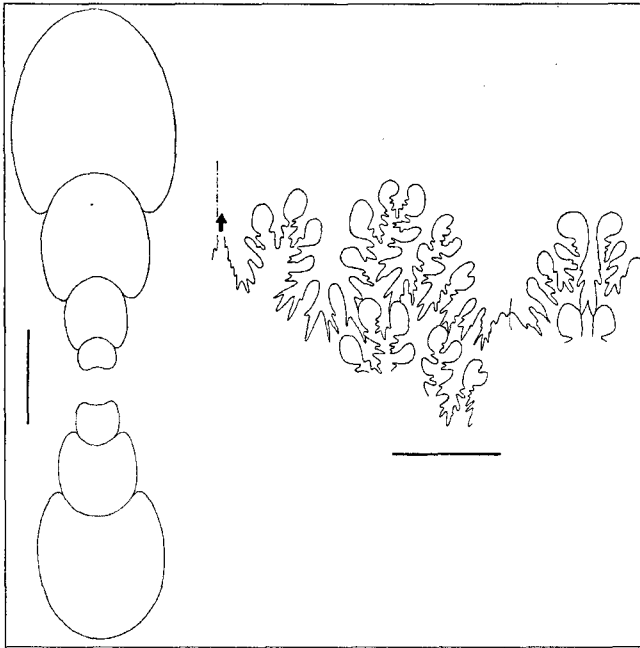
Description: This exceptional species of Psiloceratidae can be best characterised by the succession of different morphological stages. At the juvenile stage, the first whorl shows lateral nodosities or "tubercles" (= Knötchenstadium), just behind the protoconche (Text-Fig. 6). Next two whorls (up to 20 mm of diameter) show prominent prorsiradiate constrictions on the internal mould. Their number is 8–9 per whorl (Text-Fig. 6). At the beginning of the third whorl they are missing.

Subadult stage: It is characterised by subrectangular whorl section (Text-Fig. 6) with parallel and flat sides. Surface of the whorls is smooth, or covered with very fine growth lines. From the fifth whorl fold-like ribs appear on the sides and they do not cross over the venter. They are prorsiradiate. The fine growth line with slight apertural projection are present too. The whorl section of the body chamber is always subrectangular.

Plate 2

- Fig. 1: *Euphyllites struckmanni* (NEUMAYR, 1879), Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,2x.
 Fig. 2: *Euphyllites struckmanni* (NEUMAYR, 1879), an immature specimen with well visible "Knötchenstadium", a specimen from collection NHM in Vienna num. 1911, leg. Kappler, Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,8x.
 Fig. 3: *Psiloceras calliphylum* (Neumayr, 1879), juvenile specimen with radiate to rursiradiate ribs, Lower Hettangian, loc. Pfonsjoch, Austria, 0,5x.
 Fig. 4: *Nevadaphyllites* aff. *glaberrimus* (NEUMAYR, 1879), a specimen with body chamber partly preserved, Lower Hettangian, loc. Zlambachgraben near Goisern, Austria, 1,4x.
 Fig. 5: *Psiloceras calliphylum* (NEUMAYR, 1879), an incomplete specimen, Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,4x.
 Fig. 6: *Euphyllites struckmanni* (NEUMAYR, 1879), an adult specimen depicted by Wähner 1897, Pl. LXIV, Fig. 4, coll. NHM in Vienna, Lower Hettangian, loc. Pfonsjoch, Austria, 1,4x.





Text-Fig. 8.
Suture line and cross section of *Psiloceras calliphyllum* (NEUM.).

The suture line (Text-Fig. 7): At the first look it is clear that this suture has many common characters with Juraphyllitid and the external saddles are typical spatulated foliols. Main differences consist in the internal lobe, which is not lituitid as must be at true Juraphyllitids.

Remark: This particular species was described in detail by (WÄHNER, 1898) and LANGE (1952). Due to the evolute coiling, subrectangular whorl section as well as the type of ribs many authors ranged it to the Family Psiloceratidae (WÄHNER, 1898, LANGE, 1952, ARKELL, 1957 and GUÉX, 1987). This systematic position was contested by DONOVAN & FORSEY (1973), who ranged this genus to the Family Juraphyllitidae. As we demonstrated above the original proposition was correct. The evolute shape, the presence of "Knötchenstadium" as well as paralituitid internal lobe confirm with sufficient certitude its attachment to Psiloceratidae. All these characters can be evaluated as apomorphic, but on the other side it is also clear that our species has still plesiomorphic character as spatulation of the foliols.

Occurrence: Zlambach Graben near Goisern and Pfonsjoch, Austria, Lower Hettangian, Planorbis or Calliphyllum Zone

***Psiloceras calliphyllum* (NEUMAYR, 1879)**

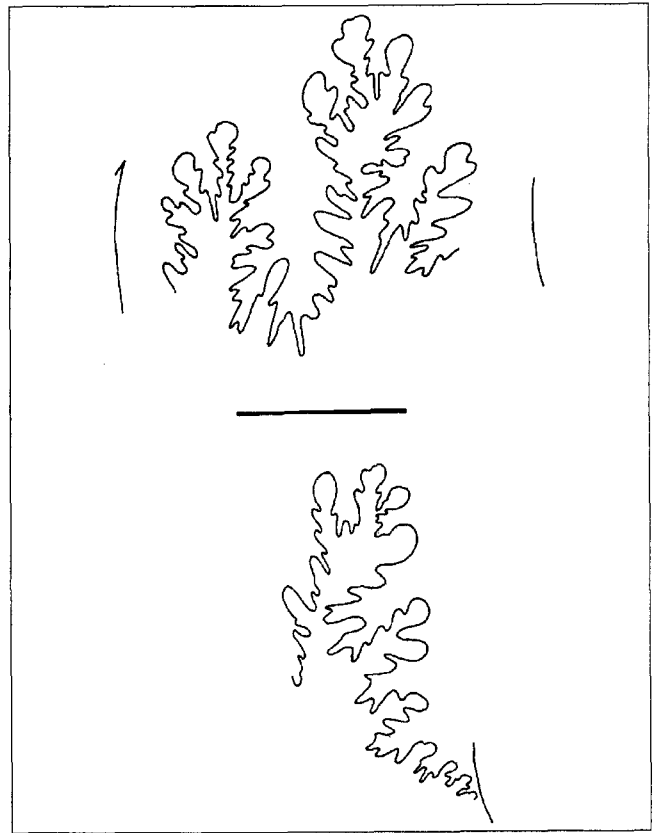
Text-Fig. 8, Pl. 2, Fig. 3, 5

1879 *Aegoceras calliphyllum* n. f. – NEUMAYR: 27, Pl. 4, Fig. 5

1886 *Aegoceras calliphyllum* NEUM. – WÄHNER: 137, Pl. 15, Fig. 4

1895 *Psiloceras calliphyllum* NEUM. – WÄHNER: 32, 43–44, Pl. 6, Fig. 6–9 (non 5)

1952 *Psiloceras* (*Paraphylloceras*) *calliphyllum* (NEUMAYR). –



Text-Fig. 9.
Suture line of *Psiloceras naumanni* (NEUM.).

LANGE: 112, Pl. 13, Fig. 11–13, Pl. 14, Fig. 1, Pl. 9, Fig. 1a

1963 *Psiloceras calliphyllum* (NEUMAYR) – BLIND: 46, Pl. 1, Fig. 3

Material: one partly preserved specimen from Zlambach Graben and two specimens from Pfonsjoch (besides this material I studied many specimens from the collections of the NHM Vienna and BSM in Munich)

Dimensions:	D	Wh	Wb	O
	36,0	10,6	7,0	17,3 (Pfonsjoch)
	37,8	11,2	8,5	18,8 (Pfonsjoch)
	48,6	12,7	–	25,5

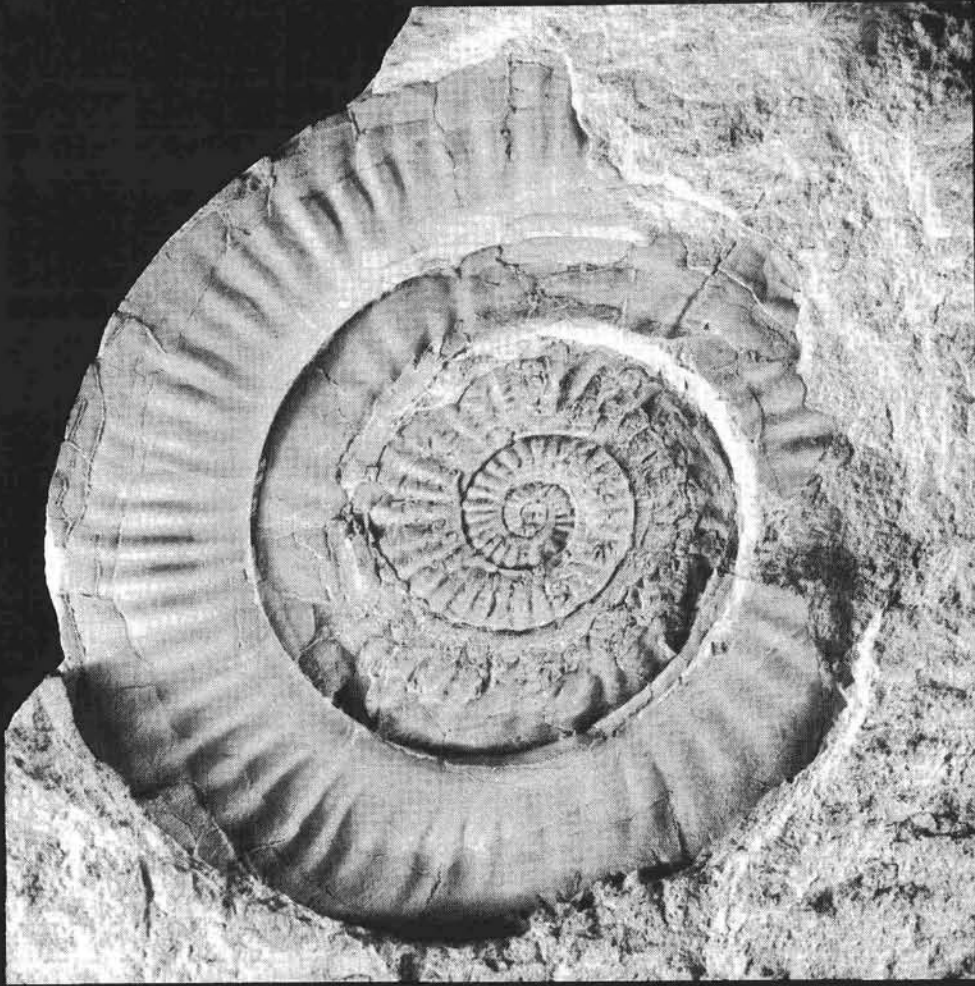
Remark: This for stratigraphy of Tethyan domain very important species is in the locality of Zlambach Graben rather rare, but its presence was registered long ago by NEUMAYR (1879: 7). Because this species was described in detail by LANGE (1952) we give only some complementary observations.

The juvenile stages are characterised by very well developed "Knötchenstadium" which is followed by relatively prominent slightly rursiradiate ribs on the flanks (Pl. 2, Fig. 3). They are present on the 3rd – 4th whorls. In the older parts of the phragmocone they start to be more and more prominent and on the body chamber they

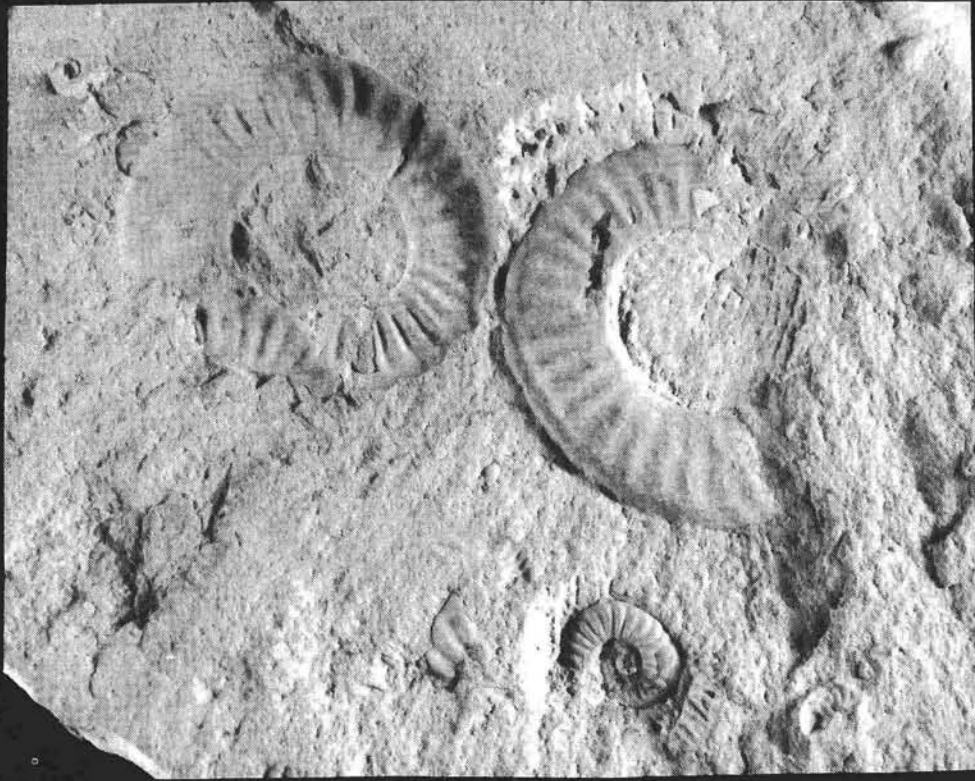
Plate 3

Fig. 1: *Psiloceras naumanni* (NEUMAYR, 1879), an adult specimen with body chamber, Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, natural size.

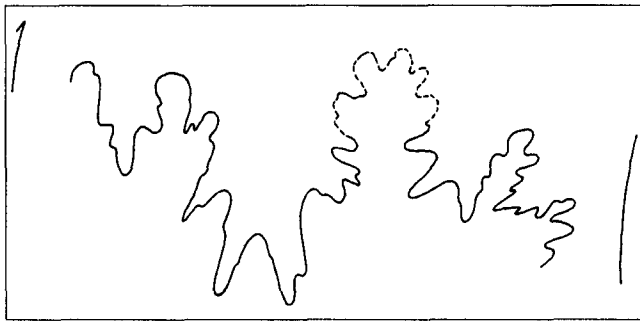
Fig. 2: *Kammerkarites rahana* (WÄHNER, 1884), Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, natural size.



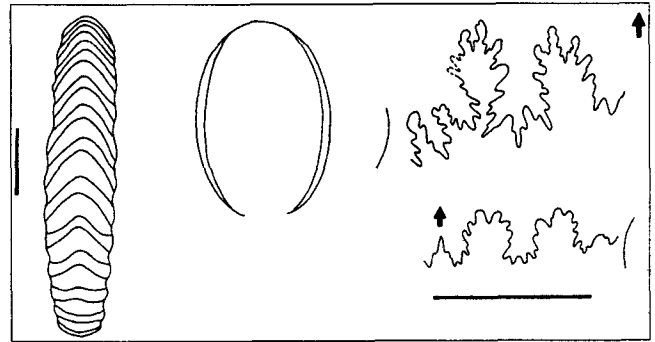
1



2



Text-Fig. 10.
Suture line of *Psiloceras (Caloceras) johnstoni* (Sow.).



Text-Fig. 11.
Ventral view, cross section and suture lines of *Kammerkarites frigga* (WÄH.).

are completely missing. The whorl section is oval (Text-Fig. 8)

Suture (Text-Fig. 8): it is slightly asymmetric with well prominent spatulation of the folioles on the external saddles, indicating the phylloceritic origin. The saddles are narrow, deeply dissected. Dorsal lobe paralituitid.

Occurrence: Zlambach Graben near Goisern and Pfonsjoch, Lower Hettangian, Pilonotum or Calliphylum Zone

Subgenus *Caloceras* HYATT, 1870

Psiloceras (Caloceras) naumanni (NEUMAYR, 1879)

Text-Fig. 9, Pl. 1, Fig. 1

- 1879 *Aegoceras Naumanni* n. f. – NEUMAYR: 27, Pl. 4, Fig. 1
 1884 *Aegoceras n. f. ind.* – WÄHNER: 122, Pl. 23, Fig. 10
 1886 *Aegoceras Naumanni* NEUM. – WÄHNER: 145
 1952 *Psiloceras (Paraphylloceras) naumanni* (NEUMAYR). – LANGE: 120, Pl. 15, Fig. 2–7, Text-Fig. 49–53
 1963 *Psiloceras naumanni* (NEUMAYR) – BLIND: 48, Pl. 1, Fig. 13

Material: one laterally compressed specimen with body chamber

Dimensions:	D	Wh	Wb	O
	104,0	22,0	–	55,0

Remark: This polygyrate, medium sized form is characterized by laterally compressed, subrectangular whorl section as well as by numerous strong ribs on the sides during its whole ontogenesis.

The suture (Text-Fig. 9) shows strongly dissected saddles with well spatulated folioles. The first lateral saddle (S1) is clearly lesser than the second (S2). The height of the auxiliary saddles going rapidly down in direction of umbilicus.

Occurrence: Zlambach Graben near Goisern, Lower Hettangian, Planorbis or Calliphylum Zone

Psiloceras (Caloceras) cf. johnstoni (SOWERBY, 1824)

Text-Fig. 10, Pl. 4, Fig. 9

Material: one incomplete laterally compressed phragmocone

Dimensions:	D	Wh	Wb	O
	75,0	18,0	–	44,6
D=	12,4	22,0	35,0	56,0
R/2=	8	11	12	15
				20

Remark: The specimen from Zlambach Graben in its evolution as well as in density of ribs is similar to the depiction of neotype (see DONOVAN, 1952, Pl. 22, Fig. 3). In the past this raricostate *Psiloceras* was often ranged to the species *Psiloceras (Caloceras) torus* (d'ORB.). As it was pointed by GUERIN-FRANCIATTE in FISHER (1994: 55), our species differs from it in a stable elliptic whorl section.

On the other hand the group *Ps. johnstoni* is not easy to distinguish from other costate Psiloceratids as is *Ps. plicatulum* POMPECKJ, 1893 or *Ps. polymorphum* GUEX, 1980. This species should be considered as extra Alpine and its presence in the Alpine region evokes some problems.

Occurrence: Zlambach Graben near Goisern, Austria, Lower Hettangian, Planorbis Zone - Johnstoni subzone

DISCAMPHERATINAE GUEX & RAKÚS, 1991

Kammerkaroceras LANGE, 1941

Kammerkaroceras guidonii (SOWERBY, 1833)

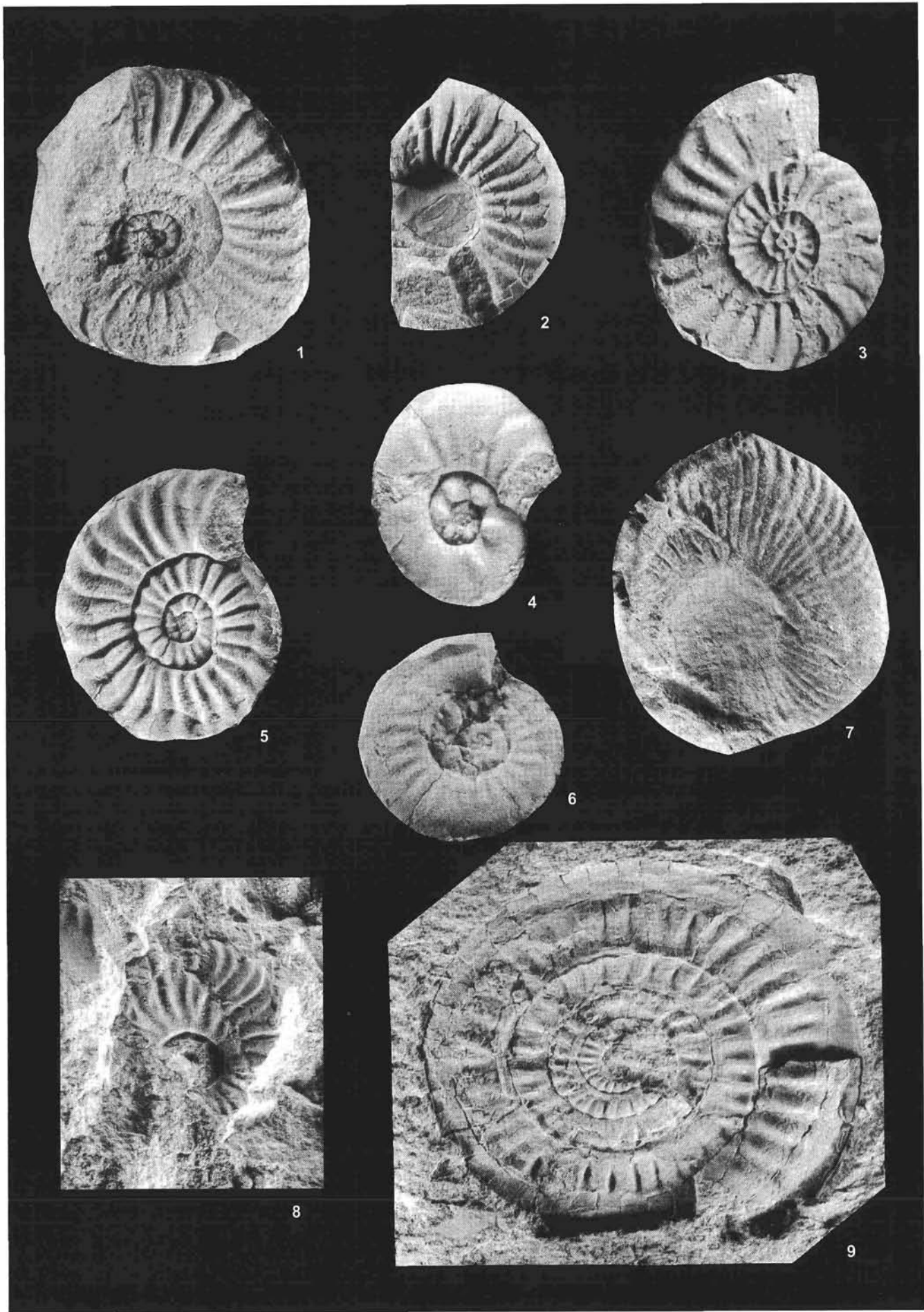
Pl. 4, Fig. 8

1833 *Ammonites guidonii* SOWERBY – SOWERBY in de la BÈCHE: 33, Fig. 69

1993 *Kammerkaroceras guidonii* (SOWERBY, 1833) – RAKÚS & LOBITZER: 925, Text-Fig. 13, 14, Pl. 1, Fig. 6–9 (cum syn.)

Plate 4

- Figs. 1, 3, 5: *Kammerkarites frigga* (WÄHNER, 1884), Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,5x
 Fig. 2: *Kammerkarites sp.*, Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 1,5x
 Fig. 4: *Kammerkarites frigga* (WÄHNER, 1884), juvenile stage with well visible "Knötchenstadium", Middle Hettangian, loc. Zlambach Graben near Goisern, Austria, 4x.
 Fig. 6: *Psiloceras sp. juv.*, Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, 2,5x.
 Fig. 7: *Angulaticeras cf. marmoreum* (OPPEL, 1862), Upper Hettangian ("Marmorea zone"), white sandy crinoidal limestone, loc. Zlambach Graben near Goisern, Austria, natural size.
 Fig. 8: *Kammerkaroceras guidonii* (SOWERBY, 1833), Upper Hettangian ("Marmorea zone"), loc. Zlambach Graben near Goisern, Austria, 1,5x.
 Fig. 9: *Psiloceras (Caloceras) johnstoni* (SOWERBY, 1824), Lower Hettangian, loc. Zlambach Graben near Goisern, Austria, 0,6x.



Material: one incomplete specimen

Remark: our specimen is an incomplete phragmocone with very characteristic sigmoidal and bifurcated ribs. This type of ornamentation as well as the involute coiling confirm clearly its ranging to the *guidoni* species.

Occurrence: Zlambach Graben near Goisern, Upper Hettangian, "Marmorea" Zone

Kammerkarites SPATH, 1924

Kammerkarites frigga (WÄHNER, 1884)

Text-Fig. 11, Pl. 4, Fig. 1, 3, 5

1884 *Aegoceras Frigga* n. f. – WÄHNER: 106, Pl. 23, Fig. 1–3

1993 *Kammerkarites frigga* (WÄHNER, 1884) – RAKÚS: 22, Text-Fig. 13–15, Pl. 2, Fig. 2–4, Pl. 3, Fig. 2–5 (cum syn.)

1995 *Kammerkarites Frigga* (WÄHNER) – GUÉX: 32, Pl. 17, Fig. 5–14

Material: 13 more or less complete specimens, sometimes slightly deformed

Dimensions:	D	Wh	Wb	O
	9,0	3,8	–	3,0
	12,0	4,8	–	4,0
	13,0	4,8	–	4,8
	13,8	5,4	–	5,0
	15,0	6,0	4,0	6,0
	18,0	6,8	–	7,0
	22,1	6,4	–	7,4
	22,2	7,0	–	9,3
	22,7	7,0	–	8,4
	23,5	8,0	–	9,4
	25,0	7,8	–	10,0
	28,0	9,8	6,0	11,3

Remark: The species *K. frigga* belongs to the numerous representatives of Hettangian ammonites at the Zlambach Graben locality. It is a little, laterally compressed form (Text-Fig. 11) with prominent, relatively dense, radiate or slightly rursiradiate ribs. The ribs are strongly developed only on the sides. Their ventral part – projection is a little weakened, but distinct, forming the "chevrons". The juvenile stage has typical "Knötchenstadium", which is quickly replaced by ribs.

The suture line (Text-Fig. 11) is slightly asymmetric, with irregular diphyllid saddles from which S2 is higher as S1.

Occurrence: Zlambach Graben near Goisern, Middle Hettangian, Liasicus Zone.

Kammerkarites rahana (WÄHNER, 1884)

Pl. 3, Fig. 2

1884 *Aegoceras Rahana* n. f. – WÄHNER: 105, Pl. 21, Fig. 1–4

Material: two partly preserved specimens (one of them is a negative impression)

Dimensions:	D	Wh	Wb	O
	42,0	13,0	–	20,0
	46,0	14,0	–	21,7

Remark: General shape as well as the typical radial ribs with short ventral projection indicate attachment of our specimens to the species *K. rahana* without doubt.

Occurrence: Zlambach Graben near Goisern, Austria, Middle Hettangian, Liasicus Zone.

HETTANGIAN			SPECIES
Planorbis „Calliphyllum“	Liasicus „Megastoma“	Angulata „Marmorea“	
-----	-----	-----	<i>Cenoceras (C.) schlumbergeri</i> <i>Togaticeras togatum</i> <i>T. goisernense</i> <i>Nevadaphyllites aff. glaberrimus</i> <i>N. glaberrimus</i> <i>Schistophylloceras aulonotum</i> <i>Geyerocheras subcylindricum</i> <i>Phylloceras occiduale</i> <i>Euphyllites struckmanni</i> <i>Psiloceras calliphyllum</i> <i>P. (Caloceras) naumanni</i> <i>P. (C.) cf. johnstoni</i> <i>Kammerkarites frigga</i> <i>K. rahana</i> <i>Kammerkaroceras guidonii</i> <i>Angulaticeras cf. marmoreum</i>

Text-Fig. 12. Stratigraphic range of Lower Liassic species determined from the Zlambach Graben.

Schlotheimiidae SPATH, 1923

Angulaticeras QUENSTEDT, 1883

Angulaticeras cf. marmoreum (OPPEL, 1862)

Pl. 4, Fig. 7

Material: one negative imprint in the calcareous sandstone intercalated in the light-grey marlstones.

Remark: The type of the ribbing and the general shape of the specimen do not make any doubt that our specimen belongs to the *marmorea* group.

Occurrence: Zlambach Graben near Goisern, Upper Hettangian, "Marmorea" zone.

3. Stratigraphic range of Cephalopod fauna

The described cephalopod fauna is without doubt Hettangian in age. More than a half of the recognised specimens are exclusively Lower Hettangian (Planorbis Zone), although three of them extending to the Middle Hettangian (Liasicus Zone). Three species are contrary only in the Upper Hettangian (Angulata Zone) with possibility to going in the lowermost Sinemurian, or "Marmorea Zone" in sense of TAYLOR (1986; see Text-Fig. 12)

Confirmation of the Hettangian age in the uppermost part of the Zlambach formation, which has been already signalled by NEUMAYR (1879) inevitably evokes the question of the total stratigraphic range of the Zlambach formation. Up to the present time it is considered as Upper Norian – Rhaetian only (see above). Now, if we take in consideration our new results, we must admit that their stratigraphic range is greater as it was at present assumed.

For Hettangian part of "Zlambachschichten" NEUMAYR (1879, p. 6) introduced the name Aegoceras-Mergel. Because this marlstone is lithologically indistinguishable from the marlstones of Rhaetian part of the Zlambach formation, we prefer to keep henceforth this name only. Based on our results, we understood the Zlambach Formation as a lithological unit, whose stratigraphic range is from the Upper Norian to the Hettangian.

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