Ann. Naturhist. Mus. Wien	106 A	167–211	Wien, November 2004

More Ammonites (Puzosiinae, Pachydiscidae, Placenticeratidae, Nostoceratidae, Diplomoceratidae) from the Campanian (Late Cretaceous) of the Gschliefgraben (Ultrahelvetic Nappe; Austria)

by Herbert SUMMESBERGER[1] & William J. KENNEDY[2]

(With 11 Plates, 8 Text-figures and 5 Tables)

Manuscript submitted on 9 February 2004,
the revised manuscript on 14 April 2004

Abstract

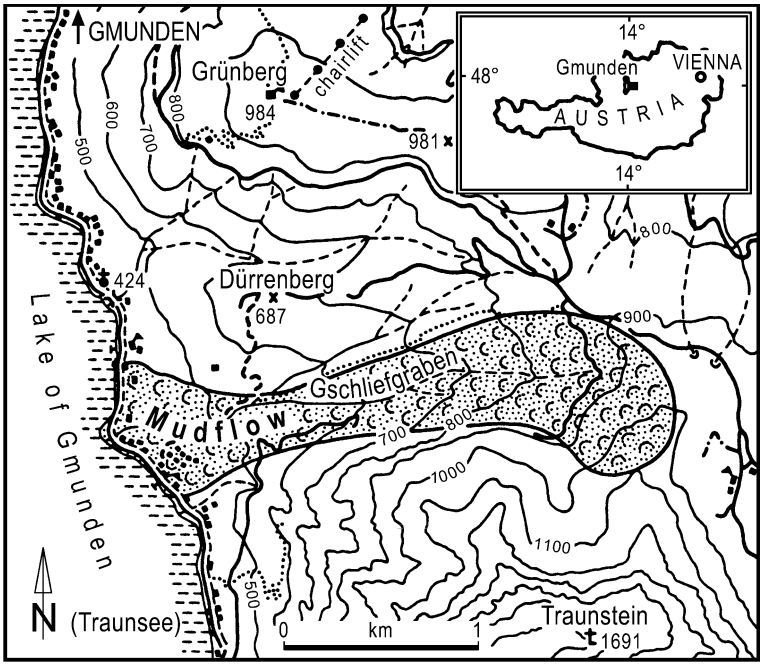
13 taxa from the Campanian of the Gschliefgraben (Ultrahelvetic Nappe; Gmunden, Upper Austria) are described, 10 of them new for the locality: *Menuites deccanensis* (STOLICZKA, 1865), *Hauericeras pseudogardeni* (SCHLÜTER, 1872), *Placenticeras* cf. *milleri* (HAUER, 1866), *Eubostrychoceras (Eubostrychoceras)* cf. *reevesi* (YOUNG, 1963), *Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ, 1980), *Diplomoceras cylindraceum* (DEFRANCE, 1816), *Neocrioceras* sp., *Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov., *Pseudoxybeloceras* sp**.,** *Lewyites elegans* (MOBERG, 1885). The fauna now comprises 47 taxa: 45 ammonoids, 1 belemnite, and 1 nautiloid, making the Gschliefgraben fauna one of the most diverse Campanian cephalopod faunas known. The lithostratigraphically undecipherable section of the "Buntmergelserie" (variegated shales) yields ammonoids from the Early and Late Campanian and, possibly (Texanitinae indet.) also from the Santonian. Large parts of the sections from the Early Cretaceous upwards are indicated by microfossils only (PREY, 1983) but not represented by ammonoids. The bulk of the fauna (KENNEDY & SUMMESBERGER, 1984) is Late Campanian, with the Early Campanian indicated by the occurrence of *Hauericeras pseudogardeni* (SCHLÜTER) and *Placenticeras* cf. *milleri* (HAUER).

Zusammenfassung

13 Taxa Ammoniten aus dem Campanium des Gschliefgrabens (Ultrahelvetikum; Gmunden, Oberösterreich) werden beschrieben, 10 davon neu für den Gschliefgraben: *Menuites deccanensis* (STOLICZKA, 1865), *Hauericeras pseudogardeni* (SCHLÜTER, 1872), *Placenticeras* cf. *milleri* (HAUER, 1866), *Eubostrychoceras (Eubostrychoceras)* cf. *reevesi* (YOUNG, 1963), *Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ, 1980), *Diplomoceras cylindraceum* (DEFRANCE, 1816), *Neocrioceras* sp., *Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov., *Pseudoxybeloceras* sp**.,** *Lewyites elegans* (MOBERG, 1885). Die Cephalopodenfauna umfaßt derzeit: einen Belemniten, einen Nautiloiden und 45 Ammoniten und ist damit weltweit eine der artenreichsten im Campanium. In der lithostratigraphisch nicht auflösbaren Schichtfolge der Buntmergelserie sind neben Ober- und Untercampanium und (?) Santonium (Texanitinae indet.) mit Hilfe von Mikrofossilien (PREY, 1983) auch Unterkreide und tiefere Oberkreide (Cenomanium – Coniacium) nachgewiesen. Der Großteil der Ammoniten ist aus dem Obercampanium (KENNEDY & SUMMESBERGER, 1984), Untercampanium ist durch *Placenticeras* cf. *milleri* (HAUER) und *Hauericeras pseudogardeni* (SCHLÜTER) belegt.

[1] Herbert SUMMESBERGER, Naturhistorisches Museum, A-1014 Wien Burgring 7. – Austria, e-mail: herbert.summesberger@nhm-wien.ac.at

[2] William J. KENNEDY, Oxford University Museum of Natural History, Oxford OX1 3PW. – United Kingdom, e-mail: jim.kennedy@earth.ox.ac.uk



Text-fig. 1: Sketchmap of the Gschliefgraben area (after TRÖGER et al. 1999)

Conventions

The following abbreviations are used to indicate repositories of specimens mentioned in the text:

EST: Ferdinand Estermann collection (Pinsdorf, Upper Austria)

M: Wolf Peter Maherndl collection (Bad Ischl, Upper Austria)

R: Ulrich Roschger collection (Vienna)

SK: Dr. Peter Skoumal collection (Vienna)

NHMW: Naturhistorisches Museum Wien, ex Walter Schauberger collection (Gmunden)

OÖLM: Oberösterreichisches Landesmuseum (Linz, Upper Austria)

RESCH: Resch collection (Schwanenstadt, Upper Austria)

The former Hütter collection (Gmunden, Upper Austria, indicated by "H" in KENNEDY & SUMMESBERGER, 1984) is now integrated into the collections of the Museum of Natural History Vienna. All measurements are given in millimeters. With a few exceptions the specimens were coated for the photos with ammoniumchloride.

Systematic Palaeontology

Order Ammonoidea ZITTEL, 1884

Suborder Ammonitina HYATT, 1889

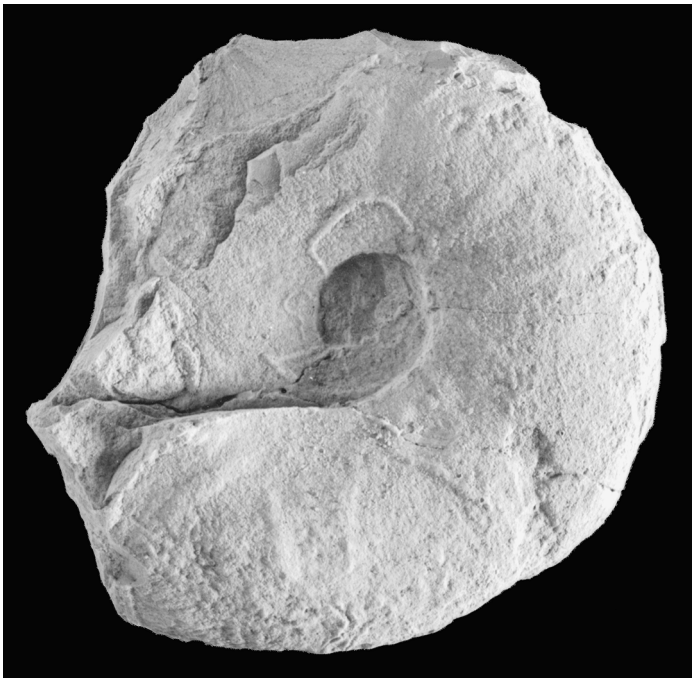
Superfamily Desmoceratoidea ZITTEL, 1895

Family Desmoceratidae ZITTEL, 1895

Subfamily Puzosiinae SPATH, 1922

Genus and Subgenus *Hauericeras* DE GROSSOUVRE, 1894

Type species: *Ammonites pseudo-gardeni* SCHLÜTER, 1872 by original designation.



Text-fig. 2: *Hauericeras pseudogardeni* (SCHLÜTER); EST 2003/19, from the Gschliefgraben, x1.

***Hauericeras (Hauericeras) pseudogardeni* (SCHLÜTER, 1872)**
(Text-fig. 2)

For synonymy see KENNEDY & KAPLAN (1995, p.18)

L e c t o t y p e : the original of SCHLÜTER, 1872: pl. 16, figs. 5, 6 subsequently designated by MATSUMOTO in: MATSUMOTO et al. (1990: 440) from Dülmen, Germany, refigured by KENNEDY & KAPLAN (1995: pls. 1-3).

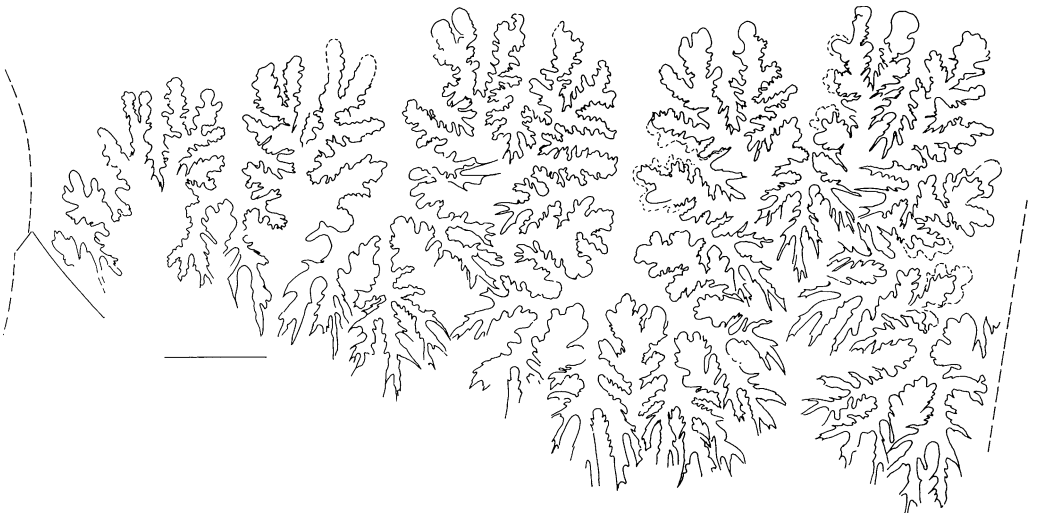
M a t e r i a l : A single specimen, EST 2003/19 in the Estermann collection

D e s c r i p t i o n : EST 2003/19 is an internal mould of a subadult phragmocone with completely preserved body chamber. Wh increases rapidly, the umbilicus is relatively small, the flanks flat, with a distinct umbilical edge and gently rounded ventrolateral shoulder. The venter is fastigiate, the keel is not preserved. The specimen is slightly laterally flattened by *post-mortem* compaction, reducing the $Wb_{-180°}$ data. There are about 4 constrictions per whorl.

Dmax	Wh	Wb	Wb/Wh	U	U %
82.1_{max}	32.3_{max}	14.9_{max}	0.46	19.0	23.1 %

Tab. 1: Measurements of *Hauericeras (H.) pseudogardeni* (SCHLÜTER); EST 2003/19.

D i s c u s s i o n : *Hauericeras pseudogardeni* (SCHLÜTER, 1872) from the Gschliefgraben differs from *Hauericeras fayoli* DE GROSSOUVRE, 1894 (see KENNEDY & SUMMESBERGER 1984) by its distinctly smaller umbilicus. For discussion of the species and synonymy see the revision by KENNEDY & KAPLAN (1995: 18 ff.).



Text-fig. 3. External suture of *P. (P.) perfidus* De Grossouvre, NHMW 1979/2077/1 from the Gschliefgraben, Austria. – Scale 10 mm.

O c c u r r e n c e : *Hauericeras pseudogardeni* is an Early Campanian species (see the discussion in Summesberger et al. 1999: 159) and the present specimen is older than the Upper Campanian majority of the Gschliefgraben fauna. It is a NW- Europe form (Germany, Sweden, England). A very large individual (*H.* cf. *pseudogardeni*) was described from the Campanian of the Gosau Group of Gams (Austria; Summesberger et al. 1999), the present record from the Ultrahelvetic of the Gschliefgraben closes the information gap between palaeogeographic realms.

Family Pachydiscidae Spath, 1922

Genus and subgenus *Pachydiscus* Zittel, 1884

Type species: *Ammonites neubergicus* Hauer, 1866 by the subsequent designation of De Grossouvre, 1894.

Pachydiscus (Pachydiscus) perfidus De Grossouvre, 1894
(Pls. 1, 2; Text-fig. 3)

1894 *Pachydiscus perfidus* De Grossouvre: 213, pl. 34, fig.1.
1980 *Pachydiscus perfidus* De Grossouvre, 1894 – Blaszkiewicz: 43; pl. 29, figs. 1- 4, pl. 30, figs. 1, 3, 4; pl. 31, figs. 1-3; pl. 32, figs. 1-3; pl. 33, figs. 3, 4; pl. 37, figs. 1-2.
1984 *Pachydiscus (Pachydiscus) perfidus* De Grossouvre, 1894 – Kennedy & Summesberger: 160; pl. 3; pl. 6, fig. 6.
1993 *Pachydiscus (Pachydiscus) perfidus* De Grossouvre, 1894 – Hancock & Kennedy: 161, pl. 9, figs. 9, 10; pl. 10, figs. 1, 2, 4, 5; pl. 11, figs. 5, 6; pl. 12, figs.1- 4, 6; pl. 13, figs. 3, 4.

L e c t o t y p e by the subsequent designation of Kennedy & Summesberger 1984 is the original of De Grossouvre, 1894: pl. 34, fig. 1, from the Late Campanian of Tercis, France, refigured by Hancock & Kennedy 1993 (pl. 13, figs. 3, 4).

M a t e r i a l : 5 specimens, NHMW 1979/2077/1, OÖLM 58/1975/3, NHMW 1984/71 ex Coll. Schauberger, EST 2003/9 and EST 2003/8 all from the Gschliefgraben.

D e s c r i p t i o n : Two recently discovered specimens (pls. 1, 2) demonstrate the abrupt ontogenetic change in ornament (HANCOCK & KENNEDY 1993: 161). The complex suture (Text-fig. 3) is documented for the first time, on the basis of the large specimen in the SCHAUBERGER collection (NHMW 1984/71).

Dmax	Wh	Wb	Wb/Wh	U	U %
290_{est}	120	71.5	0.59	68.4	23.6 %

Tab. 2: Measurements of NHMW 1979/2077/1; $_{est}$ = estimated.

D i s c u s s i o n : For full description and discussion of the species see HANCOCK & KENNEDY (1993: 161), for description and discussion of previously collected Gschliefgraben specimens, see KENNEDY & SUMMESBERGER (1984: 160).

O c c u r r e n c e : Upper Campanian *Nostoceras hyatti* – Zone of Poland, France and Austria.

Genus *Menuites* SPATH, 1922

Type species: *Ammonites Menu* FORBES (1846: 111, pl. 10, fig.1) by original designation of SPATH (1922: 123).

Menuites deccanensis (STOLICZKA, 1865)

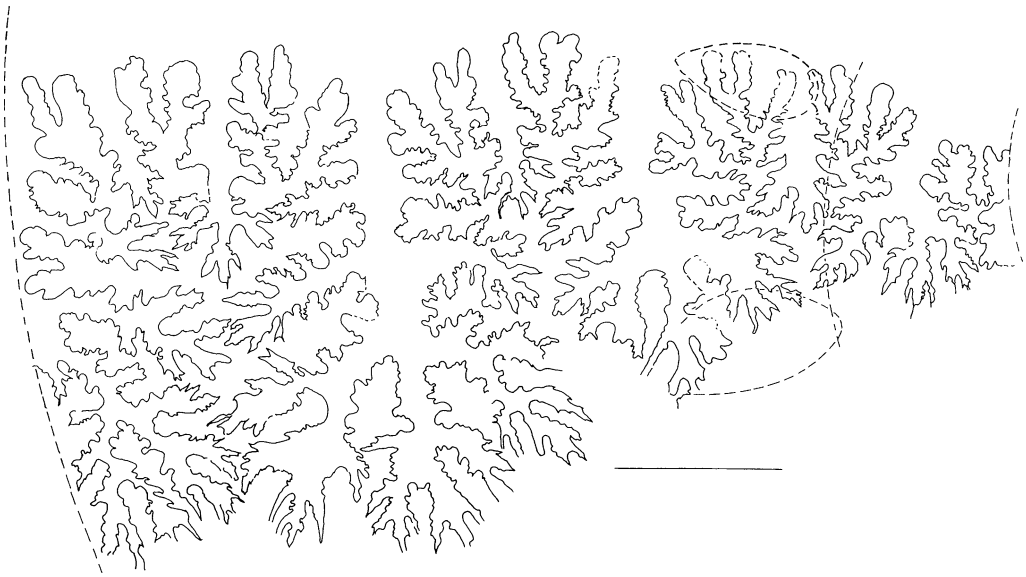
(Pl. 3, Figs. 1, 2; Text-figs. 4, 5)

1865 *Ammonites deccanensis* STOLICZKA: 126; pl. 63, fig. 1.
1898 *Pachydiscus deccanensis* (STOLICZKA) – KOSSMAT: 168.
1925 *Parapachydiscus deccanensis* STOLICZKA – DIENER: 115.
non 1952 *Anapachydiscus deccanensis* var. *menabensis* COLLIGNON: pl. 18, fig. 3.
non 1955 *Anapachydiscus deccanensis* var. *menabensis* COLLIGNON: pl. 18, fig. 3.
1955 *Anapachydiscus deccanensis* (STOLICZKA) – MATSUMOTO: 181.
? 1984 *Anapachydiscus* cf. *A. deccanensis* (STOLICZKA, 1865) – MATSUMOTO & MIYAUCHI: 46; pl. 15, fig. 1.

H o l o t y p e by monotypy is the original of STOLICKA's (1865, pl. 63, figs. 1, 1a) figured specimen from the Arrialoor group of Karapaudy, India.

M a t e r i a l : a single specimen, EST/2003/282 from the Estermann Collection.

D e s c r i p t i o n : This beautiful specimen is a phragmocone with partially preserved body chamber. The light brownish shell is totally preserved, although a part was removed for observation of the suture line. The phragmocone is uncrushed, but the body chamber is crushed by lateral compaction. Hardness of the shell, adherent matrix and excellent preservation suggest the specimen came from an early diagenetic concretion. Coiling is involute, the umbilicus comprises about 24 % of the diameter. Umbilical wall steep, umbilical shoulder rounded. Whorl section slightly depressed, maximum whorl breadth at the inner third of the flank. The flanks are rounded, without a distinct ventrolateral shoulder. The venter is rounded, with a slight trend to becoming fastigiate on the last 90° section of the phragmocone (this is possibly a result of *post-mortem* deformation). Body chamber and aperture are damaged by compaction. About 7 regular ribs per half whorl arise in pairs at strong umbilical bullae, which are situated outside the umbilical shoulder on the inner third of the flanks. Primary ribs are separated by one to



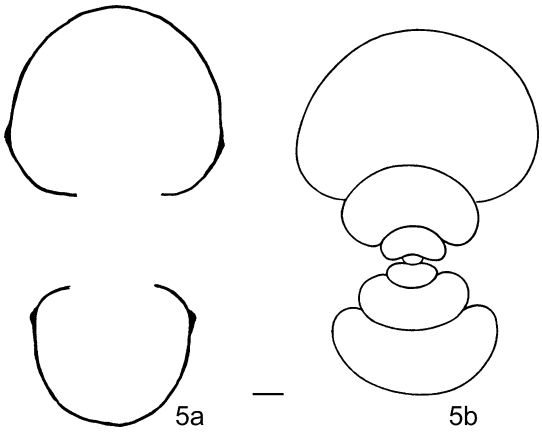
Text-fig. 4: External suture of *Menuites deccanensis,* EST/282/03; scale bar 10 mm.

three equally spaced secondaries, which arise on the umbilical shoulder in the same flank position as the primaries. Ribs strengthen towards the venter with a maximum thickness at mid-venter. The width of the ribs on the outer third of the flank is about 3 mm, the width of the interspaces about 4 mm. At the adapertural end of the phragmocone a third order of somewhat weaker ribs arises singly on the outer third of the flank, to give a total of about 26 ribs per half whorl. Ribs are in general prorsiradiate and concave, some of them with a feeble falcoid flexure on the inner third of the flanks, near the adapertural end of the phragmocone. All project forwards on the outer third of the flank and over the venter. On the body chamber, ribbing and tuberculation weaken progressively towards the aperture, and fine growth striae are visible. Another striking feature are 6 or 7 strong tubercles per half whorl at the position of the umbilical shoulder; these become smaller and more elongate towards the aperture. A very distinctive feature is the relatively broad unsculptured area around the umbilicus. The deeply incised and highly complicated suture line (Text-fig. 4) is typical for Pachydiscidae.

Tab. 3: Proportions of the Austrian specimen of *Menuites deccanensis* in relation to the Indian type specimen and COLLIGNON's (1952: pl. 18, fig. 3) Madagascan subspecies.

$D_{austria}$	142.8	U	34.2	Wh	62.2	Wb	67.2	Wb/Wh	1.08	U %	23.9 %
D_{india}	102.8	U	20.3	Wh	55.0	Wb	61.3	Wb/Wh	1.10	U %	20.2 %
D_{menab}	122	U	27	Wh	67	Wb	87	Wb/Wh	1.29	U %	22.1 %

D i s c u s s i o n : The specimen described above is interpreted as a macroconch of this rare pachydiscid species, originally described from the Arrialoor Group of South India. Microconchs are unknown. Pachydiscids are the most common ammonite family in the Gschliefgraben: most of them belong to typically dimorphic *Pachydiscus haldemsis*



Text-fig. 5: Section of *Menuites deccanensis,* EST/282/03, in relation to the Madagascan subspecies (after COLLIGNON, 1957: fig. 16); scale bar 10 mm.

(SCHLÜTER, 1872) (KENNEDY & SUMMESBERGER 1984); they occur in shales and are normally flattened by compaction. Rare *Menuites arrialoorensis* (STOLICZKA, 1865) (KENNEDY & SUMMESBERGER 1984) and *Pachydiscus (P.) subrobustus* (SEUNES, 1891) also occur in the shales. *Pachydiscus (P.) perfidus* DE GROSSOUVRE, 1894 (KENNEDY & SUMMESBERGER 1984: pl. 3; pl. 6, fig.6) occurs in nodules of the *Hyatti* Zone. *Menuites deccanensis* (STOLICZKA, 1865) also seems to be from a distinct nodule horizon of either Campanian or Maastrichtian age.

Macroconchs of *Menuites portlocki portlocki* (SHARPE, 1855) (KENNEDY & KAPLAN 1997: e.g. pl.21, fig. 2, pls. 22, 23, 24, 25) are similar in general shape but have a wider umbilicus, and fewer ribs per half volution (10 – 12) which are much stronger than those of *M. deccanensis*. This is also more or less the case in *M. vistulensis* (BLASZKIEWICZ, 1980), which has about 17 ribs per half whorl (KENNEDY & KAPLAN, 1997: e.g. pl. 27, figs. 1-3). *Menuites wittekindi* (SCHLÜTER, 1872) revised by KENNEDY & KAPLAN (1997: 47; pl. 16, fig. 1, pl. 20, fig. 2,3; pl.21, fig. 1; pls. 29-36; pl. 38, fig. 3) shows reduced ornament at larger diameters, followed by the appearance of coarse distant ribs when adult, as in the lectotype (SCHLÜTER, 1872: pl. 22, fig. 1) refigured by KENNEDY & KAPLAN (1997: pl. 36). None of the German and Polish representatives of *Menuites* combine characteristics of smooth umbilical region, prominent umbilical bullae and high number of ribs as is seen in the Indian species. *Menuites fascicostatus* (YABE, 1921: 57) from the Late Cretaceous of Japan, revised by MATSUMOTO (1984: 14, pl. 4, figs. 1, 2; pl.5., figs. 2; pl. 8, fig. 7; text-fig. 4) has more, delicate ribs (about 40 per half volution), the whorl section being more depressed, with long umbilical spines, as noted already by MATSUMOTO (1984: 13). *Anapachydiscus* cf. *A. deccanensis* (STOLICZKA, 1865) of MATSUMOTO & MIYAUCHI (1984: 46; pl. 15, fig. 1) has elongate, narrow bullae, rather than umbilical tubercles or spines. Elongate narrow umbilical bullae also separate *Pachydiscus subtililobatus* JIMBO, 1894 (pl. 4, figs 2, 2a,b) from *M. deccanensis* STOLICZKA, 1965. *Anapachydiscus deccanensis* var. *menabensis* (COLLIGNON, 1952: pl. 18, fig. 3; 1955: pl. 18, fig. 3) is markedly stouter than the nominate subspecies (see text-fig. 5). *Menuites arrialoorensis* (STOLICZKA,1865) including *Anapachydiscus arrialoorensis* var. *bererensis* (COLLIGNON, 1952 and 1955; KENNEDY & SUMMESBERGER 1984: 162) differs in having a smaller umbilicus, elongate umbilical bullae, and coarsening sculpture towards the aperture. *M. sutneri* (YOKOYAMA, 1890: pl. 23) has a wider umbilicus

and higher rib density, with narrow and elongate umbilical bullae. *Menuites menu* (FORBES, 1846) is based on a bituberculate microconch, but has a similar arrangement and proportions of the umbilical tubercles, also differing by its more delicate ribbing (KENNEDY & HENDERSON, 1992: pl. 14, figs. 1-15).

O c c u r r e n c e : Campanian or Maastrichtian of the Gschliefgraben (Austria), Arrialoor group of Karapaudy (India).

Superfamily Hoplitoidea H. DOUVILLÉ, 1890

Family Placenticeratidae HYATT, 1900

Genus *Placenticeras* MEEK, 1876

Type species: *Ammonites placenta* DEKAY, 1828 by original designation.

Placenticeras cf. *milleri* (HAUER, 1866)

(Pl. 4, Figs. 1, 2; Text-fig. 6)

Compare:

1866 *Ammonites Milleri* HAUER: 5, pl. 2, figs, 1,2.
1902 *Placenticeras Milleri* HAUER – HILBER: 279.
1908 *Placenticeras syrtale* MORTON var. *Milleri* v. HAUER – SCHMIDT: 239, pl. 5, figs. 1 - 4.
1996 Placenticeratidae gen. et spec. indet. – SUMMESBERGER, JURKOVSEK & JURKOVSEK: 4; pl. 2, fig. 1; pl. 3 figs. 1,2, pl. 4, fig. 1, pl. 5, fig. 2.

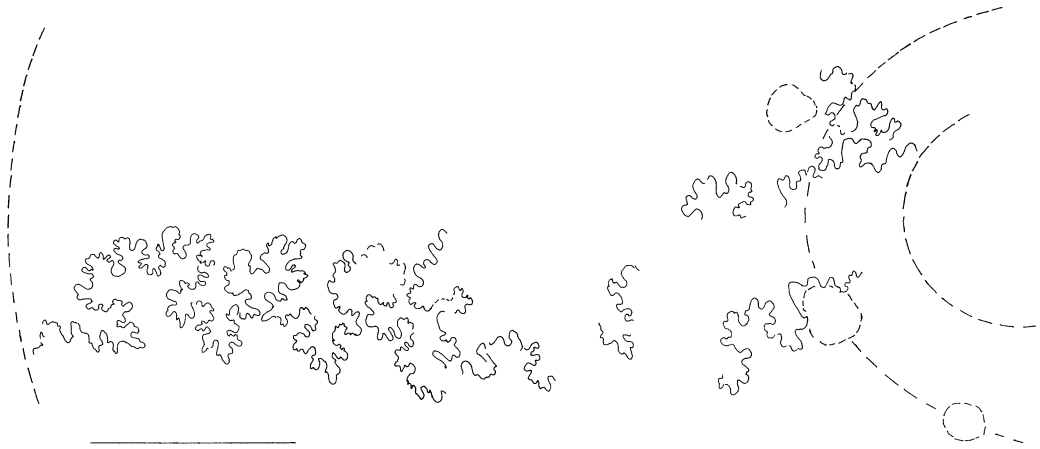
M a t e r i a l : a single specimen, EST/2003/280 from the Estermann Collection, Pinsdorf (Upper Austria)

D e s c r i p t i o n : EST/280/03 is an internal mould of an adult phragmocone with partially preserved body chamber, and traces of adherent shell. The specimen is deformed in a characteristic manner: on the right side the umbilicus is overdeepened by crushing, on the left side it protrudes; nevertheless, the umbilicus is well preserved. The venter is broken away throughout. The specimen appears to have been preserved inside a relatively small concretion, with the venter being outside the concretion, which explains its absence. The oligogyral shell is discoidal with convergent flanks, the whorl height increasing rapidly. The greatest whorl breadth is below mid-flank. The whorl section of the phragmocone is lanceolate, the whorl section of the body chamber is unknown, but may have been high oval, the venter seems to have been entire, without the typical double keel of placenticeratids. The flanks are smooth, with a row of four small and distant umbilical tubercles on the last half whorl of the phragmocone; these disappear on the body chamber. The suture (Text-fig. 6) is visible where the shell was removed. Where the shell is preserved (e.g. in the umbilicus of the right side: Pl. 4, fig. 1) a faint striation is visible with slightly concave growth lines projecting strongly forward. As far as it can be observed there are no ventrolateral clavi, and there is no tuberculation on the body chamber.

Tab. 4: EST/280/03; measurements in mm, D_{rest} being the restored maximum diameter.

D_{rest}	140-150	U	30	U %	20 %	$Wh_{last\ but\ one}$	47.8 mm	W_{hmax}	80	$Wb_{max\ estim}$	31

D i s c u s s i o n : Placenticeratids of comparable shape appearing in the Early Campanian belong to the *milleri – bidorsatum* group (SUMMESBERGER et al. 1996). *Placen-*



Text-fig. 6: *Placenticeras* cf. *milleri* (HAUER); external suture of EST/280/03; scale bar 10 mm.

ticeras cf. *milleri* (HAUER, 1866) differs from typical *P. bidorsatum* (A. RÖMER, 1841) by the absence of ventrolateral clavi, although these may also be absent in some german specimens of *bidorsatum* (KENNEDY & KAPLAN, 1995: pl. 15, fig. 5). More indicative is the significant increase in strength of the ornament of the body chamber of German representatives of the species; in contrast tuberculation, present on the phragmocone of *Placenticeras* cf. *milleri* (HAUER) (Pl.5, fig.1), disappears on the body chamber.

Most of the topotypes of *Placenticeras milleri* (HAUER) from the Gosau Basin of Kainach (Steiermark, Austria) bear ventrolateral clavi (HAUER, 1866: pl. 2, figs. 1, 2). *P.* cf. *milleri* (HAUER) (EST/280/03) described above lacks these clavi. This may reflect sexual dimorphism, for macroconchs of placenticeratids from the Gosau (SUMMESBERGER, 1979) generally have weak and reduced ornament when compared to microconchs. With so few specimens, open nomenclature is applied to the Gschliefgraben specimen.

Occurrence: EST/280/03 is the first representative of the genus *Placenticeras* from the Gschliefgraben. The general absence of *Placenticeras* in the Late Campanian suggests that the specimen is older than the bulk of the known fauna, and the presence of an Early Campanian nodule horizon lower in the sequence seems likely (Text-fig. 8).

Suborder Ancyloceratina WIEDMANN, 1966

Superfamily Turrilitoidea GILL, 1871

Nostoceratidae HYATT, 1894

Genus and Subgenus *Eubostrychoceras* MATSUMOTO, 1967

Type species: *Eubostrychoceras indopacificum* MATSUMOTO, 1967 (p.333, pl. 18, fig.1) by original designation of MATSUMOTO (1967: 332).

***Eubostrychoceras (Eubostrychoceras)* cf. *reevesi* (YOUNG, 1963)**
(Pl. 5, Figs. 2,3)

Compare:

1963 *Cirroceras reevesi* YOUNG: 44, pl. 5.
2001 *Eubostrychoceras reevesi* (YOUNG) – KENNEDY & COBBAN: 21, pl. 2, figs. 1-5; pl. 4, figs. 1-5; pl. 5, fig. 4.

M a t e r i a l : NHMW 2003z0028/0001, a single specimen from the Gschliefgraben.

D e s c r i p t i o n : The specimen is a crushed internal mould of a middle growth stage, with slightly corroded surface. Two whorls of an open dextral helix, tightly coiled but not in contact are preserved. The height is about 56 mm, $D_{restored}$ may have measured about 40 mm, U % may have been around 35 %. The original whorl section may have been circular, now it is flattened by lateral compaction. Ornament consists of about 40 regular and undivided ribs per whorl which are delicate and closely spaced on the dorsum, coarsening on the venter, and crossing it in a slight rursiradiate curve. Rib index is about 3 per cm on the venter, 4-6 per cm on the dorsum. There are no tubercles. The suture is not visible.

D i s c u s s i o n : The holotype (YOUNG, 1963: pl. 5, figs. 3, 4) differs by its larger whorl section compared to the smaller umbilicus. Specimens figured by KENNEDY & COBBAN (2001: pl. 2, figs. 1-5, 8) differ by the presence of constrictions.

O c c u r r e n c e : *Eubostrychoceras (E.) reevesi* (YOUNG, 1963) occurs in the lower part of the Late Campanian of Texas (KENNEDY & COBBAN 2001: 15).

Genus *Nostoceras* HYATT, 1894

Type species: *Nostoceras stantoni retrorsum* HYATT (1894: 570) by original designation.

Subgenus *Didymoceras* HYATT, 1894

Type species: *Ancyloceras nebrascense* MEEK & HAYDEN, 1857: 71 by orginal designation.

Nostoceras (Didymoceras) cf. *binodosum* (KENNEDY & COBBAN, 1993)
(Pl. 5, Figs. 4 - 6)

Compare:

1993 *Didymoceratoides binodosum* KENNEDY & COBBAN: 92; figs. 8.1, 2, 5, 6, 13-15, 22-24, 28, 29, 32, 33, 35-39; 9.1-5; 12.1
1999 *Didymoceras binodosum* (KENNEDY & COBBAN, 1993) – KENNEDY & COBBAN: 72, pls. 2-4, pl. 5. figs. 11-20, text-figs. 3, 4.
1999 *Didymoceras binodosum* (KENNEDY & COBBAN, 1993) – KENNEDY & SUMMESBERGER: 26; pl. 2, figs. 12.13; text-fig. 1 (with synonymy)

M a t e r i a l : A single unregistered specimen from the Gschliefgraben in the Estermann collection.

D e s c r i p t i o n : The specimen is a crushed fragment of an internal mould of a single whorl without preservation of shell and with a slightly corroded surface. Two broken ends of the whorl point into different directions suggesting the specimen being a part of a helical stage crushed vertically to its helical axis. Data are measured from the crushed specimen and are exaggerated by compaction: D about 60 mm, U about 19, U % about

30 %. The specimen has about 20 coarse and distant ribs per whorl, some of them branching at the tubercles. There are two rows of tubercles at least partially corresponding in an irregular zigzag arrangement. 2 or 3 very indistinct constrictions are visible. No sutures are preserved.

D i s c u s s i o n : There is not much doubt that the fragment described is identical or at least very close to *Nostoceras (Didymoceras) binodosum* (KENNEDY & COBBAN, 1993). It differs from the Gschliefgraben specimens figured (KENNEDY& SUMMESBERGER: pl. 2, figs. 12, 13) by wider and more irregular ribbing but agrees well with specimens from Texas (e.g. KENNEDY & COBBAN 1999: pl. 3, fig. 1).

O c c u r r e n c e : *N. (D.) binodosum* occurs in the Late Campanian (*Polyplocum* Zone) of the Gschliefgraben (Austria) and Poland an in the *Baculites scotti* Zone of Texas and the Western Interior of the United States.

Subgenus *Euskadiceras* KÜCHLER, 2000

Type species: *Nostoceras (Euskadiceras) euskadiense* KÜCHLER, 2000a by original designation from the Late Campanian of Navarra, Spain.

Nostoceras (Euskadiceras) unituberculatum (BLASZKIEWICZ, 1980)
(Pl. 5, Fig. 1)

1980 *Bostrychoceras unituberculatum* n.sp. – BLASZKIEWICZ: 21, pl. 3, figs. 1-8, pl. 4, figs. 3-6.
1984 *Nostoceras (Bostrychoceras) polyplocum* (ROEMER, 1841) – KENNEDY & SUMMESBERGER: 164 (p.p.), pl. 9, figs. 4, 8, 12, 13.
1999 *Nostoceras (Bostrychoceras) polyplocum* (ROEMER, 1841) – KENNEDY & SUMMESBERGER: 164 (p.p.), pl. 2, figs. 4, 5.
2000a *Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ, 1980) – KÜCHLER: 297, pl. 1, fig. 2; pl. 3, figs. 4, 5, 6; pl. 4, fig. 6 (with full synonymy).
2000b *Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ) – KÜCHLER: 477, pl. 15, fig. 7.

H o l o t y p e is the original of BLASZKIEWICZ, 1980 (pl. 3, figs. 3, 6) from the lower *Polyplocum* Zone of the middle Vistula valley, Poland.

M a t e r i a l : NHMW 1998z/29/6, NHMW 1998z/40/1, OÖLM 58/1975/5, 6; R 56, M 3, altogether 5 specimens because the fragments OÖLM 58/1975/5,6 belong to a single specimen (Pl. 6, fig. 1), all from the Gschliefgraben. Not to our disposal an additional specimen on display at the Kammerhofmuseum (Gmunden, Upper Austria).

D e s c r i p t i o n : Initial whorls in a tightly coiled dextral or sinistral spire with narrow apical angle of 25-30°, the middle growth stage with relatively tightly coiled whorls (pl. 6, fig. 1). The initial stage (KENNEDY & SUMMESBERGER 1999: pl. 2, figs. 4, 5) bears 50 – 60 fine ribs per whorl, some of them bifurcating at the tubercles. About three ribs per whorl are collar ribs preceded by a constriction.

The best preserved specimen (OÖLM 58/1975/5, 6) consists of two parts, which were figured separately in 1984 (KENNEDY & SUMMESBERGER: pl. 9, figs. 8, 12). Preserved are the middle growth stages (Pl. 5, fig.1). Style of ribbing of the adapical whorls continues over the two next ones, and becomes coarser and more widely spaced on the two last preserved whorls. A single row of about 15 relatively large tubercles per whorl is situated in a submedian row on single ribs on the adapical 3 whorls, diminishing on the

fourth whorl, and almost fading out on the fifth. Neither embryonic stage, or suture are preserved in the Austrian specimens. The comma-like downturned body chamber is best visible in the specimen on display at the Kammerhofmuseum Gmunden.

M e a s u r e m e n t s : OÖLM 58/1975/5,6 is about 105 mm high with Wb_{max} of about 30 – 35 mm (restored), Wh_{max} of about 22 mm (restored). NHMW 1998z/40/1 (KENNEDY & SUMMESBERGER: pl. 2, fig. 5) is about 33 mm high (three whorls), Wd of the largest whorl is about 20 mm (restored), Wh is 7, 11 and 14 mm at three subsequent whorls.

D i s c u s s i o n : The single row of tubercles makes certain that all the Gschliefgraben specimens belong to one species: *Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ, 1980). This was already discussed by KENNEDY & SUMMESBERGER (1999: 26). Two fragments OÖLM 58/1975/5,6 figured separately by KENNEDY & SUMMESBERGER (1984: pl. 9, figs. 8, 12) belong to a single individual and are refigured here in a proper arrangement (Pl. 6, fig. 1). According to KÜCHLER (2000: 297) *Turrilites polyplocus* A. ROEMER (SIMIONESCU, 1899: pl. 1, fig. 2) from Transsylvania also belongs to the species, although it has more – about 20 – tubercles per whorl. *Nostoceras (Euskadiceras) euskadiense* KÜCHLER, 2000, in having a second row of tubercle is distinguished from *Nostoceras (Bostrychoceras) polyplocum* (A.ROEMER, 1841) by its relatively large tubercles in a single row, and by the different shape of the body chamber where it is preserved. For further discussion of the species see KÜCHLER (2000: 298).

O c c u r r e n c e : Late Campanian of Roumania, Germany, Gschliefgraben (Austria), Poland and Northern Spain.

Family Diplomoceratidae SPATH, 1926

Subfamily Diplomoceratinae SPATH, 1926

Genus *Diplomoceras* HYATT, 1900

Type species: *Baculites cylindracea* DEFRANCE, 1816 by original designation.

Diplomoceras cylindraceum (DEFRANCE, 1816)
(Pl. 6)

1816 *Baculites cylindracea* DEFRANCE: 160.
1987 *Diplomoceras cylindraceum* (DEFRANCE) – KENNEDY: 181, pl. 17, fig. 3; pl. 18, fig.5; pl. 21, figs. 2,3,5,6; pl. 22, fig.6; pl. 23, figs. 1,2; pl. 24, figs. 1-3; pl. 25, figs. 1-8; pl. 26, fig. 18; pl. 33, fig. 16; pl. 36, fig. 6; text-figs. 9-10. (with full synonymy)
2001 *Diplomoceras cylindraceum* (DEFRANCE) – KÜCHLER & ODIN: 521; pl. 6, figs. 12,13.
2003a *Diplomoceras cylindraceum* (DEFRANCE) – KLINGER & KENNEDY: 171 et seq., figs. 1-7.
2003b *Diplomoceras cylindraceum* (DEFRANCE) – KLINGER & KENNEDY: 303, figs. 53-55 (with additional synonymy)

N e o t y p e designated by KENNEDY (1987: 183, pl. 24, figs. 1-3) is no. 10511 in the collections of the Institut Royal des Sciences Naturelles de Belgique, from the Late Maastrichtian of St. Pietersberg (Maastricht, The Netherlands).

M a t e r i a l : A single specimen EST/2003/1 in the ESTERMANN collection is from the Gschliefgraben locality.

D e s c r i p t i o n : EST 2003/1 is a fragment of a laterally crushed, flattened internal mould with adherent remnants of shell. The surface is brownish, coloured by iron oxide. The fragment is U-shaped with two almost parallel shafts. The straight part of the adapertural one measures about 140 mm in length, the smaller adapical one about 80 mm long, excluding the U-shaped section that joins the two shafts. Total length including the curved part is 173 mm, total length, measured around the venter is about 310 mm. The Wh_{max} is 34 mm, the Wh_{min} is about 20 mm. Distance between the shafts from 33 to 36 mm. Ornament consists of narrow and closely spaced ribs; the rib index is about 11.

D i s c u s s i o n : see KENNEDY (1986), KLINGER & KENNEDY (2003a, b).

O c c u r r e n c e : *Diplomoceras cylindraceum* has a worldwide distribution. It occurs predominantly in the Maastrichtian but is also recorded from the Late Campanian, as in Poland (MACHALSKA, 1996) and in SE France (KÜCHLER & ODIN, 2001: Fig. 2). A nannofossil sample from the specimen described yielded *Reinhardtites levis*, *Broinsonia parca constricta* and *Eiffellithus eximius* and *Reinhardtites* cf. *anthophorus* (pers. comm. Dr. M. WAGREICH, Vienna) indicating Upper Campanian nannofossil zone CC22, comparable to three samples taken earlier from Gschliefgraben ammonites (WAGREICH 1999). That means that *Diplomoceras cylindraceum* belongs to the bulk of the Late Campanian ammonites, and a Maastrichtian age seems unlikely.

Genus *Neocrioceras* SPATH, 1921

Type species: *Neocrioceras spinigerum* JIMBO 1894: 38, pl. 24, fig.1 by the subsequent designation of DIENER 1925: 129.

***Neocrioceras* sp.**

(Pl. 7, Fig. 2)

Compare:

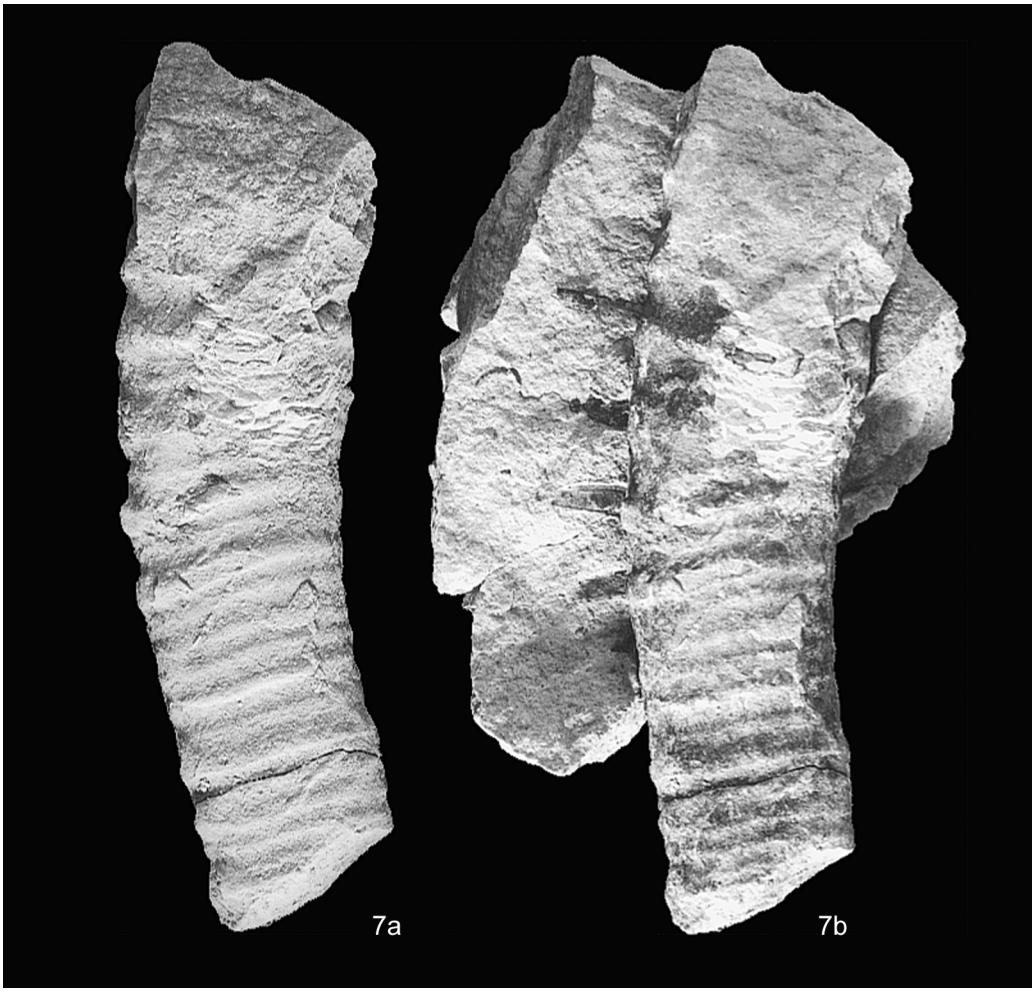
1984 *Neocrioceras (Schlueterella)* sp. – KENNEDY & SUMMESBERGER: 166; pl. 10, fig. 4.

M a t e r i a l : Two specimens, EST 2003/7 and R 70

D e s c r i p t i o n : EST 2003/7 is an internal mould of an almost circular crioconic whorl, preserved as a composite internal mould, deformed by lateral compaction, with a somewhat rusty surface. The middle part of the whorl is damaged. The external mould of a second, larger whorl, apparently in the same plane, is visible on the margin of the slab. The general shape seems to have been crioconic, with several whorls increasing slowly in diameter. Ornament consists of about 60 rursiradiate narrow ribs per whorl; the rib index is about 5, with interspaces somewhat wider than the ribs. All ribs bear four tiny tubercles, arranged in 4 rows, one in a lateral, one in a ventrolateral position on either flank of the shell. The sutures are not visible. R70 from the Gschliefgraben figured by KENNEDY & SUMMESBERGER (1984: pl.10, fig.4) shows that crioconic growth continues to a much larger size.

D i s c u s s i o n : Similar fragments of *Glyptoxoceras* with rursiradiate ribs are easily distinguished by the absence of tubercles. The new specimen indicates that *Neocrioceras* sp. might be a distinct taxon or the juvenile part of a distinct taxon.

O c c u r r e n c e : Late Campanian of the Gschliefgraben.



Text-fig. 7: *Lewyites elegans* (MOBERG); (a) EST 2003/2, coated without matrix; (b) EST 2003/2 uncoated on matrix, showing the spines. From the Gschliefgraben. x 1.

Genus *Lewyites* MATSUMOTO & MIYAUCHI, in MATSUMOTO, 1984

Type species: *Idiohamites (?) oronensis* LEWY, 1969 by the original designation of MATSUMOTO & MIYAUCHI (1984: 64).

***Lewyites elegans* (MOBERG, 1885)**
(Pl. 7, Figs. 3, 4; Text-fig. 7A, B)

1885 *Ancyloceras* ? *elegans* MOBERG: 30; pl. 3, fig. 10.
1984 *Pseudoxybeloceras* cf. *phaleratus* (GRIEPENKERL) – KENNEDY & SUMMESBERGER: pl. 6, figs. 4, 5 (only).
1986 *Neocrioceras* (*Schlueterella*) ? *elegans* (MOBERG, 1885) – KENNEDY: 102, pl. 17, figs. 3-6.
1997 *Lewyites elegans* (MOBERG, 1885) – KENNEDY & KAPLAN: 57, pl. 58, figs. 1-5; pl. 59, figs. 1,2; pl. 60, figs. 1-5; (with synonymy).
1997 *Lewyites elegans* (MOBERG, 1885) – KENNEDY & CHRISTENSEN: 106, figs. 22-23; (with synonymy).

H o l o t y p e : By monotypy, the original of MOBERG (1885: pl. 3, fig. 10) refigured by KENNEDY & CHRISTENSEN (1997: Fig. 22 A-B) and by KENNEDY & KAPLAN (1997: pl. 58, figs. 3-4).

M a t e r i a l : 3 specimens: EST 2003/2 in the Estermann collection, SK 1992/S 45 in the Skoumal collection, and R 71 in the Roschger collection, all from the Gschliefgraben.

D e s c r i p t i o n : EST 2003/2 is a badly preserved fragment of an internal mould of an adult body chamber, laterally compressed by post-mortem crushing. Total length is about 110 mm, the whorl height ranges from 25 to 33 mm. The fragment is slightly curved. There are doubtful traces of shell remains on the corroded surface. The ornament consists of somewhat irregularly spaced strong rursiradiate primary ribs, bifurcating at ventral spines. Some are preceded by a broad constriction, indicating proximity to the aperture. The external mould (Text-fig. 7B) preserves prominent, possibly hollow spines up to 14 mm long in a ventral or ventrolateral position corresponding to clavate tubercles on the primary ribs of the internal mould (Text-fig. 7A). Two or three relatively coarse, widely and irregularly spaced non-bifurcating secondary ribs occur between the tuberculate/spinose primaries. The rib index is about 7. SK 1992/S 45 (Pl. 7, Figs. 3,4) is smaller, only 60.6 mm long, with Wh from 12.0 to 18.6 mm. This apparently juvenile fragment has an identical style of ribbing to EST 2003/2. In all cases the ribs are weakened on the dorsum. Lack of secondaries between primaries gives the appearance of a constriction (KENNEDY & SUMMESBERGER 1984: pl. 6; figs. 3,4). The suture is not preserved.

D i s c u s s i o n : The Gschliefgraben material corresponds to the north European species *Lewyites elegans* (MOBERG, 1884). *Lewyites oronensis* (LEWY, 1969) and *Lewyites circularis* (LEWY, 1969) differ in their more regular ornamentation. The presence of long spines in *Lewyites* is confirmed for the first time. *Lewyites sulcatus* KENNEDY, COBBAN & SCOTT (2000: pl. 3, figs. 5, 6, 10-13) differs by its much denser ribbing with most of the ribs being tuberculate. *Lewyites clinensis* (ADKINS, 1929) differs by its more regular ribbing and tiny tubercles, each of them connecting a pair of ribs, pairs being separated by a single nontuberculate one (KENNEDY & COBBAN 2001: 24; pl. 4, figs. 7-9, text-fig. 4).

O c c u r r e n c e : *Lewyites elegans* (MOBERG, 1884) is known from the Late Campanian of Sweden, from the early Upper Campanian *Spiniger/Basiplana* Zone of NW Germany (Westphalia), the Late Campanian (Assize P^3) of the Aquitaine basin, France and from Poland and now for the first time from the Late Campanian of the Gschliefgraben.

Subfamily Polyptychoceratinae MATSUMOTO, 1938

Genus and Subgenus *Polyptychoceras* YABE, 1927

Type species: *Ptychoceras pseudogaultinum* YOKOYAMA, 1890: 181, pl. 20, figs. 1-3 by original designation.

***Polyptychoceras (Polyptychoceras) obliquecostatum* (SCHLÜTER, 1872)**
(Pl. 7, Fig.1)

H o l o t y p e : By monotypy, the original of SCHLÜTER, 1872: 187, pl. 29, fig. 6 from the Late Campanian of Coesfeld, Westphalia (Germany).

M a t e r i a l : EST 2003/6, NHMW 1996/z29/13, 14, 15, 16.

D e s c r i p t i o n : EST 2003/6 provides better information about the general shape of the shell than previously described specimens (KENNEDY & SUMMESBERGER 1999: 29, pl. 2, figs. 1-3, 7-9). It consists of three parallel shafts, connected by curved sections. The adapertural shaft is 157,9 mm long; about 93 mm are preserved as internal mould, of which 25 mm are broken away, exposing the external mould. The proximal part of the shaft is badly crushed and covered with a black crust. The second shaft is an external mould 85 mm long, also covered with a black crust. The terminal hook of the body chamber appears to be broken away. The inner shaft is almost invisible; it must have been about 44 - 45 mm long. Wh expands from 4.2 mm to 13 mm, possibly exaggerated by compaction. Ribs are equal and slightly oblique; the rib index is about 5.

D i s c u s s i o n : For discussion and synonymy see KENNEDY & SUMMESBERGER (1999: 29).

O c c u r r e n c e : Late Campanian of the Münster basin (Westphalia) and the Gschliefgraben.

Genus and Subgenus *Pseudoxybeloceras* WRIGHT & MATSUMOTO, 1954

Type species: *Hamites quadrinodosus* JIMBO 1894, p. 39, pl. 7, figs. 3,4 by original designation.

***Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov.**
(Pls. 8, 9)

H o l o t y p e : designated herewith is EST 2003/5 (Pl. 8) from the Late Campanian of the Gschliefgraben (Austria).

D e r i v a t i o n o m i n i s : in honour of Dr. Heinz A. Kollmann, Natural History Museum, Vienna.

M a t e r i a l : Two specimens: EST 2003/5 from the Estermann collection and RESCH /2003/1 from the Resch collection, Schwanenstadt, Upper Austria.

D e s c r i p t i o n : Both specimens are large fragments of adult body chambers consisting of a longer part of the penultimate shaft, terminal curvature and a fragment of the terminal shaft. Both are internal moulds, laterally flattened, the surface partially covered by a rusty layer. The surface of both specimens is corroded, parts of the sculpture of RESCH/2003/1 are missing, due to mechanical treatment or deformation. Typical traces indicate that the now missing shell was bored by *Vioa,* or a *Vioa*-like organism. EST 2003/5 measures 235 mm in total length around the venter, the adapical part of the shaft being about 120 mm, the adapertural part being 35 mm long. Wh increases from 31,2 mm to 40,5 mm, measured at the beginning of the curvature. RESCH/2003/1 measures 245 mm around the venter, the longer shaft is 160 mm long, the shorter one is practically broken away. Wh expands from about 27,8 mm to 34,7 mm measured at the beginning of the curvature. The distance between the shafts, the beginning of the curved sector, is about 9 mm. The preserved parts suggest a general morphology of straight shafts with a terminal hook. A slight curvature towards the ventral side in RESCH/2003/1 (pl. 9) might be due to deformation. The original whorl section may have been high oval or rounded.

Both specimens preserve their spectacular ornamentation: broad prorsiradiate, slightly convex ribs (3.5 mm) separated by even broader interspaces (9 mm; rib index between 2 and 3.8 ribs per 100 mm), each rib bearing 3 rows of tubercles (spine-bases?) on either flank, in ventrolateral, ventral and dorsal position. All are arranged in regular rows. Initial coiling of phragmocone and suture unknown.

D i s c u s s i o n : The coarse ornament and trituberculation distinguishes the species from all previously described Campanian heteromorph ammonites. It is a heterochronous homoeomorph of Cenomanian *Anisoceras* (e.g. STOLICZKA, 1865: pl. 81, fig. 10).

O c c u r r e n c e : Campanian (?) of the Gschliefgraben, Austria

***Pseudoxybeloceras* sp.**
(Pl. 10, Figs. 1, 2; Pl. 11, Figs. 1, 2)

M a t e r i a l : Three large fragments: NHMW 1998z/29/12 and NHMW/2004z0090/0001, 2.

D e s c r i p t i o n : NHMW/2004z0090/0001,2 are large crushed fragments of a straight shaft. NHMW/2004z0090/0002 is 410 mm long and about 80 mm wide. NHMW/2004z0090/0001 is 240 mm long with tapering width from 64 to 73 mm. In both specimens only the figured sides (pl. 10, fig. 1; pl. 11, figs. 1, 2) are preserved. As parts of the shell are present, the surface is not much corroded. In both specimens whorl height is exaggerated by compaction, and the section may have been high oval. In both specimens the style of ribbing is identical. The surface is covered by a regular sequence of about 14 (NHMW/2004z0090/0002) - 18 (NHMW/2004Z0090/0001) rectiradiate shallow ribs and equal interspaces within 100 mm length. The section of the straight and undivided ribs is convex, the section of the interspaces is concave. In NHMW/2004Z0090/0002 four regular rows of tubercles (spine-bases) are in possibly ventrolateral and ventral position, there are about 11 or 12 tubercles per 100 mm length, that means that most of the ribs bear tubercles, but not all. There are no sutures visible in either specimens, and no tuberculation is visible in NHMW/2004Z0090/0001.

NHMW/1998z/29/12 is a 201 mm long fragment of the body chamber with high oval section and an estimated whorl height of about 75 mm. About 18 ribs per 100 mm crossing the flanks recti- or slightly rursiradiate. Some of them are tuberculated. Style of ribbing of all three specimens seems to be identic. Common to all three specimens is also their large size. Initial stage is unknown.

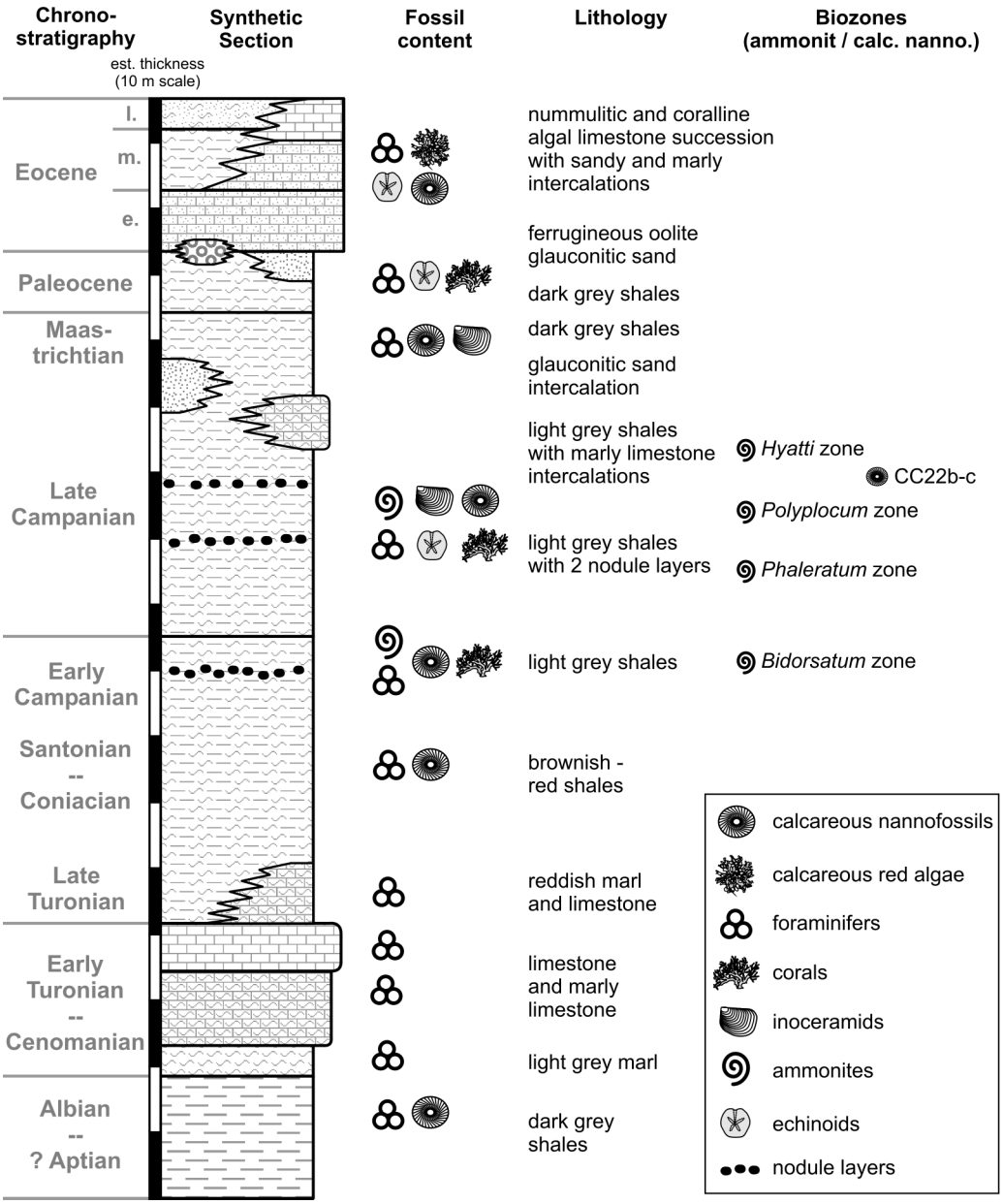
D i s c u s s i o n : The taxon is tentatively interpreted as belonging to the genus *Pseudoxybeloceras*. The general shape appears to have consisted of several, probably parallel shafts connected by curved parts; initial coils are unknown. NHMW/2004Z0090/0002 (pl. 11, figs. 1, 2) is crushed in such a way that tubercles are visible, and NHMW/2004Z0090/0001 (pl. 10, fig. 1) shows the non-tuberculate dorsum. The large *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1972; sensu KENNEDY & SUMMESBERGER 1999: pl. 3, fig. 5 (only)) from the Gschliefgraben differs in having narrow rectiradiate ribs (24 per 100 mm) on the shaft, connected to coarse rursiradiate pairs on the curved part of the body chamber, which is not preserved in the specimens of *Pseudoxybeloceras* sp. from the Gschliefgraben nor in the German repre-

sentatives of *Neocrioceras (Schlueterella)* aff. *pseudoarmatum* (SCHLÜTER, 1972) (KAPLAN & KENNEDY 1997: pl. 59, fig. 4; pls. 62, 63). The originals of SCHLÜTER's (1872) *Ancyloceras pseudoarmatum* revised and refigured by KAPLAN & KENNEDY 1997: pls. 64, 65) under *Neocrioceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1972) differ by their relatively large tubercles compared to the size of the ribs (e.g. the holotype: SCHLÜTER 1872: pl. 31, figs. 1-3), by coarse ribbing with few fine intercalatories (e.g. SCHLÜTER 1872: pl. 43, fig. 5) and ribs narrower than the interspaces on the microconch, as figured by KAPLAN & KENNEDY (1997: pl. 64), the of original SCHLÜTER's pl. 43, fig. 8. NHMW 1998z/29/12 interpreted as *P. (S.) pseudoarmatum* (SCHLÜTER) by KENNEDY & SUMMESBERGER (1999: pl. 3. fig. 3) and by FRAAYE & SUMMESBERGER 1999 (pl. 1, fig. A) is united here with *Pseudoxybeloceras* sp. *Neocrioceras (Schlueterella)* aff. *pseudoarmatum* (SCHLÜTER, 1972) from NW-Germany and *Neocrioceras (Schlueterella) pseudoarmatum* (SCHLÜTER) from the Gschliefgraben seem to be the closest allies.

O c c u r r e n c e : Late Campanian of the Gschliefgraben

Tab. 5. The ammonite fauna from the Gschliefgraben, Upper Austria, new taxa in bold letters.

Phylloceras (Hypophylloceras) sp.	*Nostoceras (Nostoceras)* sp.
Gaudryceras jukesi (SHARPE, 1857)	*Didymoceras donezianum* (MIHAILOV, 1951)
Tetragonites cf. *obscurus* (SCHLÜTER, 1872)	*Didymoceras binodosum* (KENNEDY & COBBAN, 1993)
Saghalinites cf. *cala* (FORBES, 1846)	*Glyptoxoceras* cf. *retrorsum* (SCHLÜTER, 1872)
Pseudophyllites teres (VAN HOEPEN, 1920)	***Diplomoceras cylindraceum* (DEFRANCE, 1816)**
Desmophyllites larteti (SEUNES, 1891)	*Neocrioceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872)
Parapuzosia ? sp. indet.	
Kitchinites sp.	***Neocrioceras* sp.**
Puzosiinae gen. et sp. indet.	*Neancyloceras bipunctatum* (SCHLÜTER, 1872)
***Hauericeras (Hauericeras) pseudogardeni* (SCHLÜTER, 1872)**	***Pseudoxybeloceras* sp.**
Hauericeras (Gardeniceras) fayoli DE GROSSOUVRE, 1894	***Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov.**
Yokoyamaoceras ? sp.	*Pseudoxybeloceras (Parasolenoceras) wernickei* (WOLLEMANN, 1902)
Pachydiscus (P.) haldemsis (SCHLÜTER, 1867)	
Pachydiscus (P.) perfidus DE GROSSOUVRE, 1894	*Pseudoxybeloceras (Parasolenoceras) interruptum* (SCHLÜTER, 1872)
Pachydiscus (P.) cf. *subrobustus* SEUNES, 1891	
Menuites arrialoorensis (STOLICZKA, 1865)	*Pseudoxybeloceras (Parasolenoceras)* cf. *phaleratum* (GRIEPENKERL, 1889)
***Menuites deccanensis* (STOLICZKA, 1865)**	
***Placenticeras* cf. *milleri* (HAUER, 1866)**	***Lewyites elegans* (MOBERG, 1885)**
Hoplitoplacenticeras (H.) coesfeldiense (SCHLÜTER, 1867)	*Polyptychoceras (P.) obliquecostatum* (SCHLÜTER, 1872)
	Polyptychoceras (P.) cf. *pseudogaultinum* (YOKOYAMA, 1890)
Hoplitoplacenticeras (H.) preyi KENNEDY & SUMMESBERGER, 1999	
***Eubostrychoceras (Eubostrychoceras)* cf. *reevesi* (YOUNG, 1963)**	*Polyptychoceras (P.)* sp.
	Polyptychoceratinae indet.
Nostoceras (Bostrychoceras) polyplocum (ROEMER, 1841)	*Baculites* sp. 1
***Nostoceras (Euskadiceras) unituberculatum* (BLASZKIEWICZ, 1980)**	*Baculites* sp. 2
	Baculites sp. 3
	Trachyscaphites pulcherrimus (ROEMER, 1841)



Text-fig. 8: Restored section of the Gschliefgraben with additions and alterations after KROH & JAGT (in press), PREY (1983) and KENNEDY & SUMMESBERGER (1984).

Conclusion

A diverse fauna of 45 taxa makes the Gschliefgraben one of the best documented Late Campanian ammonite occurrences. There is a strong palaeobiogeographic relationship to the faunas of the Northern Temperate Realm of NW Europe (KENNEDY & SUMMESBERGER 1984, 1999). Belemnites in contrast suggest an additional palaeogeographic connection with the eastern part of the Gosau occurrences (e.g. "Neue Welt"; CHRISTENSEN 1998).

Acknowledgements

Without the cooperation of private collectors over many years the present, and previous accounts of the Gschliefgraben fauna (e.g. KENNEDY & SUMMESBERGER 1984, 1999, 2001) would have been impossible; we are grateful to them for their help. We thank Mr. Ferdinand ESTERMANN (Pinsdorf near Gmunden, Upper Austria) and Dr. Peter SKOUMAL (Vienna) and Mr. RESCH (Schwanenstadt, Upper Austria) for the loan of the specimens described. Thanks to the generous donation of Director Mag. Herbert HÜTTER (Gmunden) his former collection is now under care of the Museum of Natural History Vienna. For investigation of nannosamples we are grateful to Prof. Dr. Michael WAGREICH (Vienna University), for technical assistance to Mag. Andreas KROH (NHMW). Our thanks are also due to the staff of the Museum of Natural History (Vienna) for technician work and photography. H.S. is grateful for financial support of the Museum of Natural History Vienna and the Theodor Körner Stiftungsfonds. The editorial support of Dr. Ortwin SCHULTZ (NHMW) is gratefully acknowledged.

References

BLASZKIEWICZ, A. (1980): Campanian and Maastrichtian ammonites of the Middle Vistula Valley, Poland: a stratigraphic-paleontological study. – Prace Inst. Geol., **92**: 1-63, 56 pls. – Warszawa.

CHRISTENSEN, W.K.(1998): Upper Campanian *Belemnella* from Austria. – Beitr. Paläont., **22**: 3-21, 1 pl. – Vienna.

COLLIGNON, M. (1952): Ammonites néocrétacées du Menabe (Madagascar) II. Les Pachydiscidae. – Travaux du Bureau Géologique du Haut Commissariat de Madagascar et Dépendances, **41**: 1-114, 33 pls. – Tananarive.

—— (1955): Ammonites néocrétacées du Menabe (Madagascar) II. Les Pachydiscidae. – Ann. Géol. Serv. Mines; Haut Comm. de Madagascar et Dép., **21**:98 pp., 28 pls., 21 text-figs. – Paris.

DIENER, C. (1925): Fossilium Catalogus. Ammonoidea Neocretacea. – 244 pp. – Berlin.

FATMI, A.N. & KENNEDY, W.J. (1999): Maastrichtian ammonites from Balochistan, Pakistan. – Journ. Paleont. **73**/4: 641-662, 15 figs. – Lawrence.

FRAAYE, R.H.B. & SUMMESBERGER, H. (1999): New crustacean records from the Late Campanian of Austria. – Beitr. Paläont., **24**: 1-6. – Wien.

GROSSOUVRE, A. DE (1894) : Recherches sur la Craie supérieure, 2. Paléontologie. Les ammonites de la craie supérieure. – Mém. Serv. Carte géol. dét. France: 264 pp., 39 pls. – Paris.

HANCOCK, J.M. & KENNEDY, W.J. (1993): The high Cretaceous ammonite fauna from Tercis, Landes, France. – Bull. Inst. Roy. Sci. Nat. Belgique, Sci. de la Terre, **63**: 149-209, 20 pls. – Brussel.

HAUER, F. v. (1866): Neue Cephalopoden aus den Gosaugebilden der Alpen. – Sitzber. K. Akad. Wiss., **53**: 9 pp., 2 pls. – Wien.

HILBER, V. (1902): Fossilien der Kainacher Gosau. – Jahrb. k.k. Geol. Reichsanstalt, **52:** 277-284, 1 pl. – Wien.

KENNEDY, W.J. (1986): Campanian and Maastrichtian Ammonites from northern Aquitaine, France. – Spec. Pap. Palaeontology, **36**: 1-145, 23 pls., 43 text-figs. – London.

—— (1987): The ammonite fauna of the type Maastrichtian with a revision of *Ammonites colligatus* BINKHORST, 1861. – Bull. K. Belg. Inst. Nat. Wet.: Aardtwetenschappen, **56**: 151-267. – Brüssel.

—— & COBBAN, W.A. (1993): Campanian ammonites from the Annona Chalk near Yancy. – Journal of Paleontology, **67**: 83-97.

—— & COBBAN, W.A. (1999): Campanian (Late Cretaceous) ammonites from the Bergstrom Formation in Central Texas. – Acta Geologica Polonica, **49**/1: 67-80. – Warszawa.

—— & COBBAN, W.A. (2001): Campanian (Late Cretaceous) Ammonites from the upper part of the Anacacho limestone in South-Central Texas. – Acta Geologica Polonica, **51**/1:15-30. – Warszawa.

—— , COBBAN, W.A. & SCOTT, G.R. (2000): Heteromorph ammonites from the middle Campanian *Baculites scotti* Zone in the U.S. Western Interior. – Acta Geologica Polonica, **50**/2:223-242. – Warszawa.

—— & HANCOCK, M. (1993): Upper Maastrichtian Ammonites from the Marnes de Nay between Gan and Rébénacq (Pyrénées - Atlantiques), France. – Geobios, **26**/5: 575-594, 7 pls. – Lyon.

—— & HENDERSON, R.A. (1992): Non heteromorph ammonites from the Upper Maastrichtian of Pondicherry, South India. – Palaeontology, **35**: 381-442, 18 pls. – London.

—— & KAPLAN, U. (1995): *Parapuzosia (Parapuzosia) seppenradensis* (LANDOIS) und die Ammonitenfauna der Dülmener Schichten, unteres Unter-Campan, Westfalen. – Geol. Paläont. Westfalen, **33**: 127 pp., 7 text-figs., 43 pls. – Münster.

—— & KAPLAN, U. (1997): Ammoniten aus dem Campan des Stemweder Berges, Dammer Oberkreidemulde, NW-Deutschland. – Geol. Paläont. Westfalen, **50**: 31-245, 82 pls., 2 text-figs. – Münster.

—— & SUMMESBERGER, H. (1984): Upper Campanian ammonites from the Gschliefgraben (Ultrahelvetic, Upper Austria). – Beitr. Paläont. Österreich, **11**: 149-206, pls. 1-14. – Wien.

—— & SUMMESBERGER, H. (1999): New Upper Campanian Ammonites from the Gschliefgraben near Gmunden (Ultrahelvetic, Austria). – Beitr.Paläont., **24**: 23-39, 3 pls. – Wien.

—— & SUMMESBERGER, H. (2001): Additional ammonites from the Upper Campanian (Upper Cretaceous) of the Gschliefgraben (Ultrahelvetic; Austria). – Ann. Naturhist. Mus. Wien, **102** A: 85-107. 1 text-fig., 1 tab., 7 pls. – Wien.

KLINGER, H.C. & KENNEDY, W.J. (2003a): Observations on the systematics, geographic and stratigraphic distribution of *Diplomoceras cylindraceum* (DEFRANCE, 1816) (Cephalopoda: Ammonoidea). – Annals South African Mus., **110**/4: 171-198, 17 figs. – Cape Town.

—— & KENNEDY, W.J. (2003b): Cretaceous Faunas from Zululand and Natal, South Africa. The ammonite families Nostoceratidae HYATT, 1894 and Diplomoceratidae SPATH, 1926. – Annals South African Mus., **110**/6: 219-336, 64 figs. – Cape Town.

KOLLMANN, H. A. & SUMMESBERGER, H. (1982): Excursions to Coniacian – Maastrichtian in the Austrian Alps. – 4. Meeting, Working Group Coniacian - Maastrichtian Stages: 105 pp. – Vienna.

KOSSMAT, F. (1895 – 1898): Untersuchungen über die südindische Kreideformation. – Beitr. Paläont. Österr. Ungarns u. d. Orients., **9**: 97-203 (1895); **11**: 1-46 (1897); **11**: 89-152 (1898). – Wien.

KROH, A. & JAGT, J. W. M. (in press): Additional records of Late Cretaceous and Early Palaeogene echinoids from the Gschliefgraben (Ultrahelvetic, Austria) (with a contribution by M. WAGREICH). – Acta Geologica Polonica, **54**/4 (2004).

KÜCHLER, T. (2000a): *Nostoceras (Euskadiceras) euskadiense* a new ammonite subgenus and species from the higher Upper Campanian (Upper Cretaceous) of northern Spain. – Berliner geowiss. Abh., E **34**: 291-307. – Berlin.

—— (2000b): Upper Cretaceous of the Barranca (Navarra, northern Spain); integrated litho-, bio- and event stratigraphy. Part II: Campanian and Maastrichtian. – Acta Geologica Polonica, **50**/4: 441-499. – Warszawa.

—— & ODIN, G.S. (2001): Upper Campanian - Maastrichtian ammonites (Nostoceratidae, Diplomoceratidae) from Tercis les Bains (Landes, France). – In: G.S. ODIN (Ed.): The Campanian-Maastrichtian Boundary. – Developments in Palaeontology and Stratigraphy, **19**. Chapter D4e: 500-528. – Elsevier Science B.V.

LEWY, Z. (1969): Late Campanian heteromorph ammonites from southern Israel. Israel J. Earth Sci., **18**: 109-135, pls.1- 4. – Jerusalem.

LOMMERZHEIM, A. (1995): Stratigraphie und Ammonitenfaunen des Santons und Campans im Münsterländer Becken (NW-Deutschland). – Geol. u. Paläont. in Westfalen, **40**: 97 pp., 19 text-figs., 8 pls. – Münster.

MACHALSKA, M. (1996): *Diplomoceras cylindraceum* (Defrance, 1816): a typically Maastrichtian ammonite in the Piotrawin section. – Przd. Geol., **44**: 953-954.

MATSUMOTO, T. (1955): The bituberculate Pachydiscids from Hokkaido and Saghalin. – Mem. Fac. Sci. Kyushu Univ. Ser. D, Geology, **5**/3: 153-184, pls. 31-37. – Fukuoka.

—— (1984): Some Ammonites from the Campanian (Upper Cretaceous) of Northern Hokkaido. Pal. Soc. Japan, Special papers, **27**: 1-32, 9 pls. – Tokyo.

—— & MIYAUCHI, T. (1984): Some Campanian Ammonites from the Soya Area. – Pal. Soc. Japan, Special papers, **27**: 33-76, pls. 10-31. – Tokyo.

—— , TOSHIMITSU, S. & KAWASHITA, Y. (1990): On *Hauericeras* De Grossouvre, 1894, a cretaceous ammonite genus. – Trans. Proc. Palaeont. Soc. Japan, N.S., **158**: 439-458. – Tokyo.

PREY, S. (1983): Das Ultrahelvetikum-Fenster des Gschliefgrabens südsüdöstlich von Gmunden (Oberösterreich). – Jb. Geol. Bundesanstalt, **126**/1: 95-127, 4 text-figs., 1 geol. map. – Wien.

SCHLÜTER, C. (1867): Beitrag zur Kenntniss der jüngsten Ammoneen Norddeutschlands. – 36 pp., 6 pls. – Bonn.

—— (1871-1876): Cephalopoden der oberen deutschen Kreide. – Palaeontographica, **21**: 1-24, pls.1-8 (1871); **21**: 25-120, pls. 9-35 (1872); **24**: 1-144 (121-264) + x, pls. 36-55 (1876). – Cassel.

SCHMIDT, W. (1908): Die Kreidebildungen der Kainach. – Jahrb. k.k. Geol. Reichsanstalt, **58**: 223-246, 3 pls. – Wien.

SIMIONESCU, J. (1899): Fauna Cretacica Superióra de la Ürmös (Transilvania). – Acad. Rom. Publ. Fond. Vasilie Adamachi, **4**: 38 pp, 3 pls. – Bucuresci.

STOLICZKA, F. (1865): The fossil Cephalopoda of the Cretaceous Rocks of Southern India. AMMONITIDAE, with revision of the NAUTILIDAE. – Mem geol Surv. India (1), Palaeont. Indica, **3**/1: 1-56, pls. 26-31 (1863); 2-5: 57-106, pls. 32-54 (1864); 6-9: 107-154, pls. 55-80 (1865); 10-13: 155-216, pls. 81-94 (1866). – Calcutta.

SUMMESBERGER, H., JURKOVSEK, B. & KOLAR-JURKOVSEK, T. (1996): Aptychi associated with ammonites from the Lipica-Formation (Upper Cretaceous, Slovenia). – Ann. Naturhistor. Mus. Wien, **97** A: 1-19. – Wien.

—— , WAGREICH, M., TRÖGER, K.-A. & JAGT, J. W.M. (1999): Integrated biostratigraphy of the Santonian/Campanian Gosau Group of the Gams Area (Late Cretaceous; (Styria, Austria). – Beiträge zur Paläontologie, **24**: 155-205**,** 12 Taf. – Wien.

TRÖGER, K.-A., SUMMESBERGER, H. & SKOUMAL, P. (1999): Inoceramidae from the Campanian (Upper Cretaceous) of the Gschliefgraben (Ultrahelvetic; Austria). – Beitr. Paläont., **24**:41-61, 4 Taf., 16 Textfig., 15 Tab. – Wien.

WAGREICH, M. (1999): Calcareous nannofossil assemblages from the Gschliefgraben near Gmunden (Ultrahelvetic, Austria). – Beitr.Paläont., **24**: 41-61. – Wien.

YABE, H. (1921). – In: YABE, H. & SHIMIZU, S.: Notes on some Cretaceous Ammonites from Japan and California. – Sci. Rep. Tohoku Imp. Univ., (2) **5**: 53-59, pls. 8-9. – Tokyo.

YOKOYAMA, M. (1890): Versteinerungen aus der japanischen Kreide. – Palaeontographica, **36**: 159-202, pls. 18-25. – Stuttgart.

Plate 1

***Pachydiscus (Pachydiscus) perfidus* De Grossouvre, 1894**; EST 2003/9, Gschliefgraben, x 1.

Plate 2

***Pachydiscus (Pachydiscus) perfidus* De Grossouvre, 1894**; EST 2003/8,
showing change of ornament, Gschliefgraben, x 0.9.

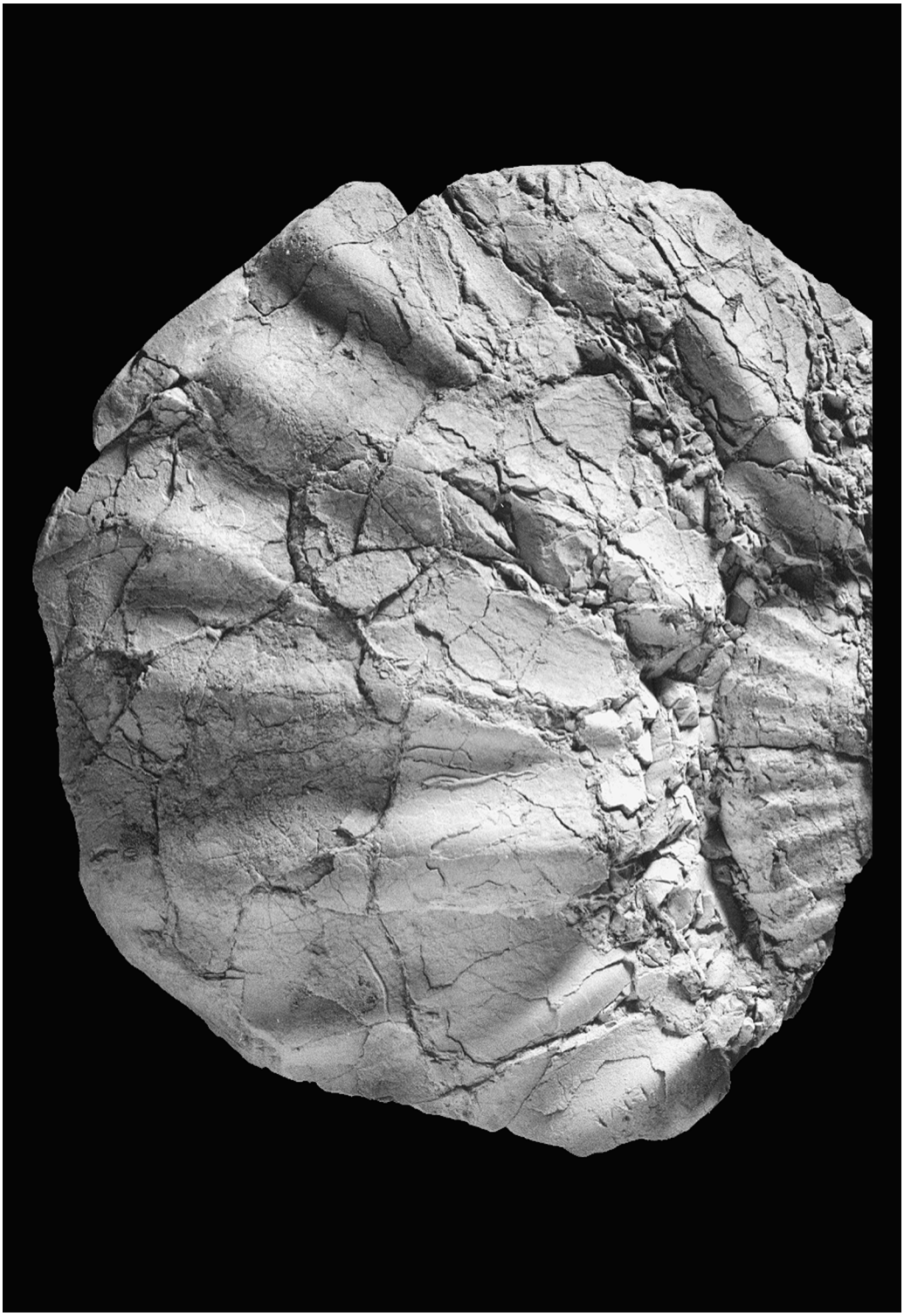


Plate 3

Figs. 1, 2: ***Menuites deccanensis*** **(STOLICZKA, 1865)**; EST/2003/282, Gschliefgraben, x 0.9.

Plate 4

Figs. 1, 2: ***Placenticeras* cf. *milleri* (HAUER, 1866)**; EST/2003/280, Gschliefgraben, x 1.

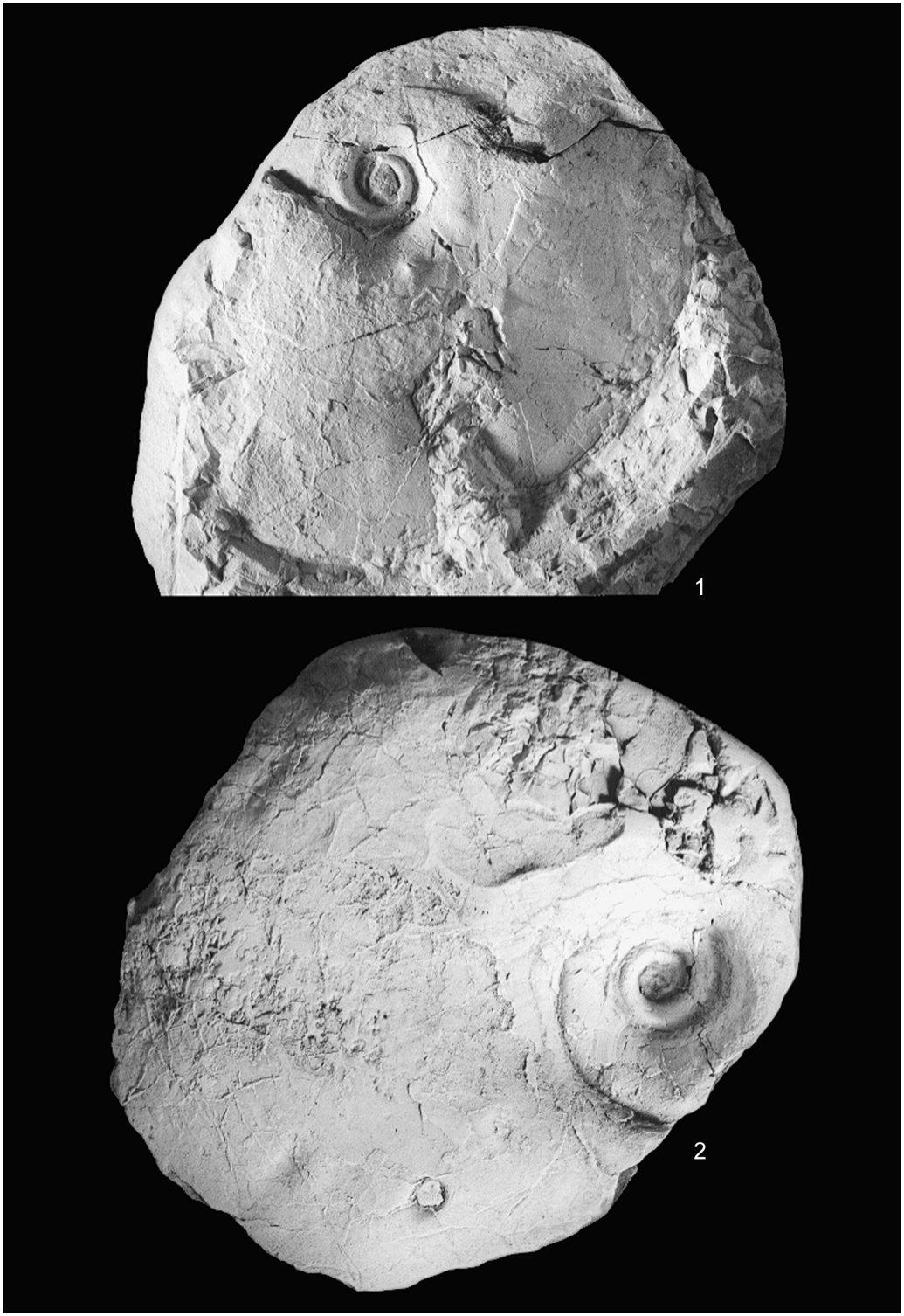


Plate 5

Fig. 1: ***Nostoceras (Euskadiceras) unituberculatum*** **(BLASZKIEWICZ, 1980)**
is OÖLM 58/1975/5,6;

Figs. 2, 3: ***Eubostrychoceras (Eubostrychoceras)*** **cf. *reevesi* (YOUNG, 1963)**
is NHMW 2003z0028/0001;

Figs. 4-6: ***Nostoceras (Didymoceras)*** **cf. *binodosum* (KENNEDY & COBBAN, 1993)**
is unregistered from the Estermann collection; all from the Gschliefgraben, all x 0.95.

Plate 6

***Diplomoceras cylindraceum* (DEFRANCE, 1816)**; EST/2003/1, Gschliefgraben, x 1.

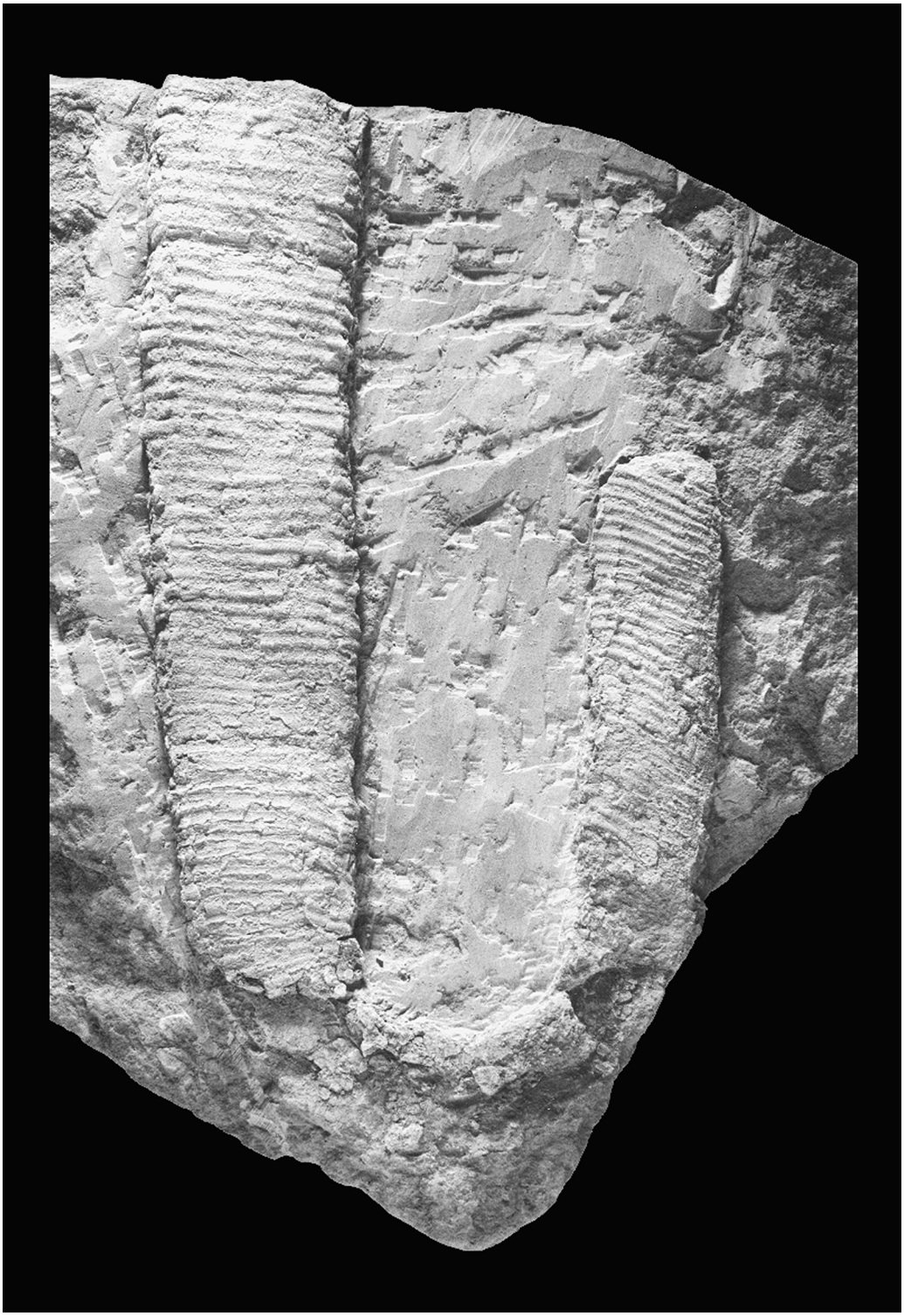


Plate 7

Fig. 1: ***Polyptychoceras (Polyptychoceras) obliquecostatum* (SCHLÜTER, 1872)**; EST 2003/6.

Fig. 2: ***Neocrioceras* sp.**; EST 2003/7.

Figs. 3, 4: ***Lewyites elegans* (MOBERG, 1885)**; SK/1992/S 45; all from the Gschliefgraben, all x 1.

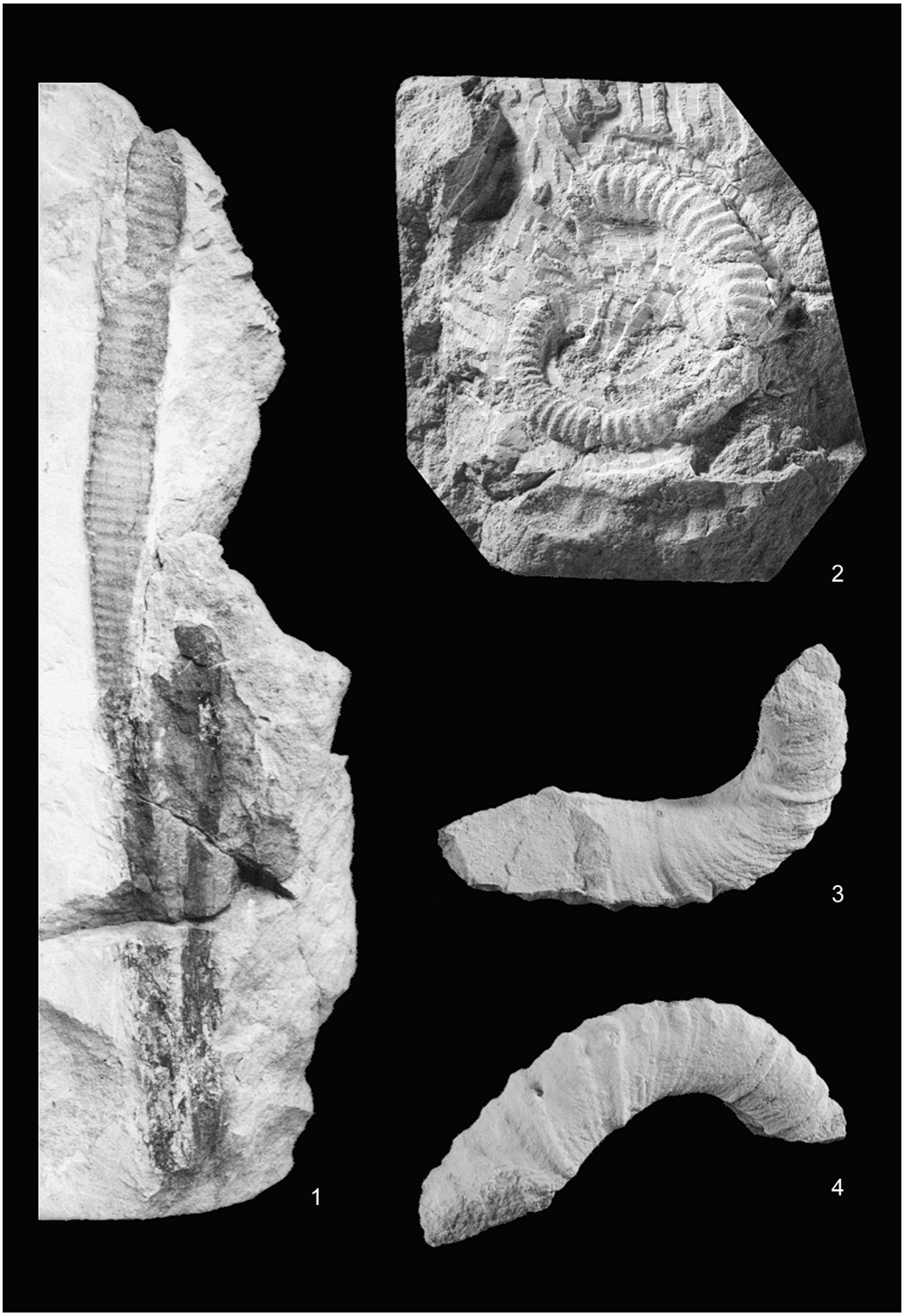


Plate 8

***Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov.**;
EST 2003/5, Gschliefgraben, the holotype, x 1.

Plate 9

***Pseudoxybeloceras (Pseudoxybeloceras) kollmanni* sp. nov.**;
RESCH/2003/1, Gschliefgraben, paratypoid, x 1.

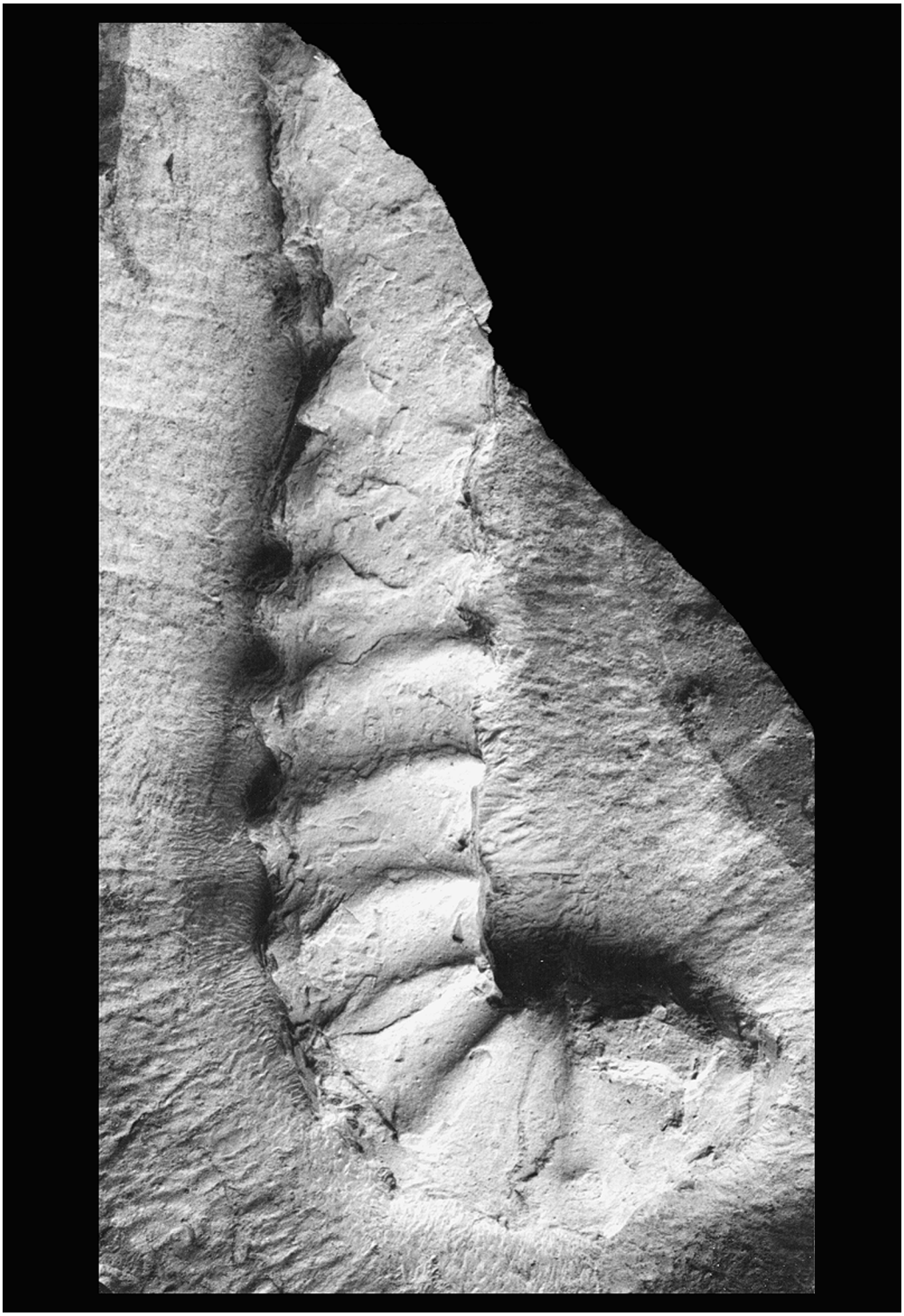


Plate 10

***Pseudoxybeloceras* sp.**; Fig. 1 is NHMW/2004z0090/0001; Fig. 2 is NHMW 1998z/29/12, Figs. 1, 2 are x 0.85. Both from the Gschliefgraben.

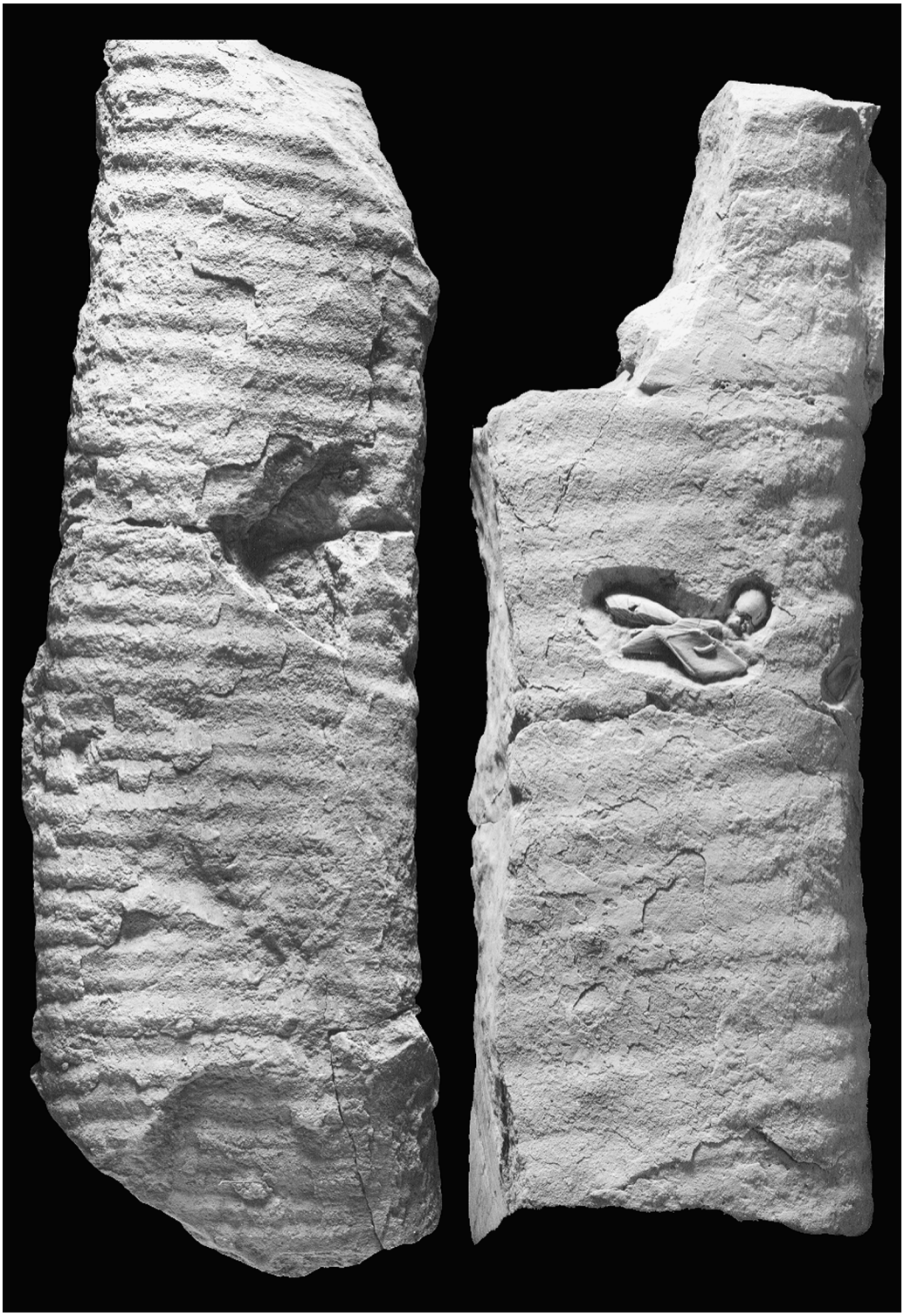


Plate 11

***Pseudoxybeloceras* sp.**; NHMW/2004z0090/0002,
Fig. 1 is x 0.45. Fig. 2 is x 0.9. Both from the Gschliefgraben.