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Turonian Ammonites from the Gosau Group (Upper Cretaceous; Northern Calcareous Alps; Austria) with a revision of *Barroisiceras haberfellneri* (HAUER, 1866)

by

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Summary

Twenty five Upper Turonian ammonite taxa are described from five sequences in the Gosau Group of the Northern Calcareous Alps of Austria. Genera *Puzosia*, *Lewesiceras*, *Tongoboryceras*, *Coilopoceras*, *Reesidites*, *Hyphantoceras*, *Tridenticeras*, *Eubostrychoceras* and *Pseudoxybeloceras* are recorded from the Gosau Group for the first time. *Barroisiceras haberfellneri* (HAUER) is interpreted as an extremely variable species, common in the Eastern Alps and otherwise known only from the Caucasus. The sedimentary cycle of the Gosau Group began in the Turonian in several of the "Gosau basins", earlier than was previously believed.

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Zusammenfassung

Aus fünf Schichtfolgen der Gosau Gruppe in den Nördlichen Kalkalpen Österreichs werden Ammoniten (25 Taxa) des Oberturons beschrieben. Die Gattungen *Puzosia*, *Lewesiceras*, *Tongoboryceras*, *Coilopoceras*, *Reesidites*, *Hyphantoceras*, *Tridenticeras*, *Eubostrychoceras* und *Pseudoxybeloceras* werden zum erstenmal aus der Gosau-Gruppe gemeldet. *Barroisiceras haberfellneri* (HAUER) wird als eine sehr variable Art aufgefaßt, die in den Ostalpen verbreitet ist und sonst nur noch aus dem Kaukasus bekannt ist. Die Transgression der Gosau Gruppe setzt im Turon ein, wenigstens in einigen der Gosaubecken früher als bisher angenommen.

1. Introduction

The present investigation of the Upper Turonian ammonites of the Gosau group is part of our overall revision of the Gosau ammonites (KENNEDY & SUMMESBERGER, 1979, 1986, and KENNEDY, KLINGER & SUMMESBERGER (1981).

The Turonian ammonite bearing localities discussed below have been attributed to a range of different ages by previous authors. Brandenberg I was regarded as Middle Coniacian by WIEDMANN (in HERM, WIEDMANN & KAUFFMAN, 1979) and Lower Coniacian by KAUFFMAN in the same paper (p. 76, 81). SUMMESBERGER (1985:148) placed Brandenberg I around the Turonian/Coniacian boundary. The locality "Ofenwand" (Strobl/Weißenbach) was thought to be Lower Coniacian (SUMMESBERGER, 1985:149: "Strobl I"), St. Wolfgang (parking area no. 3) was regarded as of "probably middle Santonian" age by

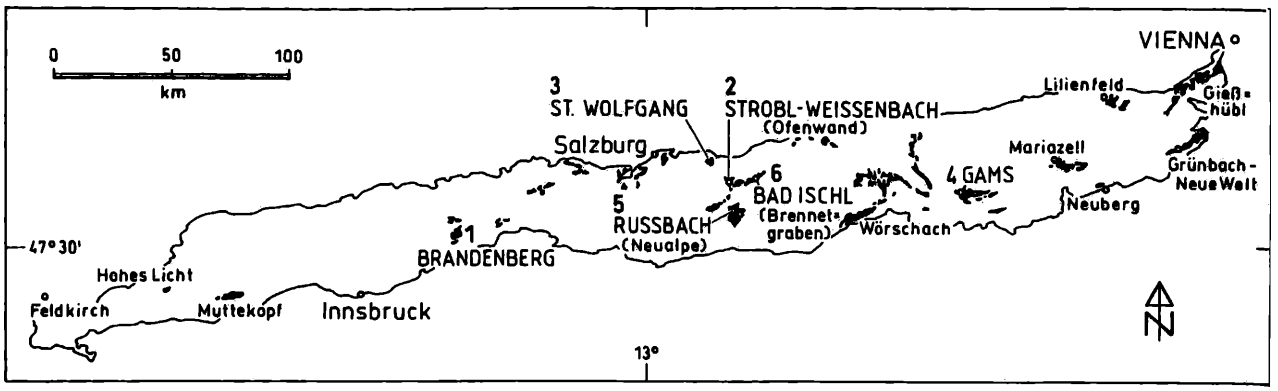


Figure 1. Upper Turonian sites in the Northern Calcareous Alps. 1. Brandenberg I (Tyrol), 2. Strobl/Weißenbachtal (Salzburg), 3. St. Wolfgang (Upper Austria), 4. Gams (Steiermark), 5. Rußbach/Neualpe (Salzburg), 6. Brennetgraben (Bad Ischl). Black areas indicate major Gosau-basins.

SUMMESBERGER (in KOLLMANN & SUMMESBERGER, 1982:31), late Santonian by SUMMESBERGER (1985:158) and early Santonian by IMMEL (1987:45). The Gams fauna was correlated with that of Strobl I by SUMMESBERGER (1985:149). Neualpe/Rußbach was regarded as ? Upper Coniacian–Santonian by KOLLMANN ([in:] PLÖCHINGER, 1982:32) on the basis of its stratigraphic position in the Gosau basin succession.

2. Locality descriptions

Brandenberg (Tyrol)

Three ammonite bearing sites have been described previously: Zöttbachgraben (a), Mösl-Brandenberger Ache–Mühlberg (b) and Heuberg (c).

a) Zöttbachgraben (fauna Brandenberg I of SUMMESBERGER, 1985:147).

Fauna:

Romaniceras (Romaniceras) cf. *deverianum* (d'ORBIGNY)
Romaniceras (Yubariceras) gosavicum WIEDMANN
Coilopoceras cf. *requienianum* (d'ORBIGNY)
Collignoniceratinae gen. et sp. indet.
Inoceramidae div. gen. et sp.

Restudy of the ammonites suggests the Upper Turonian *deverianum* Zone. "*Acanthoceras gentoni* DEFR." was recorded from "grünen und rotbraunen Sandsteinen" in the Brandenberg valley by Dr. J. SCHRÖDER (BRINKMANN, 1935:9). The specimen could not be traced in the collections of the "Haus der Natur" (Salzburg). We presume that it was a further specimen of *Romaniceras*.

Valuable stratigraphic information is also provided by the Inoceramidae: the majority of taxa present range from Upper Turonian to Lower Coniacian (KAUFFMAN [in:] HERM, KAUFFMAN & WIEDMANN, 1979:77); the presence of *Cremnoceramus? walters-dorfensis hannovrensis* (HEINZ) (l.c.: 59, pl. 9, D, G) at Brandenberg indicates Upper Turonian to Lower Coniacian on the basis of its range in the United States (KAUFFMAN in HERM, KAUFFMAN & WIEDMANN, 1979:61), but Lower Coniacian following WOOD, ERNST & RASEMANN (1984: fig. 3), although the *I. (Cr.) walt. hannovrensis* Zone of ERNST, SCHMID & SEIBERTZ (1983: figs. 2, 3) is top Turonian.

b) The Mösl-Brandenberger Ache–Mühlbach section (Brandenberg 2 of SUMMESBERGER 1985:155) is of Santonian age (HERM, WIEDMANN & KAUFFMAN, 1979: Fig. 6) and not discussed further here.

c) The Heuberg locality E of Brandenberg (text-fig. 2) was regarded as Upper Turonian by IMMEL (1987:41, tab. 6, 7). Three ammonites were collected from a block in the river bed. They are of Lower Callovian to Kimmeridgian age in our opinion. *Subprionocyclus angolaense* IMMEL (1987:41, 105, pl. 10, fig. 4) **non**

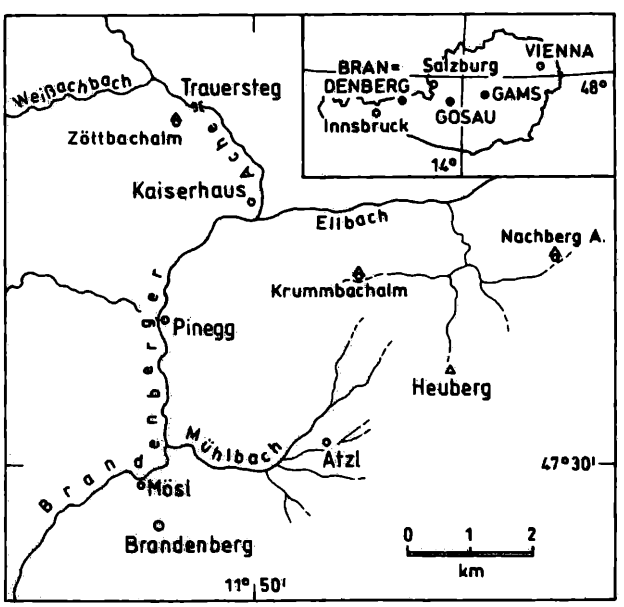


Figure 2. Sketch map of the Brandenberg sites mentioned in the text.

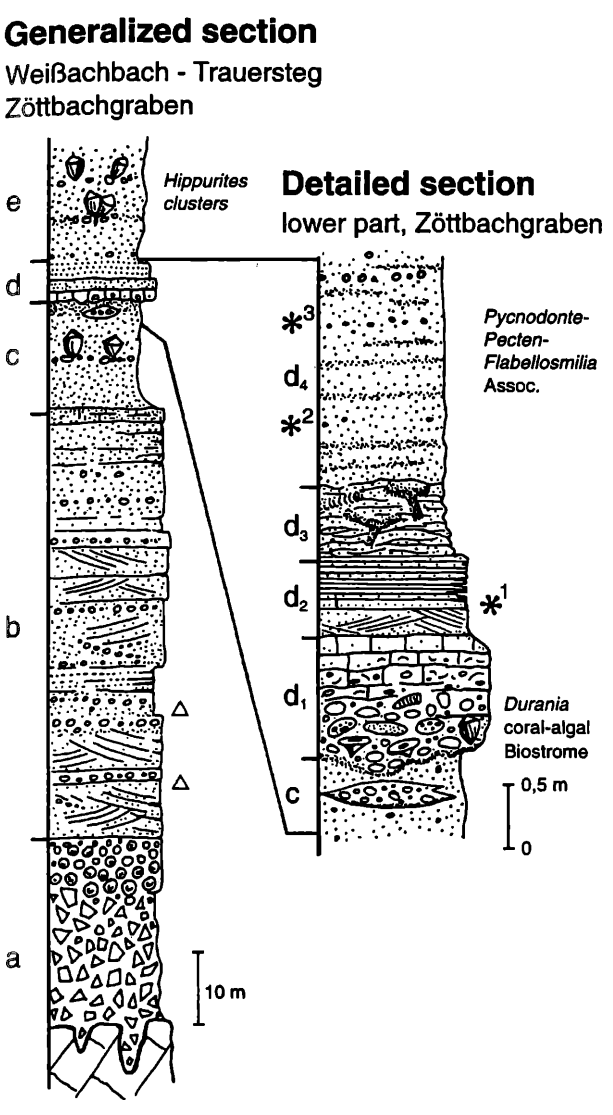


Figure 3. Lithologic section of the Weißachbach–Zöttbachgraben sequence, Brandenberg, after HERM, WIEDMANN & KAUFFMAN (1979: fig. 4). Asterisks indicate beds with ammonite and inoceramid fauna

BASSE DE MENORVAL (1962:871, pl. 22, fig. 6–8; pl. 23, fig. 2a; pl. 24, fig. 1–3) is a *Chanasia* sp. (Prof. A. ZEISS, pers. comm.). *Kossmaticeras (Kossmaticeras) rursicostatum* IMMEL (1987:41, 91, pl. 9, fig. 2) and *Pseudokossmaticeras duereri* IMMEL (1987:41, 92, pl. 9, fig. 3) **non** (REDTENBACHER 1873:118, pl. 27, fig. 2) are possibly two species of *Indosphinctes*. REDTENBACHERS's original of *Ammonites düreri* is probably of Upper Campanian/ Maastrichtian age on the basis of associated nannofossils (M. WAGREICH, pers. comm.). The Maastrichtian age of the species was recently confirmed by WARD & KENNEDY (1993) and HANCOCK & KENNEDY (1993:158). The Heuberg fauna has nothing to do with the Gosau group.

Neualpe near Rußbach (Salzburg, basin of Gosau)
A freshwater gastropod fauna from the terrestrial transgressive conglomerate of the Gosau Group – the Kreuzgraben formation – of Neualpe (= Neualm) was described, together with a reptile tooth, by STOLICKA (1860). The stratigraphic position of the fauna was unclear until *B. (B.) haberfellneri* (HAUER) and *Inoceramus* ex aff. *kleini* MÜLLER (det. K.A. TRÖGER) were collected above the coalseam in marine shales by Summesberger and Skoumal. This indicates that at least part of the Kreuzgraben formation is high in the Upper Turonian and that the overlying Streiteck formation may be largely Coniacian (TRÖGER & SUMMESBERGER, 1994: text-fig. 1).

Fauna:

Barroisiceras haberfellneri (HAUER)
Inoceramus ex aff. *kleini* MÜLLER, 1887

Strobl/Weißenbachtal ("Ofenwand", "Weidringer Alpe", Salzburg)
The "Ofenwand" site is situated about 2 kilometres W of the village of Strobl by the lake of St. Wolfgang (text-fig. 6). The Weißenbach creek is a tributary of the Ischl river. Recent collections were made in a small tributary of the Weißenbach creek opposite the toll station on the Postalm road. The section is extremely faulted and there are several outcrops ($SWP_{1,2,5}$, see text-fig. 8) of ammonite bearing shales from the same level or a limited interval only.
The Weißenbach valley (= Weißenbachtal) comprises Upper Turonian ("Ofenwand", "Weidringer Alpe") and Coniacian ammonite localities (Schmolnauer Alpe, ? Leiner Alpe). Only the sites close to the "Ofenwand" ($SWP_{1,2,5}$; fauna Strobl I of SUMMESBERGER, 1985: 148) are of Upper Turonian age.
The term "Ofenwand" was introduced by the collector HINTERHUBER (1866:16 "*Ammonites* sp., *Scaphites* sp., .."), for an escarpment of rudist breccia about 200 metres from the fossil site SWP_1 (text-figs. 7, 8). This is the same as the locality of PLÖCHINGER (1955:203) and STOJASPAL & LOBITZER (1976:116 "Seitengraben des Weißenbachtales").
BRINKMANN's "Weidringer Alpe" locality (1935:3) may correspond with SWP_5 (*B. haberfellneri* (HAUER), GIUW collection) higher up in the same gully. The "Waidinger Alpe" (sic!) of the official 1 : 50000 map, sheet 95 is situated about 500 m S of SWP_5.
Confusion of the names of the Strobl–Weißenbachtal sites is due to inprecise labelling and previous authors' poor knowledge of the sites: BRINKMANN's term "St. Wolfgang" (1935:3) encompasses the Upper Turonian of the Weißenbach valley and possibly the Santonian from the confluence of the Nussenseebach and the Ischl river (= Schneiderwirtsbrücke of labels). No ammonites were collected from the village of St. Wolfgang itself before 1976 (STOJASPAL & LOBITZER).
The holotype of *Ammonites mitis* HAUER is labelled "Weg von Ischl nach Strobl" (HAUER, 1866:7; BRINKMANN, 1935:3). This is a distance of about

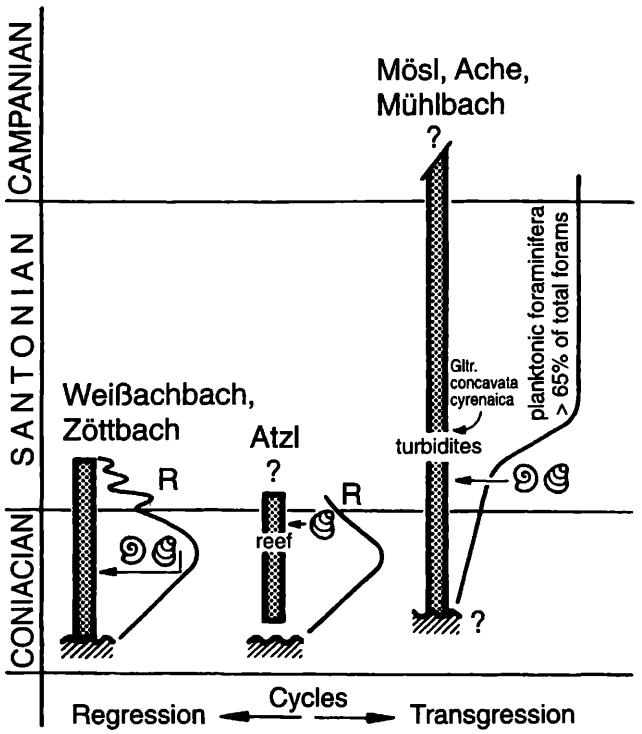


Figure 4a. Original interpretation of the Brandenberg sections, after HERM, KAUFFMAN & WIEDMANN 1979: text-fig. 11b).

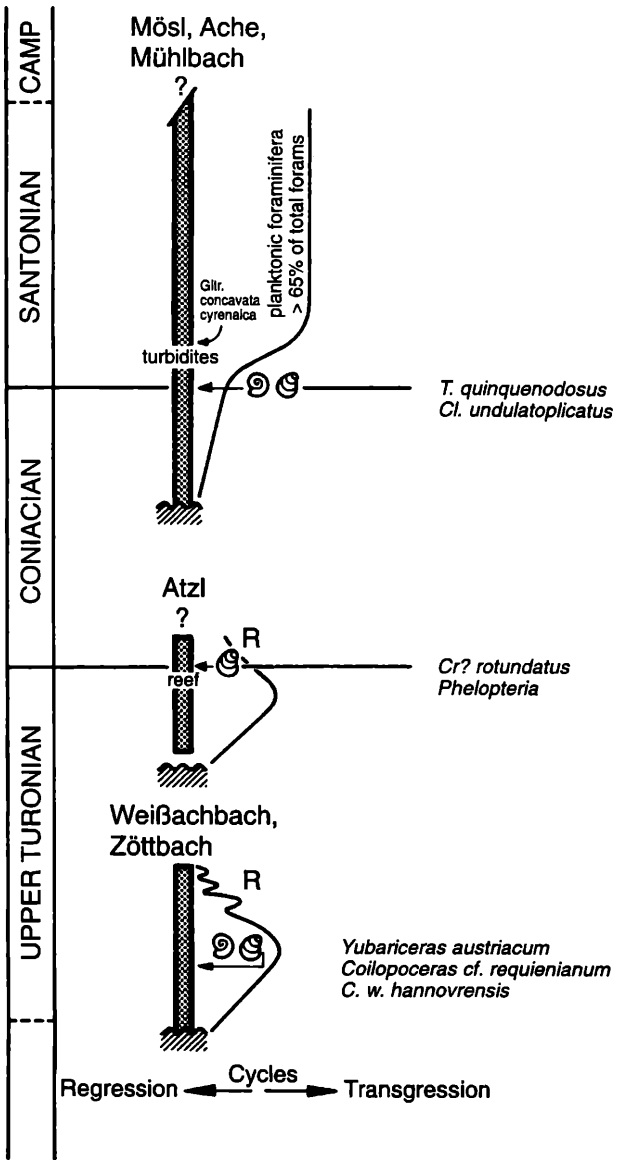


Figure 4b. Reinterpretation based on the present revision of the ammonite fauna agrees closely with KAUFFMAN's opinion in HERM et al. (1979).

10 km; the road crosses Coniacian, Santonian and Maastrichtian outcrops. We believe that the specimen is from SWP_1 or $_2$, and of Upper Turonian age.

Fauna:

Gaudryceras mite (HAUER)
Puzosia sp.
Tongoboryceras rhodanicum (ROMAN & MAZERAN)
Barroisiceras haberfellneri (HAUER)
Hyphantoceras reussianum (d'ORBIGNY)
Eubostrychoceras sp.
Pseudoxybeloceras sp.
Sciponoceras bohemicum bohemicum (FRITSCH)
Baculites cf. *undulatus* d'ORBIGNY
Baculites yokoyamai TOKUNAGA & SHIMIZU
Baculites sp. indet.
Didymotis sp.
Inoceramus ex aff. *kleini* MÜLLER

St. Wolfgang, parking area no. 3

This site was discovered by STOJASPAL & LOBITZER (1976:A 115). It was erroneously thought to be of Santonian age on the basis of a misidentification of *Reesidites* sp. as *Muniericeras gosauicum* (SUMMESBERGER in KOLLMANN & SUMMESBERGER (1982:31–32). IMMEL's (1987:44) term "St. Wolfgang" includes both the St. Wolfgang site (parking area no. 3) and the locality of REDTENBACHER's (1873:109) *Ammonites quinquenodosus*. REDTENBACHER believed his original (1873: pl. 24, fig. 3) to be from St. Wolfgang. The specimen is labelled "Ischl – St. Wolfgang" and is undoubtedly from the Santonian of Schneiderwirtsbrücke at the confluence of the Nussenseebach tributary and the Ischl river.

A tunnel construction in 1992/93 revealed additional material from the same level.

Fauna:

Barroisiceras haberfellneri (HAUER)
Reesidites minimus (HAYASAKA & FUKADA)
Inoceramidae indet.
Didymotis sp.

Gams (Radstatt)

Ammonites described from Gams by previous authors (HAUER, 1866; REDTENBACHER, 1873; BRINKMANN, 1935) are from the Radstatt roadcut (= Radstattkogel) and from E of Langriedler (KOLLMANN,

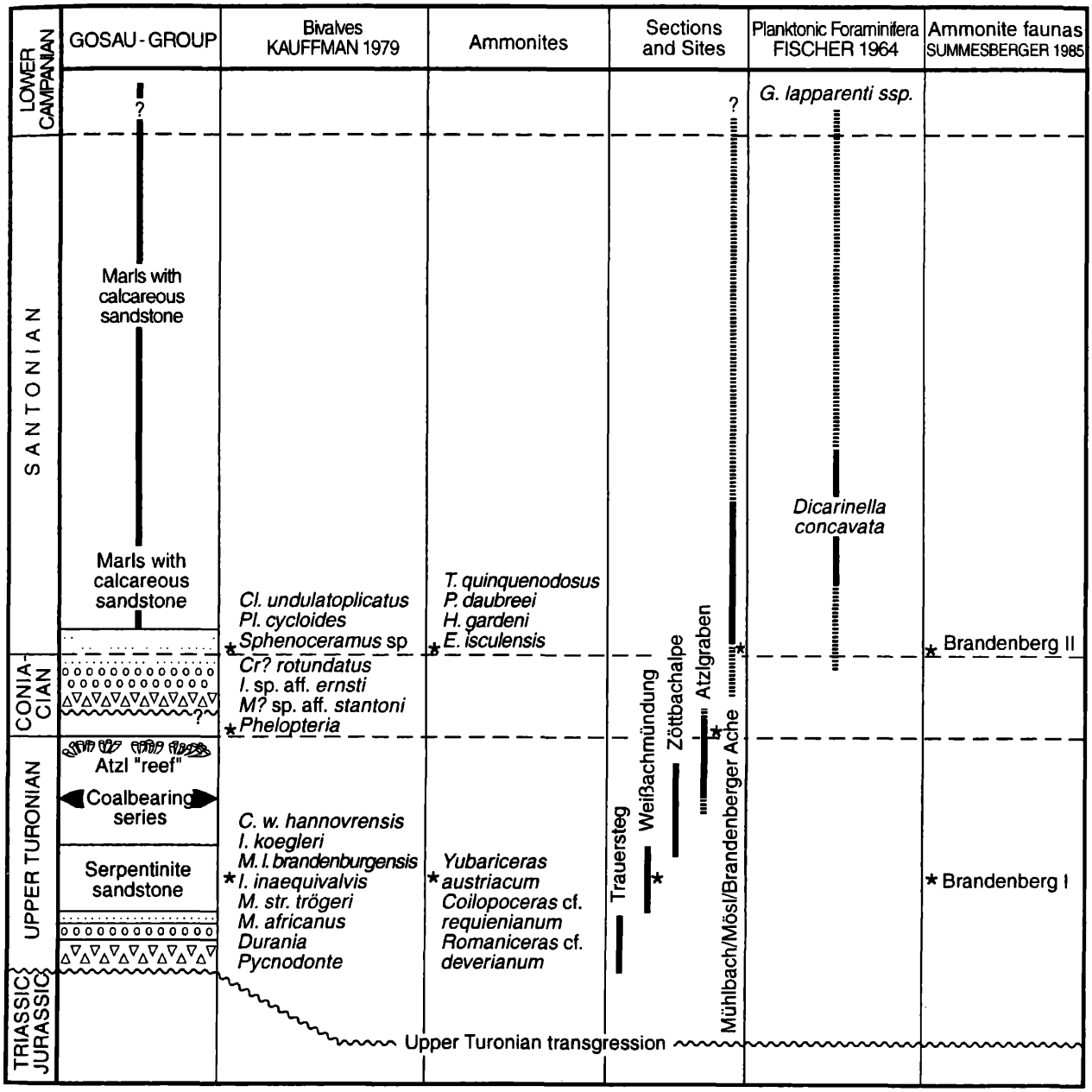


Table 1. Stratigraphic position of the Brandenberg sites after revision of the ammonite fauna (this paper) and additional fieldwork by one of us (H.S.) together with WAGREICH (GIUW) and SANDERS (GIU Innsbruck).

1964:90) in the western part of the Gams basin (Steiermark). Radstatt is the type locality of *Ammonites haberfellneri* HAUER, 1866 and of several other ammonites discussed in this paper. The age of the dark silty shales there remained uncertain until WOOD found *Didymotis* (REDTENBACHER's, 1874:6 "kleine Inoceramen") on the occasion of the Coniacian to Maastrichtian stages Working Group 1982 excursion. We further recognize BRINKMANN's (1935:5) "*Muniericeras gosauicum*" as a Turonian *Reesidites*. In consequence the underlying transgressive series of the Gams basin with coal seams, rudist bioherms and beds with *Trochactaeon lamarcki* (SOWERBY) is of late Turonian age or older.

Fauna:

Gaudryceras sp. indet., group of *mite* (HAUER)
Pseudophyllites postremus (REDTENBACHER)
Tetragonitidae gen. et sp. indet.
Lewesiceras cf. *mantelli* WRIGHT & WRIGHT
Barroisiceras haberfellneri (HAUER)
Reesidites minimus (HAYASAKA & FUKADA)
Tridenticeras binodosum (HAUER)
Neocrioceras (Schlueterella) sp.
? Nostoceratidae gen. et sp. indet.
Baculites cf. *undulatus* d'ORBIGNY
Baculites sp. indet.
Scaphites sp. indet.
Didymotis costata (FRIC)

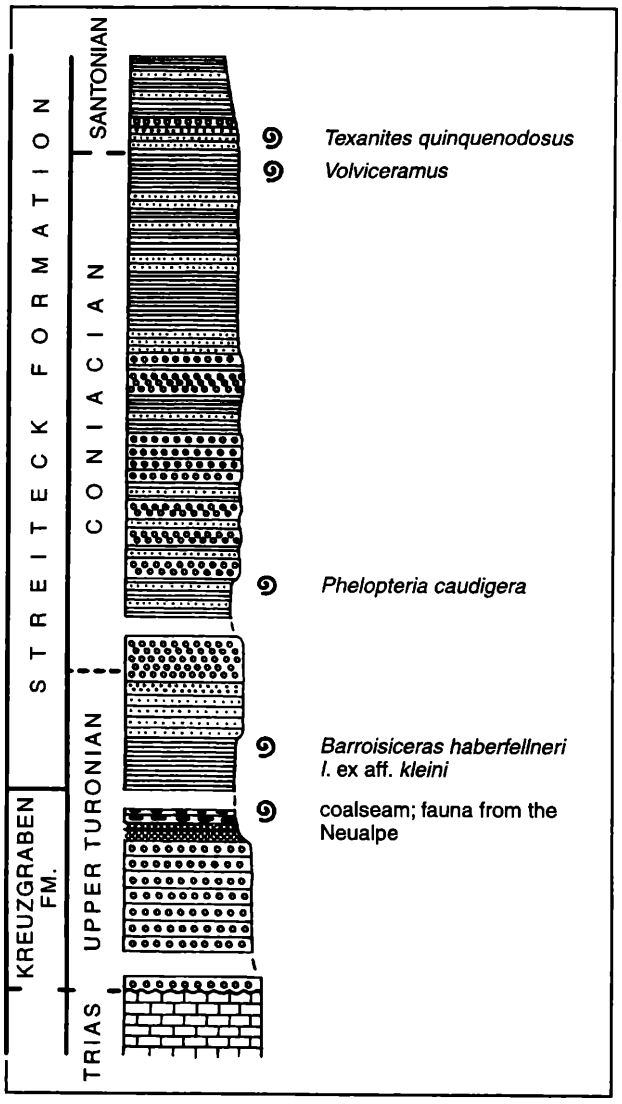


Figure 5. Tentative section of the transgressive series at Neualpe (Gosau-basin, Rußbach, Salzburg, not to scale).

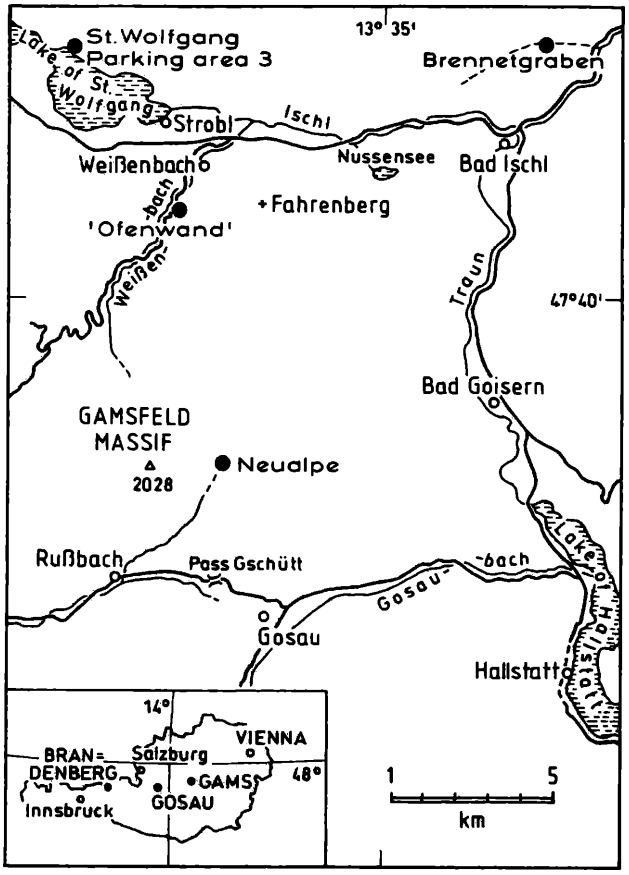
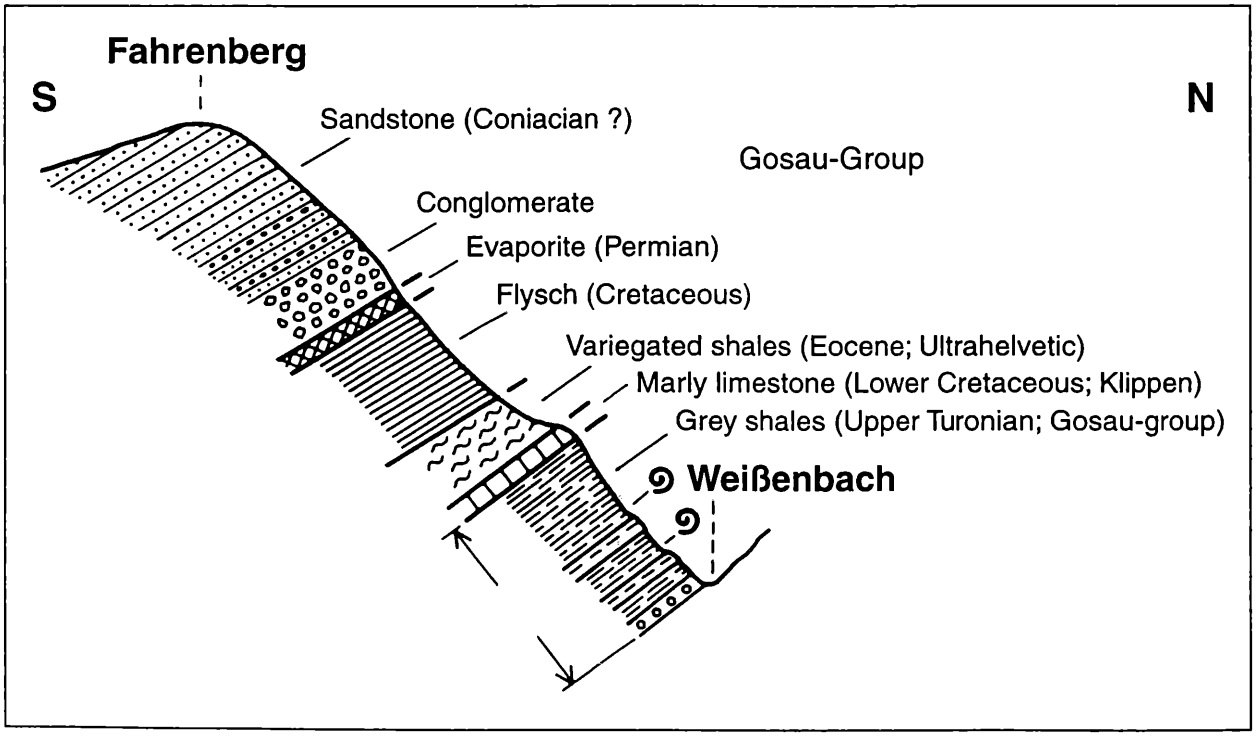


Figure 6. Locality map of the St. Wolfgang, Strobl/Weißenbach, Bad Ischl/Brennetgraben and Rußbach/Neualpe sites.

Figure 7. Generalized sequence of the tectonically disturbed section from the Weißenbachtal to the Fahrenberg, including the historic Ofenwand ($SWP_{1,2}$) and (?) Weidringer Alpe (SWP_5) localities.



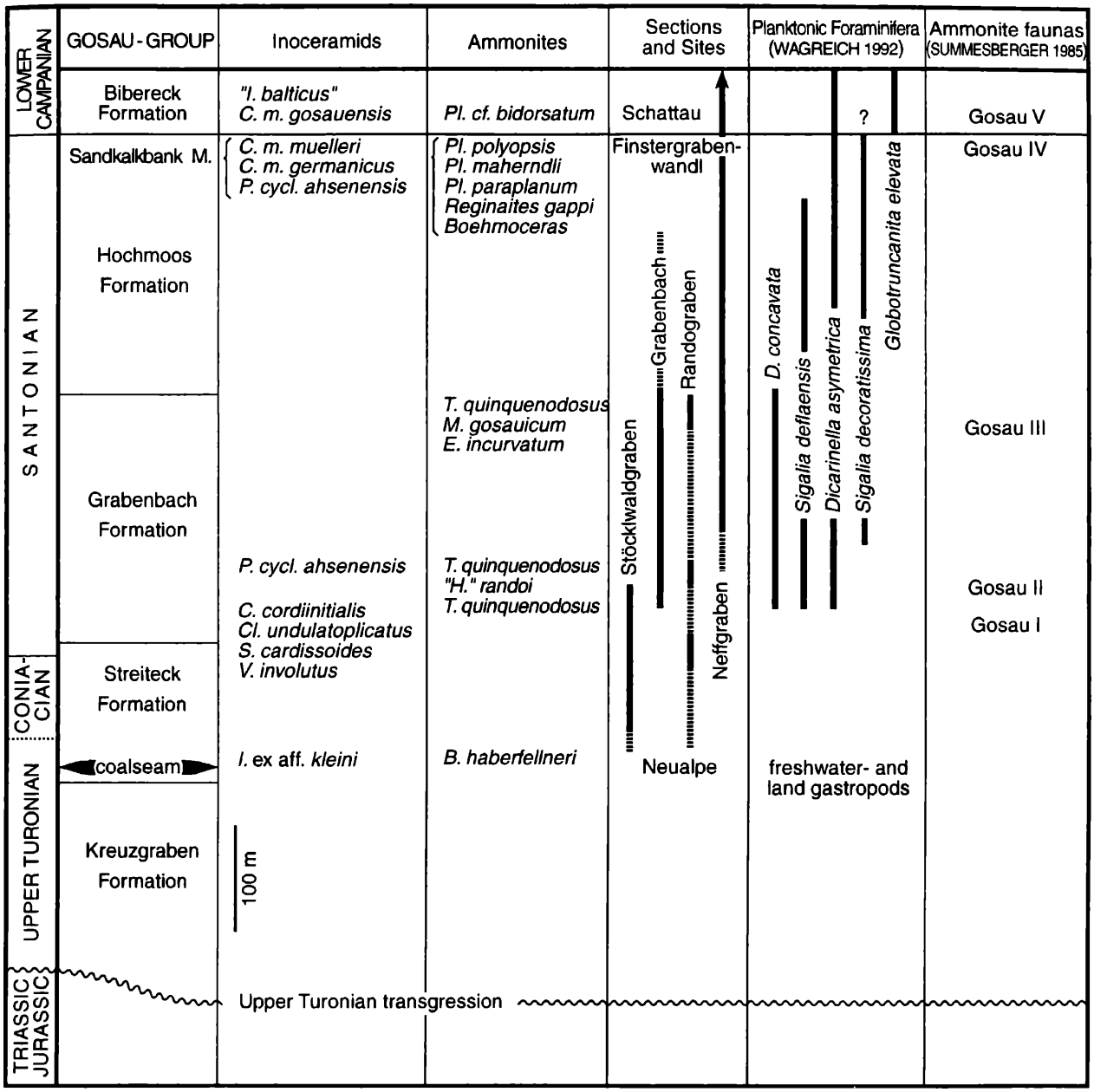


Table 2. The position of the Upper Turonian fauna in the transgressive series of the Gosau-group (Neualpe, Rußbach/Salzburg, after TRÖGER & SUMMESBERGER 1994: tab. 15).

3. Abbreviations

GBA	Geologische Bundesanstalt (formerly Geologische Reichsanstalt) Wien
NHMW	Naturhistorisches Museum Wien
PIUW	Paläontologisches Institut Universität Wien
GIUW	Geologisches Institut Universität Wien
GITW	Geologisches Institut der Technischen Hochschule Wien – now: PIUW
BSP	Bayerische Staatssammlung für Paläontologie und historische Geologie, München
MNHP	Muséum National d'Histoire Naturelle, Paris
JOA	Steiermärkisches Landesmuseum Joanneum, Graz
OÖLM	Oberösterreichisches Landesmuseum, Linz
HNS	Haus der Natur, Salzburg
SK	Skoumal Collection, Vienna
MA	Maherndl Collection, Bad Ischl
PL	Plöchinger Collection, Mödling, Lower Austria
SA	Sanders Collection, Innsbruck
KÖ	Kögl Collection, Brixlegg, Tirol.

4. Systematic Paleontology

Order Ammonoidea ZITTEL, 1884

Suborder Lytoceratina HYATT, 1889

Superfamily Tetragonitaceae HYATT, 1900

Family Gaudryceratidae SPATH, 1927

Genus *Gaudryceras* de GROSSOUVRE, 1894

Type species: *Ammonites mitis* HAUER, 1866, by the subsequent designation of BOULE, LEMOINE and THÉVENIN (1906).

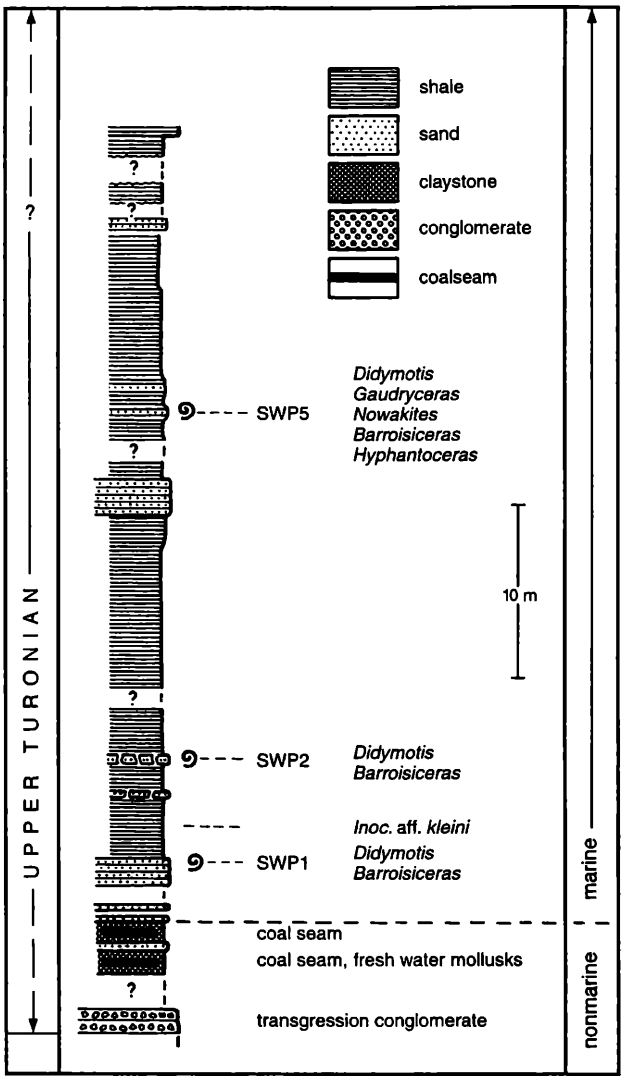


Figure 8. Lithological section through the side valley to the Weißenbach valley.

Gaudryceras mite (HAUER, 1866)
(Plate 1, figs. 1, 2, 3, 4)

Synonymy:

1866 *Ammonites mitis* HAUER, p. 6, pl. 2, figs. 3, 4.
1873 *Ammonites glaneggense* REDTENBACHER, p. 119, pl. 27, fig. 3.
1979 *Gaudryceras mite* (HAUER), KENNEDY & SUMMESBERGER, p. 74, pl. 1, figs. 1 a–d; pl. 2, figs. 1 a–c, 2 a–b, text-fig. 1 (with synonymy).
1979 *Gaudryceras glaneggense* (REDTENBACHER), KENNEDY & SUMMESBERGER, p. 76, pl. 3, figs. 1 a–b; pl. 4, figs.1 a–b (with synonymy).
1979 *Gaudryceras glaneggense* (REDTENBACHER), KENNEDY & KLINGER, p. 142.
1979 *Gaudryceras mite* (HAUER), SUMMESBERGER, p. 113, pl. 1, fig. 1.
1980 *Gaudryceras mite* (HAUER), SUMMESBERGER, p. 276, pl. 1, fig. 1; text-fig. 2.
1985 *Gaudryceras mite* (HAUER), SUMMESBERGER, p. 149.
1985 *Gaudryceras glaneggense* (REDTENBACHER), SUMMESBERGER, p. 149.
1987 *Gaudryceras mite* (v. HAUER 1866), IMMEL, p. 65.
1987 *Gaudryceras glaneggense* (REDTENBACHER 1873), IMMEL, p. 65.

H o l o t y p e : by monotypy, HAUER's original specimen (1866: pl. 2, figs. 3, 4) from the Gosau Group, possibly of Strobl/Weißenbach.

M a t e r i a l : GBA 1866/01/3, the holotype, possibly from the Upper Turonian of the Ofenwand near Strobl/Weißenbach; NS 6373, the holotype of *G. glaneggense* (REDTENBACHER) from the Upper Coniacian of Glanegg near Salzburg; SK/W 1988/19, 20 from the Upper Turonian of locality SWP$_5$, near the

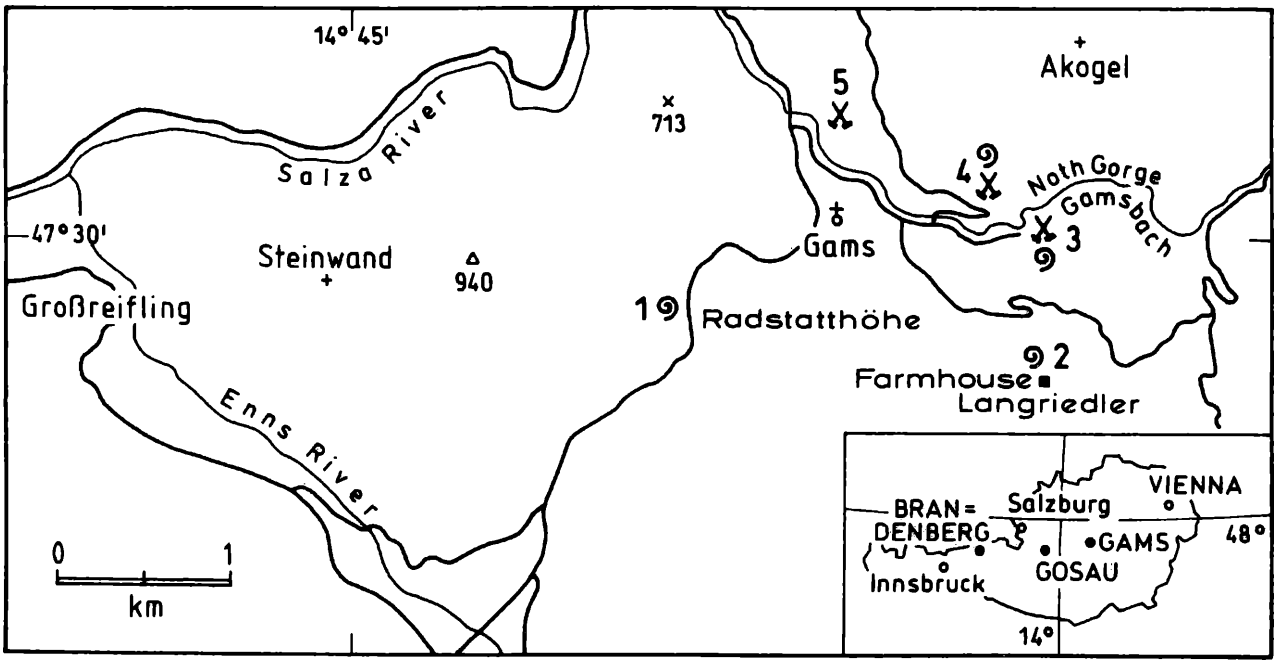


Figure 9. Sketch map of sites in the Gams basin. 1. Radstatt. 2. Berngraben by the Langriedler farmhouse. 3. Site with *Trochactaeon lamarcki* by the abandoned coal mine at the confluence of the Gamsbach and a minor tributary. 4. Measured nonmarine transgressive series with molluscs; abandoned coalmine. 5. Measured section by the abandoned jet mines.

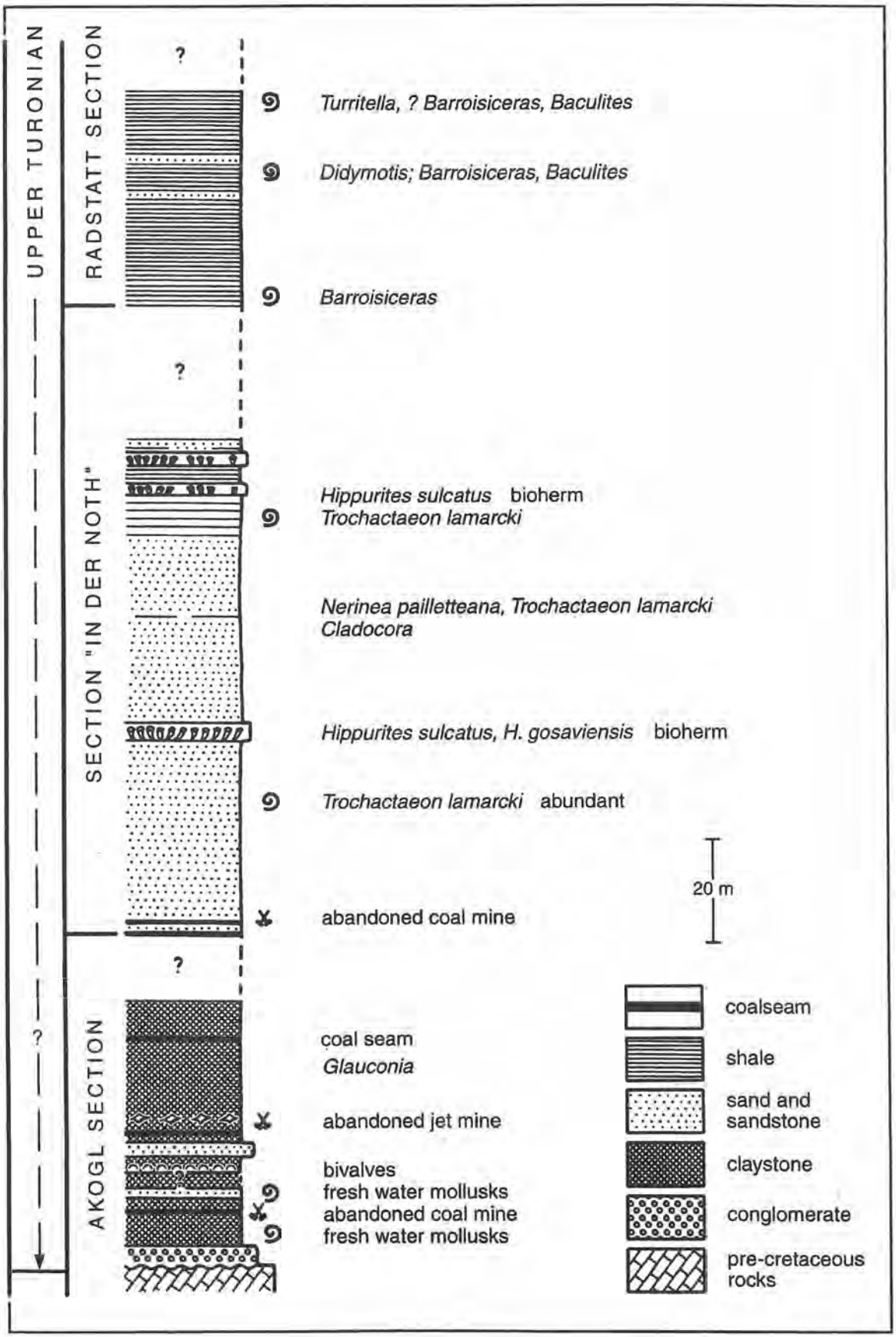


Figure 10. Provisional integrated lithostratigraphic sections (not to scale) of the western part of the Gams basin.

"Ofenwand"; NHMW 1989/50/14, Middle Coniacian, Schmolnauer Alpe, N of Fahrenberg; text-fig. 6); OÖLM 1938/32, from Bad Ischl, Upper Austria (?Coniacian).

Description: The type specimens are described at length by KENNEDY & SUMMESBERGER (1979). SK/W1988/20 (Wh 140, pl. 1, fig. 4) is a fragment of an adult body chamber with strong single ribs parallel to the lirae which also cover the ribs. Three of the visible ribs are crowded, indicating proximity of the adult aperture. NHMW 1989/50/14 (D 27, Wh 10) is a badly crushed fragment of phragmocone with adherent shell. It shows ornament typical of the juvenile stage with more than 20 flexuous lirae per cm, many of them bifurcating.

Discussion: *G. mite* (HAUER, 1866) and *G. glaneggense* (REDTENBACHER, 1873) are thought to be conspecific. HAUER's holotype (GBA 1935/01/3), refigured by KENNEDY & SUMMESBERGER (1979: pl. 1) is a juvenile or subadult specimen with "normal" lirate ornamentation, REDTENBACHER's specimen, the holotype of *G. glaneggense* (KENNEDY & SUMMESBERGER (1979: pl. 3) shows the ribbing style of the mature body chamber. *"Neogaudryceras denseplicatum* JIMBO" (COLLIGNON, 1956: pl. 9, fig. 1; COLLIGNON, 1965b: fig. 1719) and *"N. glaneggense"* (COLLIGNON, 1965b: fig. 1716) from Madagascar both show the same ontogenetic change in ornament.

Occurrence: *Gaudryceras mite* (HAUER) ranges from Turonian to Maastrichtian and has a world-wide distribution. In the Weißenbach area it occurs in the Upper Turonian of "Ofenwand" and in the Middle Coniacian of Schmolnauer Alpe. HAUER (1866:7) gave the route from Ischl to Strobl as the type locality for his *A. mitis* but, as discussed above, we believe it to be from the "Ofenwand" locality of previous collectors.

Gaudryceras* sp.** indet., group of ***mite (HAUER)
(Plate 2, figs. 1, 7)

Material A single specimen from Gams, GBA unregistered.

Description: The specimen is a fragment of the flank and venter of a *Gaudryceras* with an estimated Wh in excess of 80 mm. The aragonitic shell is preserved. The fragment shows coarse liration (3–4 lirae per cm ventrally). Ribbing of the adult body chamber is not visible.

Discussion: It seems most likely that this fragment belongs to a large but subadult individual of *Gaudryceras mite* (HAUER).

Occurrence: Upper Turonian of Gams.

Family Tetragonitidae HYATT, 1900

Genus *Pseudophyllites* KOSSMAT, 1895

Type species: *Ammonites indra* FORBES, 1846: 105, pl. 11, fig. 7 by original designation.

Pseudophyllites postremus
(REDTENBACHER, 1873)
(Plate 2, figs. 3, 5, 6, 8, text-fig. 11)

Synonymy:

1873 *Ammonites postremus* REDTENBACHER, p. 115, pl. 26, figs. 3a–d.
1895 *Ammonites postremus* REDTENBACHER, KOSSMAT, p. 140.
1925 *Pseudophyllites postremus* REDTENBACHER, DIENER, p. 53.
1935 *Tetragonites postremus* REDTENBACHER, BRINKMANN, p. 5.
1956 *Pseudophyllites postremus* (REDTENBACHER), COLLIGNON, p. 59.
1977 *Pseudophyllites postremus* (REDTENBACHER), KENNEDY & KLINGER, p. 186.
1992 *Pseudophyllites postremus* (REDTENBACHER), SUMMESBERGER, a: p. 100.

Types REDTENBACHER (1873: pl. 26, fig. 3a–d) figured two specimens of *Ammonites postremus* from Gams; they were also seen by BRINKMANN (1935:5). We have traced only one of these, GBA 1873/01/18, the original of REDTENBACHER's, pl. 26, figs. 3c–d; it is here designated lectotype of the species.

Material: The lectotype only, GBA 1873/01/18, from the Upper Turonian of Gams.

Description: The lectotype is a crushed fragmentary individual of approximately 65 mm diameter. It retains much of the original nacreous aragonitic shell, and almost one third of a whorl of body chamber. Coiling is involute, with a small, deep umbilicus. The umbilical wall is subvertical, inclining outwards. The umbilical shoulder is abruptly rounded, the flanks flattened, subparallel, with broadly rounded shoulders and venter. There is no ornament besides growth striae. The suture (text-fig. 11) is highly subdivided, with a deep E with a large median element, irregularly trifid

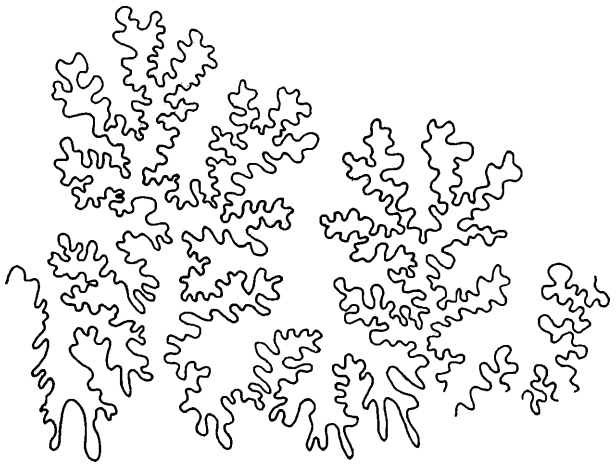


Figure 11. External suture of GBA 1873/01/18, the lectotype of *Pseudophyllites postremus* (REDTENBACHER), from Gams; bar scale 10 mm.

E/L, deep bifid L, smaller asymmetrically divided L/U and a large first auxiliary saddle.

Discussion: The overall shell form and suture line suggests the specimen to be a *Pseudophyllites*. *P. indra* (FORBES) (KENNEDY & KLINGER, 1977: 82, figs. 19A–F, 20–22; KENNEDY & HENDERSON, 1992:398, pl. 3, figs. 7–9, 13–27; pl. 4, figs. 1–3) has higher, rounded whorls, and an outwards-sloping umbilical wall. *P. latus* (MARSHALL) (see KENNEDY & KLINGER, 1977:190 for discussion) is a broad-whorled species with convergent flanks. The closest similarities are to *Pseudophyllites teres* (van HOEPEN), the holotype of which was refigured by KENNEDY & KLINGER (1977: fig. 23), which has a steep umbilical wall and flattened flanks. The greater flattening of flanks and venter of *P. postremus* may be due to crushing; we incline very much to the view that these two species are conspecific, but poor preservation of the holotypes renders full confirmation of this impossible. We maintain them apart at this time with considerable doubt.

Occurrence: The lectotype of *Pseudophyllites postremus* is from the Upper Turonian of the Gams basin (Steiermark) where it occurs together with *Barroisiceras haberfellneri* (HAUER) and *Didymotis* sp. A further specimen is from the Middle Coniacian of the Schmolnauer Alpe.

Tetragonitidae gen. et sp. indet.
(Plate 2, fig. 2)

Material: A single specimen NHMW 1878/2028/5.

Description: The specimen is a crushed internal mould with adherent powdery white aragonitic shell, 11 mm in diameter. The umbilicus is small, the whorl height increasing rapidly, possibly also due to crushing.

Discussion: Due to poor preservation generic and specific identity remains unclear. The individual might be a juvenile *Tetragonites* or *Pseudophyllites*.

Occurrence: Upper Turonian Gosau-group of the Gams basin, Steiermark.

Suborder Ammonitina HYATT, 1889
Superfamily Desmoceratacea ZITTEL, 1895
Family Desmoceratidae ZITTEL, 1895
Subfamily Puzosiinae SPATH, 1922
Genus *Puzosia* BAYLE, 1878

Type species: *Ammonites planulatus* J. de C. SOWERBY, 1827:137, pl. 570, fig. 5, non SCHLOTHEIM, 1820:59 = *Ammonites mayorianus* D'ORBIGNY, 1841:267, pl.79, figs. 1–3, by subsequent designation by DOUVILLÉ, 1879:91.

***Puzosia* sp.** indet.
(Plate 2, fig. 9)

Synonymy:

1873 *Ammonites* sp. indet. confr. *Ammonites Guettardi* RASPAIL, REDTENBACHER, p. 126, pl. 30, fig. 6.

Material: GBA 1873/01/28 (3431), the original of REDTENBACHER (1873: pl. 30, fig. 6).

Description: GBA 1873/01/28 (3431) is a fragment of a crushed internal mould. Two narrow sectors of a single whorl and the umbilicus are preserved. There are at least three slightly biconcave constrictions per whorl. They are distinctly prorsiradiate at the umbilical shoulder. Weak ribs arise at mid flank, coarsening as diameter increases. The umbilicus is narrow, with a steep umbilical wall.

Discussion: The poor preservation of this specimen makes specific identification difficult. Weak ribbing recalls *Puzosia* rather than *Mesopuzosia*, although the umbilicus is narrower than in typical *Puzosia* species. The specimen does not, therefore, belong to the Upper Turonian to Lower Coniacian *Puzosia (Puzosia) muelleri* DE GROSSOUVRE (KAPLAN & KENNEDY, 1994:34).

Occurrence: Upper Turonian of the Gosau group, "Ofenwand" as indicated by REDTENBACHER (p. 126, pl. 30, fig. 6) and the label. REDTENBACHER's citation of Schmolnauer Alpe (table on p. 136) is an error.

Family Pachydiscidae SPATH, 1922
Genus *Lewesiceras* SPATH, 1939

Type species *Ammonites peramplus* MANTELL, 1822:200, by original designation by SPATH, 1939:296.

Lewesiceras* cf. *mantelli WRIGHT & WRIGHT, 1951
(Plate 2, fig. 4)

Compare:

1951 *Lewesiceras mantelli* WRIGHT & WRIGHT, p. 20.
1967 *Lewesiceras mantelli* WRIGHT & WRIGHT, HOUSA, p. 26, pl. 4, figs. 3, 4; pl. 5, figs. 1–4; pl. 6, figs. 1–4 (with synonymy).
1977 *Lewesiceras mantelli* WRIGHT & WRIGHT, KENNEDY & COOPER, p. 40, 41, figs. 2i, 3a–c, h, i.
1979 *Lewesiceras mantelli* WRIGHT & WRIGHT, WRIGHT, p. 310, pl. 4, figs.1–3; pl. 6, figs. 4, 5 (with additional synonymy).
1981 *Lewesiceras mantelli* WRIGHT & WRIGHT, WRIGHT & KENNEDY, p. 31, pl. 2, fig. 5, 6.
1982 *Lewesiceras mantelli* WRIGHT & WRIGHT, TZANKOV, p. 33, pl. 14, figs. 2, 3, 4.
1983 *Lewesiceras mantelli* WRIGHT & WRIGHT, DEVALQUE, AMÉDRO, PHILIP & ROBASZYNSKI, p. 64/65.
1991 *Lewesiceras mantelli* WRIGHT & WRIGHT, KENNEDY, p. 312.

Material: 1 juvenile specimen, NHMW 1978/2030/3.

Description: The specimen is crushed, 11 mm in diameter, with nacreous shell preserved. The venter seems to have been rounded originally. The umbilical shoulder is narrowly rounded, the umbilical wall steep. The umbilicus is wide and shallow, possibly due to crushing. Ornament is slightly irregular. An estimated 5 rather weak rounded umbilical tubercles per whorl are present already at the smallest diameter visible. Feebly prorsiradiate weak ribs arise at the umbilical tubercles. Intercalated ribs appear on the outer third of the flank. About 10 weak ribs are visible on the last half whorl terminating at the ventrolateral shoulder. The innermost whorls lack ribs.

Discussion: Style of ornament shows this specimen to be a juvenile *Lewesiceras*. Specific identification is doubtful due to small size, although it probably belongs to the Upper Turonian *L. mantelli* WRIGHT & WRIGHT.

Occurrence: *L. mantelli* is a predominantly Upper Turonian species, recorded from western Europe to the Crimea, northern Caucasus, the Don region and Mangyshlak. In the Uchaux section it occurs in the zones of *Romaniceras deverianum* and *Subprionocyclus neptuni* of DEVALQUE, AMÉDRO, PHILIP & ROBASZYNSKI (1983:64, 65). It occurs in the upper Middle Turonian and in the Upper Turonian of the Bohemian Cretaceous (HOUSA, 1967:32). It is recorded (KAPLAN, 1986: fig. 4) from the Upper Turonian of NW-Germany, with a maximum at the *Hyphantoceras*-event in the *neptuni* Zone. As with its predecessor *L. peramplum* (MANTELL), *L. mantelli* is a boreal element, and its appearance in the Gams basin indicates the presence of a boreal influence in the Upper Turonian.

Genus *Tongoboryceras* HOUSA, 1967

Type species: *Lewesiceras tongoboryense* COLLIGNON (1952:23, pl. 2, fig. 3) by original designation of HOUSA, 1967:42.

Tongoboryceras rhodanicum (ROMAN & MAZERAN)
(Plate 3, figs. 1–5, text-figs. 12, 13)

Synonymy:

1913 *Pachydiscus rhodanicus* ROMAN & MAZERAN, p. 18, pl. 1, fig. 10a, b.
1954 *Pseudopuzosia marlowensis* NOBLE, MATSUMOTO, p. 113, text-fig. 6 only.
1967 *Tongoboryceras rhodanicum* (ROMAN & MAZERAN), HOUSA, p. 42.
1979 *Tongoboryceras rhodanicum* (ROMAN & MAZERAN), WRIGHT, p. 316, pl. 6, fig. 1a, b.

Material: NHMW 1996/32/1, SK/W/1986/14.

Description: NHMW 1996/32/1 consists of the phragmocone and fragments of the body chamber. The specimen is an internal mould with adherent shell. The pachydiscid suture is partly preserved (text-figs. 12, 13). The phragmocone (D56, Wh 24, Wb 22, U13, U% 23) is crushed and distorted to a certain degree so that measurements are not meaningful.

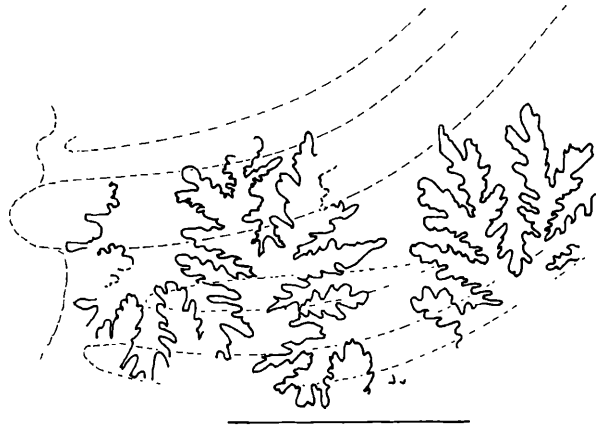


Figure 12. Partial external suture of *Tongoboryceras rhodanicum* NHMW 1996/32/1 from Strobl/Weißenbach; bar scale 10 mm.

The whorls seem to have been higher than wide. Flanks and venter are evenly curved, without distinct ventrolateral and umbilical shoulders. The umbilical wall is vertical. Ornamentation is well developed; about 7 collar-ribs per whorl arise at distinct umbilical tubercles followed by an equally distinct constriction. Interspaces between collar-ribs bear several coarse, intercalated ribs which arise either singly or in pairs close to the umbilicus.

Discussion KENNEDY, BILOTTE & MELCHIOR (1995) pointed out that *T. rhodanicum* differs from *T. canali* (DE GROSSOUVRE, 1894:195, pl. 38, fig. 2) only in minor details and might be conspecific. For additional synonymy of *T. canali* see KENNEDY et al. (1995:399).

Tongoboryceras tongoboryense COLLIGNON (1952) is a close ally. Its whorl section is more depressed than that of *T. rhodanicum*. *T. satoi* (MATSUMOTO, 1979: 34, text-fig. 3, pl. 5, fig. 1) is less inflated and more densely ribbed. *T. kawashitai* (MATSUMOTO, 1979: 32, text-fig. 2, pl. 4, fig. 1) differs by its coronate whorl section with steeply inclined umbilical wall. *T. elmii* (COLLIGNON, 1965b:36, pl. 429, figs. 1777–1779) has coarser ribs and very prominent umbilical tubercles. *Nowakites carezi* (GROSSOUVRE, 1984:190, pl. 25, fig. 3, pl. 37, fig. 5) from the French Coniacian has a wider umbilicus, narrower ribs, wider interspaces and the twice number of umbilical tubercles.

Occurrence: *T. rhodanicum* is recorded from the Upper Turonian of France, England and the Austrian Gosau-group.

Superfamily Acanthocerataceae GROSSOUVRE, 1894
Family Acanthoceratidae HYATT, 1900
Subfamily Euomphaloceratinae COOPER, 1978

Genus and Subgenus *Romaniceras* SPATH, 1923

Type species: *Ammonites deverianus* D'ORBIGNY, 1841:356, pl. 110, figs. 1, 2, original designation by SPATH, 1923:144.

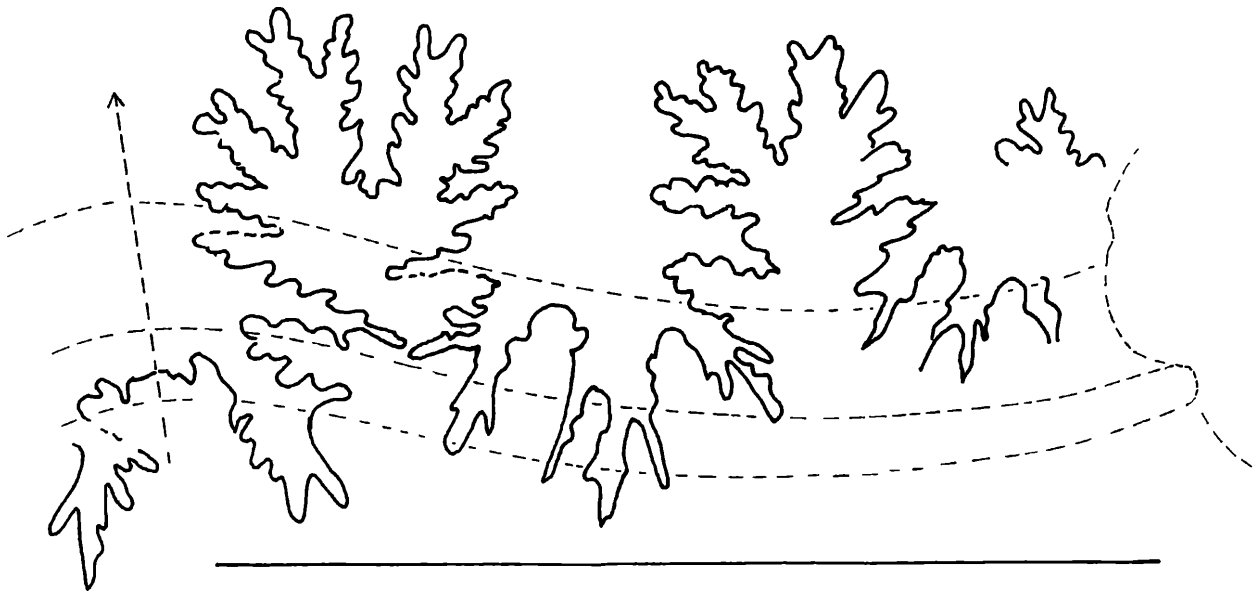


Figure 13. External suture of *Tongoboryceras rhodanicum* (ROMAN & MAZERAN), juvenile specimen, SK/W/1986/14 from Strobl/Weißenbach; bar scale 10 mm

Discussion The type species *Ammonites deverianum* d'ORBIGNY, 1841 was redescribed by KENNEDY, WRIGHT & HANCOCK (1980:326). Redescription revealed a considerable degree of variation (l.c.: pl. 39, figs. 7–10, pl. 41, figs. 1–6; pl. 42, figs. 1–7; pl. 43, figs. 1–3, text-figs. 1, 3D, 4, 5). *Romaniceras (R.) mexicanum* JONES revised by KENNEDY & COBBAN (1988:25) shows an even wider range of variation from almost smooth specimens (l.c., fig. 7G) to densely ribbed (l.c.: figs. 6A–D) and to very coarse ribbed and tuberculate (l.c.: fig. 9). There are three fragments from the Zöttbach section of Brandenberg, (Tyrol, Austria) all differing in coiling and sculpture. One belongs to the subgenus *Yubariceras* (WIEDMANN, 1979 in HERM, KAUFFMAN & WIEDMANN), the others to the subgenus *Romaniceras* sensu stricto. Poor preservation and the small number of specimens preclude confident specific determination of representatives of the latter subgenus.

Romaniceras (Romaniceras) cf. *deverianum* (d'ORBIGNY, 1841)

(Plate 4, figs. 1, 2, 3, text-fig. 14)

Compare:

1841 *Ammonites deverianum* d'ORBIGNY

1980 *Romaniceras (Romaniceras) deverianum* (d'ORBIGNY, 1841), KENNEDY, WRIGHT & HANCOCK, p. 332 ff. (with synonymy).

Material: Three specimens: KÖ/ZW/481,483, SA/1994/1.

Description: Two specimens are fragments of internal moulds. In both cases the last chambers of the phragmocone and a short section of the bodychamber are preserved. The sculpture is badly corroded. The specimen from the SANDERS collection (SA/1994/1) is slightly deformed. KÖ/ZW/481 does not seem to be deformed. KÖ/ZW/483 is an external mould. KÖ/ZW/481 is preserved in a whitish carbonaceous sandstone with rare serpentinitic grains. Coiling appears to have been moderately involute. The whorl section is high oval to slightly compressed, with the greatest breadth below mid-flank. The flanks are slightly convex, the ventrolateral shoulders evenly rounded. The venter is broadly convex. The umbilical wall is rounded and possibly undercut. There are 40 ribs on the fragment, half of which arise at the umbilical edge, the others are intercalated at mid-flank, or a little below.

The ribs are straight and rectiradiate to slightly prorsiradiate. There are 9 rows of tubercles. The primary ribs bear a small umbilical bulla. The second row of tubercles is below mid-flank, and present on the primaries only. All ribs bear inner and outer ventrolateral and siphonal tubercles. Dimensions are as follows: WH 55, $Wb_{intercost.}$ 46, $D_{est.}$ 120, $U_{est.}$ 40. SA /1994/1 is preserved in a coarse serpentinitic sandstone. Coiling is rather involute; the whorl section is slightly compressed on the phragmocone, becoming inflated on the bodychamber. The umbilicus is undercut and narrower than in the previous specimen. The single primary rib visible (pl. 4, fig. 1) is slightly biconcave and prorsiradiate. Intercalated ribs are slightly curved or straight. All ribs extend across the venter. Primary ribs bear a distinct bulla at the umbilical shoulder. A row of lateral tubercles is either not developed on the body chamber or has been worn away. There are inner and outer ventrolateral and siphonal tubercles on all ribs. Ribs are crowded on the bodychamber which also bears faint growth striae. The total number of ribs must have been about 40 per whorl. The dimensions are as follows: Wh 70, WB 56, $D_{est.}$ 130, $U_{est.}$ 30.

Discussion The presence of 9 rows of tubercles in KÖ/ZW 481 shows that this specimen belongs to the subgenus *Romaniceras (Romaniceras)*. Tuberculation of SA/1994/1 is so weak that we assigned it only tentatively to the subgenus, and cannot be certain that the two specimens are conspecific.

Romaniceras (Yubariceras) gosavicum WIEDMANN, 1979 (see below) has 11 rows of tubercles, the holotype is a smaller apparently adult individual, with irregular ribbing. *Romaniceras (Romaniceras) japonicum* (MATSUMOTO, SAITO & FUKADA (1957:31, pl. 8, fig. 2, text-figs. 11, 12); MATSUMOTO (1975:139, pl. 19, figs. 2–3, pl. 21, fig. 2, text-figs. 13–14) is superficially similar but has constrictions and a trapezoidal section with maximum width close to the umbilicus. *Romaniceras (Romaniceras) kallesi* (ZAZVORKA, 1958) is more evolute and in most cases (see KENNEDY, WRIGHT & HANCOCK, 1980) more densely ribbed, with many more primaries arising at the umbilicus. *Romaniceras (Yubariceras) ornatissimum* (STOLICKA, 1865) has eleven rows of tubercles with a generally much coarser sculpture. *Romaniceras (Romaniceras) deverianum* was distinguished from *Romaniceras (Romaniceras) mexicanum* JONES, 1938, by the coarser ornament in adult stages of the latter species and the umbilical bullae projecting into the umbilicus of the former (KENNEDY & COBBAN, 1988:33). The Japanese *Romaniceras (Romaniceras) otatumei* (MATSUMOTO, SAITO & FUKADA, 1957:25, pl. 2, fig. 2) was discussed by KENNEDY, WRIGHT & HANCOCK (1980:341) and WRIGHT & KENNEDY (1981:59) as a possible further synonym of *Romaniceras (Romaniceras) deverianum* (d'ORBIGNY, 1841). It ranges from the Middle Turonian to the Upper Turonian *Reesidites minimus* Zone of Japan (MATSUMOTO, 1975:146).

Occurrence Both specimens are from the Zöttbach section, Brandenberg (HERM, KAUFFMAN & WIEDMANN, 1979: fig. 4). Difference in preservation suggests that KÖ/ZW/481 is from level d_2; SA/1994/1 from level d_4 of HERM et al. There is a thickness of 2 metres of coarse, apparently rapidly deposited sand between these levels suggesting a very short time interval. Level d_2 also yielded *Coilopoceras requienianum* (d'ORB)("*Hemitissotia alpina*" of WIEDMANN, 1979:47, in HERM et al.) and an unidentifiable representative of the Collignoniceratinae ["*Solgerites* sp. cf. *Solgerites brancoi* (SOLGER)" of WIEDMANN, 1979:42, in HERM et al.]. Level d_4 also yielded *Romaniceras (Yubariceras) gosavicum* (WIEDMANN, 1979:46, in HERM et al.). Upper Turonian *deverianum* Zone is assumed for both levels.

Subgenus *Yubariceras* MATSUMOTO, SAITO & FUKADA, 1957

Type species: *Yubariceras yubarense* MATSUMOTO, SAITO & FUKADA (1957:27) by original designation = *Romaniceras (Yubariceras) ornatissimum* (STOLICKA) **teste** WRIGHT & KENNEDY, 1981:60.

Romaniceras (Yubariceras) gosavicum WIEDMANN, 1979

Synonymy:

? 1935 *Acanthoceras gentoni* DEFR, BRINKMANN, p. 2, 9.
1979 *Yubariceras gosavicum* WIEDMANN, in HERM, KAUFFMAN & WIEDMANN, p. 46, pl. 6, figs. C, D, text-fig. 7A.
1985 "*Romaniceras (Yubariceras)*" *gosauicum* (WIEDMANN), SUMMESBERGER, p. 147.
1987 *Romaniceras (Yubariceras) gosavicum* WIEDMANN, 1979, IMMEL, p. 105.

Holotype BSP 1970 XVII 13, by original designation.

Material: The holotype only.

Description: see WIEDMANN (1979:46).

Discussion: This species was doubtfully assigned to *Codazziceras* ETAYO-SERNA, 1979, by WRIGHT & KENNEDY (1981:58). WRIGHT, CHANCELLOR & KENNEDY (1983:342) discussed the specimen and pointed out certain affinities in tuberculation to the Lower Coniacian *Codazziceras ospinae* (KARSTEN, 1858). The type specimen was discussed again by IMMEL (1987:105). We here follow his and WIEDMANN's original opinion and place the holotype and only known specimen into *Romaniceras (Yubariceras)*. As WIEDMANN (1979:46) noted, the Austrian species is closely related to *R. (Y.) ornatissimum* (STOLICKA) of which *Y. yubarense* MATSUMOTO, SAITO & FUKADA is a junior synonym (KENNEDY, WRIGHT & HANCOCK, 1980:348, 358).

Occurrence: *R. (Y.) gosavicum* is known only from Zöttbachgraben, level d_4, Brandenberg, Tyrol, Austria, where it co-occurs with *Coilopoceras* cf. *requienianum*, a species that first occurs in the lower Upper Turonian *deverianum* Zone of French authors, although ranging higher (DEVALQUE et al., 1982).

Family Collignoniceratidae WRIGHT & WRIGHT, 1951

Subfamily Collignoniceratinae WRIGHT & WRIGHT, 1951

Collignoniceratinae gen. et sp. indet.

Synonymy:

1979 *Solgerites* cf. *S. brancoi* (SOLGER), WIEDMANN in HERM, KAUFFMAN & WIEDMANN, p. 42, pl. 5 A, B.
1985 *Solgerites* cf. *S. brancoi* (SOLGER), KENNEDY, p. 220.
1985 "*Solgerites*" cf. *brancoi* (SOLGER), SUMMESBERGER, p. 147.
1987 *Forresteria (Forresteria)* cf. *brancoi* (SOLGER, 1904), IMMEL, p. 107.

Description: see WIEDMANN, 1979:42.

Discussion: WIEDMANN (1979) described a small specimen (D 20 mm) from layer d_2 of the Zöttbach

Figure 14. *Romaniceras (Romaniceras)* cf. *deverianum* (d'ORBIGNY, 1841). External suture of SA/1994/1 from Brandenberg; bar scale 10 mm.

section, Brandenberg. Ventrolateral and siphonal ornamentation recalls that of *Subprionocyclus*, but poor preservation renders the specimen indeterminate beyond subfamily in our view.

Occurrence: Upper Turonian of Brandenberg, Tyrol.

Subfamily Barroisiceratinae BASSE, 1947

Genus *Reesidites* WRIGHT & MATSUMOTO, 1954

Type species: *Barroisiceras minimum* (YABE ms) HAYASAKA & FUKADA, 1951:325, pl. 1, figs. 1–4, pl. 2, figs. 1–7.

Reesidites minimus (HAYASAKA & FUKADA, 1951)

(Plate 13, figs. 17, 19–30, text-figs. 15, 16)

Synonymy:

1935 *Muniericeras gosauicum* (HAUER), BRINKMANN, p. 5.
1951 *Barroisiceras minimum* YABE (ms.) HAYASAKA & FUKADA, p. 325, pl. 1, figs. 1–4, pl. 2, figs. 1–7.
? 1958 *Muniericeras lapparenti* GROSSOUVRE var, PARNES, p. 167, text-fig. 1.
1978 *Reesidites minimus* (HAYASAKA & FUKADA), TANABE, OBATA & FUTAKAMI, pl. 1, figs. 1, 2.
1982 *Muniericeras gosauicum* (HAUER), KOLLMANN & SUMMESBERGER, p. 31.
1982 *Reesidites minimus* (HAYASAKA & FUKADA), FUTAKAMI, pl. 1, figs. 1–3.
1982 *Reesidites minimus* (HAYASAKA & FUKADA), MATSUMOTO & OBATA, p. 80, pl. 5, fig. 2, pl. 6, fig. 1, text-fig. 3.
1987 *Reesidites minimus* (HAYASAKA & FUKADA), TANABE & FUKUDA, p. 41.
1987 *Muniericeras gosauicum* (v. HAUER), IMMEL, p. 96, pl. 9, fig. 5.
1988 *Reesidites minimus* (HAYASAKA & FUKADA), COBBAN & KENNEDY, p. 66, figs. 1–3 (with synonymy).
1990 *Reesidites minimus* (HAYASAKA & FUKADA), AMÉDRO, p. 270, pl. 25, fig. 4a–d, 5a–d (with synonymy).

Holotype: The original of HAYASAKA & FUKADA, 1951: pl. 1, figs. 1–4, from the Upper Turonian of the Ikushumbets area, Hokkaido, Japan; refigured by MATSUMOTO (1965: pl. 14, fig. 1a–d) and by KENNEDY, WRIGHT & KLINGER (1983: text-figs. 1 C, D, 2 E).

Material 21 specimens, from St. Wolfgang: NHMW 1992/245/1; NHMW/1992/247, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15; GBA 1976/03/1; GBA unregistered (2 specimens), SK/St.W./1982/1–4, about 50 unregistered fragments in the NHMW collection; from Gams: GBA 1935/01/33, the original of BRINKMANN, 1935:5, NHMW/1978/1954/5.

Description: Specimens from St. Wolfgang are preserved with white aragonitic shell, or with original nacre. One specimen (NHMW/1992/ 247/11, text-figs. 15, 16, pl. 13, fig. 30) is preserved as a limonitic internal mould with sutures visible. One of the specimens from Gams (GBA/1935/01/33, pl. 13, fig. 21) bears original nacre, the other one (NHMW/1978/1954/5, pl. 13, figs. 28, 29) white chalky shell. All specimens have suffered post mortem crushing. The larger specimens from St. Wolfgang are up to 28 mm diameter, one exceeds 40 mm (not figured, NHMW unreg-

istered), the smallest is 13 mm in diameter. NHMW 1992/245/1 has D 28,5, Wh 14, U 7, U% 24,5. A specimen from Gams has D 45, Wh 21, U 8,4, U% about 18,6.

The whorl section cannot be determined because of post-mortem crushing, but seems to have been very compressed. Coiling is moderately involute, with about two thirds of the previous whorl covered. The umbilicus is relatively wide and shallow, the umbilical wall low and vertical. Flattening of the flanks is exaggerated by compaction. The whorl height increases rapidly. About 17 ribs arise from small but distinct umbilical tubercles, divide into twos or threes, cross the flank in a falcoid curve, ending in ventrolateral clavi, about 40 per whorl with a similar number of siphonal clavi. The ribs are broader than the interspaces, the rib section rounded. Ribs first appear at a diameter of about 3 mm, earlier whorls are smooth. The keel is narrow and fastigiate, siphonal clavi sometimes weaken to mere crenulations (pl. 13, figs. 21, 22), while in other specimens the keel is coarsely serrated (pl. 13, figs. 19, 20). There is limited intraspecific variation. GBA 1967/03/1, a small specimen (pl. 13, fig. 25), is coarsely ribbed, with wide interspaces. The specimen from Gams (pl. 13, fig. 21) has (possibly due to its larger size) weak ribs with only a few prominent ones that arise from distinct tubercles.

The suture is preserved in NHMW 1992/247/11 only, at a diameter of 3,5 mm approximately (text-figs. 15, 16). The left side shows a pattern like that of individuals of comparable size from Japan (OBATA, 1965: text-figs. 10, 11), the right side is pathological.

Discussion Specimens from Japan (e.g. MATSUMOTO, 1965: pl. 14 (holotype), 15) are more than twice the size of those from Austria. TANABE, OBATA & FUTAKAMI (1978: pl. 1) figure a large sample of small Japanese specimens, which they interprete as juveniles (p. 46), OBATA (1965:50) interpreted specimens below 40 mm diameter as juveniles. More recently MATSUMOTO & OBATA (1982:82) discussed dimorphism in the species, regarding the majority of small individuals as microconchs, the few large ones as macroconchs. We cannot tell if the Austrian specimens are microconchs or juveniles.

Figure 15. Irregularly shaped pathological external suture of a juvenile *Reesidites minimus*, NHMW/1992/247/11 from St. Wolfgang; bar scale 10 mm.

Reesidites subtuberculatus (GERHARDT, 1897:156, pl. 3, fig. 12) has generally weaker ornament, the ribs straighter and less flexuous than in *R. minimus*. *R. latus* MATSUMOTO & OBATA (1982:82, pl. 6, fig. 2) is coarser ribbed and more evolute. *R. lornae* (van HOEPEN, 1968, see KENNEDY, WRIGHT & KLINGER, 1983:247) is more inflated with a less distinctive ventrolateral shoulder and is also more evolute. *R. elegans* MATSUMOTO & INOMA in MATSUMOTO, 1971 (pl. 23, figs. 1–3, text-figs. 5–7) is finer ribbed than *R. minimus*.

Juveniles of *B. haberfellneri* (pl. 13, figs. 1–11) are similar in ornamentation to the larger specimen from Gams.

The single row of ventrolateral tubercles separates *Reesidites* clearly from *Subprionocyclus* which MATSUMOTO (1971:141) and KENNEDY, WRIGHT & KLINGER (1983:243) believed to be the ancestor of *Reesidites*.

Reesidites minimus and *B. haberfellneri* seem to be closely related; the latter may be an offshoot of the former, as discussed below.

Occurrence: *Reesidites minimus* was originally described from the Ikushumbets area of Hokkaido, Japan (HAYASAKA & FUKADA, 1951:325). It occurs abundantly in the Manji area of Hokkaido in the top 25 metres of the Upper Turonian, where it is accompanied by *S. neptuni* (TANABE, OBATA & FUTA-

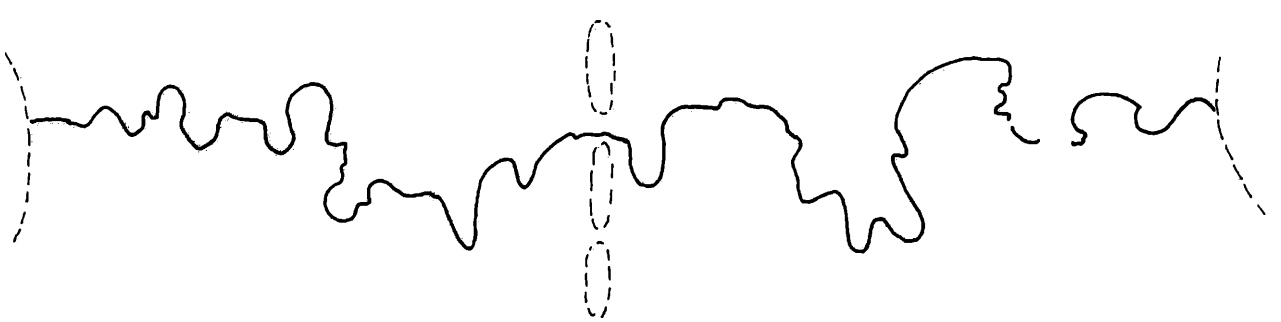


Figure 16. External suture of *Reesidites minimus*, NHMW 1992/247/11 from St. Wolfgang, pathological (right) and normal (left) suture of the same chamber. Enlarged ca. x 25.

KAMI, 1978: fig. 2). In the Ikushumbets area *R. minimus* occurs approximately 15 metres above *Subprionocyclus normalis*, about 20 metres below the tentative Turonian/Coniacian boundary and about 40 metres below the first occurrence of *Inoceramus rotundatus* (MATSUMOTO, 1984: fig. 2). This is the upper part of the *S. neptuni* Zone (MATSUMOTO, 1984: tab. 1). MATSUMOTO (1977 b:65, fig. 1) and HANCOCK, KENNEDY & WRIGHT (1977:165, tab. 1) introduced the zone of *Reesidites minimus* for the top Turonian, above the zone of *Subprionocyclus normalis.*

R. minimus is recorded also from Armenia (ATABEKIAN & AKOPIAN, 1972:7), and the Upper Turonian *Scaphites whitfieldi* and *Scaphites ferronensis* Zones in New Mexico, USA (COBBAN & KENNEDY, 1988: 65). In Tunisia (AMÉDRO, 1990:271, fig. 13) *R. minimus* was found in the top Turonian "*Prionocyclus* interval" which corresponds to the zones of *Prionocyclus wyomingensis, Scaphites whitfieldi* and *Prionocyclus quadratus* of North America. It is recorded here for the first time from the European Cretaceous. It co-occurs with *Barroisiceras haberfellneri* (HAUER) and *Didymotis costata* (FRIC) in the Gosau-group of the Gams basin (Steiermark) and St. Wolfgang (Upper Austria). The "Santonian" age of the latter locality (KOLLMANN & SUMMESBERGER, 1982:31) was based upon the erroneous identification of *R. minimus* as *Muniericeras.*

Genus *Barroisiceras* DE GROSSOUVRE, 1894

Subgenus *Barroisiceras (Barroisiceras)* DE GROSSOUVRE, 1894

Type species: *Ammonites haberfellneri* HAUER, 1866 by subsequent designation of SOLGER, 1904:163.

Discussion: KENNEDY, WRIGHT & KLINGER (1983:247) already stressed the close relation between *Reesidites* and *Barroisiceras.* Reasons for keeping the genera separate are the wide range of variation of *Barroisiceras* in its type area and the rather narrow variation of *Reesidites.* MATSUMOTO & OBATA (1982:82) discussed, whether *Reesidites* should be assigned to Collignoniceratinae or Barroisiceratinae: "In the latter case Barroisiceratinae would have proved to appear in the latest Turonian". Taking into account the co-occurrence of *Reesidites* and *Barroisiceras* in the Upper Turonian of the Gosau group, *R. minimus* could be the first representative of the Barroisiceratinae and the genus *Barroisiceras* may be an offshoot of *R. minimus.* Juveniles of *B. haberfellneri* recalling the feature of *Reesidites* support the idea. Comparison of sutures of *Reesidites* and *Barroisiceras* (see KENNEDY, WRIGHT & KLINGER, 1983: figs. 2A–C, E) together with their co-occurrence at St. Wolfgang and Gams leads to the conclusion that the presumed evolutionary lineage from *Subprionocyclus* to *Reesidites* (MATSUMOTO, 1969:299, KENNEDY, WRIGHT & KLINGER, 1983:243) continued into *Barroisiceras.* In the Gosau succession the last representatives of *Barroisiceras* disappeared at the same level as the last occurrences of *Didymotis,* and were succeeded by *Forresteria,* a close ally and presumed descendent of *Barroisiceras.* The lineage that began possibly with *Cibolaites* in the Upper Cenomanian and Lower Turonian followed by *Collignoniceras* and *Lecointriceras* in the mid Turonian ended with *Forresteria* in the mid Coniacian. The striking feature of these genera is their high degree of morphological variability (BASSE, 1947; KENNEDY, WRIGHT & KLINGER, 1983; KENNEDY, 1984).

Barroisiceras (Barroisiceras) haberfellneri HAUER, 1866

(Plate 3, figs. 6, 7, pl. 5, figs. 1–10, pl. 6, figs. 1–5, pl. 7, figs. 4–6, pl. 8, figs. 1–8, pl. 9, figs. 1–8; pl. 10, figs. 1–11, pl. 11, figs. 1–15, pl. 12, figs. 1–6; pl. 13, figs. 1–4, pl. 16, figs. 1–16, 18, text-figs. 17, 18 A–D, 19 A–G, 20 A–C, 21 A–C, 22)

Synonymy:

1866 *Ammonites Haberfellneri* von HAUER, p. 2, pl. 1, figs. 1–5.

1873 *Ammonites Haberfellneri* HAUER, REDTENBACHER, 1873, p. 101, pl. 23, figs. 2a–d.

1873 *Ammonites Päon* REDTENBACHER, p. 103, pl. 23, figs. 3a–e.

1873 *Ammonites* spec. indet., REDTENBACHER, p. 116, pl. 26, fig. 4.

non 1894 *Barroisia haberfellneri* F. v. HAUER, GROSSOUVRE, p. 51, pl. 1, fig. 1–5, pl. 2, figs. 1–5, 7–8 (= *Forresteria (Harleites) petrocoriensis* COQUAND 1859, pl. 2, fig. 6 (= *Metatissotia desmoulinsi* DE GROSSOUVRE, 1894).

1925 *Barroisiceras haberfellneri* v. HAUER, DIENER, p. 143.

non 1929 *B. haberfellneri* v. Hauer, BARRABÉ, p. 176 (= *B. onilahyense* BASSE).

non 1930 *Barroisiceras haberfellneri* V. HAUER, LOMBARD, p. 298, pl. 31, figs. a, b (= *Basseoceras congoensis* (LOMBARD) fide: KENNEDY, 1985, p. 220).

1935 *Barroisiceras haberfellneri* v. HAU, BRINKMANN, p. 3: St. Wolfgang, Ofenwand b. Strobl–Weißenbach, Weidringer Alpe b. Strobl, p. 5: Gams, lectotype.

1935 *Barroisiceras haberfellneri* v. HAU. var. *harléi* GROSS, BRINKMANN, p. 3 (St. Wolfgang).

1935 *Barroisiceras alstadenense* SCHLÜT., BRINKMANN, p. 5 (Gams).

1935 *Placenticeras orbignyanum* GEIN., BRINKMANN, p. 5 (Gams).

non 1935 *Barroisiceras haberfellneri* v. HAU. var *harléi* GROSS., BRINKMANN, p. 4 (Nefgraben, = ? " *Hemitissotia" randoi* GERTH).

non 1935 *Barroisiceras haberfellneri* v.HAU., BRINKMANN, p. 5 (Scharrergraben b. Piesting = *Placenticeras* cf. *polyopsis* (DUJARDIN).

non 1939 *Barroisiceras haberfellneri* v. Hauer, BASSE, p. 41 (= *Forresteria (Harleites) nicklesi* GROSSOUVRE, KENNEDY, 1984, p. 58).

1947 *Barroisiceras haberfellneri* VON HAUER, BASSE, p. 114 (with synonymy).
1955 *Barroisiceras haberfellneri hemitissotiformis* PLÖCHINGER, p. 203, pl.1, figs. 1, 2, text-figs. 1b, 2c.
1955 *Barroisiceras haberfellneri* v.Hauer, PLÖCHINGER, p. 203, pl. 1, figs. 3, 4, text-figs. 1a, 2a, b.
non 1955 *B. haberfellneri* HAUER var. *armenica* EGOJAN, p. 249, pl. 1, figs.1, 2.
non 1956 *Barroisiceras haberfellneri* var. *herlei* GROSS. (sic!), GERTH: p. 437 (= ? "*Hemitissotia*" *randoi* GERTH)
? 1956 ? *Barroisiceras (Barroisiceras) haberfellneri* (von Hauer), BENAVIDES-CÁCERES, p. 476, pl. 57, figs. 6–7.
1957 *Barroisiceras (Barroisiceras) haberfellneri* (HAUER), WRIGHT, p. L432, fig. 551/5a.
non 1957 *Barroisiceras haberfellneri*, WRIGHT, p. L128 (= *Forresteria (Harleites) petrocoriensis* (COQUAND)).
1958 *Barroisiceras (Barroisiceras) haberfellneri haberfellneri* (VON HAUER), REYMENT, p. 45, pl. 9, fig. 2, pl. 12, figs. 2a, b, text-fig. 6/2.
1958 *Barroisiceras (Barroisiceras) haberfellneri paeon* (REDTENBACHER), REYMENT, p. 47, pl. 12, fig. 1a, b, text-fig. 6/1.
? 1960 *Barroisiceras* cf. *haberfellneri* (HAUER), WIEDMANN, p. 719.
non 1960 *Barroisiceras haberfellneri* (Hauer), TOLLMANN, p. 134, 136 (= *Scaphites* sp.).
non 1961 *Barroisiceras haberfellneri* v. HAUER, PLÖCHINGER, p. 371 (Scharrergraben/Piesting = *Placenticeras* cf. *polyopsis* (DUJARDIN)).
non 1961 *Barroisiceras* cf.*haberfellneri* v. HAU., GERTH, p. 130, pl. 24, fig. 5 (= *Ammonites* sp. indet., not seen).
non 1961 *Barroisiceras haberfellneri* (v.HAU.), GERTH: p. 141 (= ?, not seen).
1964 *Barroisiceras (Barroisiceras) haberfellneri* HAUER, KOLLMANN, p. 90.
? 1964 *Tissotia (Hemitissotia) ewaldi* (BUCH), KOLLMANN, p. 90.
1964 *Barroisiceras haberfellneri hemitissotiformis* PLÖCHINGER, p. 26.
? 1964 *Barroisiceras* cf. *haberfellneri* (HAUER), WIEDMANN, p. 114.
1976 *Gauthiericeras* cf. *propoetidum* (REDTENBACHER), STOJASPAL & LOBITZER, p. 116.
1978 *Barroisiceras onilahyense* AKOPIAN **non** BASSE 1947, AKOPIAN, p. 73.
non 1981 *Barroisiceras haberfellneri haberfellneri* (Hauer), SZÁSZ: 108, pl. 10, fig. 2a, b (= *Tissotioides haplophyllus* (REDTENBACHER, 1873).
non 1981 *Barroisiceras haberfellneri* (Hauer), GALE & WOODROOF, pl. 1, fig. 4.
non 1981 *Barroisiceras haberfellneri* (Hauer), GALE & WOODROOF, pl. 1, figs. 1a–c, 2a–c (*Forresteria (Harleites) petrocoriensis* (COQUAND)).
non 1982 *Barroisiceras haberfellneri* (HAUER), KOLLMANN & SUMMESBERGER, p. 59 (= "*Hemitissotia*" *randoi* GERTH).
1983 *Barroisiceras haberfellneri* (VON HAUER, 1866), KENNEDY, WRIGHT & KLINGER, p. 244, fig. 1A.
1983 *Barroisiceras haberfellneri paeon* (REDTENBACHER, 1873) KENNEDY, WRIGHT & KLINGER, p. 245, fig. 2D.
1984 *Barroisiceras haberfellneri* (VON HAUER, 1866), KENNEDY, p. 52, 56, text-figs. 17A–E.
1984 *Ammonites paeon* REDTENBACHER, KENNEDY, p. 56, text-fig. 17D, E.
1985 *Barroisiceras haberfellneri* (HAUER), SUMMESBERGER, p. 149, tab. 2.
1987 *Barroisiceras haberfellneri* (V.HAUER), IMMEL, p. 106, pl. 10, fig. 7.
1987 *Barroisiceras hemitissotiformis* PLÖCHINGER, IMMEL, p. 45, 107.
1994 *Hourcquia* sp., SUMMESBERGER, p. 65.

Lectotype GBA 3464, the original of HAUER, 1866 (pl. 1, fig. 1, 2), subsequently designated by REYMENT, 1958:46; refigured by REDTENBACHER, 1873: pl. 23, fig. 2c, by WRIGHT, 1957: fig. 551/5a, by REYMENT, 1958: pl. 12, fig. 2a,b; text-fig. 6/2, by GALE & WOODROOF, 1981: pl. 1, fig. 4), by KENNEDY, WRIGHT & KLINGER, 1983: fig. 1 A and by KENNEDY, 1984: text-fig. 17 A, C; refigured here again (pl. 5, fig. 1, 2) after removal of matrix from the umbilicus.

Other figured specimens:

A) GBA 1873/01/8, the original of REDTENBACHER, 1873 (pl. 23, fig. 2b) (pl. 5, fig. 10).
B) GBA 3481, the lectotype of *Ammonites päon* REDTENBACHER, 1873 (pl. 23, fig. 3c, d, e) (pl. 5, figs. 4, 5).
C) GBA 1873/01/9, paralectotype of *Ammonites päon* REDTENBACHER, 1873 (pl. 23, ig. 3a, b) (pl. 5, figs. 6, 7).
D) PIUW, REDTENBACHER collection Nr. 25, the original of *Ammonites* sp. indet. (REDTENBACHER, 1873: pl. 26, fig. 4) (pl. 9, fig. 8).
E) GBA 1955/4/1, the holotype by monotypy of *B. haberfellneri hemitissotiformis* PLÖCHINGER (1955, pl. 1, fig. 1, 2) (pl. 6, fig. 3, 4, 5).
F) GBA 1955/4/2, the original of PLÖCHINGER, 1955 (pl. 1, fig. 3, 4) (pl. 5, figs. 8, 9).

Missing originals: HAUER, 1866: pl. 1, figs. 3, 4. REDTENBACHER, 1873: pl. 23, fig. 2a.

Additional material NHMW collection: Strobl/Weißenbach: NHMW 1988/1/7, 8, 9, 11–14, 17, 18, 20, 27; NHMW 1992/137/3–5; NHMW 1992/138/3–5; NHMW 1992/139/1; NHMW 1996/32/2,3. – St. Wolfgang: NHMW/1992/246/1; NHMW/1992/247/1,2,3; NHMW collection (Gams, old collections). – SKOUMAL collection: Strobl/Weißenbach: SK/W/1983/1, 2, 3, 4, 5–9, 10, SK/W/1984/11, 12, 13, SK/W/1988/16, 18a, b, c, d; SK/W/1988/17; SK/W/1989/26; two specimens without visible numbers. SK/W/1993/30–39, 41, 42 (14 specimens) Brennetgraben, 3 km NE of Bad Ischl. SK/BG/1994/1, 2, 4, 5, 6, 7, 8, 9 and 3 non registered specimens. Randograben/Neualpe: SK/Ra/1993/125. – JOA 6111 (HILBER collection). GBA 1976/03/3 (Brennetgraben, 3 km NE of Bad Ischl). GIUW 1864/65/II.1 (Weidringer Alpe), GIUW unregistered (?Strobl /Weißenbach). PIUW, REDTENBACHER collection/24, 25. – SCHÜSSLER collection – Leoben, Steiermark: One specimen: Inv. Nr.49/63. (NE Langriedler, Gams basin, Steiermark, text-fig. 8) and many unregistered fragments.

General description: *B. haberfellneri* (HAUER 1866) is a highly variable species, varying throughout ontogeny and in shape and sculpture of individuals of comparable size. There are both compressed and stout, inflated individuals. Ornament varies from weak and near-smooth to coarse, and the material can be described in terms of 4 morphological groups (see below). Transitions between the groups indicate that but a single species is present and that differences are not due to sexual dimorphism. The umbilicus is generally small and deep with a vertical umbilical wall. All variants have distinct ventrolateral shoulders, a narrow venter and narrow keel. 5–10 prominent umbilical bullae give rise to broad, weak to strong ribs, each bearing a distinct ventrolateral clavus (22 to approximately 40 per whorl), and a corresponding number of siphonal clavi. Ornament weakens on adult body chambers, where ribs, tubercles and keel disappear, leaving individuals virtually smooth. The suture is highly variable too. E/L is broad and asymmetrically bifid, L/U_2 bifid but narrower, L broad and shallow, or deep (e.g. text-fig. 19 E). Denticulations are generally short and irregular.

Group 1: Pl. 7, figs. 4–6, pl. 8, pl. 9. Flat-sided, slender, umbilicus initially narrow, becoming wider in later ontogenetic stages; venter fastigiate. Keel varies from undulose (pl. 9, fig. 2) to entire (pl. 9, figs. 4, 5, 6) and persists to maturity, as do well-marked ventrolateral shoulders, which are present throughout the the adult body chamber. Tiny umbilical tubercles (about 10/whorl) give rise to near-invisible ribs each terminating in distinct but weak ventral clavi, 33 per whorl. At maturity a few bullae are present at the umbilical shoulder, and give rise to strong fold-like ribs, which efface at mid flank (pl. 7, fig. 4, pl. 9, fig. 3). Extreme variants are smooth (pl. 8, figs. 3, 4, pl. 9, figs. 4, 5).

Material: From Strobl/Weißenbach: NHMW/1988/8, 9, 12, NHMW/1992/138/2; SK/W/1983/2, 3; SK/W/1986/15, SK/W/1988/21, 22, 34, 35 and the juvenile SK/W/1984/12. From Gams:PIUW/Coll. REDTENBACHER/25 and GITW/ unregistered. This specimen, erroneously identified as *Placenticeras orbignyanum* GEIN. by BRINKMANN (1935:5) is now in the PIUW Collections. Two individuals from St. Wolfgang (NHMW 1992/247/2, 3; pl. 14, figs. 14, 18) and one from Gams (PIUW/Coll. REDTENBACHER/24, pl. 9, fig. 3) are passage forms to group 2, as umbilical tubercles are present and ribs extend over the whole of the flank. The keel of these specimens is serrated. One specimen (VSEGEI 231/2–1960) is from the Vedi region of the Caucasus.

Measurements:

Specimen (group 1)	D	Wh	Wb	U	U%
NHMW/1988/1/9	99,2	48,9	—	13,1	13,2
NHMW/1996/32/3	74,8	38,8	—	8,4	11,2
NHMW/1988/1/12	46,8	25,4	10,2	4,5	9,6
PIUW/coll. REDT. 24	60,8	33,1	—	5,7	9,4
PIUW/ex coll.TU/1872	58,3	28,3	12,2	4,8	8,2
NHMW/1996/32/2	88,2	46,5	—	10,4	11,7
NHMW/1988/1/10	81,8	45,6	25,0	9,2	11,2

Group 2: Pl. 5, figs. 1–3, 6–10, pl. 6, figs. 1–5. This group includes individuals with ornamented phragmocones. Umbilicus narrow when young (e.g. the lectotype, pl. 5, figs. 1, 2) changing with age from the original logarithmic spiral to scaphitoid growth. Whorl section slightly inflated, umbilical shoulder narrowly rounded, ventrolateral shoulder pronounced, venter fastigiate. 5–7 strong umbilical bullae per whorl give rise to broad low ribs that usually arise in pairs. Most intercalated ribs arise close to the umbilical shoulder. Ribs straight or slightly prorsiradiate on inner flank, flexing gently backwards at mid flank and forward again on the outer third of the flank. They are narrow at the umbilical shoulder, but broaden across the flank. All ribs bear distinct to strong sometimes slightly oblique ventrolateral and siphonal clavi, the latter borne on a sharp siphonal keel.

Ornament weakens on the adult bodychamber (pl. 6, fig. 2) or disappears, leaving only growth lines, as in the holotype of *B. h. hemitissotiforme* PLÖCHINGER (pl. 6, fig. 3). The flanks of the adult body chamber become inflated.

Material The lectotype of *Ammonites haberfellneri* (refigured here as pl. 5, figs. 1, 2), the holotype of *Barroisiceras haberfellneri hemitissotiforme* PLÖCHINGER (1955: pl. 1, fig. 1, 2; refigured here: pl. 6, figs. 3–5), recently (1983–1994) collected material from the Strobl/Weißenbach locality "Ofenwand" (e.g. pl. 6, fig. 1, 2), and St. Wolfgang (e.g. pl. 14, figs. 12–18), many fragments from Gams (e.g. pl. 5, figs. 6, 7), the specimen figured by IMMEL (1987: pl. 10, fig. 7) and a specimen from the Neualpe (pl. 5, fig. 3).

Measurements:

Specimen (group2)	D	Wh	Wb	U	U%
GBA 3464 (lectotype)	62,6	31,1	—	8,0	12,8
SK/1993/12	38,8	16,6	—	9,5	—
GBA/1955/4/1	112	55	26	18	16
NHMW/1992/138/1	99,4	47,6	26	18,3	18,4
GBA/1955/4/2	50	25	14	10	20
NHMW/1988/1/7	79	38,5	—	15,8	20

Group 3: Pl.10, figs. 1–5, 8–11, pl. 11, figs. 1–15.

Material: NHMW 1992/138/1, 4; NHMW 1992/139/1; NHMW/1988/1/7, 18, 20; SK/W/1983/4, 9; SK/W/1984/13; SK/W/1988/16, SK/W/1993/33; GIUW 1864/65/II/1; GIUW/1888/unregistered.

Description: Stout, coarsely ornamented individuals, with inflated whorl section. Umbilicus very deep with vertical wall. Ornament strong. 5–6 very strong umbilical tubercles per whorl give rise to two or three broad and coarse ribs. Ventrolateral nodes are

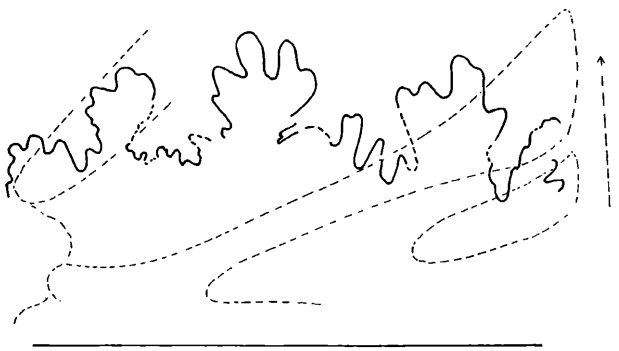


Figure 17 External suture of *Barroisiceras haberfellneri* (HAUER, 1866) from St. Wolfgang, parking area no.3; NHMW/ 1992/247/1; bar scale 10 mm.

tubercles rather than clavi. Keel serrated even in large individuals. Some individuals are markedly hypernodose.

Individual specimens with additional features occur: NHMW 1988/1/13 (not figured) is more inflated on the visible part of the delicately ornamented inner whorls, while NHMW 1988/1/18 (pl. 11, fig. 7) has very prominent umbilical tubercles but relatively weak ribs.

Measurements:

Specimen (group3)	D	Wh	Wb	U	U%
SK/W/1993/33	88,4	47,8	25	14,5	16,4
NHMW/1988/1/20	29,2	18,3	16,4	4,4	15,0
NHMW/1992/138/4	50	27	25	9	18

Group 4: Pl. 3, fig. 7, pl. 5, fig. 4, 5; pl. 12, figs. 1–5.

M a t e r i a l : 7 specimens (GBA 1873/01/9, the lectotype of *Ammonites päon* REDTENBACHER, 1873, SK/ 1988/17, SK/W/1984/11/a, b, c; SK/W/1993/32, 38).

D e s c r i p t i o n : This group is characterized by a rather wide umbilicus combined with coarse sculpture. There are transitions to groups 2 and 3. The lectotype of *Ammonites päon* REDTENBACHER, 1873 (refigured here as pl. 5, figs. 4, 5) belongs to this group.

An extreme variant is SK/1988/17 (pl. 3, fig. 6, 7, text-fig. 20 C) from the "Ofenwand" site (SWP_2, Strobl/ Weißenbach), initially thought to be a *Hourcquia* sp. (SUMMESBERGER, 1994:65). Three whorls are visible, with about two thirds of the preceding whorl covered. The keel is initally serrated, entire on the body chamber, and weakening towards the aperture. There are indistinct furrows on both sides. The umbilicus is shallow with an oblique umbilical wall. On the inner whorls 8–10 coarse umbilical tubercles per whorl give rise to shallow broad and prorsiradiate ribs. Primary ribs and rare intercalatories end in a coarse clavus at the ventrolateral shoulder, 18 approximately on the last whorl. Ribs weaken at mid flank but coarsen into the outer ventrolateral clavi. Ornament weakens on the body chamber. The suture (text-fig. 20 C) is incomplete; E is missing due to crushing.

Measurements:

Specimen (group4)	D	Wh	Wb	U	U%
SK/W/1993/38	72	40,7	23	15,4	21,4
SK/W/1993/32	64,4	28,0	–	12,7	19,7
SK/W/1988/17	113,1	51,2	22	28,9	25,5
GBA/1873/01/9	74	32,6	19,3	17,9	24,2
NHMW/1988/1/11	95,0	45,4	–	18,5	19,5

None of the measurements are meaningful, due to crushing.

J u v e n i l e s There are a number of juveniles from localities SWP_1 and SWP_5 in the Strobl/Weißenbach area. From D 12 to D 50 mm specimens already show considerable variation. All are slender, with a narrow umbilicus surrounded by distinct umbilical tubercles. SK/W/1983/5 (not figured) is hypernodose, NHMW 1992/137/4 (pl. 23, figs. 7–10) is more densely ornamented than the others. Some are relatively smooth. SK/W/1984/12 (pl. 9, fig. 7) has tiny umbilical tubercles and a serrate keel, but ribs are not developed.

P a t h o l o g i c s p e c i m e n s NHMW 1988/1/11 (pl. 6, fig. 5) has normal ornament until a diameter of 82 mm. On the initial part of the bodychamber ribs are strongly bent backwards from midflank to ventrolateral shoulder. Venter and keel are not preserved.

NHMW 1992/138/2 (pl. 12, fig. 6) is a normally ornamented specimen with laterally displaced siphonal lobe and in consequence deformed external suture on both flanks (text-fig. 22).

D i s c u s s i o n : BASSE (1947:114/115) noted that at that time all records of *B. haberfellneri* with exception of the Gosau specimens were either doubtful or misidentifications.

Forresteria (Harleites) petrocoriensis (COQUAND, 1859), which is the index species of the basal Coniacian *petrocoriensis* Zone in France (KENNEDY, 1984: 58), was confused with *B. haberfellneri* (HAUER) for 90 years (GROSSOUVRE, 1894:51; see KENNEDY, 1984:49).

Barroisiceras onilahyense BASSE (1947:100 (4), pls. 1–5; pl. 6, figs. 1–4; pl. 7, fig. 1, 1a; pl. 8, figs. 1, 2) (pl. 7, figs. 1–3; l.15, figs. 1–5) seems to be a close ally. The high variability recognized in the species was based upon a study of 300 specimens. As the variability of *B. haberfellneri* is now better known, the close similarity between the two species is confirmed. Variation in ornament is comparable to that of *B. haberfellneri*: from flat-sided to stout, from smooth to coarse-ribbed or spinose, and there is an overlap in general features and ornamentation. Our reasons for keeping the species separate are: the generally wider umbilicus of *B. onilahyense*, that large individuals of *B. onilahyense* seem to be more inflated (pl. 7, figs. 1–3), while the serrated keel of the latter species extends onto large adult bodychambers (pl. 7, fig. 3). COLLIGNON (1965b: pl. 445, fig. 1818) included large adult individuals with wide umbilicus and very coarse ornament

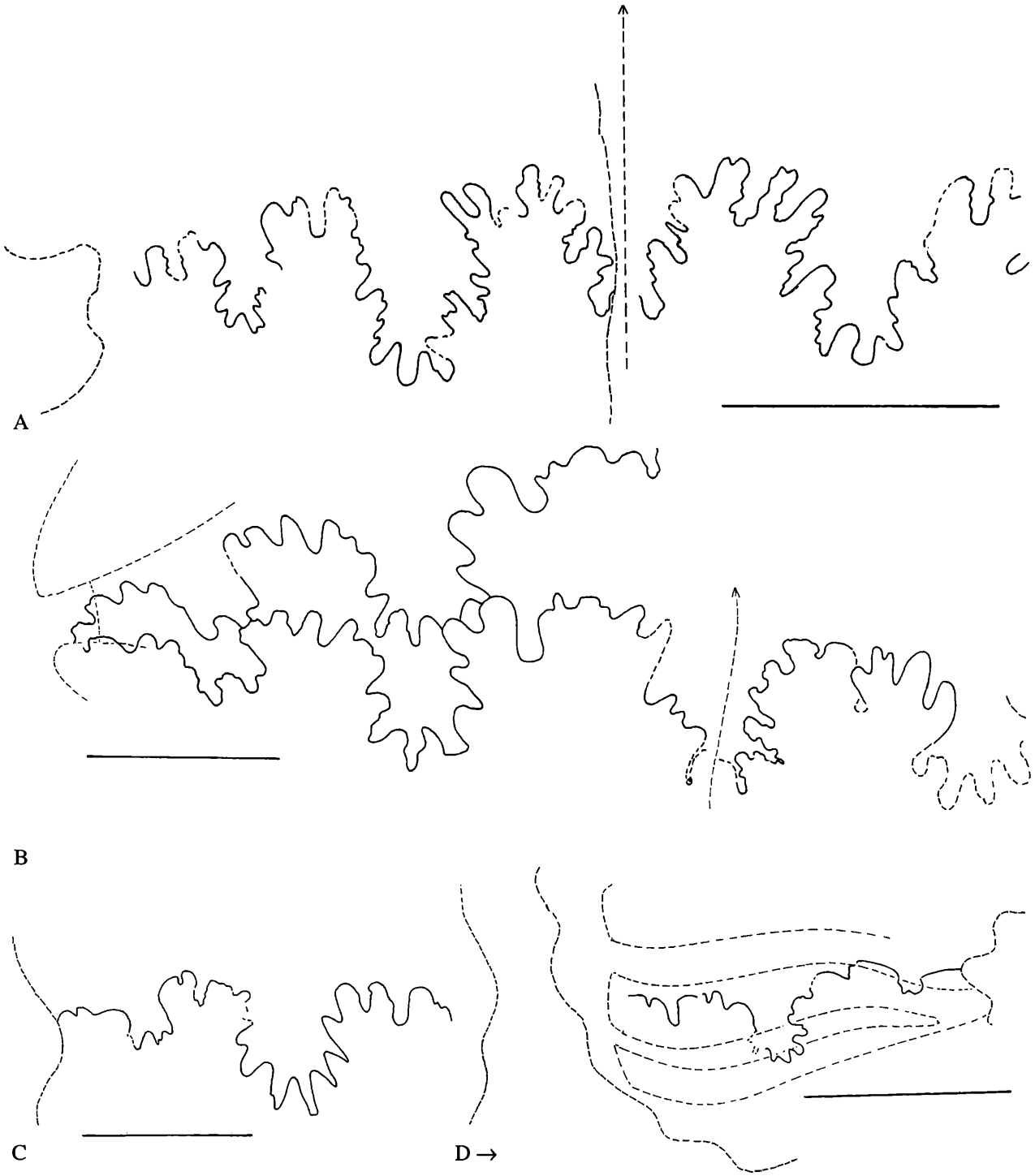


Figure 18. *Barroisiceras haberfellneri* (HAUER 1866).
External sutures. A. GBA 3464, the lectotype, original of HAUER 1866 (pl. 1, fig. 1, 2); B. GBA 3481, the lectotype of *Ammonites päon* REDTENBACHER (1873); original of pl. 23, fig. 3c, d, e). C. GBA 1955/4/1, the holotype of *B. haberfellneri hemitis sotiformis* PLÖCHINGER (1955: pl. 1, figs. 1, 2); D. GBA 1955/4/2, the original of PLÖCHINGER (1955: pl. 1, fig. 3, 4). Bar scale 10 mm.

in *B. onilahyense* BASSE. It must be admitted that individuals of one species could be referred to the other, although population structures are different. *B. onilahyense* was said by BASSE (l.c.: 109) to be a Lower Coniacian species whereas COLLIGNON (1965b:68) reported *B. onilahyense* from the "Coniacien moyen. Zone à *Kossmaticeras Theobaldi* et *Barroisiceras onilahyense*". Additional research is necessary to define the age of *B. onilahyense* in Madagascar.

Barroisiceras iberiense BASSE (1947:118, pl. 6, fig. 7, 7a; pl. 7, fig. 2, 3) is a poorly known species. WIEDMANN (1964:114, 115, 116) recorded *Barroisiceras (Texasia) iberiense* (BASSE) in Spain in the Upper Coniacian together with *Protexanites bourgeoisi* (d'ORB.) and *Gauthiericeras*: *Texasia* is a muniericeratid and we are uncertain even as to the generic identity of the Spanish species.

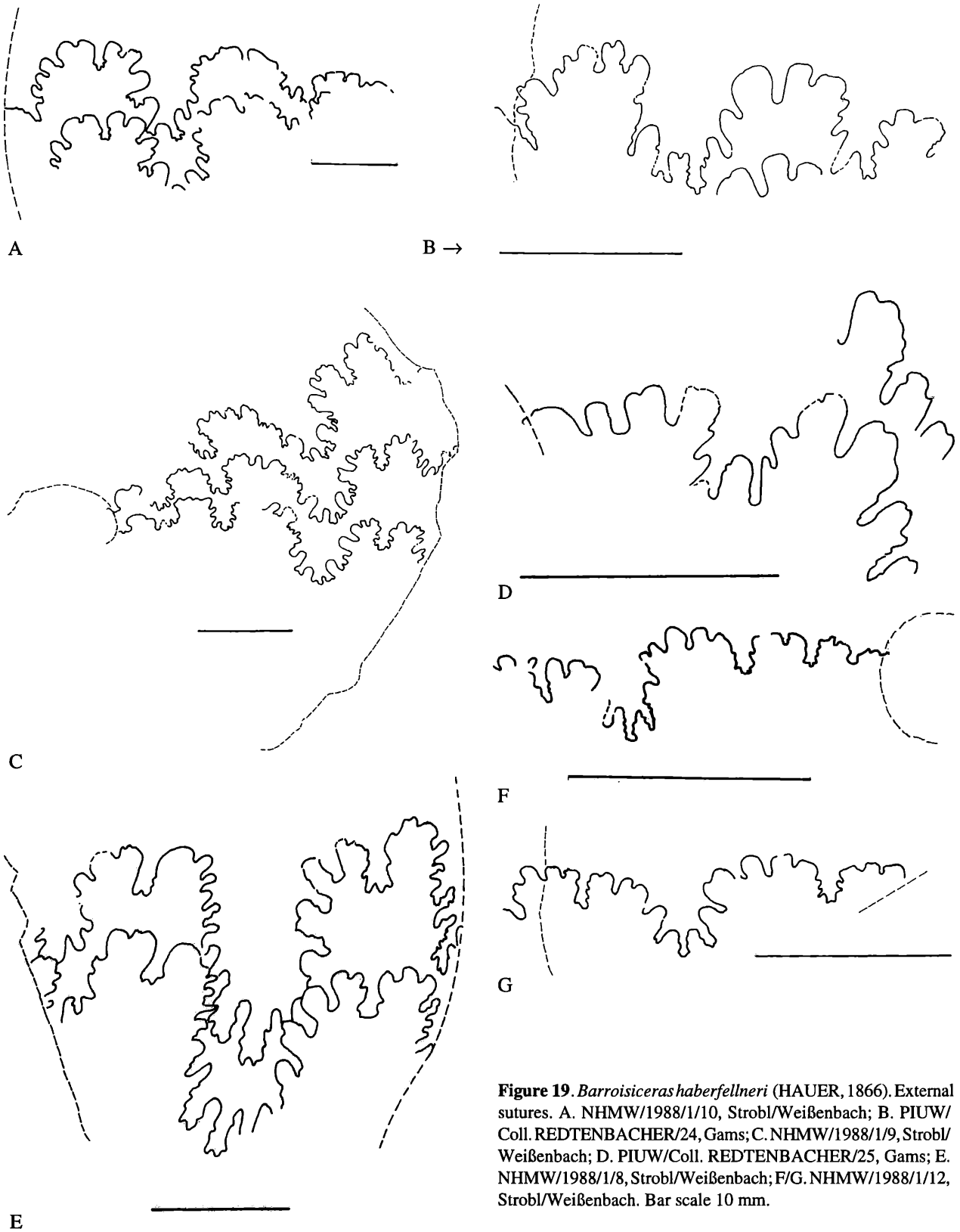


Figure 19. *Barroisiceras haberfellneri* (HAUER, 1866). External sutures. A. NHMW/1988/1/10, Strobl/Weißenbach; B. PIUW/Coll. REDTENBACHER/24, Gams; C. NHMW/1988/1/9, Strobl/Weißenbach; D. PIUW/Coll. REDTENBACHER/25, Gams; E. NHMW/1988/1/8, Strobl/Weißenbach; F/G. NHMW/1988/1/12, Strobl/Weißenbach. Bar scale 10 mm.

Barroisiceras neqarotense PARNES (1964:16, pl. 2, fig. 1–6; pl. 4, fig. 3, text-fig. 4a–c, i, m), a Coniacian species from the Negev (Israel), differs from *B. haberfellneri* by its rather simple suture.

'Barroisiceras' romieuxi PERVINQUIÈRE (1907:383, pl. 12, fig. 12 a, b, text-fig. 146) from the Lower Senonian of Tunisia differs by its regular prorsiradiate ribbing persisting to large size; it recalls certain *Forresteria* species e.g. *F. (F.) brancoi* (SOLGER, 1904).

Subbarroisiceras mahafalense BASSE (1946:71, pl. 2, fig. 1a, b) was described from the base of the "gisement d'Eboro-sur-Onilahy" (Madagascar) where it co-occurs with abundant *B. onilahyense* (BASSE, l.c.: 73). According COLLIGNON (1965b:69) it occurs in the Middle and Upper Coniacian. It was separated from other Barroisiceratinae on the basis of its inflated

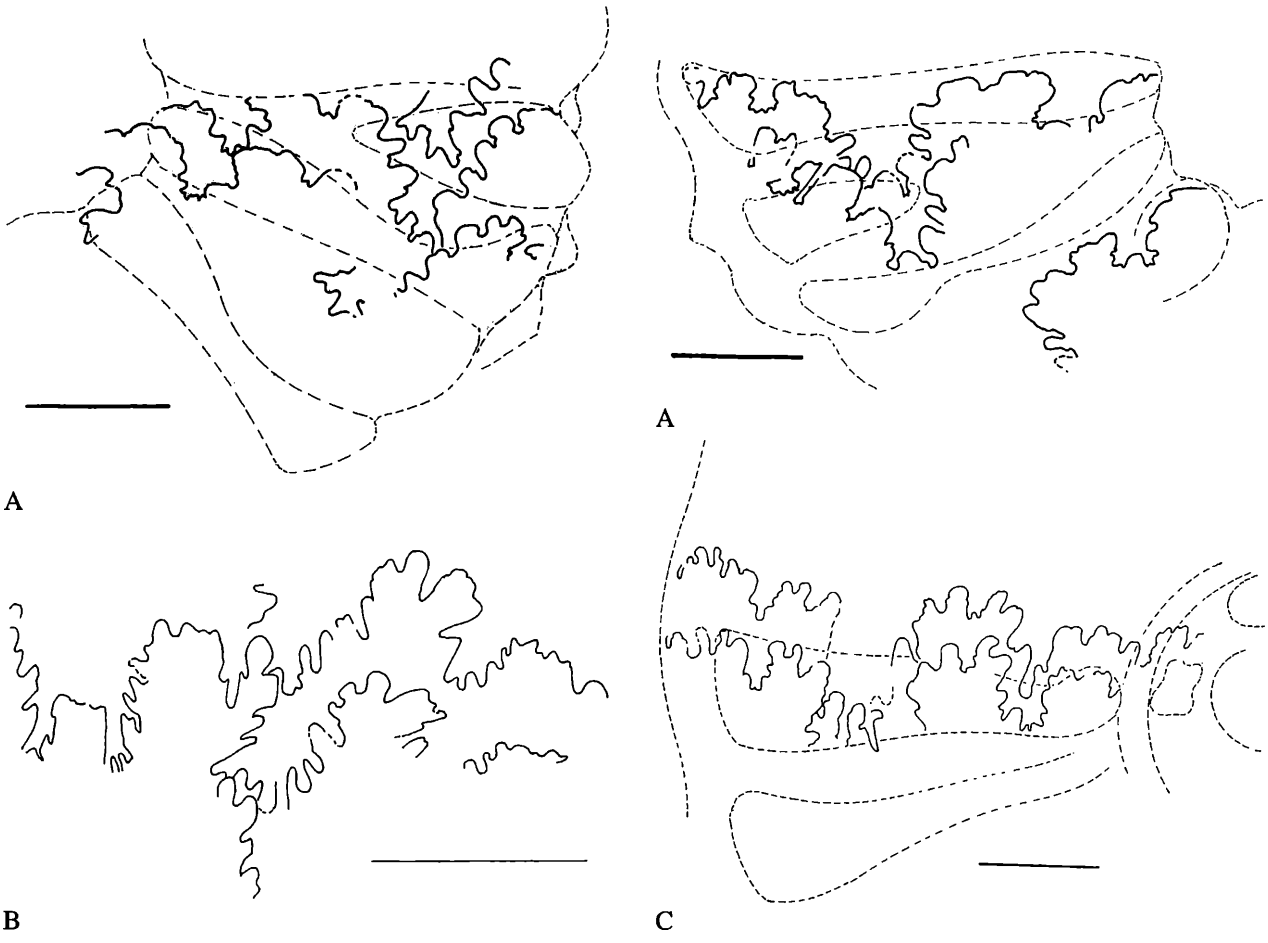


Figure 20. *Barroisiceras haberfellneri* (HAUER 1866). External sutures. A. SK/W/1993/38, Strobl/Weißenbach; B. NHMW/1978/1954/4, Gams; C. SK/W/1988/17, Strobl/Weißenbach. Bar scale 10 mm.

umbilical region. Group 3 of *B. haberfellneri* has a narrower umbilicus, group 4 comes very close. Given the wide range of variation in *B. onilahyense*, co-occurring *S. mahafalense* could well be conspecific.

? Barroisiceras (Barroisiceras) haberfellneri (von HAUER) described by BENAVIDES-CÁCERES (1957:476, pl. 57, figs. 4, 5) seems to be a juvenile specimen of *Barroisiceras (Barroisiceras) kayi* BENAVIDES-CÁCERES (1956: 467, pl. 57, figs. 6, 7) described from the same "Zone of *Buchiceras bilobatum*" and from the same bed (15) of the Bambamarca section. *B.(B.) kayi* fits well in the variation of *B.(B.) haberfellneri* (compare: pl. 6, fig. 1). As the variability of *B.(B.) kayi* is unknown but may possibly overlap with that of *B.(B.) onilahyense* we hesitated from placing *B.(B.) kayi* in synonymy with *B.(B.) haberfellneri*. Benavides-Cáceres' argument for separating species on the basis of the fewer umbilical tubercles of *kayi* cannot be sustained.

Barroisiceras (Basseoceras) colcanapi (COLLIGNON, 1965b:74, figs. 1826, 1827) has large umbilical tubercles and a serrated keel but is otherwise smooth. The relatively low whorl height distinguishes it from similarly ornamented examples of *B. onilahyense* and *B. haberfellneri*.

Barroisiceras (Barroisiceras) subtuberculatum (GERHARDT, 1897 b:156, pl. 3, fig. 12 a, b) was said (l.c.: 157, 206) to be from the Barremian of Velez (Colombia). RENZ (1982:112, pl. 37, figs. 5–8, pl. 38, figs. 1, 2, text-fig. 87) collected new material from the early Coniacian Timbetes Member of Venezuela. The specimen figured by GERHARDT (l.c.) has a fastigiate venter and undulose keel that becomes entire on the outer whorl. The specimens figured by RENZ (l.c.) have a serrate keel. The general features and degree of variation of the Venezuelan material suggests that it might be a synonym of *B. onilahyense* BASSE or *B. haberfellneri* (HAUER). It should be noted that MATSUMOTO (1965:69, 1971:138) assigned *Schloenbachia subtuberculata* GERHARDT to the genus *Reesidites*. We follow Renz, but additional studies are necessary to clarify the relation between South American representatives of Barroisiceratinae and the Madagascan and European ones. We would also note that abundant *B.(B.) onilahyense* is said to occur in the Sergipe basin of Brazil (BENGTSON, 1983:45) together with inoceramids that indicate the Turonian/Coniacian boundary, and it may be that the species is widespread in South America.

Barroisiceras (Basseoceras) inornatum MATSUMOTO (1969:303, pl. 39, fig. 1, text-fig. 3, 4)) is "nearly

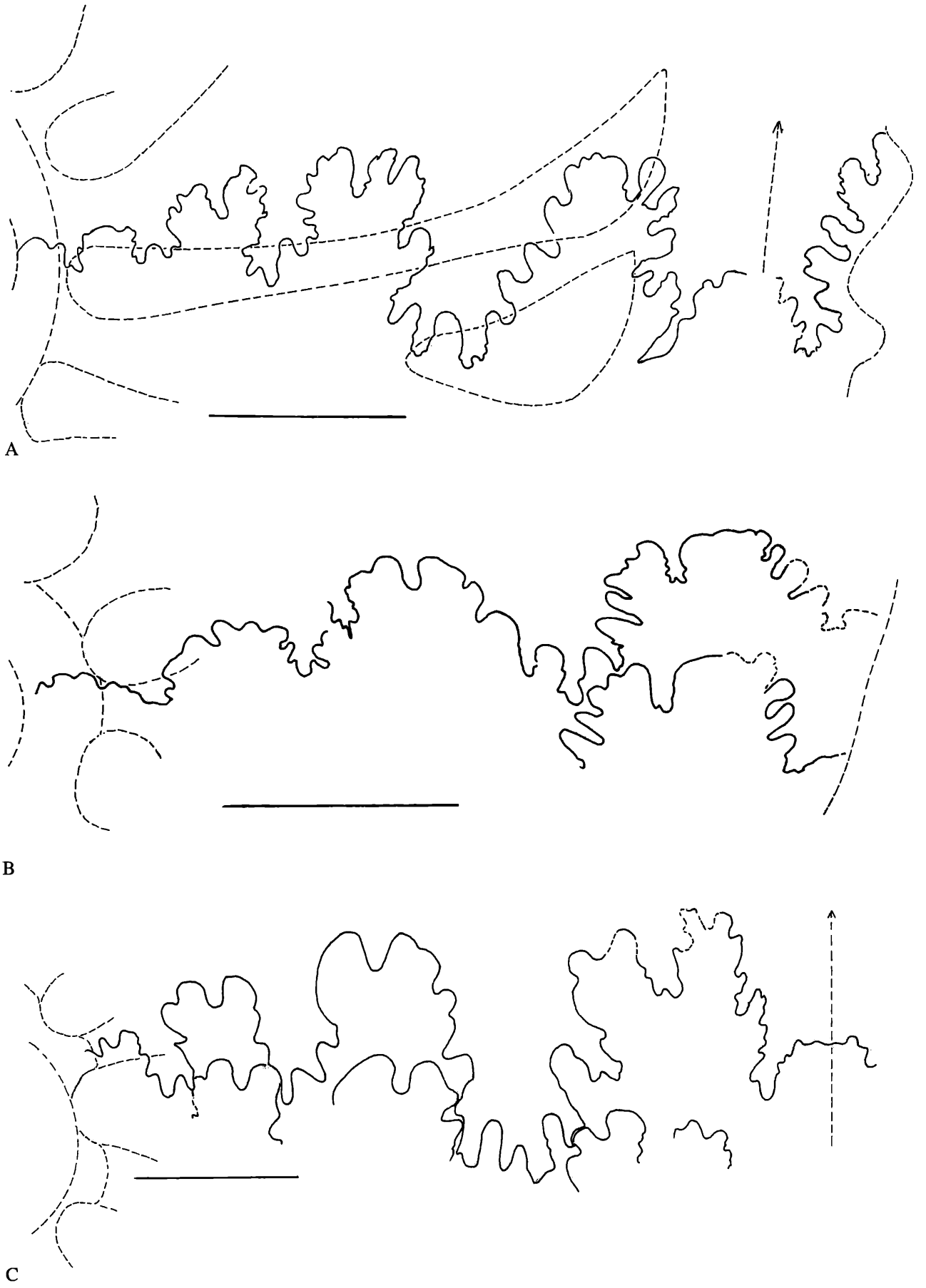


Figure 21. *Barroisiceras haberfellneri* (HAUER, 1866). External sutures. A. NHMW/1988/1/7, Strobl/Weißenbach; B. NHMW/1992/138/1, Strobl/Weißenbach; C. *Barroisiceras onilahyense* (BASSE 1847), Coll. PL/unregistered, Madagascar. Bar scale 10 mm.

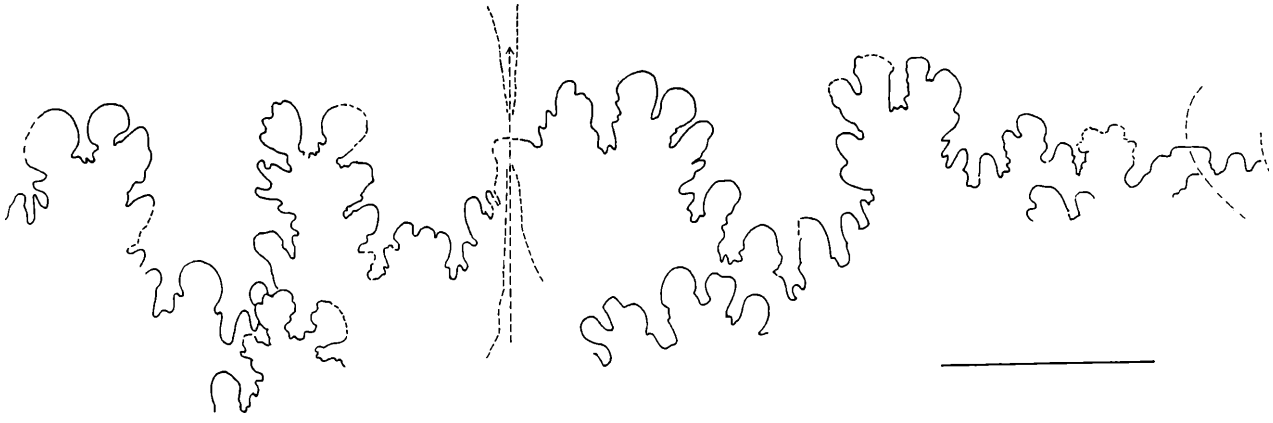


Figure 22. *Barroisiceras haberfellneri* (HAUER 1866). NHMW/1992/138/2 from Strobl/Weißenbach. Pathologic external suture with E in the area of the ventrolateral tuberculation and an E/L narrower than usual. Bar scale 10 mm.

smooth, except for the prorsiradiate lirae on the flank, faint serration on the weak keel on its posterior half and a few, occasional, blunt, remnants of the ribs and umbilical bullae."; as MATSUMOTO (l.c.: 305) noted smooth representatives of *B. onilahyense* BASSE 1947 (e.g. pl. 4, fig. 2) show the same features.

Barroisiceras (Basseoceras) peruvianum (MATSUMOTO, 1969:303) described as *Barroisiceras (Solgerites) brancoi* by BENAVIDES-CÁCERES (1956: 477, pl. 58, figs. 1–4) is distinguished from other species of *Barroisiceras (Barroisiceras)* and *Barroisiceras (Basseoceras)*, by its higher whorl section and persistent fastigiate venter.

Schloenbachia tunetana THOMAS & PERON (1890: 21, pl. 17, fig. 6–8) (pl. 14, figs. 5–8) was assigned to *Barroisiceras* by DIENER (1925:144) and by BASSE (1947:382). It differs in its minutely crenulated keel. Its stratigraphic and taxonomic position are uncertain; it may be a muniericeratid.

Barroisiceras tunetanum var. *inermis* PERVINQUIÈRE (1907:382, pl. 12, fig. 11) appears to be a poorly preserved member of the Barroisiceratinae, but is inadequately known.

B. haberfellneri from the Caucasus were mentioned by BONNET (1923:1339, 1925:1634). These specimens were cited by BASSE (1947:107) under synonymy with her new species *B. onilahyense*. Photos of a fine specimen from the Vedi region were sent to us by Dr. Atabekian, St. Petersburg (pl. 13, figs. 1–4). We believe this specimen to be a *B. haberfellneri* (See also the discussion of *B. onilahyense*, p. 124). *B. haberfellneri* var. *armenica* EGOJAN (1955:249, pl. 1, figs. 1, 2) from the Caucasian Vedi region southeast of Jerewan has rounded ventrolateral tubercles rather than clavi. A cast of the holotype is shown as Pl. 14, figs. 1–3. It differs from typical representatives of *Barroisiceras* in having weak siphonal tubercles on the phragmocone too. It most closely resembles the Lower Turonian *Thomasites nigeriensis* (WOODS), as figured by BARBER (1957: pl. 22, fig. 4).

Schloenbachia knighteni ANDERSON (1902:119, pl. 1, fig. 1–4, 11, text-fig. 39, 40) and *Schloenbachia siskyouense* ANDERSON (1902:119, pl. 1, fig. 19, 20) from the Cretaceous of California were assigned to *Barroisiceras* by DIENER (1925:144). The relatively wide umbilicus makes it unlikely that they belong to this genus, and BASSE (1947:110) excluded both taxa from *Barroisiceras*. MATSUMOTO (1959:112) placed them in synonymy with *Subprionocyclus neptuni* (GEINITZ).

Occurrence *B. haberfellneri* is largely restricted to the Austrian Gosau group at five localities:

1. Gams (Steiermark, "Radstatt"): part of HAUER's (1866:4) type series, including the lectotype. 2. Strobl/Weißenbach (Salzburg, "Ofenwand"): part of HAUER's (1866: 4) type series. 3. Neualpe (next Rußbach, basin of Gosau, Salzburg) 4. St. Wolfgang (parking area no. 3 and debris from the adjacent road tunnel). 5. Brennetgraben, 3 km NE Bad Ischl. *B. haberfellneri* (v. HAUER) (IMMEL, 1987:106, pl. 10, fig. 7), according to IMMEL (pers. comm.) this specimen came from an old collection; in our opinion it is not from the Schmolnauer Alpe, which is Middle Coniacian, but possibly from "Ofenwand" The only non-Gosau record appears to be that from the Caucasus, as suggested by the specimen shown as plate 13, figs. 1–4. Co-occurrence of stratigraphically significant taxa with *B. haberfellneri*.

Strobl/Weißenbach:

Didymotis sp.
Inoceramus ex aff. *kleini* MÜLLER
Inoceramus "frechi" sensu RADWANSKI (TRÖGER det.)
Hyphantoceras reussianum (d'ORBIGNY)

St. Wolfgang:

Didymotis sp.
Inoceramus sp.
Reesidites minimus (HAYASAKA & FUKUDA)

Gams:

Didymotis costata (FRIC).
Reesidites minimus (HAYASAKA & FUKUDA)

Gosau/Neualpe:
Inoceramus ex aff. *kleini* MÜLLER
Brennetgraben:
Didymotis sp.

Previous authors believed *B. haberfellneri* to be of Coniacian age (e.g. DIENER, 1925; BRINKMANN, 1935; PLÖCHINGER, 1955). The true age was demonstrated when C. J. WOOD (pers. comm. 1982) identified the bivalve *Didymotis* at the type locality, Radstatt, in the Gosau-basin of Gams/Steiermark. Two *Didymotis*-events are recognized in the uppermost Turonian in Germany. Following ERNST, SCHMID & SEIBERTZ (1983: fig. 4) the second *Didymotis* flood occurred immediately before the *rotundatus* inoceramid event which they took to mark the base of the Coniacian. Following KAPLAN (1986: fig. 4) both *Didymotis* layers lie within the top of the zone of *Subprionocyclus* aff. *normalis*, the uppermost zone of the German Turonian. KAPLAN & KENNEDY (1994:19, 23) renamed the *normalis* Zone the *Prionocyclus germari* Zone. CECH (1989: text-fig. 4) recognized both *Didymotis* floods in the Bohemian Cretaceous, within the uppermost Turonian, and also within the range of *Prionocyclus germari*. An upper Turonian age is confirmed by the co-occurrence of *B. haberfellneri* and *Reesidites minimus* at St. Wolfgang (see page 121).
WAGREICH (1992:508) provided evidence of a partial overlap of nannofossil zone CC13 (indicated by the presence of *Marthasterites furcatus* (DEFLANDRE & FERT)) with the *Germari* Zone at Gams (Radstatt; WAGREICH, pers. comm.), at Strobl/Weißenbach and at Brandenberg (Tyrol) in the vicinity of the Atzl – rudist "reef" situated immediately below the first occurrence of *Cremnoceramus rotundatus* FIEGE (KAUFFMAN in HERM, KAUFFMAN & WIEDMANN, 1979:78).
Hyphantoceras reussianum (d'ORBIGNY) which accompanies *B. haberfellneri* at Strobl/Weißenbach ranges from high Middle Turonian through high Upper Turonian with an acme in the middle Upper Turonian (KAPLAN & SCHMID, 1988:57).
Recent collecting by one of us (H.S.) has confirmed, that *B. haberfellneri* (HAUER) does not occur at the mid-Coniacian Schmolnauer Alpe locality, where it was recorded by IMMEL (1987:46, 106) nor does it appear elsewhere associated with Coniacian Peroniceratidae.
Occurrences outside Austria: There are no undoubted occurrences of *B. haberfellneri* (HAUER) outside the Austrian Alps other than the specimen from the Caucasus (pl. 13, figs. 1–4).
Barroisiceras haberfellneri haberfellneri SZASZ non HAUER (SZÁSZ, 1981:108, pl. 10, fig. 2a, b) from the Dobrogea (Roumania) is in our opinion a good example of *Tissotioides haplophyllus* (REDTENBACHER).

Family Coilopoceratidae HYATT, 1903

Genus *Coilopoceras* HYATT, 1903

Type species: *Coilopoceras colleti* HYATT, 1903:91, pl. 10, figs. 5–12; pl. 11, fig. 1, by original designation.

Coilopoceras* cf. *requienianum (d'ORBIGNY, 1841)
(Plate 4, fig. 4, text-fig. 23)

Compare:
1841 *Ammonites Requienianus* d'ORBIGNY, p. 315, pl. 39, figs 1–4.
1976 *Coilopoceras requienianum* (d'ORBIGNY 1840), LOMMERZHEIM, p. 231, text-fig. 10, pl. 2, fig. 4.
1979 *Hemitissotia alpina* WIEDMANN a, p. 47, pl. 5, figs. C, D, pl. 6, figs. A, B
1984 *Coilopoceras requienianum* (d'ORBIGNY, 1841), KENNEDY & WRIGHT, p. 282, pls. 35, 36, text-figs. 1–5 (with synonymy).
1985 *Hemitissotia alpina* WIEDMANN, SUMMESBERGER, p. 147.
1987 *Hemitissotia alpina* WIEDMANN, IMMEL, p. 114.
1989 *Coilopoceras requienianum* (d'ORBIGNY, 1841), LUGER & GRÖSCHKE, p. 388, pl. 46, figs. 1–3, text-fig. 12 (with synonymy).
1990 *Coilopoceras* sp. cf. *requienianum* (d'ORBIGNY, 1841), AMÉDRO [in:] ROBASZYNSKI et al., p. 271, pl. 26, fig. 1 a, b (non 2a, b).

Material: Four specimens: BSP 1970 XVII 14, the holotype by original designation of *Hemitissotia alpina* WIEDMANN, and BSP 1970 XVII 15, paratype of *Hemitissotia alpina* WIEDMANN. KÖ/ZW/290, 344.

Description: Shell (WIEDMANN, 1979a: pl. 5, fig. C, D, pl. 6, fig. A, B) is discoidal, lanceolate and smooth. Coiling is involute. The umbilicus is closed. The keel is acute. The suture (text-fig. 23, WIEDMANN, 1979a: fig. 10) has a deeply incised narrow E/L, a wide L and small auxiliary saddles.

Discussion: The suture of *C. requienianum* (d'ORBIGNY) (KENNEDY & WRIGHT, 1984: text-fig. 5) has rather stout elements and short incisions. Hence open nomenclature is used here. *Coilopoceras* cf. *requienianum* can be distinguished from the American *C. springeri* HYATT on the basis of the tiny umbilicus of the latter species in most cases (COBBAN & HOOK, 1980: pl. 1, fig. 5, 6, pl. 3, figs. 9–11, pl. 6, figs. 9, 10, pl. 10, pl. 18, figs. 7–10, pl. 19, figs. 1–9) whereas the umbilicus is often closed in *C. requienianum* (KENNEDY & WRIGHT, 1984: pl. 35, fig. 2, 5). The type species, *C. colleti* HYATT also has a tiny umbilicus and develops lateral tubercles when adult. Interestingly the deeply incised E/L diagnostic of COLLIGNON's *C. requienianum altesellatum* (1965a: 62, pl. 403, figs. 1688/89, 1965:64, pls. 404, 405) is very similar to E/L of the Austrian specimens. This form, described by Collignon as a variety, was thought to merit specific status in the opinion of KENNEDY & WRIGHT (1984:285).

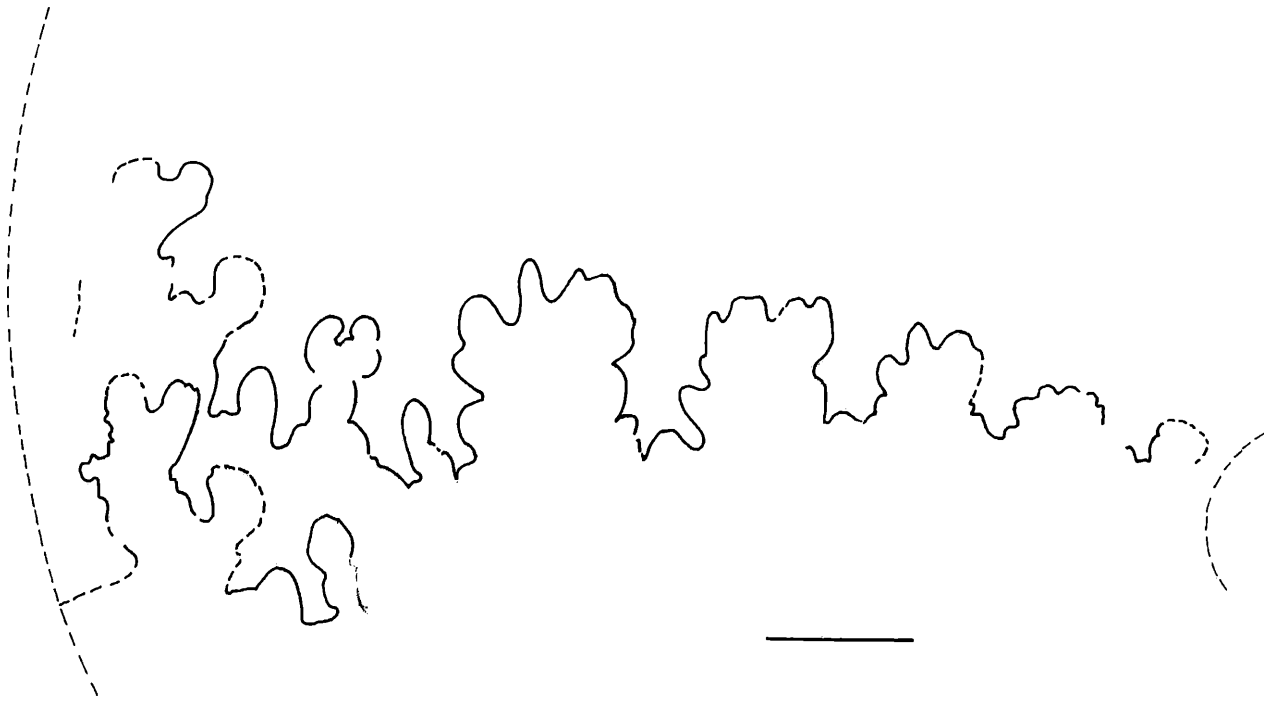


Figure 23. External suture of *Coilopoceras* cf. *requienianum* (d'ORBIGNY), KÖ/ZW/344. Brandenberg, Tyrol. Bar scale 10 mm.

Occurrence: *Coilopoceras* cf. *requienianum* appears in units d_2 and d_4 of the Zöttbach section (Brandenberg, Tyrol). *C. requienianum* indicates the Upper Turonian *deverianum* and *neptuni* Zones at Uchaux and elsewhere in France, Germany (LOMMERZHEIM, 1976:231), North Africa (AMÉDRO, 1990; LUGER & GRÖSCHKE, 1989:388), Sinai (LEWY, 1975:30), and Madagascar (COLLIGNON, 1965a). The closely related *C. springeri* occurs in the Upper Turonian *Prionocyclus hyatti* Zone of New Mexico and Texas. Occurrence of other Coilopoceratidae is discussed by COBBAN & HOOK (1980:12) and KENNEDY & WRIGHT (1984:285 ff.).

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Turrilitaceae GILL, 1871
Family Nostoceratidae HYATT, 1894

Genus *Tridenticeras* WIEDMANN, 1962

Type species *Turrilites tridens* SCHLÜTER, 1876, by original designation.

Tridenticeras binodosum (HAUER, 1866)
(Plate 15, figs. 1–3)

Synonymy:
1866 *Turrilites binodosus* HAUER, p. 8, pl. 1, fig. 6.
1873 *Turrilites binodosus* HAUER, REDTENBACHER, p. 131.
1876 *Turrilites binodosus* HAUER, SCHLÜTER, p. 138.
1925 *Turrilites binodosus* HAUER, DIENER, p. 81.
1935 *Turrilites binodosus* HAUER, BRINKMANN, p. 5.

Holotype: By monotypy HAUER's original specimen from the Upper Turonian Gosau Group of Gams, Steiermark: GBA 1866/01/5.

Description: The holotype and only known specimen is a fragment of one and a half helicoid whorls in close contact. Coiling is sinistral. The apical angle, modified by distortion, is 68° The specimen is slightly crushed with nacreous shell preserved. The whorl section is subcircular, the whorl height increases rapidly. Wh_{max} is 22 mm. Ornament consists of dense, crowded, rather irregular ribs. On the upper whorl face they are feebly concave, sweeping forwards across the shoulder to pass obliquely over the flank. Some bear a small sharp tubercle on the upper third of the face and a second at the contact with the succeeding whorl. Tubercles may be borne on a single rib, or may join a pair of ribs in button and loop fashion. Between the tuberculate ribs are from one to three nontuberculate ones. Occasional interspaces are deepened into narrow constrictions. An irregular spiral groove connects the upper row of tubercles, apparently reflecting damage to the mantle during life and subsequently irregular growth. Sutures are not exposed.

Discussion: HAUER's specimen was long regarded as a member of the genus *Turrilites*. It is interpreted here as belonging to the genus *Tridenticeras* WIEDMANN. *T. tridens* (SCHLÜTER, 1876) has three rows of tubercles, as does *Tridenticeras varians* (SCHLÜTER, 1876), which also shows a marked change of ornament at maturity. *Tridenticeras undosus* (SCHLÜTER, 1876) has markedly differentiated weak and strong ribs, and lacks tubercles. The ribs of *Tridenticeras peramplum* (LASSWITZ) from the (?) Coniacian of Texas are distantly spaced.

Occurrence: *Tridenticeras binodosum* is known only from the Upper Turonian *Germari* Zone of the

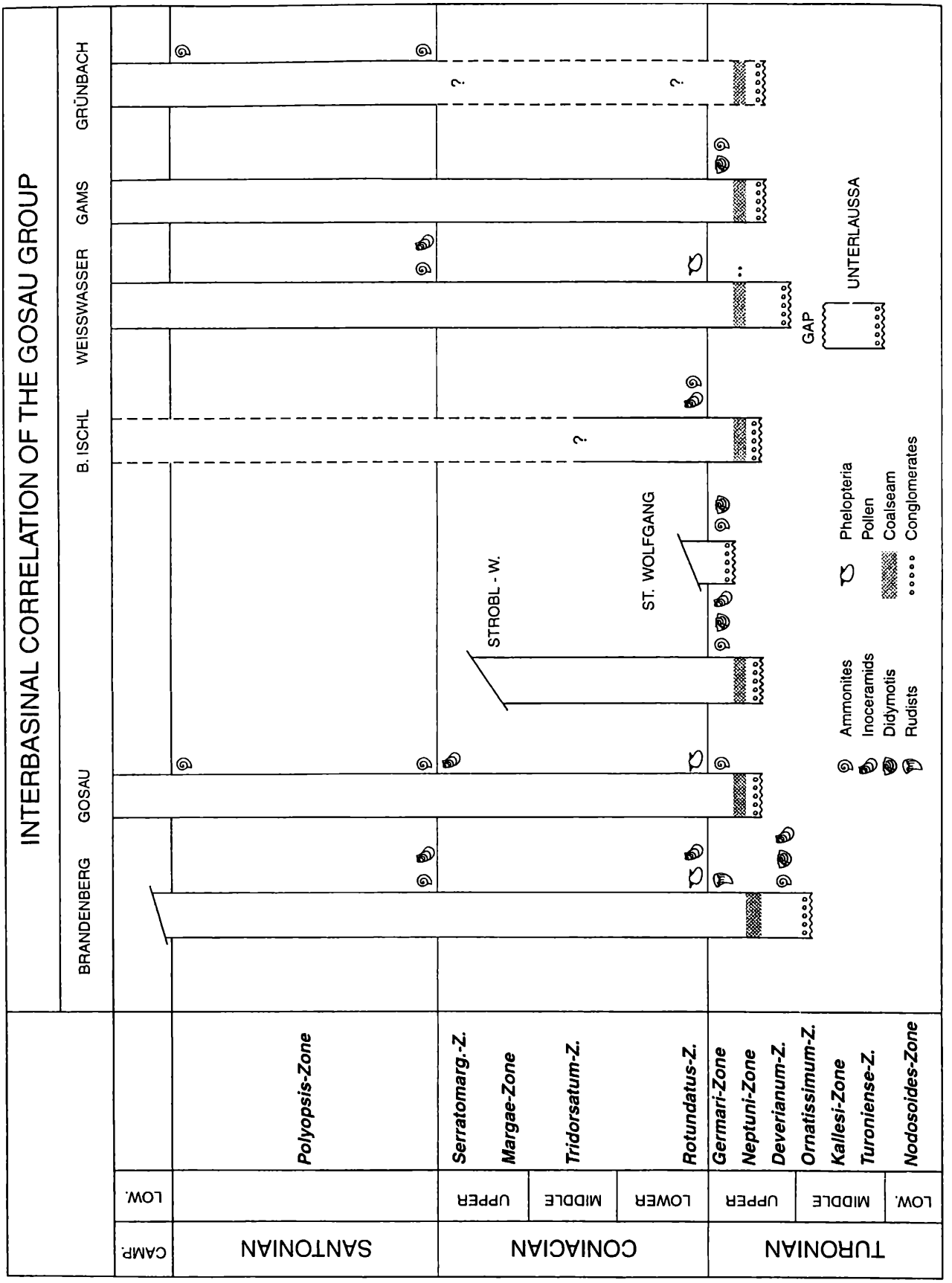


Table 3. Upper Turonian sequences of the Gosau Group.

Gams basin, Austria. The related species *T. tridens* and *T. varians* are from the Upper Coniacian (KAPLAN & KENNEDY, 1994:13) of Stoppenberg near Essen in Westphalia (Germany).

Eubostrychoceras sp.
(Plate 17, fig. 4)

Material: A single specimen (OÖLM, unregistered) with doubtful localisation.

Description The specimen is a crushed bodychamber fragment (Wh_{max} 38,5). The whorl section appears to have been circular. Ornament consists of narrow, sharp, even ribs (4–5/cm) separated by somewhat wider interspaces. Occasional ribs bifurcate close to the umbilical edge, reuniting or linking to a neighboured rib close to the siphonal area. There are two broad and deep constrictions, parallel to the ribs, and preceded by a stronger collar-rib. The dorsal area is smooth.

Discussion This fragment is specifically indeterminate but clearly a *Eubostrychoceras*.

Occurrence: The specimen is labelled Strobl–Weißenbach. Preservation makes the labelling suspect in our opinion and middle Coniacian sites around the nearby Schmolnauer Alpe cannot be excluded. The age is thus possibly Upper Turonian or Middle Coniacian.

Genus *Hyphantoceras* HYATT, 1900

Type species: *Hamites reussianus* d'ORBIGNY, 1850, by original designation.

Hyphantoceras reussianum (d'ORBIGNY, 1850)
(Plate 17, figs. 5–8)

1910 *Bostrychoceras thomasi* PERVINQUIÈRE, p. 62 (pars), pl. 14(5), fig. 34 only.
1962 *Hyphantoceras cenomanense* WIEDMANN, p. 197, footnote 37.
1979 *Hyphantoceras reussianum* (d'ORBIGNY, 1850), WRIGHT, p. 297, pl. 2, figs. 6, 7, pl. 7, figs. 4, 6 (with synonymy).
1988 *Hyphantoceras reussianum* (d'ORBIGNY, 1850), KAPLAN & SCHMID, 1988, p. 53, pl. 4, figs. 1, 2; pl. 5, figs. 1–6; pl. 6, figs. 1–4; pl. 7, figs. 1–3, pl; 8, figs. 1–4, pl. 9, figs. 1–3; pl. 10, figs. 1–4; pl. 11, figs. 1–5; pl. 12, figs. 1–4 (with synonymy).

Types: see KAPLAN & SCHMID, 1988:53.

Material: A single from Strobl/Weißenbachtal: SK/W/1990/29 from locality SWP_5.

Description: SK/W/1990/29 (pl. 17, figs. 5–8) is a tiny microconch with 4.5 helically coiled initial whorls and a fragment of the bodychamber. It is a distorted internal mould with traces of white shell preserved. The helical portion is about 13 mm high, the incomplete body chamber about 35 mm long. Wh of the first whorl is about 3 mm, of the third whorl about 5 mm. Wh_{max} of the body chamber is 10 mm, the dimensions modified by post-mortem crushing. The flared ribs bear four tubercles at the smallest diameter seen, one of them covered by the next whorl where tubercles dominate over the ribs. The last whorl of the helix has more distantly spaced ribs with strong ventral and only slightly weaker ventrolateral spines. Rib separation increases with growth. Interspaces are ornamented dorsally by weak riblets which disappear at mid flank. The body chamber bears strong, distant major ribs on venter and flanks. There are 4 rows of strong irregular tubercles. The dorsum is covered by delicate, closely spaced ribs.

Discussion: SK/W/1990/29 is a typical microconch agreeing with Westphalian specimens figured by KAPLAN & SCHMID (1988: pl. 11, fig. 5; pl. 12, fig. 1, 2).

Occurrence: *Hyphantoceras reussianum* (d'ORBIGNY) is a typical Upper Turonian species widespread in northern and central Europe (England, France, Germany, Bohemia, Russia). In Westphalia (KAPLAN & SCHMID, 1988:57) it first appears in the high Middle Turonian and ranges to the high Upper Turonian (*Normalis* Zone = *Germari* Zone). The acme is at the level of the "*Hyphantoceras*-event" close to the top of the *Neptuni* Zone (sensu KAPLAN, 1986: fig. 4). The species ranges through both *Didymotis* events. The stratigraphically highest occurrences in Germany are from the "Grau-weiße Wechselfolge" at the top of the *Germari* Zone. The Austrian occurrence is only the second known from the Tethys region.

? Nostoceratidae gen. et sp. indet.
(Plate 18, figs. 2, 3)

Material: A single specimen NHMW 1978/1954/6.

Description and discussion A 36 mm fragment appears to be part of the whorl of a nostoceratid ammonite. It is covered by strong, sharp even ribs. A single bifurcation is visible. No tubercles and no suture can be observed.

Occurrence: Upper Turonian *Germari* Zone of Gams.

Family Diplomoceratidae SPATH, 1926
Subfamily Diplomoceratinae SPATH, 1926

Genus *Neocrioceras* SPATH, 1921

Type species: *Crioceras spinigerum* JIMBO, 1894:184, pl. 24, fig. 1, by the subsequent designation of DIENER, 1925:192.

Subgenus *Schlueterella* WIEDMANN, 1962

Neocrioceras (Schlueterella) sp. indet.
(Plate 17, fig. 10)

Material: 1 fragment, NHMW 1935/III/24, from the Upper Turonian of Gams.

Description: The fragment is 26 mm long with nacreous shell preserved. Coiling unknown; whorl section crushed, originally compressed oval or rounded. About 7 ribs per cm arise at the umbilical shoulder, others intercalate. Every fourth or fifth rib bifurcates around mid-flank. The branching point is marked by a distinctly rounded tubercle, while the ribs join at a second tubercle at the ventrolateral shoulder, from which they loop across the venter to the tubercle on the opposite shoulder.
Discussion: This tiny fragment shows the typical ribbing of *N. (Schlueterella)* but is too incomplete for specific identification. *N. (Schlueterella)* sp. ex gr. *kossmati* (SIMIONESCU, 1899) (IMMEL, ROCHOW & WEIDICH, 1981:467, text-fig. 2/1) from the Upper Turonian of the Bavarian Alps differs in having tubercles on all ribs. *N. (Schlueterella) compressum* KLINGER (1976: pl. 33, fig. 5) from the Lower Santonian of Zululand and Brandenberg 2 (Tyrol) has more branching ribs and less single ones. Also the rows of tubercles are somewhat irregular.
Occurrence: Upper Turonian of Gams only.

? *Neocrioceras* sp. indet.
(Plate 17, figs. 9, 11, 12)

Material: A single specimen NHMW 1992/138/8 from locality SWP_2 at Strobl–Weißenbach.
Description: NHMW 1992/138/8 is a crushed fragment of the body chamber of a macroconch (Wh 29, Wb 44, length about 64 mm) from close to the aperture. The whorl section cannot be determined, due to post-mortem crushing. Ribbing is coarse and irregular, sometimes looping at coarse flared tubercles that appear to be arranged in 4 rows.
Discussion: NHMW 1992/138/8 is a fragment of the body chamber. Due to fragmentary preservation and post-mortem crushing identification is problematic. Style of ribbing reminds rather of a large specimen of *Neocrioceras* than *Hyphantoceras* or *Pseudoxybeloceras.*
Occurrence: Upper Turonian from Strobl/Weißenbach.

Genus *Pseudoxybeloceras* WRIGHT & MATSUMOTO, 1954

Type species: *Hamites quadrinodosus* JIMBO, 1894:185, pl. 7, figs. 3, 4 by the original designation of WRIGHT & MATSUMOTO, 1954:119.

Pseudoxybeloceras sp.
(Plate 18, fig. 1)

Material: a single specimen, OÖLM, unregistered, from either the Strobl/Weißenbach area or Nussensee (Salzburg, Austria).
Description: The specimen is a crushed, hook-shaped body chamber fragment with a 65 mm longer shaft and a 49 mm shorter one. The aperture appears to be preserved. Wh_{max} is 18,5 mm. On the smaller shaft ornament consists of 10 ribs in a distance equal to the whorl height. The ribs are straight on the longer shaft, narrow and separated by somewhat wider interspaces. There are four rows of transversely elongated tubercles on every rib. They are of variable size on the outer flank and somewhat smaller on the ventrolateral shoulder. On the shorter and apparently terminal shaft ribs are somewhat oblique and rursiradiate. The lateral tubercles are rather irregularly developed; the smaller ventrolateral ones are seen to be the bases of delicate 2 mm long hollow spines. Some of the ribs bifurcate on the curved part of the hook, some intercalate.
Discussion: The general characters of this fragment show it to be a *Pseudoxybeloceras.* It differs from *P. quadrinodosum* (JIMBO, 1894:39, pl. 7, figs. 3, 4) in having slightly larger tubercles with elongate bases. Elongate tubercle bases are present in *P. amapondense* (van HOEPEN, 1921:15). *P. matsumotoi* (COLLIGNON, 1965b:12, fig. 1731, KLINGER, 1976: 76, pl. 33, fig. 6) is known from large specimens only, and cannot be compared with the present specimen.
Occurrence: The specimen is labelled "Strobl, Wolfgangsee". Its precise locality is unknown. It comes either from the Upper Turonian of the Ofenwand or from the Mid-Coniacian of the neighbouring locality Nussenseebach. The genus ranges from Turonian to Maastrichtian elsewhere (MATSUMOTO, 1977a:345).

Family Baculitidae GILL, 1871
Genus *Sciponoceras* HYATT, 1894

Sciponoceras bohemicum bohemicum (FRITSCH, 1872)
(Plate 18, figs. 4, 26)

Synonymy:
1979 *Sciponoceras bohemicum* (FRITSCH), WRIGHT, p. 285, pl. 1, figs. 3–5, pl. 7, figs. 10–12 (with full synonymy).
1981 *Sciponoceras bohemicum bohemicum* (FRITSCH, 1872), WRIGHT & KENNEDY, p. 116, pl. 31, fig. 9.

Lectotype: The original of FRITSCH, 1872: pl. 13, fig. 25a, b, c, designated by WRIGHT (1979:285).
Material: Two specimens, SK/W/1989/23/2 from the "Ofenwand" locality of Strobl/Weißenbach, and SK/BG/1994/3 from the Brennetgraben, NE of Bad Ischl.
Description: Both specimens are fragments, 50 and 33 mm long respectively. SK/BG/1994/3 shows rather regular weak ribbing, arising on the flanks and passing over the venter with periodic coarse collar ribs and associated constrictions. Collar ribs bear bullate tubercles close to the dorsum. Ribs are oblique and slightly curved. Faint constrictions following the ribs; they may also be present on the second fragment.
Discussion: Constrictions indicate these two specimens to be *Sciponoceras.* Both individuals are also distinguished from the other Baculitidae described

herein by their narrower Wh (pl. 18, figs. 4, 26). The ribbing of the Austrian specimens is rather coarse compared with those from the English Chalk Rock (WRIGHT, 1979: pl. 1, figs. 3, 4; WRIGHT & KENNEDY, 1981: pl. 31, fig. 9).

Occurrence: *Sciponoceras bohemicum bohemicum* is a typically Upper Turonian *Neptuni* Zone species in of the Northern Temperated Realm. The Austrian specimens occur in the Upper Turonian *Germari* Zone of the "Ofenwand" site (Strobl/Weißenbach) and the Brennetgraben NE Bad Ischl.

Genus *Baculites* LAMARCK, 1799

Type species *Baculites vertebralis* LAMARCK, 1799 by subsequent designation by MEEK (1876:391).

(Plate 18, figs. 8–13, 17–20, 22–25)

Compare:

1979 *Baculites undulatus* d'ORBIGNY, WRIGHT, p. 287, pl. 1, figs. 6–8, pl. 7, fig. 11 (with synonymy).
1985 *Baculites undulatus* d'ORBIGNY, BRETON & BAVENT, p. 102, figs. 1–3.
1986 *Baculites undulatus* d'ORBIGNY, COBBAN, p. 81.
1989 *Baculites undulatus* d'ORBIGNY, KENNEDY, COBBAN, HANCOCK & HOOK, p. 101, fig. 31I.

Material: Five fragments: NHMW 1978/2030/1, NHMW 1996/33/1, both from Gams; SK/W/1989/23, SK/W/1989/24/1,2 are from the "Ofenwand" site at Strobl/Weißenbach.

Description: The fragments are between 17 and 45 mm long, the specimens from Gams preserved with iridescent nacreous shell, the others with white chalky shell. The original whorl section cannot be determined due to post-mortem crushing. Ribs are irregularly spaced, 3–5 per cm, and of different strengths. They arise close to the dorsum and are strong and prorsiradiate on the flanks, crossing the venter in a marked convexity. Interspaces bear delicate growth lines.

Discussion: *Sciponoceras bohemicum* (FRITSCH) sensu lato ranges from Upper Cenomanian to Upper Turonian in Europe. It differs from the present species in having marked constrictions and scale-like ribs (WRIGHT, 1979: pl. 1, fig. 3–4; pl. 7, fig. 10, 12). *B. yokoyamai* TOKUNAGA & SHIMIZU ranges from Turonian through Coniacian (SUMMESBERGER, 1992b: pl. 8, fig. 10, 11) and has weaker ribs. *Baculites brevicosta* SCHLÜTER (1876:141, pl. 39, figs. 9, 10) from the Coniacian of Westphalia and Touraine differs in its distinct and dorsally situated bullae and intercalated non-bullate ribs (KENNEDY, 1984: pl. 33, figs. 23–25).

Occurrence: *B. undulatus* (d'ORBIGNY) is an Upper Turonian species. It occurs in the *Subprionocyclus neptuni* Zone Chalk Rock of England, in the *Prionocyclus macombi* and *P. wyomingense* Zones of Texas and New Mexico, elsewhere in the Turonian of Japan and France, and is also present in the Upper Turonian Gosau-group of the Austrian Gams basin.

Baculites yokoyamai TOKUNAGA & SHIMIZU, 1926
(Plate 18, figs. 5, 6, 7, 16)

1988 *Baculites yokoyamai* TOKUNAGA & SHIMIZU, 1926; KENNEDY, p. 110, pl. 23, figs. 8–10, text-fig. 29 C (with full synonymy).
1992 *Baculites yokoyamai* TOKUNAGA & SHIMIZU, 1926, SUMMESBERGER, b: p. 124, pl. 8, figs. 10, 11 (with additional synonymy).

Neotype: GKH 4580 from the Lower Coniacian *Inoceramus uwajimensis* Zone of Hokkaido, Japan, designated by MATSUMOTO & OBATA, (1963:30, pl. 10, fig. 5).

Material: 6 fragments: SK/W/1989/1–6, all from the Upper Turonian of the "Ofenwand" site at Strobl/Weißenbach.

Description All specimens are fragmentary crushed internal moulds of body chambers with traces of whitish shell. Ornament consists of growth striae which are accentuated over the venter (pl. 18, figs. 5, 6, 16). SK/W/1989/25/4 (not figured) shows a fragmentary suture at the adapical end.

Discussion: Specific identification is based on the absence of tubercles and constrictions, which separates the species from co-occurring *Sciponoceras* and *Baculites undulatus.*

Occurrence All fragments are from the "Ofenwand" locality at Strobl/Weißenbach. The type occurrence of the species is in the basal Coniacian of Japan, where it co-occurs with *Didymotis akamatsui* and *Inoceramus uwajimensis* (MATSUMOTO, 1984: 174) above *Reesidites minimus.* In the USA it occurs throughout the whole of the Turonian (KENNEDY, 1988:112). In Europe it was previously known only from the mid-Turonian of Unterlaussa, Austria (SUMMESBERGER, 1992b:124, pl. 8, figs. 10, 11).

***Baculites* sp.** indet.
(Plate 18, figs. 14, 15)

Material: One specimen; NHMW unregistered, from the "Ofenwand" site, Strobl/Weißenbach.

Description: A crushed fragment of internal mould with adherent shell.

***Baculites* sp.** indet. juv.
(Plate 18, fig. 21)

Material: a single fragment, NHMW 1978/2030/2 from Gams.

Description This fragment of a juvenile phragmocone is preserved with original nacreous shell. It is about 17 mm long. Wh (4mm) and Wb(2 mm). Measurements are not meaningful due to crushing. The surface is smooth but for a single delicate oblique bulla.

Discussion: Co-occurrence with *B.* cf. *undulatus* d'ORBIGNY and irregular ornamentation suggest this may be a juvenile of that species.

Superfamily Scaphitaceae GILL, 1871
Family Scaphitidae GILL, 1871
Subfamily Scaphitinae GILL, 1871

***Scaphites* sp.** indet.
(Plate 18, fig. 27)

1873 *Ammonites* spec. indet., REDTENBACHER, p. 127, pl. 30, fig. 9.
1935 *Scaphites geinitzi* d'ORB, BRINKMANN, p. 5.

Material GBA 1873/01/30, the original of REDTENBACHER (1873: pl. 30, fig. 9) from the Upper Turonian *Germari* Zone of Gams (Radstatt). A second specimen of an indeterminate *Scaphites* from Gams (Langriedler) was listed by KOLLMANN (1964:90).
Description and Discussion: The specimen is the coiled portion of a specifically indeterminate *Scaphites*.
Occurrence: Upper Turonian *Germari* Zone of Gams.

5. Stratigraphic conclusions

The transgressive series of the Gosau basins studied appears to be generally of greater age than previously thought (SUMMESBERGER, 1985; KOLLMANN & SUMMESBERGER, 1982). Co-occurrence of *Romaniceras (Romaniceras)* cf. *deverianum, Romaniceras (Yubariceras) gosavicum* WIEDMANN with *Coilopoceras* cf. *requienianum* (d'ORBIGNY) indicates an Upper Turonian horizon (*deverianum* Zone) for the fauna of Brandenberg I.
Reesidites minimus occurs abundantly at St. Wolfgang. This marks the highest ammonite zone of the Turonian in Japan. In Europe it indicates a level equal to the *Prionocyclus germari* Zone (KAPLAN & KENNEDY, 1994:19, 23) = *Subprionocyclus normalis* Zone (KAPLAN, 1988:26, 27); see also HANCOCK & KENNEDY, 1981:537 for discussion). *Reesidites minimus* appears together with *Didymotis* and *Barroisiceras haberfellneri* at St. Wolfgang and Gams; *Didymotis* is rare at St. Wolfgang but common at Gams, whereas *Reesidites minimus* is very rare at Gams. The time interval between Gams and St. Wolfgang seems to be very short; differences may also be explained by the local facies.
Reesidites minimus is absent from Strobl/Weißenbach, whereas *Barroisiceras haberfellneri* occurs abundantly together with typical Upper Turonian faunal elements (e.g. *Hyphantoceras*). The accompanying flood of *Didymotis* appears to correlate with the first *Didymotis* event of Germany and Bohemia as indicated by the presence of *Inoceramus* aff. *kleini* (TRÖGER, pers. comm. 1994). Now that the late Turonian age of *Barroisiceras haberfellneri* is confirmed, recently discovered *B. haberfellneri* (pl. 5, fig. 3) from Neualpe (Rußbach, Salzburg, basin of Gosau) suggests a late Turonian age for the basal Streiteck formation too.
It remains uncertain as to whether the occurrence of *Didymotis* in the Gosau group of Gams and St. Wolfgang correlates with the first or second *Didymotis* ecoevent of Germany and the Bohemian Cretaceous basin (or perhaps neither). Another source of unprecise correlation is the relatively large interval between the last *R. minimus* and the first occurrence of *I. rotundatus* in Japan.

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PLATE 1

Gaudryceras mite (HAUER, 1866)

Fig. 1. GBA 1866/01/3, the holotype; possibly from Strobl/Weißenbach.

Fig. 2. SK/W/1993/40; from Strobl/Weißenbach.

Fig. 3. SK/W/1988/19; from Strobl/Weißenbach.

Fig. 4. SK/W/1988/20; from Strobl/Weißenbach.

All figures x 1

PLATE 1

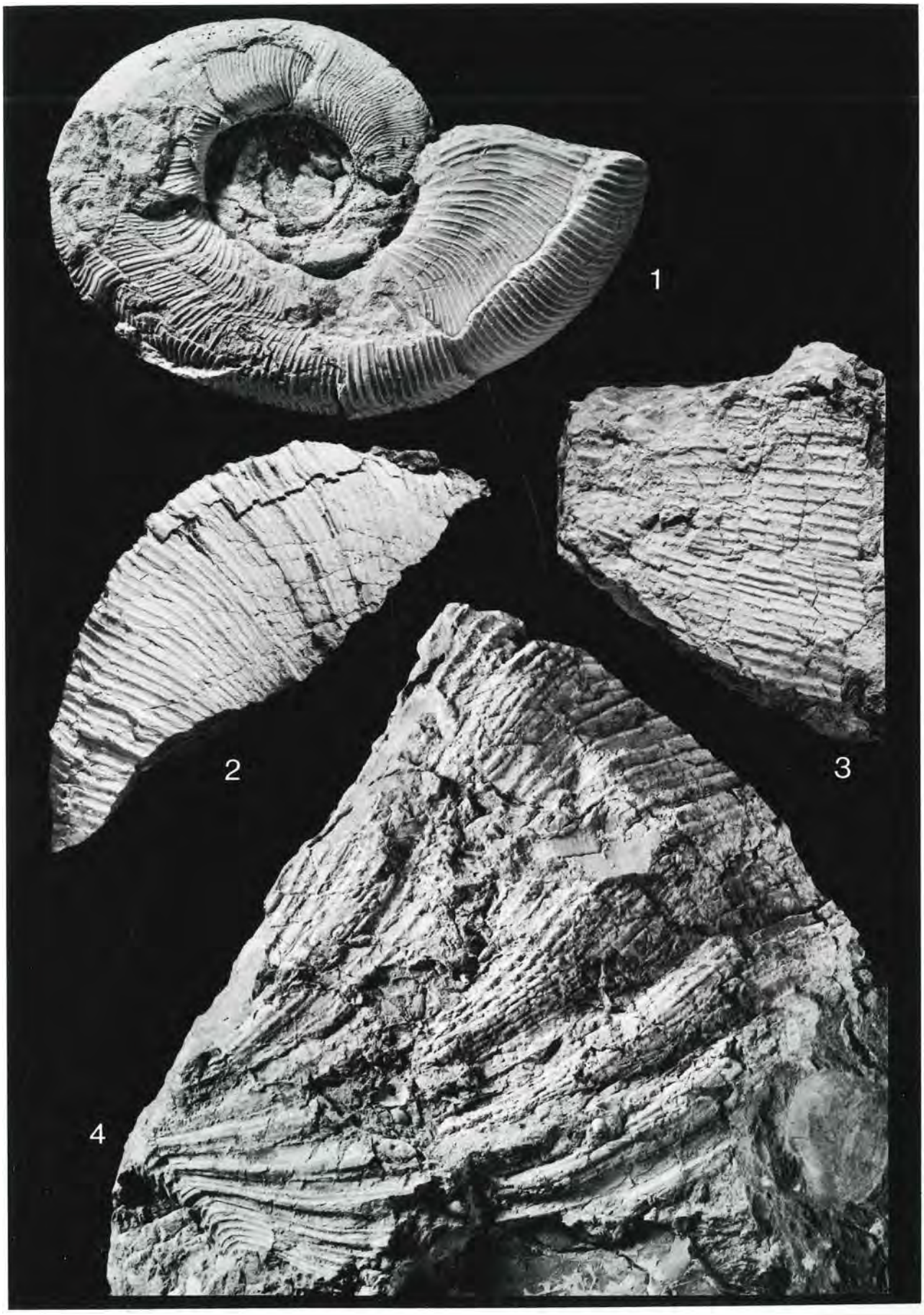

PLATE 2

Figs. 1, 7 *Gaudryceras* sp. indet., group of *mite* (HAUER, 1866). GBA unregistered; from Gams.

Fig. 2. Tetragonitidae gen. et sp. indet. NHMW/1978/2028/5; from Gams

Figs. 3, 5, 6, 8. *Pseudophyllites postremus* (REDTENBACHER, 1873, GBA 1873/01/18), the lectotype; from Gams.

Fig. 4. *Lewesiceras* cf. *mantelli* WRIGHT & WRIGHT 1951, NHMW 197/2030/3; from Gams.

Fig. 9. *Puzosia* sp.: GBA 1873/01/28, the original of REDTENBACHER, 1873, pl. 30, fig. 6; from Strobl/ Weißenbach.

Figs. 2, 3 x 2; all other figures x 1.

PLATE 2

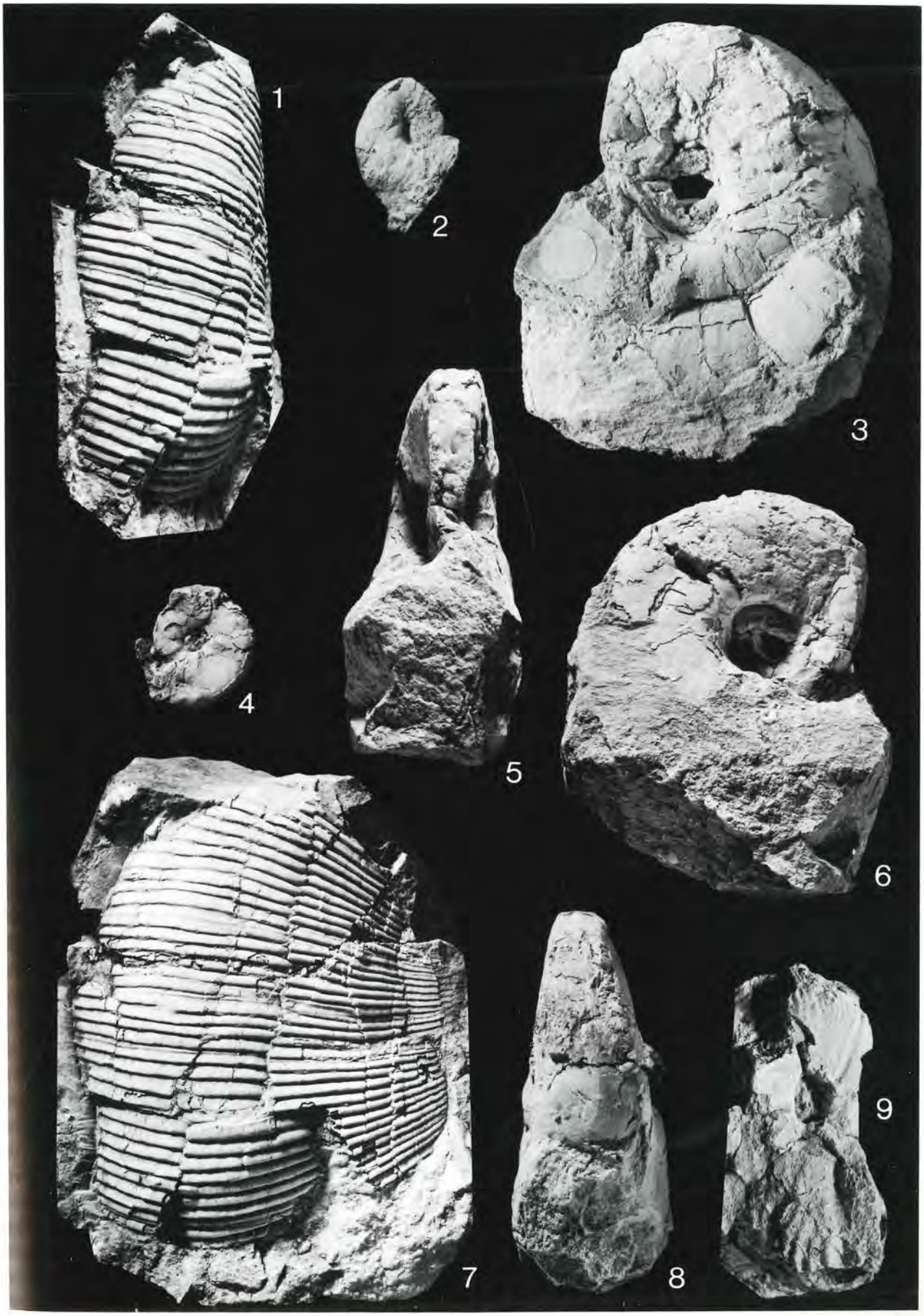

PLATE 3

Figs. 1, 2, 5. *Tongoboryceras rhodanicum* (ROMAN & MAZERAN, 1913), NHMW 1996/32/1; from Strobl/Weißenbach.

Figs. 3, 4. *Tongoboryceras rhodanicum* (ROMAN & MAZERAN, 1913), SK/W/1986/14; from Strobl/Weißenbach. Juvenile specimen.

Figs. 6, 7. *Barroisiceras haberfellneri* (HAUER), group 4., SK/W/1988/17; from Strobl/Weißenbach.

PLATE 3

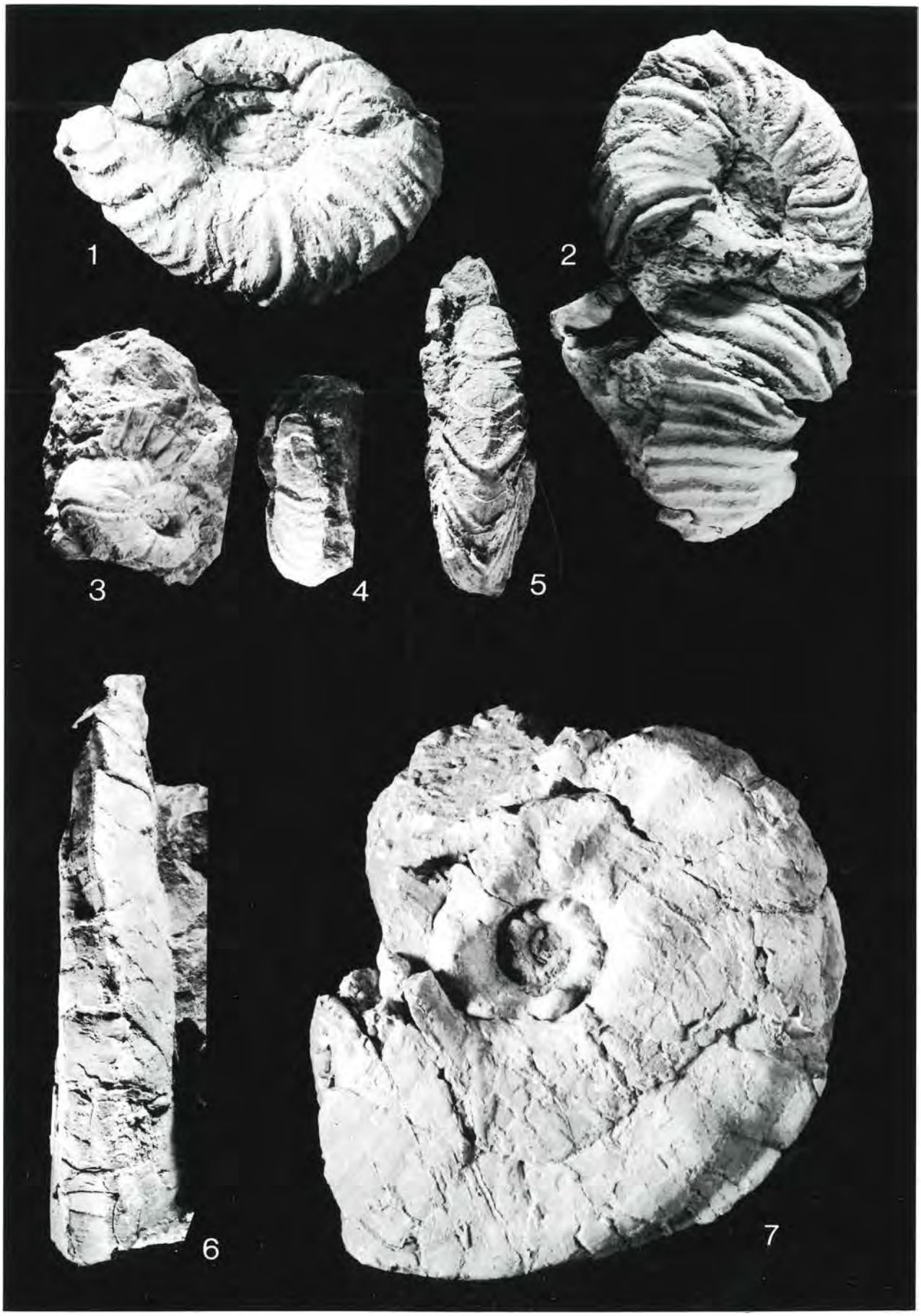

PLATE 4

Figs. 1, 2, 3. *Romaniceras (Romaniceras)* cf. *deverianum* (d'ORBIGNY, 1941); from the Zöttbach section of Brandenberg (Tyrol); fig. 1 is SA/1994/1, fig. 2 and 3 are KÖ/ZW/481.

Fig. 4. *Coilopoceras* cf. *requienianum* (d'ORBIGNY, 1841); KÖ/ZW/344; from the Zöttbach section of Brandenberg (Tyrol).

All figures are x 1.

PLATE 4

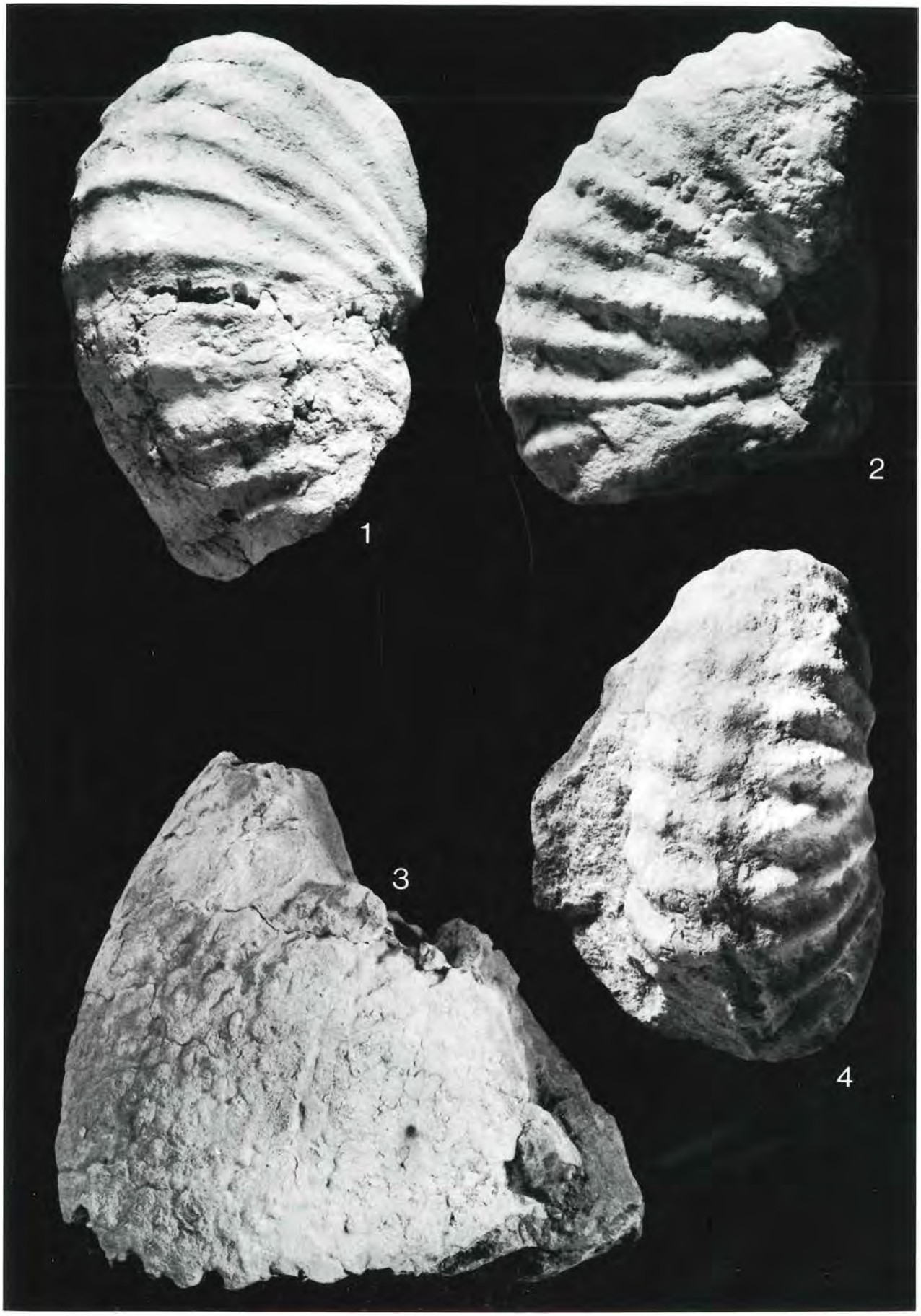

PLATE 5

Barroisiceras haberfellneri (HAUER, 1866)

Figs. 1, 2. The lectotype, GBA 3464; original of HAUER (1866, pl. 1, fig. 1, 2) from Gams.

Fig. 3. SK 1993/12, from the Neualpe near Rußbach (Salzburg), basin of Gosau.

Figs. 4, 5. GBA 1873/01/9 (3481), the lectotype of *Ammonites päon* REDTENBACHER (pl. 23, fig. 3c, d, e); from Strobl/Weißenbach.

Figs. 6, 7 GBA 1873/01/7, paralectotype of *Ammonites päon* (REDTENBACHER, 1873: pl. 23, fig. 3a, b; from Gams.

Figs. 8, 9. GBA 1955/4/2, original of PLÖCHINGER (1955: pl. 1, fig. 3, 4); from Strobl/Weißenbach.

Fig. 10. GBA 1873/01/8, original of REDTENBACHER (1873: pl. 23, fig. 2b); from Gams.

All figures x 1

PLATE 5

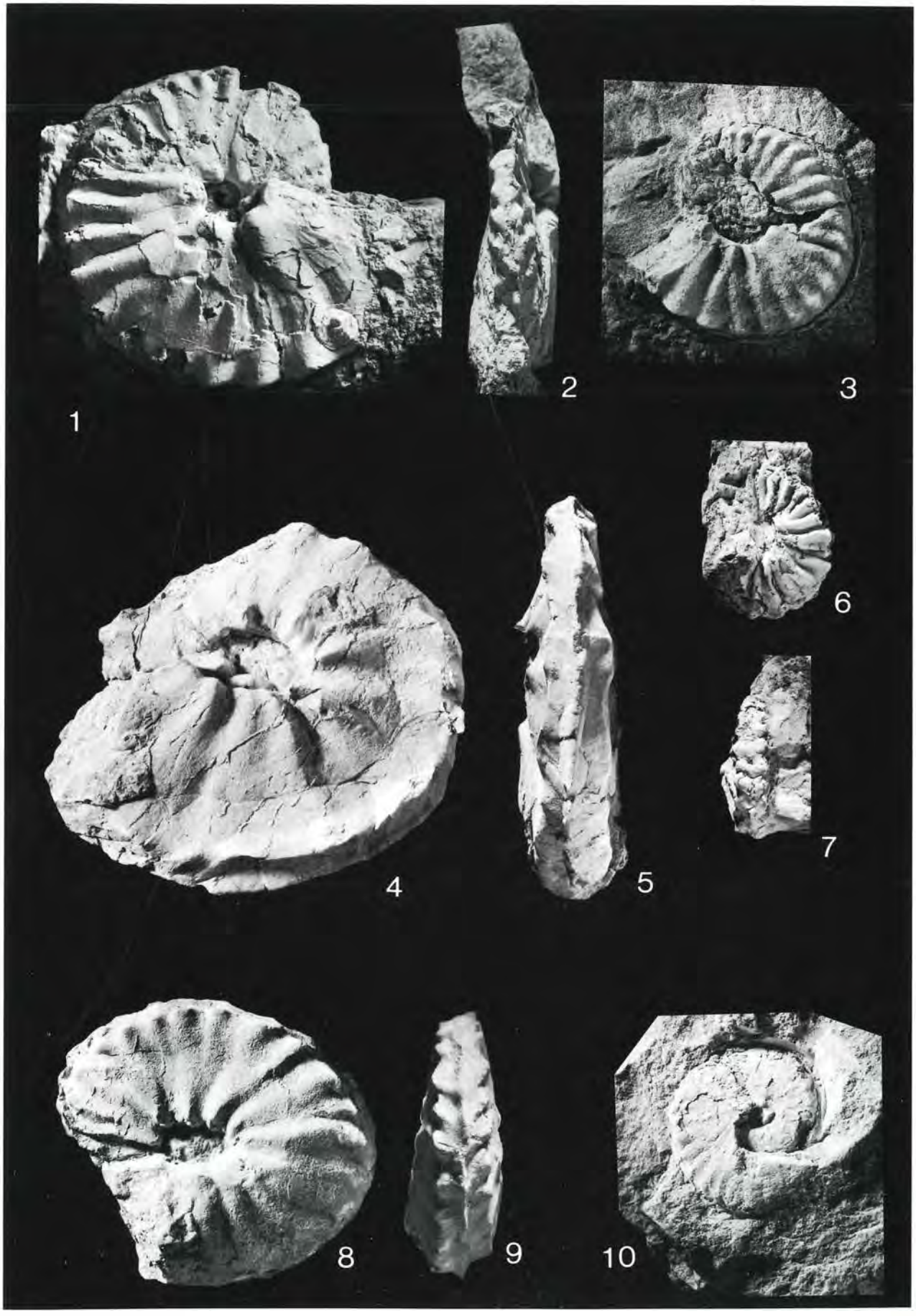

PLATE 6

Barroisiceras haberfellneri (HAUER, 1866)

Fig. 1. NHMW/1988/1/7.

Fig. 2. NHMW/1992/138/1.

Figs. 3, 4, 5. GBA/1955/4/1, the original of PLÖCHINGER, 1955 (pl. 1, figs. 1,2; the holotype of *Barroisiceras haberfellneri hemitissotiformis* PLÖCHINGER, 1955.

All figured specimens are from Strobl/Weißenbachtal. All figures x 1.

PLATE 6

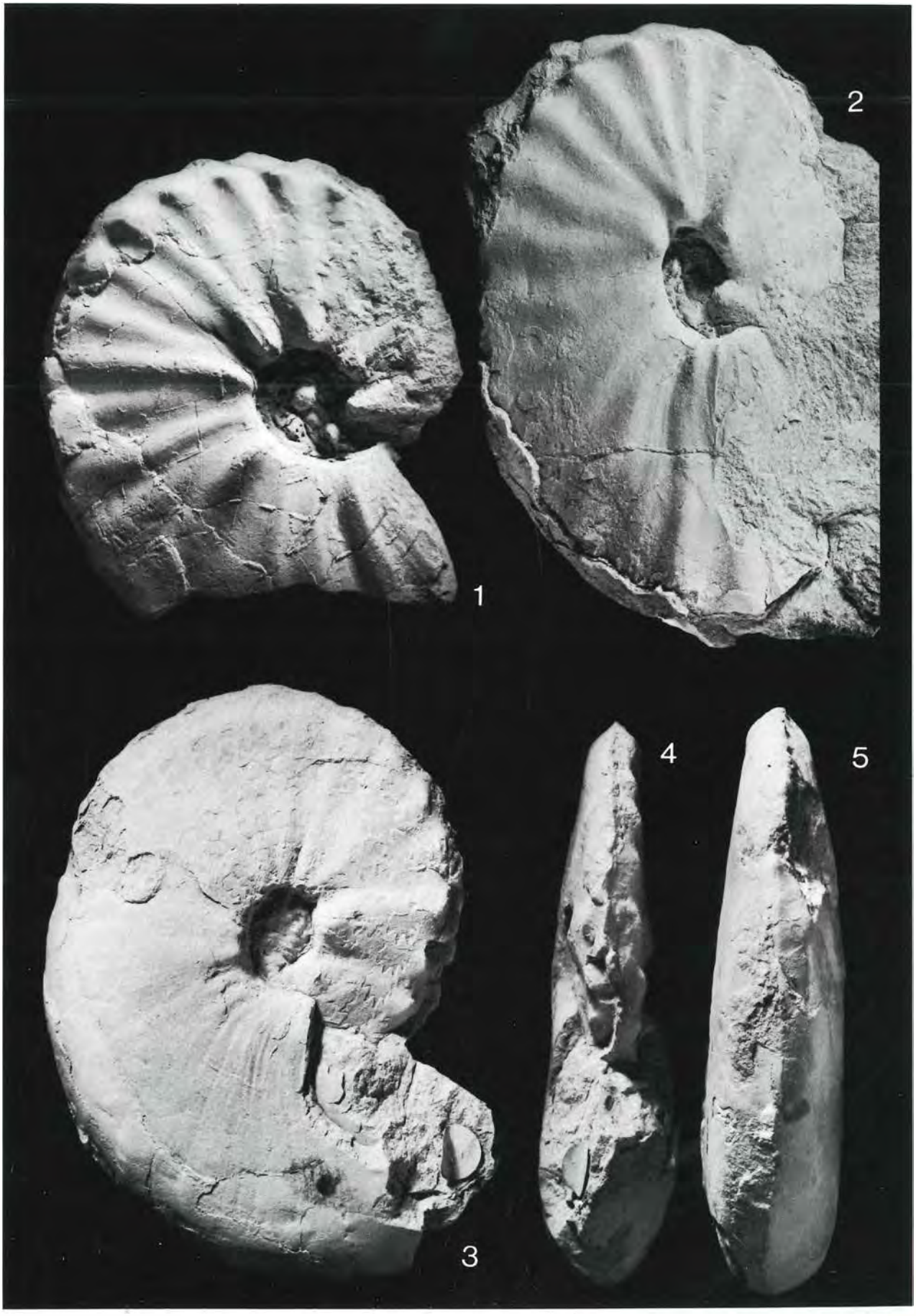

PLATE 7

Figs. 1, 2, 3. *Barroisiceras onilahyense* BASSE 1947, collection B. PLÖCHINGER, Mödling; topotype from Madagascar, "Coniacien moyen. Zone à *Kossmaticeras Theobaldi* et *Barroisiceras onilahyense*" See page 124.

Figs. 4, 5. *Barroisiceras haberfellneri* (HAUER 1866), NHMW/1988/1/9; from Strobl/Weißenbach

Fig. 6. *Barroisiceras haberfellneri* (HAUER 1866), OÖLM/1938/27; labelled Ischl – St. Wolfgang, probably from the "Ofenwand" at Strobl/Weißenbach.

PLATE 7

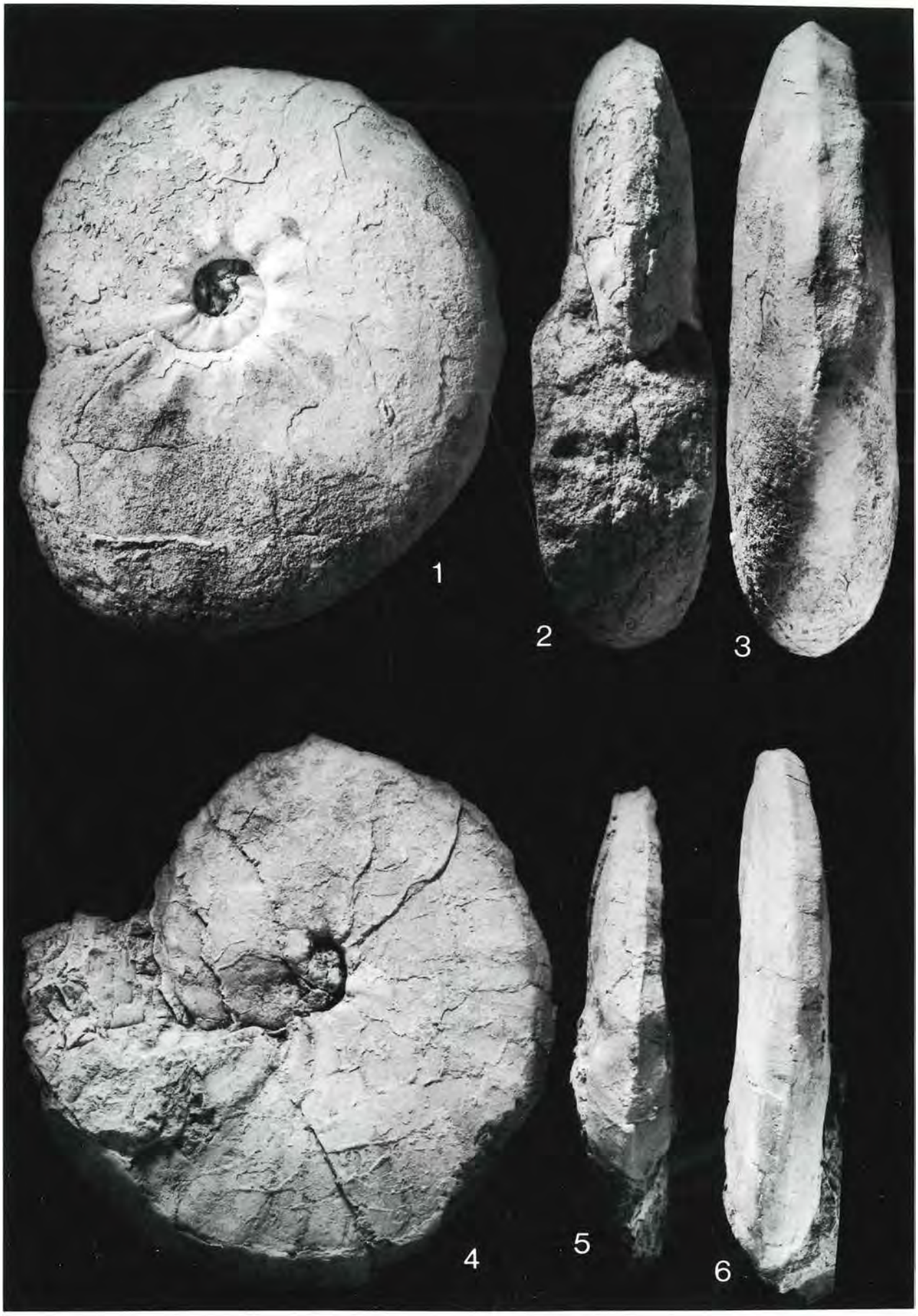

PLATE 8

Barroisiceras haberfellneri (HAUER, 1866)

Figs. 1, 2. SK/W/1983/3.

Fig. 3. OÖLM/1938/27, labelled Ischl – St. Wolfgang, probably from the "Ofenwand" at Strobl/Weißenbach.

Fig. 4. NHMW/1996/32/3.

Figs. 5, 6, 7, 8. NHMW/1988/1/12.

Specimens figured 1,2, 4–8 are from Strobl/Weißenbach. All figures x 1.

PLATE 8

PLATE 9

Barroisiceras haberfellneri (HAUER, 1866)

Fig. 1. GBA 1976/03/3, from the Brennetgraben near Bad Ischl.

Fig. 2. NHMW/1996/35/1 together with *Didymotis* sp., from the Brennetgraben near Bad Ischl.

Fig. 3. PIUW, unregistered; from Gams.

Fig. 4. NHMW/1988/1/10; from Strobl/Weißenbach.

Figs. 5, 6. PIUW unregistered, ex collection of the k.k. polytechnisches Institut, 1872/unregistered; from Gams.

Fig. 7. SK/W/1984/12; from Strobl/Weißenbach.

Fig. 8. PIUW/Coll. REDTENBACHER 25; from Gams. Orig. of REDTENBACHER, 1873, pl. 26, fig. 4a, b.

All figures x 1.

PLATE 9

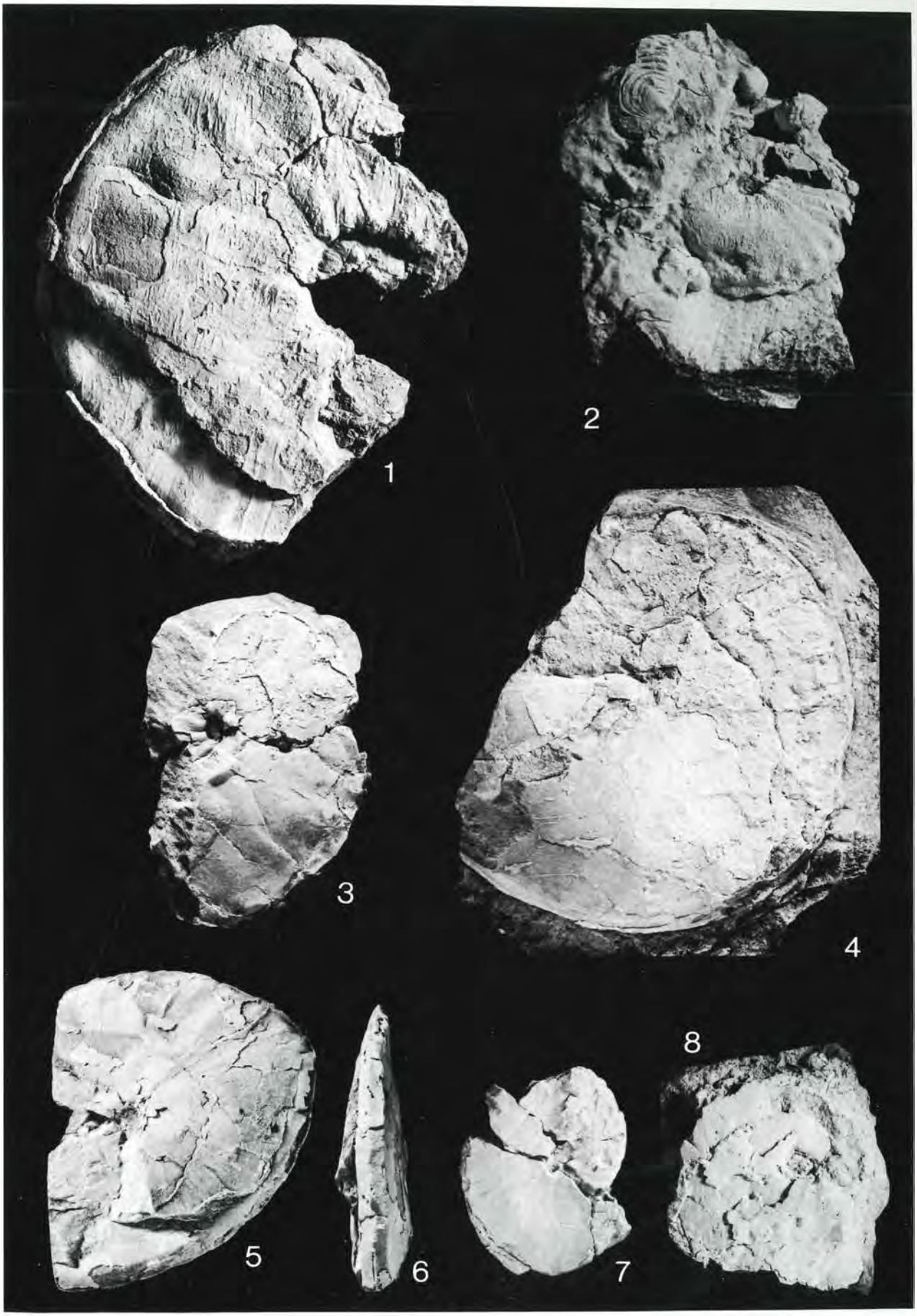

PLATE 10

Barroisiceras haberfellneri (HAUER, 1866)

Figs. 1, 2. SK/W/1993/33.

Fig. 3. NHMW 1988/1/7.

Fig. 4. NHMW 1992/138/1.

Fig. 5. SK/W/1983/9.

Fig. 6, 7. SK/W/1983/2.

Figs. 8, 9. SK/W/1983/4.

Figs. 10, 11. SK/W/1988/16.

All specimens are from Strobl/Weißenbach. All figures x 1.

PLATE 10

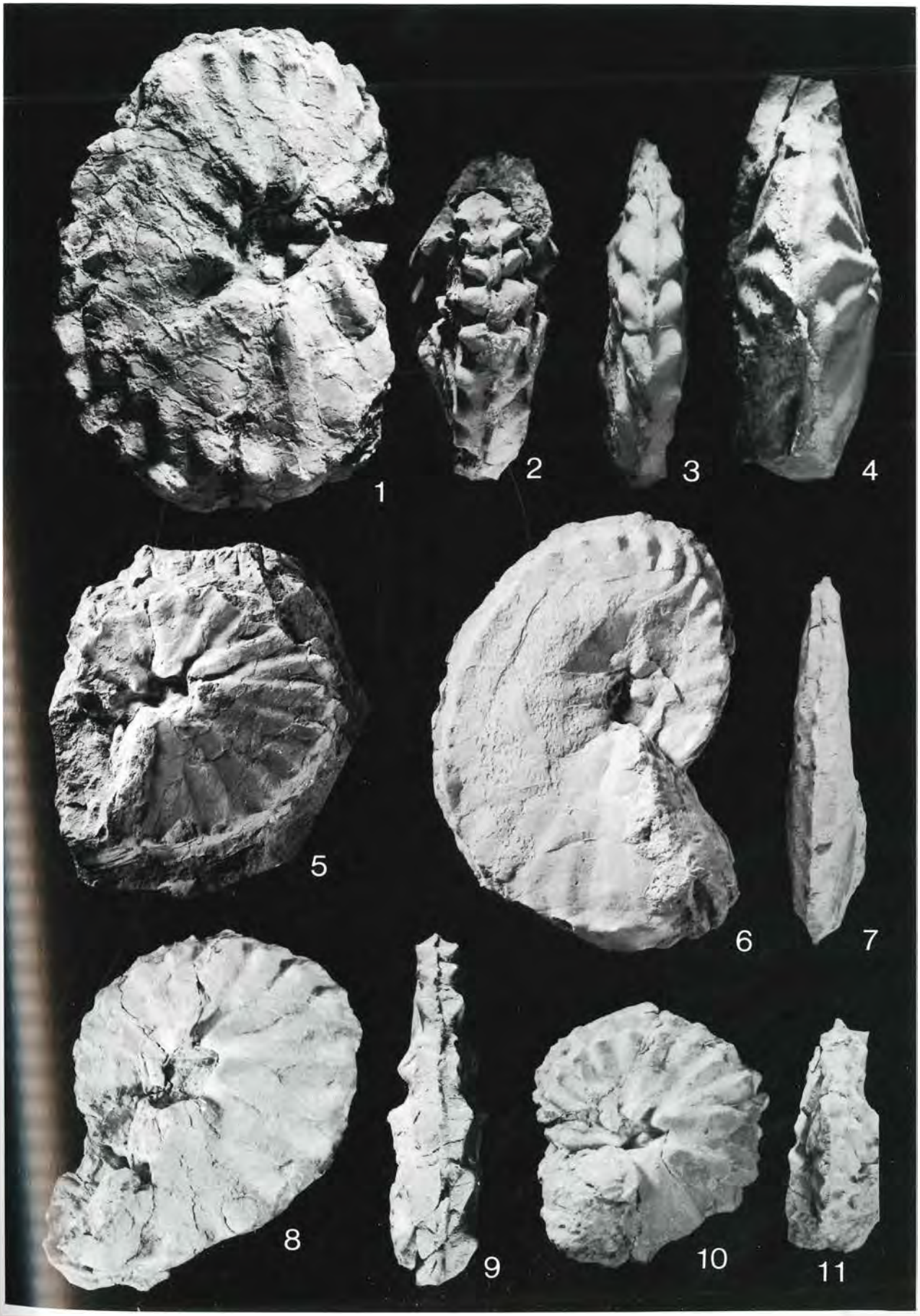

PLATE 11

Barroisiceras haberfellneri (HAUER, 1866)

Figs. 1, 2. GBA 1976/03/2.

Figs. 3, 4. NHMW/1992/139/1.

Figs. 5, 6, 8. NHMW/1992/138/4.

Figs. 7, 11. NHMW/1988/1/18.

Figs. 9, 10. NHMW/1988/1/20.

Figs. 12, 13. GIUW 1864/65/II/1;labelled: "Weidringer Alpe, Strobl Weißenbach"

Figs. 14, 15. GIUW/1881/unregistered; erroneously labelled: "Krampen b. Neuberg"

All specimens are from Strobl/Weißenbach. All figures x 1.

PLATE 11

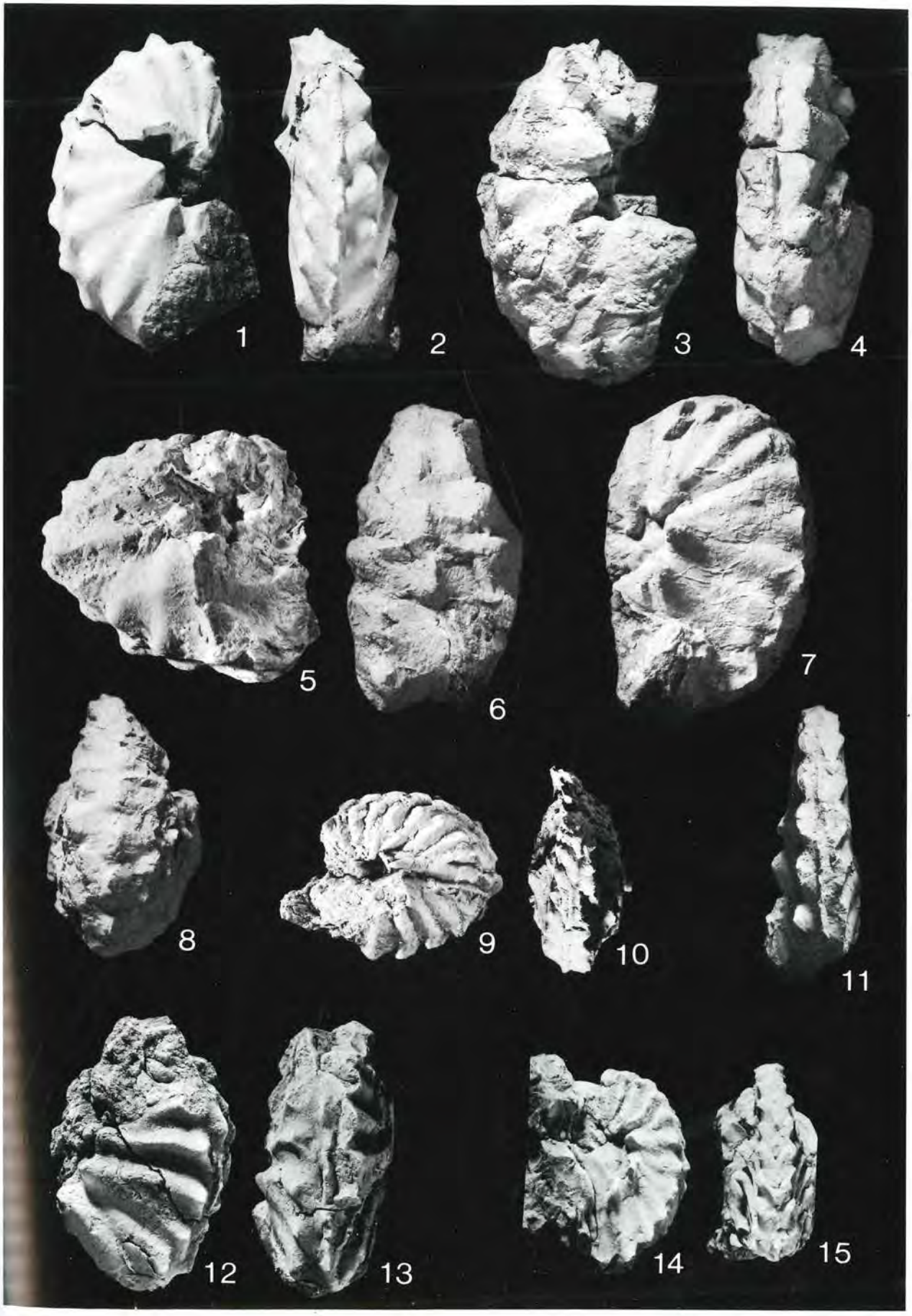

PLATE 12

Barroisiceras haberfellneri (HAUER, 1866)

Fig. 1. SK/W/1984/11.

Figs. 2, 3. SK/W/1992/32.

Fig. 4. SK/W/1993/38.

Fig. 5. NHMW/1988/1/11; ribbing of the bodychamber pathologically rursiradiate.

Fig. 6. NHMW/1992/138/2; individual with pathologically deformed suture (text-fig. 22).

All specimens are from Strobl/Weißenbach. All figures x 1.

PLATE 12

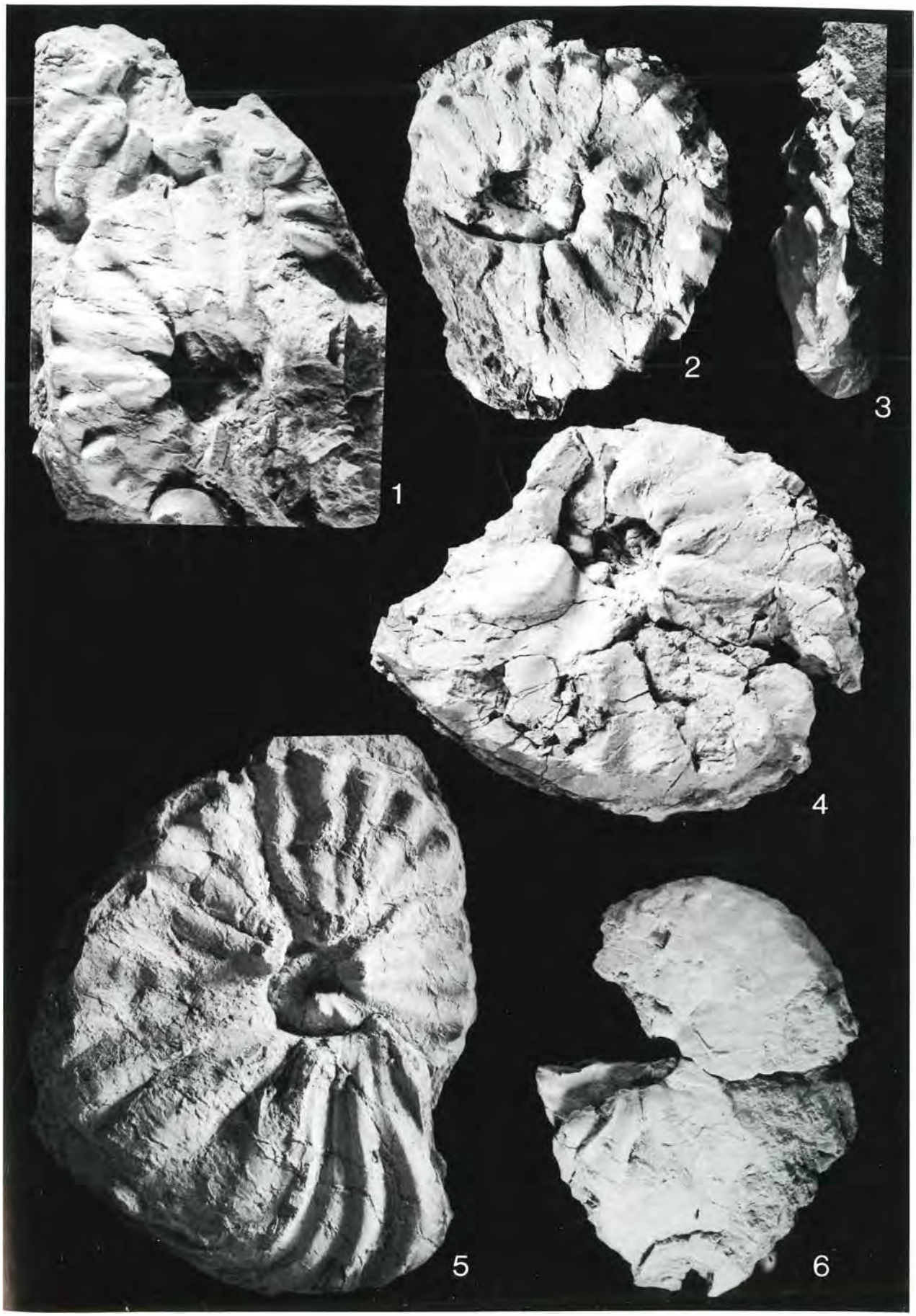

PLATE 13

Figs. 1–4. *Barroisiceras haberfellneri* (HAUER, 1866); VSEGEI 231/2–1960 from the Vedi region, Caucasus, Armenia. All figures x 1.

PLATE 13

PLATE 14

Figs. 1–4. *Barroisiceras haberfellneri* var. *armenica* EGOJAN, figs. 1–3: photos of a cast of the holotype (MNHNP); Fig. 4: photo of a cast of a topotype (MNHNP).

Figs. 5–8. *Schloenbachia tunetana* THOMAS & PERON;
Figs. 5, 6: Djebel bou Driès, Tunisia, original of PERVINQUIÈRE, 1907:382 (MNHNP);
Figs. 7, 8: Sidi bou Ghanem, Tunisia (MNHNP, Collection Thomas, 1901–11).

All figures x 1.

PLATE 14

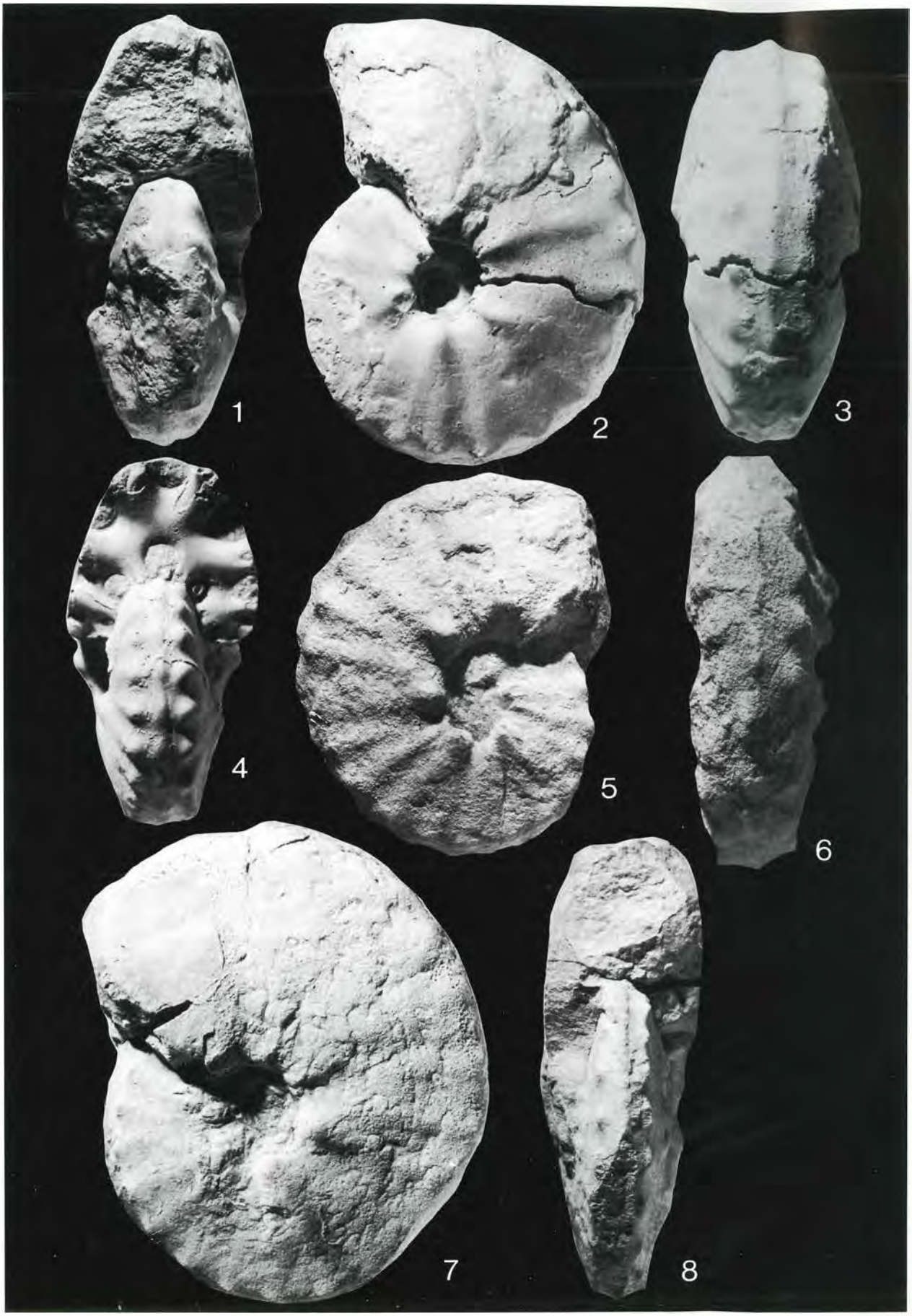

PLATE 15

Figs. 1–5. *Barroisiceras onilahyense* BASSE; MNHP collections, topotypes from Onilahy, Madagascar. All figures x 1.

PLATE 15

PLATE 16

Figs. 1, 2. *Barroisiceras haberfellneri* (HAUER 1866); NHMW/1992/138/3; from Strobl/Weißenbach, x 1.

Figs. 3, 4. *Barroisiceras haberfellneri* (HAUER 1866), NHMW/1992/137/3; from Strobl/Weißenbach, x 1.

Figs. 5, 6. *Barroisiceras haberfellneri* (HAUER 1866), NHMW/1988/1/14; from Strobl/Weißenbach, x 1.

Figs. 7, 8. *Barroisiceras haberfellneri* (HAUER 1866), NHMW/1992/137/4; from Strobl/Weißenbach, x 2.

Figs. 9, 10. *Barroisiceras haberfellneri* (HAUER 1866), NHMW/1992/137/4; from Strobl/Weißenbach, x 1.

Fig. 11. *Barroisiceras haberfellneri* (HAUER, 1866), NHMW/1988/1/17; from Strobl/Weißenbach, x 2.

Figs. 12,13. *Barroisiceras haberfellneri* (HAUER, 1866), SK/SW/1993/5; from St. Wolfgang, x 1.

Fig. 14. *Barroisiceras haberfellneri* (HAUER, 1866), NHMW/1992/247/2; from St. Wolfgang, x 1.

Figs. 15, 16. *Barroisiceras haberfellneri* (HAUER, 1866), NHMW/1992/246; from St. Wolfgang, x 1.

Figs. 17, 22. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), NHMW/1992/247/13; from St. Wolfgang, x 1.

Fig. 18. *Barroisiceras haberfellneri* (HAUER, 1866), NHMW/1992/247/3; from St. Wolfgang, x 1.

Figs. 19, 20. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), NHMW/1992/245; from St. Wolfgang, x 1.

Fig. 21. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), GBA/1935/01/33; from Gams, x 1.

Figs. 23, 24. *Reesidites minimus* (HAYASAKA & FUKADA 1951), NHMW/1992/247/12; from St. Wolfgang, x 2.

Fig. 25. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), GBA/1976/03/1; from St. Wolfgang, x 2.

Figs. 26, 27. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), SK/SW/1993/4; from St. Wolfgang, x 2.

Figs. 28, 29. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), NHMW/1978/1954/5; from Gams, x 2.

Fig. 30. *Reesidites minimus* (HAYASAKA & FUKADA, 1951), NHMW/1992/247/11; from St. Wolfgang, x 3.

PLATE 16

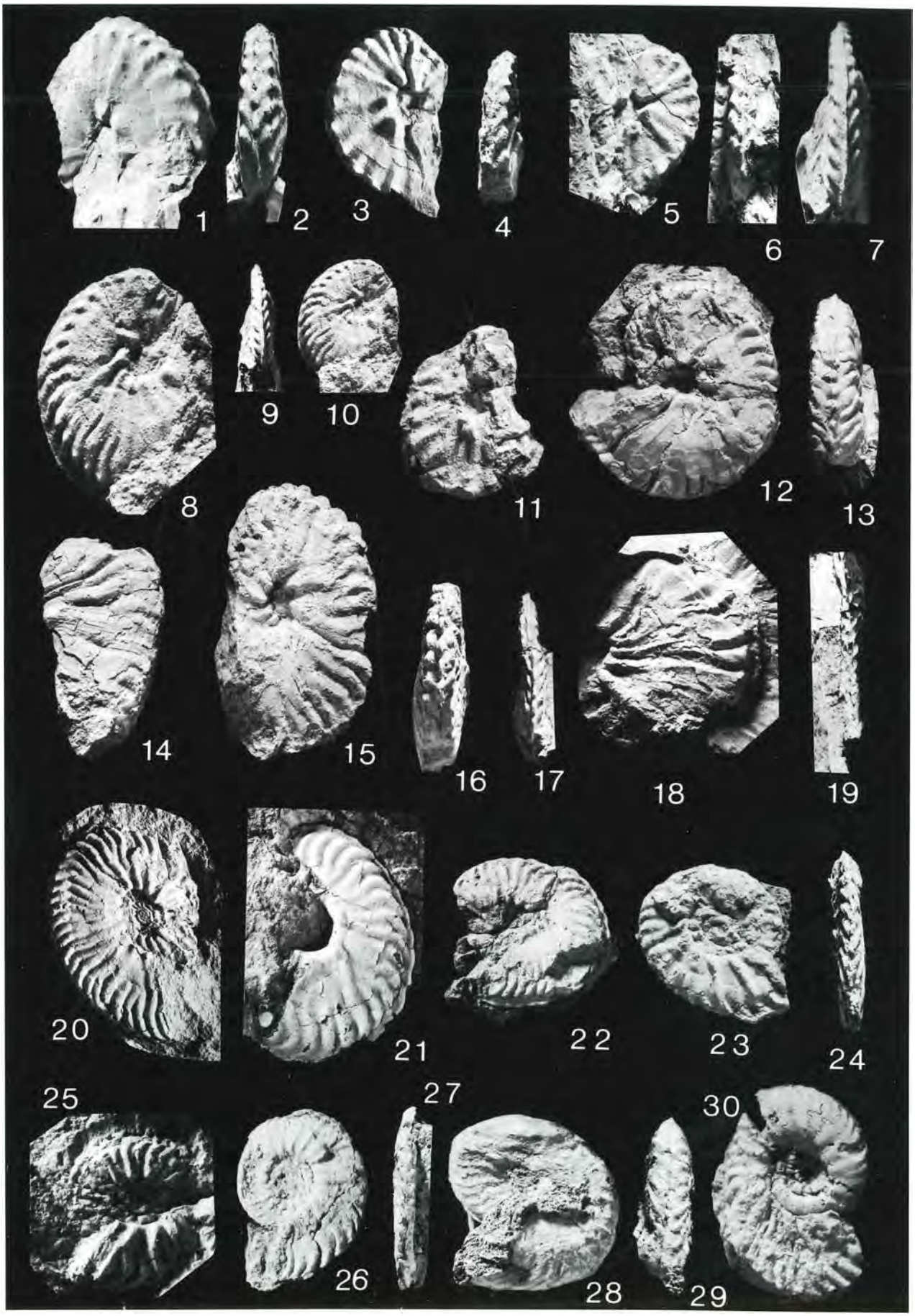
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PLATE 17

Figs. 1, 2, 3. *Tridenticeras binodosum* (HAUER, 1866), GBA/1866/01/5; the holotype of *Turrilites binodosus* HAUER 1866 (pl. 1, fig. 6), from Gams.

Fig. 4. *Eubostrychoceras* species 1, OÖLM/unregistered; labelled: "Strobl – Weißenbach",

Figs. 5, 6, 7, 8. *Hyphantoceras reussianum* (d'ORBIGNY, 1850), SK/W/1990/29; microconch, from Strobl/ Weißenbach.

Figs. 9, 11, 12. ? *Neocrioceras* sp. indet.; from Strobl/Weißenbach.

Fig. 10. *Neocrioceras (Schlueterella)* sp. indet., NHMW/1935/3/24; from Gams.

All figures x 1.

PLATE 17

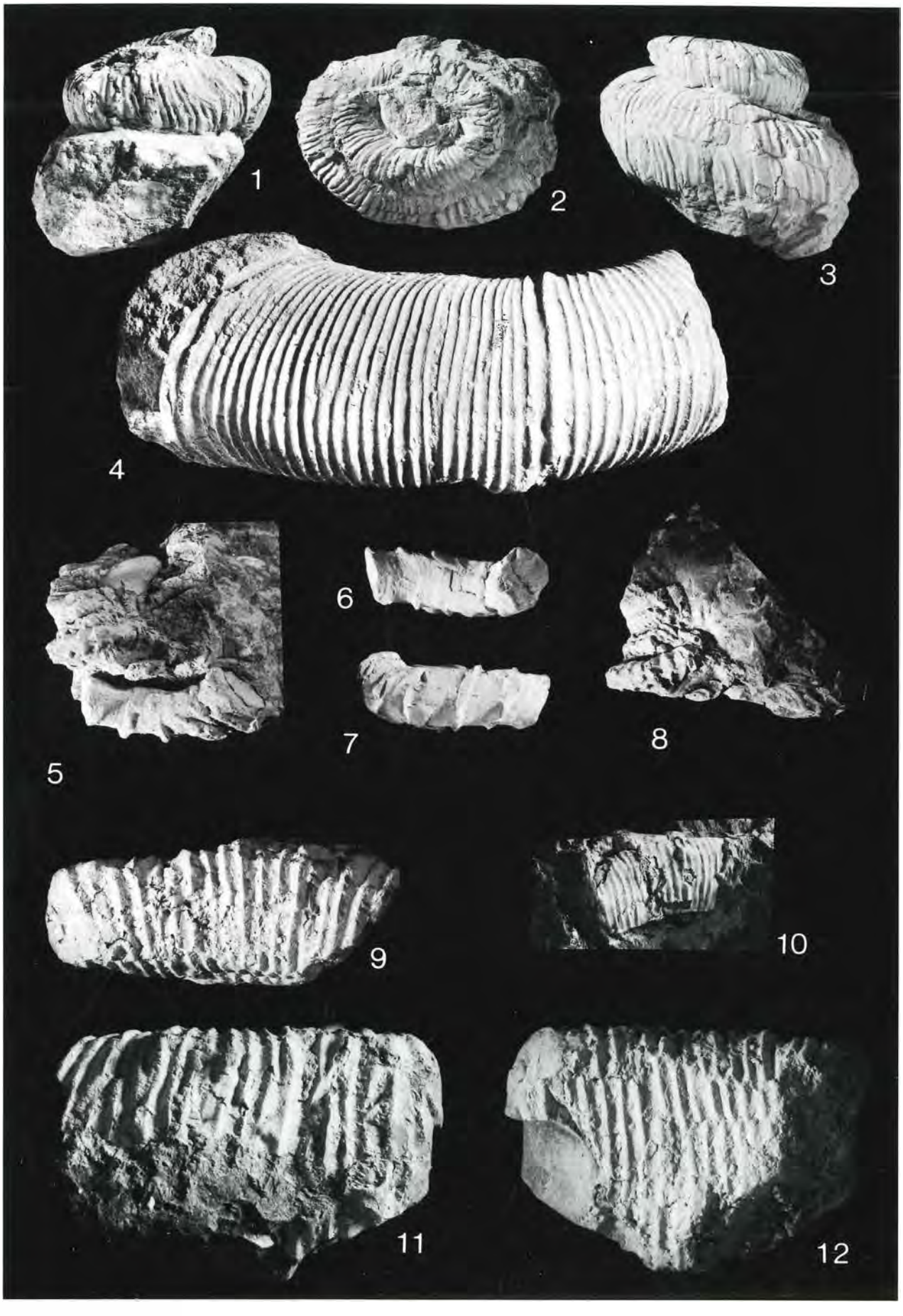

PLATE 18

Fig. 1. *Pseudoxybeloceras* sp., OÖLM/unregistered, labelled: "Strobl, Wolfgangsee"; possibly from the Coniacian of the Nussensee locality.

Figs. 2, 3. ? Nostoceratidae gen. et sp. indet.; NHMW/1987/1954/6; from Gams.

Fig. 4. *Sciponoceras bohemicum bohemicum* (FRITSCH); SK/W/1989/23/2; from Strobl/Weißenbach, x 1.

Figs. 5, 6, 7. *Baculites yokoyamai* TOKUNAGA & SHIMIZU; SK/W/1989/25/6; from Strobl/Weißenbach, x 1.

Figs. 8, 9, 10, 11. *Baculites* cf. *undulatus* d'ORBIGNY; SK/W/1989/23/1; from Strobl/Weißenbach, x 1.

Figs. 12, 13. *Baculites* cf. *undulatus* d'ORBIGNY; NHMW/unregistered; from Gams, x 2.

Figs. 14, 15. *Baculites* sp. indet.; NHMW/unregistered; from Strobl/Weißenbach, x 1.

Fig. 16. *Baculites yokoyamai* TOKUNAGA & SHIMIZU; SK/W/1989/25/1; from Strobl/Weißenbach, x 1.

Figs. 17, 18, 19, 20. *Baculites* cf. *undulatus* d'ORBIGNY; SK/W/1989/24/1; from Strobl/Weißenbach, x 1.

Fig. 21. *Baculites* sp. indet. juv.; NHMW/1978/2030/2; from Gams, x 2.

Figs. 22, 23, 24. *Baculites* cf. *undulatus* d'ORBIGNY; SK/W/1989/24/2; from Strobl/Weißenbach, x 1.

Fig. 25. *Baculites* cf. *undulatus* d'ORBIGNY; NHMW/1978/2030/1; from Gams, x 2.

Fig. 26. *Sciponoceras bohemicum bohemicum* (FRITSCH); SK/BG/1994/3.

Fig. 27. *Scaphites* sp. indet.; GBA/1873/01/30; the original of *Ammonites* sp. indet. (REDTENBACHER, 1873, pl. 30, fig. 9); from Gams, x 1.

PLATE 18