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New Late Campanian Ammonites from the Gschliefgraben near Gmunden (Ultrahelvetic, Austria)

by

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Abstract

Eleven taxa are described from the Late Campanian of the Gschliefgraben near Gmunden. Six of them are new for the Gschliefgraben: *Kitchinites* sp., *Yokoyamaoceras ?* sp., *Hoplitoplacenticeras preyi* sp. nov., *Didymoceras binodosum* (KENNEDY & COBBAN, 1993), *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872) and Polyptychoceratinae indet. Taken together with the previously described forms, the ammonite fauna of the Gschliefgraben comprises 32 taxa.

Zusammenfassung

Aus dem Obercampan des Gschliefgrabens bei Gmunden werden elf Taxa beschrieben, sechs davon neu für die Fundstelle: *Kitchinites* sp., *Yokoyamaoceras ?* sp., *Hoplitoplacenticeras preyi* sp. nov., *Didymoceras binodosum* (KENNEDY & COBBAN, 1993), *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872) und Polyptychoceratinae indet. Zusammen mit den früher beschriebenen umfaßt die Ammonitenfauna des Gschliefgrabens 32 Taxa.

Introduction

The Gschliefgraben is situated in Upper Austria, east of the Traunsee, some 55 km SW of Linz (Text-fig.1 [in:] TRÖGER et al., 1999, this volume). The first note on the ammonite fauna of the Gschliefgraben was published by MOJSISOVICS & SCHLÖNBACH (1868, p. 213: „Baculites, Hamites, Scaphites, Ammonites"). BRINKMANN (1935) noted five ammonite taxa. Twenty-five taxa were described by KENNEDY & SUMMESBERGER (1984). The geologic situation of the Gschliefgraben tectonic window is best described in PREY (1983) and KENNEDY & SUMMESBERGER (1984). The belemnites were published recently by CHRISTENSEN (1998). The bivalves (TRÖGER, SUMMESBERGER & SKOUMAL 1999), echinoderms (JAGT 1999), crustaceans (FRAAYE & SUMMESBERGER 1999) and nannofossils (WAGREICH 1999) were investigated in an integrated study and are published in this volume. The sponges will also be studied and published in a subsequent volume. There is no measurable section at the Gschliefgraben; a synthetic section (KENNEDY & SUMMESBERGER 1984, Text-fig. 3) is based upon estimated thicknesses and stratigraphic data in PREY (1983). All fossils were collected from the surface of an active mudflow, most of them by amateur collectors.

About 250 ammonite specimens (32 taxa) comprising 18 heteromorph species, and 14 non-heteromorphs are preserved in the collections of the Natural History Museum Vienna and the Austrian Geological Survey, the private collections of Mag. Ulrich ROSCHGER (Vienna), Dr. Peter SKOUMAL (Vienna), Wolf-Peter MAHERNDL (Bad Ischl), and Ferdinand ESTERMANN (Pinsdorf, Upper Austria). The former SCHAUBERGER collection, the VÁVRA collection (inoceramids) and the PREY collection (included in the legacy of Othmar KÜHN) are now integrated in the NHMW collection. The HÜTTER collection (HÜ of KENNEDY & SUMMESBERGER 1984) was donated to the Natural History Museum Vienna in 1998.

Conventions

NHMW	Naturhistorisches Museum Wien
RO	Collection ROSCHGER, Vienna
SK	Collection SKOUMAL, Vienna

1 Oxford University Museum of Natural History, Oxford, OX1 3PW, United Kingdom
2 Naturhistorisches Museum, Burgring 7, A-1014 Wien, Austria

Systematic Palaeontology

Order Ammonoidea ZITTEL, 1884
Suborder Phylloceratina ARKELL, 1950
Superfamily Phylloceratacea ZITTEL, 1884
Family Phylloceratidae ZITTEL, 1884
Subfamily Phylloceratinae ZITTEL, 1884
Genus ***Phylloceras*** SUESS, 1866

Type species: *Ammonites heterophyllus* J. SOWERBY, 1820, p. 119, pl. 226, by monotypy.

Phylloceras sp. ?
(Pl. 1, Figs. 1–3)

? 1984 *Phylloceras (Hypophylloceras)* sp. KENNEDY and SUMMESBERGER, p. 153, pl. 1, fig. 5.

Discussion: What appears to be a second specimen of a phylloceratid from the Gschliefgraben is represented by NHMW/1998z/29/1, a very crushed individual with a maximum preserved diameter of 60 mm. Delicate lirae, typical of the group, are preserved on the outer flank and venter of the initial 240° of the outer whorl; the last 90° sector, possibly the adapertural part of the body chamber, is characterized by growth lines only. The specimen is specifically indeterminate, and in the absence of sutural details, cannot be placed in a subgenus.
Occurrence: Late Campanian of the Gschliefgraben.

Suborder Ammonitina Hyatt, 1889
Superfamily Desmoceratacea ZITTEL, 1895
Family Desmoceratidae ZITTEL, 1895
Genus ***Desmophyllites*** SPATH, 1929

Type species *Desmoceras larteti* SEUNES, 1891, p. 19, pl. 12(3), fig. 2; pl. 13(4), figs. 2, 3, by subsequent designation by SPATH, 1921, p. 46, as type species of *Schlueteria*, of which *Desmophyllites* is the replacement name.

Desmophyllites larteti (SEUNES, 1892)
(Pl. 1, Figs. 6–9)

1892 *Desmoceras larteti* SEUNES, p. 19, pl. 12(3), fig. 2; pl. 13(4), figs. 2, 3.
1984 *Desmophyllites larteti* (SEUNES, 1891); KENNEDY and SUMMESBERGER, p. 156, pl. 1, fig. 6; pl. 7, figs. 1–3, 5, 6 (with synonymy)
1992 *Desmophyllites larteti* (SEUNES, 1891); KENNEDY and HENDERSON, p. 407, pl. 18, figs. 1–6.
1993 *Desmophyllites larteti* (SEUNES, 1891); WARD & KENNEDY, p. 23, figs. 23.1, 23.2, 23.3, 23.5–23.7, 23.9–23.12, 24, 25.15.
1993 *Desmophyllites larteti* (SEUNES, 1892); HANCOCK & KENNEDY, p. 154, pl. 2, figs. 1–3, 10, 11, 14; pl. 3, figs. 1, 4, 5.
1993 *Desmophyllites larteti* (SEUNES, 1892); KENNEDY & HANCOCK, p. 578, pl. 1, figs. 1–3, 8–10.

Types Lectotype, designated by KENNEDY and SUMMESBERGER, 1984, p. 156, is the original of SEUNES, 1892, pl. 13(4), fig. 2; paralectotype is the original of SEUNES, 1892, pl. 12(3), fig. 2; pl. 13(4), fig. 3, from the Late Maastrichtian, Assize à *Pachydiscus Fresvillensis*, *P. Jacquoti* et *Stegaster*, Gan, Route de Gan à Rébénacq, Pyrénées-Atlantiques, France, in the Sorbonne Collections, Paris.
Material: NHMW/1998z/29/2, a single specimen.
Discussion: The adult individual of 90 mm in diameter compares well with the lectotype, showing the biconcave constrictions and delicate associated collar ribs on the body chamber.
Occurrence: Late Campanian to Late Maastrichtian, Pyrénées-Atlantiques and Landes in France, the coastal sections of the Biscay region of France and NW Spain, the Gschliefgraben, Austria, and possibly Madagascar.

Subfamily Puzosiinae SPATH, 1922
Genus ***Kitchinites*** SPATH, 1922

Type species *Holcodiscus pondicherryanus* KOSSMAT, 1897, p. 40(147), pl. 6(17), fig. 6, by original designation.

Kitchinites sp.
(Pl. 1, Figs. 4, 5)

Description NHMW/1998z/29/3 (pl. 1, fig. 4) is a crushed composite mould 46 mm in diameter. Coiling appears to have been fairly involute, the umbilicus comprising 30% of the diameter. The original whorl proportions cannot be established, but the umbilicus appears to have been shallow with a low wall, the umbilical shoulder narrowly rounded, whorl sides subparallel and the venter and ventrolateral shoulders broadly rounded: a planulate shell form. There are traces of four constrictions on the outer whorl; prominent, straight and prorsiradiate on the flanks, they sweep forward and are concave across the ventrolateral shoulder, forming a marked chevron on the venter. The constrictions are flanked by low, incipiently bullate collar ribs. Delicate striae arise on the inner flank between constrictions, and strengthen into flexuous riblets, convex across the middle of the flank and feebly convex on the outer flank, where they are at their maximum development, and are relatively coarse. NHMW/1998z/29/4 (Pl. 1, fig. 5) is a very crushed individual with a maximum preserved diameter of 65 mm. Ornament is as in the previous specimen to a diameter of 50 mm, beyond which the specimen appears to be body chamber, lacking constrictions, with smooth inner flanks, the outer flanks ornamented by relatively distant coarse ribs of variable strength.
Discussion: These specimens are interpreted as poorly preserved examples of *Kitchinites* on the basis of the collar ribs and constrictions, with near-smooth

inner, and distantly ribbed outer flanks. The ornament is different from that of previously described species, suggesting that a new taxon is represented. Reference is made to MATSUMOTO (1988) for a recent review of *Kitchinites*. SUMMESBERGER (1979) listed species referred to the genus at that date; other references are HENDERSON (1970), MACELLARI (1986) and STINNESBECK (1986).

Occurrence: Late Campanian of the Gschliefgraben.

Puzosiinae gen. et sp. indet.

Discussion: We have seen very large fragments of indeterminate Puzosiinae in the Estermann Collection (Pinsdorf near Gmunden, Upper Austria).

Family Kossmaticeratidae SPATH, 1922
Subfamily Kossmaticeratinae SPATH, 1922
Genus ***Yokoyamaoceras*** WRIGHT & MATSUMOTO, 1954

Type species *Holcodiscus kotoi* JIMBO, 1894, p. 33, pl. 21, fig. 2, by original designation.

Yokoyamaoceras ? sp.
(Pl. 2, Fig. 11)

Description: NHMW/1998z/29/5 is a tiny distorted individual with a diameter of 14.5 mm. Coiling appears to have been moderately involute, with a deep umbilicus, narrowly rounded umbilical shoulder, broadly rounded flanks, more narrowly rounded ventrolateral shoulder and broadly convex venter. Two narrow, deep constrictions are visible on the outer whorl, approximately 180° apart, and associated with narrow collar ribs, the adapical with tiny ventral tubercles. The sector of shell between the ribs bears four tiny ventral tubercles; obscure traces of ventrolateral ribs are associated with the tubercles.

Discussion This specimen is a microconch desmoceratacean, but we are uncertain of its taxonomic position. The simple style of ornament recalls some of the diminutive *Menuites* described by MATSUMOTO (1955), but these do not acquire tubercles until a larger diameter, and have a rounded, rather than subrectangular whorl section. Early acquisition of tubercles and whorl section more closely resemble those of *Yokoyamaoceras* WRIGHT & MATSUMOTO, 1954 (see KENNEDY, 1986, MATSUMOTO, 1991, and MAEDA, 1993 for discussion), to which genus we provisionally refer the specimen.

Occurrence: Late Campanian of the Gschliefgraben.

Superfamily Hoplitaceae H. DOUVILLÉ, 1890
Family Placenticeratidae Hyatt, 1900
Genus and Subgenus ***Hoplitoplacenticeras*** PAULCKE, 1907

Type species: *Hoplites-Placenticeras plasticus* PAULCKE, 1907, p. 186; ICZN Opinion 555, Name no. 1629.

Hoplitoplacenticeras (Hoplitoplacenticeras) preyi sp. nov.
(Pl. 3, Figs. 1, 4)

Type species The holotype is NHMWz1998/29/0013, collected by Dr. PREY, incorporated together with the legacy of Prof. Othmar KÜHN in the collections of the Museum of Natural History.

Derivatio nominis: named after Dr. Siegmund PREY (1912–1992), brilliant field geologist of the Austrian Geological Survey, who described the geology of the Gschliefgraben (1951, 1983) and collected the holotype.

Locus typicus: Gschliefgraben near Gmunden (Upper Austria), Ultrahelvetic tectonic zone.

Stratum typicum: Gschliefgraben shales (Cretaceous).

Description: Crushed and corroded internal mould of a phragmocone with body chamber and aperture preserved. Lateral compaction makes observation of venter almost impossible. Measurements are: D 95 mm, Wh 53 mm, U 12,9 mm, U% 13,6. The shell appears to have been compressed, with rapidly increasing whorl height and a rather small umbilicus. The umbilical wall is vertical and slightly convex, the umbilical shoulder narrowly rounded. The flanks are slightly convex, the ventrolateral shoulders gently rounded. The aperture is high oval. On the phragmocone, relative strong, flexuous closely spaced ribs arise in pairs from a tiny umbilical tubercle, crossing the flank with a double concavity; they are prorsiradiate on the inner flank, and markedly rursiradiate on the outer. All bear a tiny ventral clavus. Ribbing weakens on the body chamber, towards the aperture. On the body chamber pairs of ribs arise without a tubercle or bulla on the inner third of the flank crossing the venter with a slight flexure and flexing forwards to join in pairs at eight large distantly spaced ventrolateral clavi. The last pair of ribs close to the aperture are fused into a broad and shallow single rib. The total number of ribs on the outer whorl is about 50. The venter is damaged by compaction. Outer ventrolateral clavi are visible only between the last three pairs of ribs.

Discussion: Despite the poor preservation the specimen appears to be distinct from all other European species. See the extensive descriptions and discussions of KENNEDY (1986:63 ff.; revision of the genus); KAPLAN, KENNEDY & ERNST (1996:34 ff.) and KENNEDY & KAPLAN (1997:49 ff.)

H. (H.) vari (SCHLÜTER, 1876) is more regularly ribbed without looped pairs of ribs. Umbilical tubercles ex-

tend to the aperture. The surface is covered with dense lirae (e.g. KAPLAN, KENNEDY & ERNST, 1996, pl. 19; pl. 20; figs. 1, 4, pl. 21; figs. 1, 4).

H. (H.) coesfeldiense (SCHLÜTER, 1867) is densely ribbed throughout ontogeny, ribs being bundled in threes and fours, umbilical bullae persisting to the body chamber (e.g. KAPLAN, KENNEDY & ERNST, 1996, pl.21, figs.3,4). Outer ventrolateral clavi connecting the ribs in twos and threes are described by KAPLAN, KENNEDY & ERNST, 1996 (p. 39: „äußere Ventrolateralclavi"). This feature differs from that of the present species in that the ribs are dense and equal.

H. (H.) costulosum (SCHLÜTER, 1867) bears narrow ribs, and never has distantly spaced ventrolateral clavi (e.g. KAPLAN, KENNEDY & ERNST, 1996, pl. 20, fig. 2, pl. 22, figs. 2, 5; pl. 23, fig. 5; pl. 24, figs. 1–6, 8; pl. 27, fig. 1). Tiny umbilical tubercles or bullae persist onto the body chamber.

H. (H.) dolbergense (SCHLÜTER, 1876) is more evolute and has much coarser ornament and umbilical tubercles on phragmocone and body chamber.

H. (H.) marroti (COQUAND, 1859), revised by KENNEDY (1986, p. 70) differs by its coarser and more regular ornament, ribs arising in pairs from a coarse bulla and terminating separately in a ventrolateral clavus (e.g. KENNEDY, 1986, pls. 9, 10). Its coiling is less involute than in *H. (H.) preyi* sp. nov.

H. rejaudryi (de GROSSOUVRE, 1894) has narrower, sharp ribs arising from long bullae, and a wider umbilicus (KENNEDY 1986, pl. 7, figs. 1–3; pl. 14, figs. 6, 7).

H. gosseleti (de GROSSOUVRE, 1894, pl. 36, fig. 1) is much more evolute and has strong, straight ribs.

H. vancouverensis (MEEK,1861) differs by its coarse, nearly straight ribs and numerous fine striae (USHER 1952, p. 93, pl. 25, figs. 1, 2).

H. rarecostatum (KHAKIMOV, in ATABEKIAN & KHAKIMOV, 1976, p. 88, pl. 10, fig. 5) has coarse, distant long and short ribs, long ribs sometimes arising in pairs from coarse bullae, with strong inner and outer ventrolateral tubercles.

Occurrence: As for type.

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Turrilitaceae GILL, 1871
Family Nostoceratidae HYATT, 1894
Genus ***Bostrychoceras*** HYATT, 1900

Type species *Turrilites polyplocus* ROEMER, 1841, pl. 14, figs. 1, 2, by original designation.

Bostrychoceras polyplocum (ROEMER, 1841)
(Pl. 2, Figs. 4, 5)

1841 *Turrilites polyplocus* ROEMER, 1841, p. 92, pl. 14, fig. 1 only, non 2 (= *Eubostrychoceras saxonicum* (SCHLÜTER, 1876)).

1997 *Bostrychoceras polyplocum* (ROEMER, 1841); KENNEDY and KAPLAN, p. 52, pls. 39–50 (with full synonymy).

Type: Neotype, by the subsequent designation of KENNEDY & KAPLAN (1997), is the lower part of specimen no. 37092 in the collections of the Natural History Museum, London, from the Late Campanian of Haldem, Westphalia.

Material: NHMW/1998z/29/6; NHMW/1998z/40/1.

Discussion: Two well-preserved spires, one dextral, one sinistral, represent the early whorls of this species. They show the coiling to be relatively tight, and the whorls nearly in contact, while there is only a single row of tubercles, a rather different coiling to that shown by the abundant topotype material figured by KENNEDY & KAPLAN (1997), corresponding, as does the tuberculation, to that of *Bostrychoceras unituberculatum* BLASZKIEWICZ, 1980 (p. 21, pl. 3, fig. 1–8; pl. 4, figs. 3–6), notably the original of his pl. 3, figs. 2 and 4. KENNEDY (1986) and KENNEDY & KAPLAN (1997) regarded *B. unituberculatum* as a synonym of a variable *B. polyplocum*; the present material confirms the tighter coiling of *unituberculatum* morphotypes during early development.

Occurrence: Late Campanian, Germany; Norfolk, England; Northern Ireland; northern Aquitaine and Landes in France; Catalonia and Navarra, Spain; Poland; Donbass, European Russia; Turkmenia; Kazakhstan; Tadzhikistan; Iran; Bulgaria; North Africa; Texas and northern Mexico.

Genus ***Didymoceras*** HYATT, 1894

Type species *Ancyloceras nebrascense* MEEK & HAYDEN, 1856, p. 71, by original designation.

Didymoceras binodosum (KENNEDY & COBBAN, 1993)
(Pl. 2, Figs. 12, 13; Fig. 1)

1963 *Bostrychoceras secoense* YOUNG, p. 42 (pars), pl. 4, fig. 8 only.

1980 *Didymoceras* cf. *secoenes* (sic) (YOUNG); BLASZKIEWICZ, p. 24, pl. 5, figs. 4, 6; pl. 7, figs. 16, 19.

1993 *Didymoceratoides binodosum* KENNEDY & COBBAN, p. 92, figs. 8.1, 8.2, 8.5, 8.6, 8.13–8.15, 8.22–8.24, 8.28, 8.29, 8.32, 8.33, 8.35–8.39, 9.1–9.5, 12.1.

1994 *Didymoceratoides binodosum* KENNEDY & COBBAN; EMERSON, EMERSON, AKERS and AKERS, p. 314, unnumbered figures.

1997 *Didymoceras binodosum* (KENNEDY & COBBAN, 1993b); LARSON, JORGENSEN, FARRAR & LARSON, p. 53, unnumbered figures.

1999 Didmoceras binodosum (KENNEDY & COBBAN, 1993A); KENNEDY & COBBAN, p.72, pls. 2–4; pl. 5, figs. 11–20; text-figs. 3–4.

Types: Holotype is USNM 441521, from the Pierre Shale, *Baculites scotti* Zone, USGS Mesozoic locality

D1412, about 1.6 km north-northeast of Oral in the NW1/4 NW1/4 sec. 26, T.7 S., R.7 E., Fall River County, South Dakota.

Material Two specimens: RO/1986/3; NHMW/1998z/29/8.

Description Complete specimens of *Didymoceras binodosum* from the United States show the shell to consist of a loose open planispire (as in the holotype), followed by a loose elliptical or circular whorl; the later whorls form a helix with the whorls barely in contact except for the last part of the body chamber that is slightly uncoiled. Ornament consists of prominent, narrow ribs, most of which bear two tubercles. Widely spaced constrictions are present (Text-fig. 1). The material from the Gschliefgraben includes a specimen with just over two whorls from the loosely coiled early growth stage (RO/1986/3; pl. 2, fig. 12) with well-developed constrictions, and bituberculation that varies from clearly differentiated to more-or-less obscured by *post mortem* crushing and abrasion. Much better preserved is NHMW/1998z/29/8, with parts of three whorls from the more tightly coiled helical stage, preserved to a maximum whorl height of 38 mm (Pl. 2, fig. 13). Ribbing is dense and even, with tuberculation evenly developed; there are occasional constrictions.

Discussion The Gschliefgraben specimens differ in no significant respects from material from the United States Western Interior and Gulf Coast, a reconstruction of which is shown in Text-fig. A. KENNEDY & COBBAN (1993) interpreted juvenile body chambers of this species as adult body chambers of a paedomorphic derivative of *Didymoceras*. They have subsequently demonstrated (COBBAN & KENNEDY, 1999) these loosely coiled planispiral whorls to be the early growth stages of a form with helical whorls in middle growth as is *Didymoceras* of which *Didymoceratoides* KENNEDY & COBBAN, 1993, with *D. binodosum* as type species, is therefore a synonym. The style of coiling, regular bituberculate ribs and periodic constrictions distinguish *D. binodosum* from other species referred to the genus.

Occurrence: Late Campanian of the Gschliefgraben, Austria and Poland. *Baculites scotti* Zone of South Dakota, Utah, and Colorado; Bergstrom Formation in Travis County, Texas; Annona Chalk near Yancy, Arkansas. Some of the poorly preserved *Didymoceras* sp. from the Wenonah Formation of New Jersey may also belong to this species (KENNEDY & COBBAN, 1994).

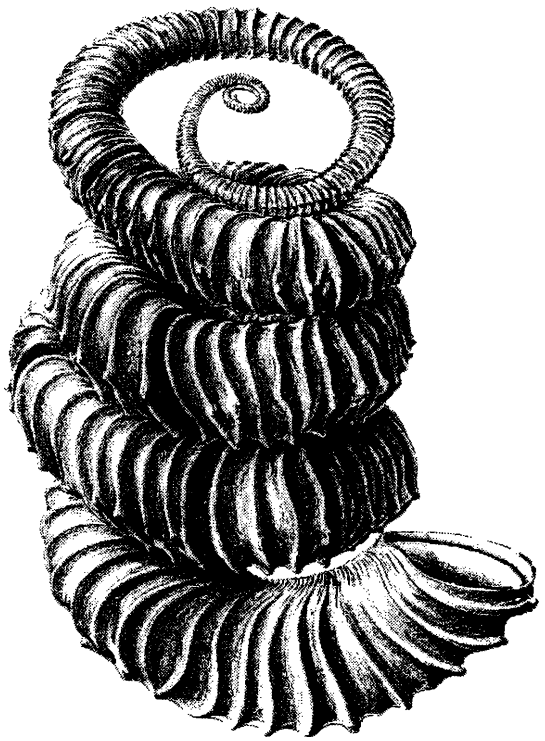

Figure 1. Restoration of *Didymoceras binodosum* (KENNEDY and COBBAN, 1993). Drawing by John R. STACY is based on specimens from the Pierre Shale of South Dakota and is approximately natural size. Figure supplied by Dr. W.A. COBBAN (Denver).

Family Diplomoceratidae SPATH, 1926
Subfamily Diplomoceratinae SPATH, 1926
Genus ***Neancyloceras*** SPATH, 1926

Type species *Ancyloceras bipunctatum* SCHLÜTER, 1872, p. 98, pl. 29, figs. 1–3, by original designation.

Neancyloceras bipunctatum (SCHLÜTER, 1872)
(Pl. 2, Fig. 6)

1872 *Ancyloceras bipunctatum* SCHLÜTER, p. 98, pl. 29, figs. 1–3.
1935 *Ancyloceras bipunctatum* SCHLÜTER; BRINKMANN, p. 5.
1982 *Ancyloceras bipunctatum* SCHLÜTER, 1872; KLINGER, p. 221, figs. 1 (1–3) (with full synonymy).
1982 *Exiteloceras bipunctatum* (SCHLÜTER, 1872); KLINGER, p. 222 ff., figs. 2–8A–E, 9.
1986 *Neancyloceras* cf. *bipunctatum* (SCHLÜTER, 1872a); KENNEDY, p. 104, pl. 16, fig. 5.
1993 *Neancyloceras bipunctatum* (SCHLÜTER, 1872); KENNEDY, p. 107, pl. 3, figs. 11–16, 20, 21; text-fig. 3.
1993 *Neancyloceras* cf. *bipunctatum* (SCHLÜTER, 1872a); KENNEDY & COBBAN, p. 139; pl. 6, fig. 17.
1996 *Neancyloceras bipunctatum* (SCHLÜTER, 1872); WRIGHT, p. 250.
? 1997 *Neancyloceras* cf. *bipunctatum* (SCHLÜTER, 1872); KENNEDY & KAPLAN, p. 61.

Types Lectotype, by the subsequent designation of BLASZKIEWICZ, 1980, p. 29, is the original of SCHLÜTER, 1872, pl. 29, fig. 3 (refigured by KLINGER, 1982, figs. 3, 4a), no. 65–10 in the collections of the Museum der Georg-August Universität, Göttingen, from the Late Campanian of Ahlten, Germany.

Description NHMW/1998z/29/9 is a slightly curved shaft 99 mm long, with a maximum preserved whorl height of 12.4 mm. The rib index is four, the ribs effaced on the dorsum, narrow, distant, prorsiradiate and straight to feebly convex across the flanks, and strong and transverse on the venter, where they bear delicate rounded-feebly clavate ventral tubercles.

Discussion The fragment agrees well with juvenile topotypes figured by KLINGER (1982, figs. 5, 6, 7a–c).

Occurrence: Late Campanian of Germany; Poland; the Gschliefgraben, Austria; European Russia; northern Aquitaine, France. Specimens from the Mons Basin, Belgium, described by KENNEDY (1993), are said to be from the Early Maastrichtian Craie phophatée de Ciply.

Subfamily Polyptychoceratinae MATSUMOTO, 1938

Genus ***Pseudoxybeloceras*** WRIGHT & MATSUMOTO 1954, p. 119

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

Subgenus ***Schlueterella*** WIEDMANN, 1962

Type species *Ancyloceras pseudoarmatum* SCHLÜTER, 1872, p. 99, pl. 31, figs. 1–3, b original designation.

Pseudoxybeloceras (Schlueterella) pseudoarmatum
(SCHLÜTER, 1872)
(Pl. 2, Fig. 10; Pl. 3, Figs. 3, 5)

	1872	*Ancyloceras (?) pseudoarmatum* SCHLÜTER, p. 99, pl. 31, figs. 1–3.
	1876	*Ancyloceras pseudoarmatum* SCHLÜTER; SCHLÜTER, p. 164, pl. 43, figs. 5–9.
	1913	(?) *Anisoceras pseudoarmatum* SCHLÜTER sp.; NOWAK, p. 385, pl. 40, fig. 4.
	1925	*Anisoceras pseudoarmatum* SCHLÜTER; DIENER, p. 73.
?	1974	*Neocrioceras* aff. *pseudoarmatum* (SCHLÜTER, 1872); NAIDIN, p. 167, pl. 57, fig. 2.
? non	1982	*Neocrioceras (Schlueterella)* aff. *pseudoarmatum* (SCHLÜTER); SZÁSZ, p. 48, pl. 1, fig. 1.
	1986	*Neocrioceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872a); KENNEDY, text–fig. 37.
	1996	*Pseudoxybeloceras(Schlueterella) pseudoarmatum* (SCHLÜTER, 1872); WRIGHT, p. 253, fig. 196/1a, b.
?	1997	*Neocrioceras (Schlueterella)* aff. *pseudoarmatum* (SCHLÜTER, 1872a); KENNEDY and KAPLAN; p. 60; pl. 59, fig. 4; pl .62, figs. 1–3; pl. 63, figs. 1–3.
	1997	*Neocrioceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872a); KENNEDY & KAPLAN; pl. 64, figs. 1–3; pl. 65, figs. 1–5.

Type: The holotype, by monotypy, is the original of SCHLÜTER, 1872, pl. 31, figs. 1–3, no. 68 in the collections of the Paläontologisches Institut of Bonn University, from the Campanian near Darup, Westphalia.

Description NHMW/1998z/29/10 is an external mould of a straight to slightly curved shaft 70 mm long, with a maximum preserved whorl height of 17 mm. The fragment shows two rows of tubercles borne on a relatively strong, transverse rib, separated by up to four weaker nontuberculate ribs. Much larger is NHMW/1998z/29/12. It is a straight shaft with a curved part of the body chamber preserved. The total length is 600 mm from the adapical part of the shaft to the apex of the curvature. From the apex to the preserved adoral part of the body chamber it measures 176 mm. An additional fragment of the body chamber (NHMW/1998z/29/11) that is tentatively referred to the present species measures 201 mm in length. The general shape seems to consist of parallel straight shafts connected by curved portions. Initial whorls are unknown. Whorl section may have been rounded or oval. The fragment of the body chamber described below suggests a high oval section. On the straight portion of the shaft about 24 narrow, straight and rectiradiate ribs per 100 mm cross the venter and dorsum without interruption. The ribs are linked together in pairs by tubercles that are clearly spine-bases. These are arranged into four regular rows, in mid-flank and ventrolateral positions. Tuberculated ribs are separated by one, two or three nontuberculated ones. There is a distinct change of ornament on the final hook. Ribs become stronger and are grouped in pairs, with interspaces of about the same width as one pair of ribs; the tubercles increase in strength. Ribs become rursiradiate from the apex of the curvature on. This style of ribbing is even coarser on the large fragment of body chamber (NHMW/1998z/29/11) that may also belong to this species. About 18 double ribs per 100 mm are fused on the flank to broad flat ones. Tubercles are relatively weak and not every rib is tuberculated.

Discussion We follow WRIGHT (1996, p. 253) in treating *Schlueterella* as a subgenus of *Pseudoxybeloceras* rather than of *Neocrioceras* because *A. pseudoarmatum*, type species of the subgenus, consists mainly of parallel shafts whereas *Crioceras spinigerum* JIMBO, type species of *Neocrioceras*, is crioceratiticone. The closest specimen described is *N. (S.)* aff. *pseudoarmatum* (SCHLÜTER, 1872a) figured by KENNEDY & KAPLAN (1997, pl. 63, figs. 1–3). It differs in the larger distances between tuberculated ribs and consequently greater number of intercalatories. The ornament of the body chamber hook is unknown. The shaft of the holotype, refigured by KAPLAN & KENNEDY (1997, pl. 65, figs. 1–4) and material from the SCHLÜTER Collection (Bonn) refigured by KAPLAN & KENNEDY (1997, pls.64,65) shows coarser ribbing with only 1–2 intercalatories.

Occurrence Late Campanian *Polyplocum* Zone of the Gschliefgraben, early Late Campanian of NW Germany.

Subfamily Polyptychoceratinae MATSUMOTO, 1938
Genus and subgenus ***Polyptychoceras*** YABE, 1927

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

Polyptychoceras (Polyptychoceras) obliquecostatum (SCHLÜTER, 1872)
(Pl. 2, Figs. 1 –3, 7–9).

1872 *Hamites obliquecostatus* SCHLÜTER, p. 187, pl. 29, fig. 6.
1876 *Hamites Berkelis* SCHLÜTER, p. 45.
non 1890 *Ptychoceras pseudogaultinum* YOKOYAMA, pl. 20, fig. 3 only.
non 1953 *Polyptychoceras* sp. juv. ind., SPATH, p. 18, pl. 7, fig. 5.
? 1962 *P. (Polyptychoceras) obliquecostatum* (SCHLÜTER); WIEDMANN, p. 85, pl. 10, fig. 6.
1965 *P. (?) obliquecostatum* (SCHLÜTER); Howarth, p. 385.
1984 *Polyptychoceras (Polyptychoceras) obliquecostatum* SCHLÜTER, 1872); KENNEDY & SUMMESBERGER, p. 169.
1984 *Polyptychoceras (Polyptychoceras)* sp.; KENNEDY & SUMMESBERGER, p. 169, pl. 10, figs. 2, 3.

Type: Holotype, by monotypy, is the original of SCHLÜTER, 1872, p. 187, pl. 29, fig. 6, from the Late Campanian near Coesfeld, Westphalia, Germany.

Material four specimens; NHMW/1998z/29/13–16.

Description We have four specimens in addition to the two described in 1984. Of the new material, three are interpreted as macroconchs (e.g. Pl. 2, figs. 7–9) and one as a microconch (Pl. 2, figs. 1–3). NHMW/1998z/29/15 (Pl. 2, fig. 9) is a 101 mm long, partially septate shaft with a maximum preserved whorl height of 13.4 mm. The whorl section is compressed oval, with a whorl breadth to height ratio of 0.79, the degree of compression probably modified by post-mortem crushing. The rib index is 8–9, the ribs weak and transverse on the dorsum, strengthening across the dorsolateral margin, straight, feebly prorsiradiate, low, rounded and of approximately the same width as the interspaces on both flank and dorsum, where they are transverse. NHMW/1998z/29/16 (not figured) consists of two subparallel shafts joined by a narrowly curved section of shell, the shafts closely spaced and nearly touching at the apertural end of the larger shaft. NHMW/1998z/29/14 (Pl. 2, figs. 7, 8) is essentially identical, but lacks the penultimate shaft. Rib direction shifts from feebly prorsiradiate to recti- to feebly rursiradiate around the curved sector before reverting to feebly prorsiradiate. The final shaft is very short, and the final sector prior to the adult aperture is characterized by an abrupt loss of ribs, the surface bearing growth lines and irregular constrictions and folds. The aperture is marked by a pronounced collar-rib. These macroconchs have whorl heights of 14.8 mm at the aperture. The microconch is represented by SK.1985.20 (Pl. 2, figs. 1–3), which shows exactly similar ornament on the penultimate shaft, the ornament weakening around the curved sector before rejuvenating. A marked constriction separates the ribbed portion of the final shaft from the essentially smooth section that precedes the adult aperture, which is prolonged into a blunt ventral rostrum.

Discussion These specimens confirm the generic identity of SCHLÜTER's *Hamites obliquecostatus*. As we have noted elsewhere (1984, p. 169), the paralectotype of *P. (P.) pseudogaultinum* (YOKOYAMA, 1890) (pl. 2, fig. 3) from the Santonian of Japan that was referred to the present species by WIEDMANN (1962) has much more prorsiradiate ribs, and widely separated shafts. The juvenile *Polyptychoceras* from Antarctica figured by SPATH (1953, p. 18, pl. 7, fig. 5) was also referred to *P. (P.) obliquecostatum* by WIEDMANN (1962); we prefer SPATH's more cautious assignation. The specimen from the Santonian of Spain described by WIEDMANN (1962, p. 185, pl. 10, fig. 6) cannot be afforded even generic assignation with any confidence in our view.

Occurrence Late Campanian of the Münster Basin, Germany and the Gschliefgraben, Austria.

Polyptychoceratinae indet.
(Pl. 3, Fig. 6)

Material a single specimen, SK/1998/1.

Description partly preserved initial whorl with a portion of the succeeding straight shaft. The diameter of the whorl is about 23 mm. The preserved length of the shaft is 33 mm including the preceding part of the coil, Wh is 9,8 mm at the preserved end of the fragment. The whorl seems to have been circular, deformed *post mortem* into an ellipse. The original shape might have deviated from planispiral coiling, and been somewhat helicoidal. The whorls are preserved as a rusty film only, with a very small fragment of internal mould, which is smooth. Ornament may have been lost during fossilisation. Visible ribbing starts on the first quarter of the coil and extends over the whole preserved length of the shaft. Ribbing is dense (17/cm) slightly rursiradiate, convex and circular. There are no constrictions visible and no tubercles.

Discussion This initial stage of a heteromorph ammonite can be separated from fragments of equal size of *Polyptychoceras (P.) obliquecostatum* (SCHLÜTER) by their parallel shafts and constrictions. We cannot tell if it belongs to one of the other taxa described from the Gschliefgraben.

Occurrence: Late Campanian of the Gschliefgraben.

Aptychus sp. indet.
(Pl. 3, Fig. 2)

Material A single specimen, NHMW/1998z/41/1.

Description: This double winged lower jaw of an ammonite is badly corroded, as a result of which the black substance of the surface is only partially preserved and is of coaly lustreless condition. The two wings are displaced along the symphysis. The rostrum is somewhat damaged; the wings show concentric undulations.

Measurements: length 23,45 mm, width 20,4 mm.

Discussion The specimen cannot be assigned to a specific ammonite taxon.

The Late Campanian ammonite assemblage of the Gschliefgraben:

Ammonites (250 specimens, 32 taxa) comprising 18 heteromorph species, 14 non heteromorph ones are the dominant elements in the Gschliefgraben fauna. As already stated by KENNEDY & SUMMESBERGER (1984) the fauna is comparable to the Late Campanian faunas of northwestern Europe. Genera such as *Phylloceras, Tetragonites, Anapachydiscus* are more widely occurring also in the Tethyan realm or as with *Polyptychoceras* cf. *pseudogaultinum,* in circumpacific regions.

Faunal list

Phylloceras (Hypophylloceras) sp.
Saghalinites cf. *cala* (FORBES)
Tetragonites cf. *obscurus* (SCHLÜTER)
Gaudryceras jukesi (SHARPE)
Desmophyllites larteti (SEUNES)
Kitchinites sp.
Puzosiinae gen. et sp. indet.
Hauericeras fayoli De GROSSOUVRE
Yokoyamaoceras? sp.
Pachydiscus (Pachydiscus) haldemsis (SCHLÜTER)
Pachydiscus (Pachydiscus) perfidus De GROSSOUVRE
Pachydiscus (Pachydiscus) cf. *subrobustus* SEUNES
Anapachydiscus arialoorensis (STOLICZKA)
Hoplitoplacenticeras (Hoplitoplacenticeras) preyi sp. nov.
Bostrychoceras polyplocum (ROEMER)
Nostoceras (Nostoceras) sp.
Didymoceras donezianum (MIHAILOV)
Didymoceras binodosum (KENNEDY & COBBAN)
Neoglyptoxoceras cf. *retrorsum* (SCHLÜTER)
Neancyloceras bipunctatum (SCHLÜTER, 1872)
Pseudoxybeloceras (Schlueterella) pseudoarmatum (SCHLÜTER)
Pseudoxybeloceras (Schlueterella) sp. ?
Pseudoxybeloceras (Parasolenoceras) wernickei (WOLLEMANN)
Pseudoxybeloceras (Parasolenoceras) interruptum (SCHLÜTER)
Pseudoxybeloceras (Parasolenoceras) phaleratum (GRIEPENKERL)
Polyptychoceras (P.) obliquecostatum (SCHLÜTER)
Polyptychoceras (P.) cf. *pseudogaultinum* (YOKOYAMA)
Polyptychoceratinae indet.
Baculites sp. 1
Baculites sp. 2
Baculites 3
Trachyscaphites pulcherrimus (ROEMER)

Accompanying fauna and flora:

Plankton: Coccolithophores (PREY 1983, p.101, WAGREICH, 1999).
Planktonic foraminifera (PREY 1983, p.101)
One fragment of driftwood, no other plant remains.
Nekton: Nautiloidea (rare, one taxon)
Ammonites (abundant; diverse with prevailing *Pachydiscus* and heteromorphs)
Belemnites (rare, a single taxon; CHRISTENSEN 1998)
Fish teeth (PREY 1983, p. 101)
Benthos: Sponges (fairly common)
Corals (extremely rare, three small solitary corals)
Brachiopods (? a single disciniscid)
Gastropods (very rare; four specimens, three taxa; one Pleurotomariidae gen. et sp. indet.(det. H.A. KOLLMANN),
Inoceramids (large and common; some articulated; TRÖGER, SUMMESBERGER & SKOUMAL, 1999)
Ostracods (PREY 1983, p. 101)
Cirripedia (a single specimen; FRAAYE & SUMMESBERGER, 1999)
Other Crustacea (two specimens, two taxa; FRAAYE & SUMMESBERGER, 1999)
Regular echinoids (one specimen)
Crinoids (rare skeletal elements only)
Infauna: Bivalves, other than inoceramids (small and very rare, 5 specimens; *Pholadomya* cf. *cordata* Tate, *Microchlamys wisniowskii* PASTERNAK; *Cuspidaria acutissima* (J. MÜLLER); Cardiidae indet.; identifications by A.V. DHONDT).
Burrowers:
Irregular echinoids (*Echinocorys*, *Micraster* and others; very common; JAGT, 1999)
Ichnofossils (rather common in the field).

Palaeoecology

The fauna is dominated by a nektonic population of cephalopods. The diversity of the benthic fauna is low. The plankton is extensively represented by foraminifera and coccolithophores which probably lived close

to the surface. The soft substratum of the seafloor supported an abundant population of burrowing echinoids and other, unidentified groups. There are no hardground settling communities present. The only cirripede (pl. 3, fig. 5) was found within the body chamber of a large heteromorph ammonite. There is no evidence for shallow water nor for tropical or subtropical conditions. Temperate conditions and a relatively deep continental slope environment are indicated.

Sedimentology

Pale greenish-grey to yellowish fine sandstones with calcitic cement alternate with shales with high carbonate and rather low clay mineral content. They were deposited under offshore conditions. Post-sedimentary transportation by slumping or suspension turbidites cannot be demonstrated.

Stratigraphic conclusions

The ammonite fauna of the Gschliefgraben was interpreted as Late Campanian *Bostrychoceras polyplocum* Zone by KENNEDY & SUMMESBERGER (1984), the index species occurring abundantly. *Hauericeras fayoli* De GROSSOUVRE and *Pachydiscus (Pachydiscus) perfidus* De GROSSOUVRE are also recorded from the highest Campanian *Nostoceras hyatti* Zone (HANCOCK & KENNEDY, 1993), whereas *Pseudoxybeloceras (Parasolenoceras) phaleratum* is the index species of the lower Late Campanian *Phaleratum* Zone of the Vistula valley (BLASZKIEWICZ 1980). As the total range is still not of many of these taxa known, we follow KENNEDY & SUMMESBERGER (1984) in interpreting the bulk of the fauna as from the Late Campanian *Polyplocum* Zone. The highest Late Campanian *Hyatti* Zone is also represented and now confirmed by nannoplankton ages. Nannoplankton samples taken from *Trachyscaphites pulcherrimus* indicate nannoplankton zones CC 20–21a–22c; from *Bostrychoceras polyplocum* CC22b; from *Hauericeras fayoli* CC22c (WAGREICH, 1999). This coincides with the known range of the ammonites. A Late Campanian age is also confirmed by echinoids (JAGT, 1999) and inoceramids (TRÖGER et al., 1999).

Palaeobiogeography

Occurrence of belemnites and *Trachyscaphites* make it likely that the Gschliefgraben fauna belongs to the Northern Temperate Realm. Heteromorphs seem to be absent in contemporaneous Tethyan sediments of the Gosau Group (SUMMESBERGER et al., 1999) with pachydiscids as dominating element of the fauna.

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Plate 1

Figs. 1–3: *Phylloceras* sp.; NHMW/1998z/29/1

Fig. 4: *Kitchinites* sp.; NHMW/1998z/29/3

Fig. 5: *Kitchinites* sp.; NHMW/1998z/29/4

Figs. 6-9: *Desmophyllites larteti* (SEUNES 1892); NHMW/1998z/29/2

All from the Upper Campanian of the Gschliefgraben; all figures x 1.

PLATE 1

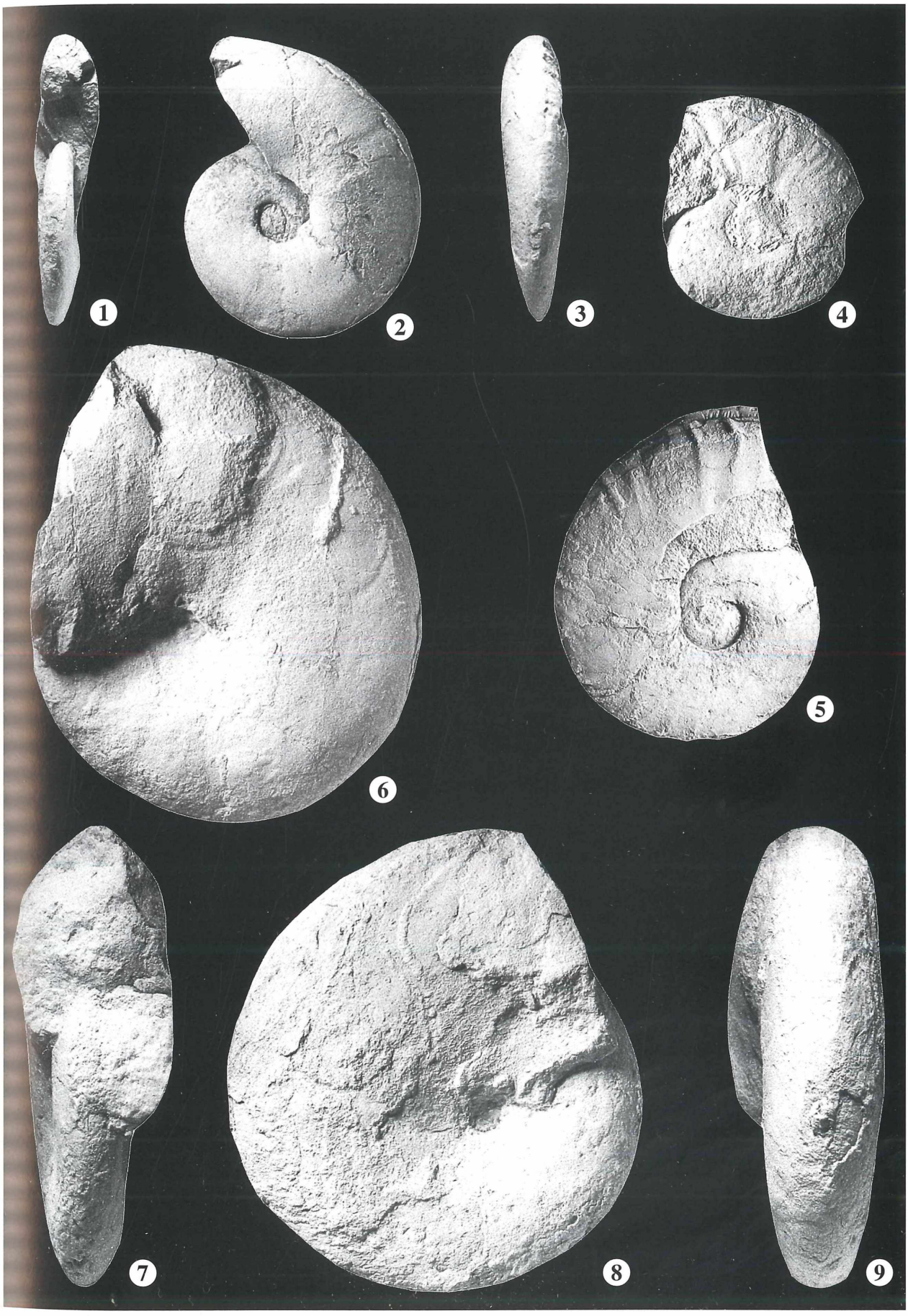

Plate 2

Figs. 1–3, 7–9: *Polyptychoceras (Polyptychoceras) obliquecostatum* (SCHLÜTER, 1872); figs. 1–3 is SK 1985/20, figs. 7,8 is NHMW/1998z/29/14, fig. 9 is NHMW/1998z/29/15.

Figs. 4, 5: *Bostrychoceras polyplocum* (ROEMER, 1841); 4 is NHMW/1998z/29/6; 5 is NHMW/1998z/40/1.

Fig. 6: *Neancyloceras bipunctatum* (SCHLÜTER, 1872); NHMW/1998z/29/9.

Fig. 10: *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872), NHMW/1998z/29/10.

Fig. 11: *Yokoyamaoceras?* sp.; NHMW/1998z/29/5.

Figs. 12, 13: *Didymoceras binodosum* (KENNEDY & COBBAN, 1993). 12. is RO/1986/3; 13 is NHMW/1998z/29/7, 8.

All from the Upper Campanian of the Gschliefgraben; all figures x 1.

PLATE 2

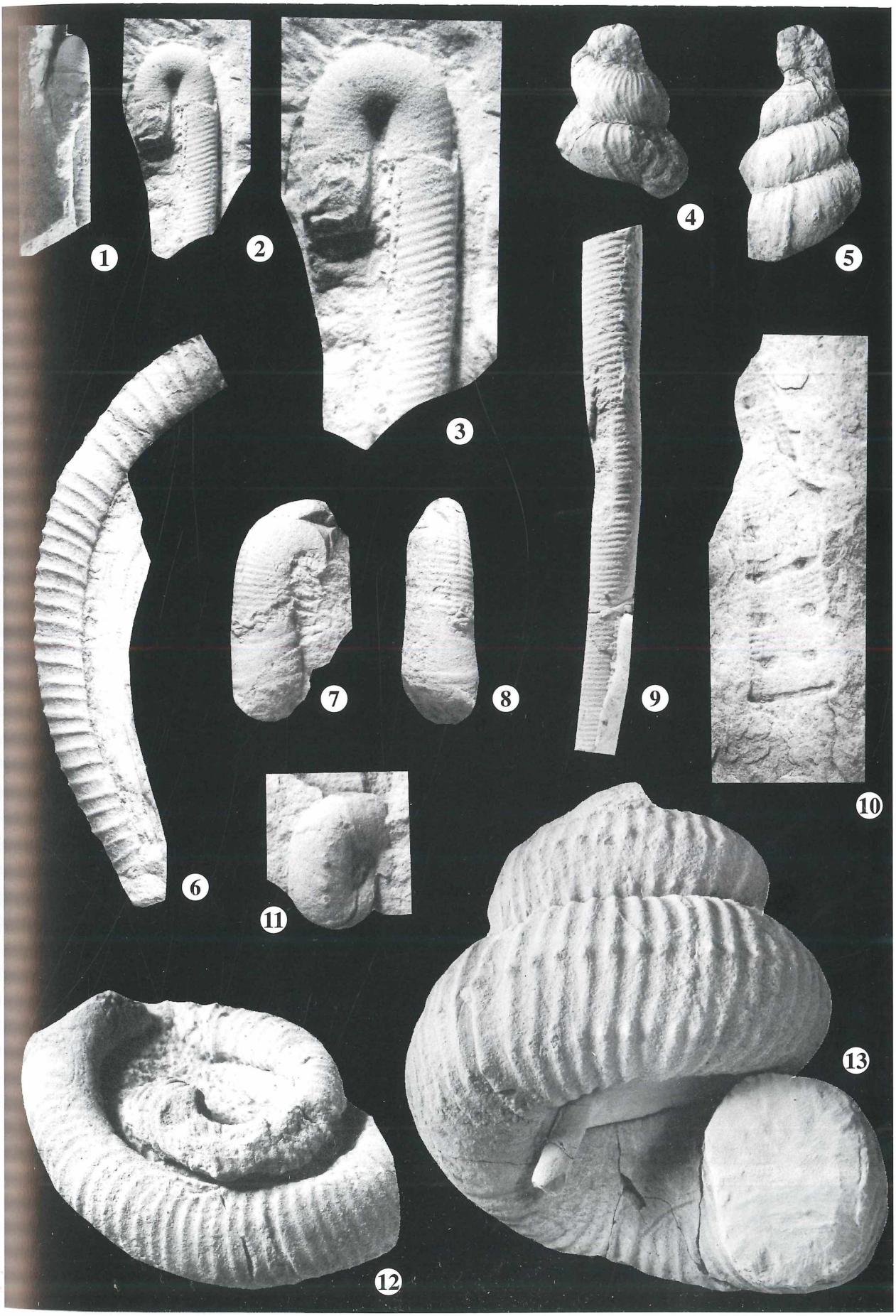

Plate 3

Fig. 1, 4: *Hoplitoplacenticeras (Hoplitoplacenticeras) preyi* sp. nov. Holotype, NHMW/1998z/29/13.

Fig. 2: *Aptychus sp.* indet. Lower jaw of an indeterminate ammonite; NHMW/1998z/41/01; uncoated x 1.

Fig. 3: *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872), NHMW/1998z/29/12; x 0,43. With a cirripede in the body chamber.

Fig. 5: *Pseudoxybeloceras (Schlueterella) pseudoarmatum* (SCHLÜTER, 1872), NHMW/1998z/29/11; x 0,43.

Fig. 6: Initial growth stage of Polyptychoceratinae indet.; SK/1998/1; uncoated.

All from the Upper Campanian of the Gschliefgraben; The figures 3 and 5 are reduced x 0,43, the remainder are x 1.

PLATE 3