Ann. Naturhist. Mus. Wien	88	A	41–101	Wien, April 1987

Bivalves from the Hochmoos Formation (Gosau-Group, Oberösterreich, Austria)

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(With 2 textfigs. and 6 plates)

Manuscript submitted on April, 28th, 1986

Abstract

The Late Santonian Hochmoos Fm. at Bibereck, Gosau (Austria) contains a diverse bivalve fauna. Despite the relatively poor preservation of the fossils 50 species have been recognised. Pteriomorphs are numerous (27 species) and amongst them are especially interesting bakevellid and inoceramid species. The latter indicate latest Santonian age.

The Heterodonts (15 species) have because of insufficient preservation often only been tentatively identified.

The bivalve assemblage contains infaunal and epifaunal species.

The palaeobiogeographic affinities of this Gosau fauna are found in the Tethys (especially in India and in S. E. France) and in deposits of Late Santonian and Early Campanian Age in NW Europe (Harz and around Aachen, G. F. R.).

Résumé

La Formation de Hochmoos d'âge Santonien supérieur (à Bibereck, Gosau, Autriche) contient une faune de bivalves riche et diversifiée. Malgré la préservation souvent insuffisante 50 espèces ont pu être reconnues. Les Ptériomorphes sont nombreux (27 espèces) et les Bakevellidés et Inocéramidés sont particulièrement intéressants. Ces derniers indiquent un âge Santonien le plus supérieur. La préservation assez médiocre des Hétérodontes (15 espèces) n'a pas toujours permis des déterminations précises.

L'assemblage de bivalves contient des espèces épibenthiques et des fouisseurs.

Les affinités paléobiogéographiques de cette faune sont aussi bien téthysiennes (Inde et le SE de la France) que nordiques (dépôts d'âge Santonien supérieur et Campanien inférieur dans le Harz et près d'Aix-la-Chapelle, R. F. A.).

Zusammenfassung

Erstmals wird eine reiche, gut horizontierte Bivalvenfauna aus der Gosau-Gruppe der österreichischen Ostalpen beschrieben. In der obersantonen Fauna der „Sandkalkbank" der Hochmoosschichten (Gosau, Oberösterreich) konnten trotz des schlechten Erhaltungszustandes 50 Taxa unterschieden werden. 27 Arten sind Pteriomorphia, darunter sind die Bakevelliidae und die Inoceramidae die interessantesten. Letztere bestätigen die Datierung durch Ammoniten. Die Heterodonta sind mit 15 Arten vertreten. Wegen des Erhaltungszustandes sind die Bestimmungen oft nur gefühlsmäßig.

Die Zusammenstellung der Bivalvenfauna (Infauna und Epifauna sind vertreten) läßt auf Seichtwasserbedingungen schließen.

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Paläogeographische Beziehungen dieser Gosau-Fauna ergeben sich vor allem zu den Tethysablagerungen Indiens und Südostfrankreichs aber auch zu den Obersanton/Untercampanfaunen Nordwesteuropas (Aachen und Harz).

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Introduction

Faunas of "Gosau-age" deposits from the Eastern Alps have been described for the last 150 years. Only recently has the wide stratigraphical range of these different "Gosau" outcrops been recognised: WEIGEL (1937), KOLLMANN (1965, 1980), WEISS (1977), WIEDMANN (1978), HERM, KAUFFMAN & WIEDMANN (1979), SUMMESBERGER (1979, 1980, 1985), KOLLMANN & SUMMESBERGER (1982).

As a result new bed-by-bed collections have been undertaken in many localities, especially by Austrian and Southgerman geologists. In localities where the faunas are well-preserved, studies of such well dated fossil beds also allow re-interpretation of older works. The Hochmoos Fm. (Hochmoosschichten) at Bibereck (near Gosau, Oberösterreich, locality map in SUMMESBERGER [1979]) are an example of such a well documented outcrop. Extensive collections have been made by the Geological-Palaeontological Department of the Naturhistorisches Museum Wien. The detailed stratigraphy has been discussed in SUMMESBERGER (1979, 1985) and in KOLLMANN (1980). KOLLMANN (1980) described the gastropods and SUMMESBERGER (1979, 1980) the ammonites. As already stated by SUMMESBERGER (1979, 1985) and by KOLLMANN & SUMMESBERGER (1982) the larger part of the fauna from the Hochmoos Fm. consists of bivalves, of which several thousands were collected. Unfortunately the preservation of these bivalves is not good: generally the shell whether originally calcitic or aragonitic is not present. The nacreous layer, however, is generally preserved. Also many specimens have been strongly deformed ("pélomorphose" of the French authors) during fossilisation, and this is especially strong on cucullaeids, cardiids and *Poromya* species.

Previous work on "Gosau-age" bivalves from Austria was done by SOWERBY in SEDGWICK & MURCHISON (1832), REUSS (1854) and ZITTEL (1865–1866); FELIX (1908) listed the complete fauna per locality and specifically studied corals and rudists; other authors studied specific bivalve groups: ZEKELI (1852), PETRASCHECK (1906), SEITZ (1961, 1971) the inoceramids, KUEHN (1965) the rudists.

In this study of the Bivalvia from the Hochmoosschichten I attempt to present as complete as possible an inventory of the species collected at Bibereck, and to give a palaeobiogeographic interpretation of the possible origin of the fauna.

Material and Methods

All the specimens discussed and described in the fauna from the Hochmoosschichten have been collected at one locality, namely Bibereck, Gosau (OÖ) from the "Sandkalkbank" and from the underlying grey sandy shales. The same bivalves seem to occur in both beds, but the Sandkalkbank contains relatively fewer specimens. The material studied has been collected by the Geologisch-Palaeontologische Abteilung of the Naturhistorisches Museum in Vienna and is housed there.

The taxonomic study was made difficult by the preservation of the specimens, and especially for the heterodont bivalves the results have remained only tentative, especially concerning the generic assignment.

The resulting faunal list presents a large fauna, with epifaunal and infaunal species. A more or less detailed palaeoecological interpretation seemed pointless in view of the preservation.

A palaeobiogeographic interpretation despite the limitations of the data seemed useful.

Palaeobiogeographical affinities of the bivalve fauna from the Hochmoos Fm. at Bibereck

The bivalve fauna from the Hochmoos Fm. at Bibereck contains 50 taxa. Four of these have not been identified beyond the family or generic level and are not included in the data used for palaeobiogeographic comparisons. However, the species which have only tentatively been identified have been included.

Table I lists the 46 species which were specifically identified from Bibereck and indicates the occurrences in other regions geographically close or stratigraphically similar. The results can only be seen as indicative, because some identifications are only tentative and some occurrences outside the Gosau s. s. have not been checked beyond literature.

Table 1. Palaeobiogeographical comparison of the bivalve fauna from the Hochmoos Fm. at Bibereck.

1. Upper Santonian fauna at Bibereck, OÖ, Austria.
2. Maastrichtian bivalve fauna from the Neue Welt, NÖ, Austria.
3. Turonian – Santonian bivalve fauna from S. E. France: Martigues (Bouches-du-Rhône) and Uchaux (Vaucluse).
4. Lower Campanian bivalve fauna from the area around Aachen (GFR): faunas from "Hervensche Kreide", "Aachner und Vaalser Grünsand" auctorum.
5. Upper Cretaceous (Trichinopoly group and Arrialoor group) bivalve fauna from S. India (data from FORBES 1846, STOLICZKA 1871 etc.).
6. Campanian – Maastrichtian bivalve faunas from the Bavarian Alps (out of J. BOEHM and personal data).
7. Bivalve faunas from other Upper Cretaceous temperate localities (f. i. Czechoslovakia, S. England, S.W. and W. France, Saxony and Harz in Germany).
8. Bivalve faunas from other Upper Cretaceous Tethys deposits (f. i. Spain, N. and W. Africa, Madagascar).

Table 1. Palaeobiogeographical distribution.

	1.	2.	3.	4.	5.	6.	7.	8.
Nucula concinna	+	–	–	–	–	–	–	–
N. redempta	+	–	–	–	–	–	–	–
N. cf. *N. stachei*	+	–	–	–	–	?	–	–
Arca aquisgranensis	+	–	–	+	?	–	?	–
Barbatia? inaequidentata	+	–	?	–	–	–	+	–
Cucullaea cf. *matheroniana*	+	–	+	+	–	–	+	–
Limopsis calvus	+	–	?	–	–	?	–	–
Glycymeris marrotianus	+	–	–	–	–	–	+	–
G. noricus	+	+	–	–	–	–	–	–
Inoperna flagellifera	+	–	+	–	+	–	+	+
Modiolus typicus	+	–	–	?	+	–	+	+
M. capitatus	+	–	+	+	–	–	+	–
M. cf. *siliquus*	+	–	+	–	–	–	–	–
Pinna cf. *cretacea*	+	+	+	+	+	+	+	+
Gervillia solenoides	+	–	+	+	+	–	+	+
Gervillaria neptuni	+	–	–	–	–	–	+	–
Pseudoptera raricosta	+	–	–	+	–	+	–	+
Aguileria ? falcata	+	–	?	–	–	–	–	–
Inoceramus muelleri	+	–	–	–	?	–	+	?
I. cycloides ahnesensis	+	–	–	–	–	–	+	–
I. angustus	+	–	–	–	–	–	+	+
Camptonectes virgatus	+	?	+	+	+	+	+	+
Merklinia septemplicata	+	–	–	?	–	–	+	+
Neithea coquandi	+	–	+	–	–	–	–	+
Spondylus coquandianus	+	–	+	–	?	–	–	+
Sp. requienianus	+	–	+	–	–	–	–	–
Plagiostoma cretaceum	+	–	?	?	–	–	+	–
Pycnodonte vesiculare	+	–	+	+	+	?	+	+
Ceratostreon pliciferum	+	–	+	+	?	–	+	+
Mutiella ? coarctata	+	–	–	–	–	–	–	–
Astarte similis	+	+	–	+	+	+	+	+
Crassatella macrodonta	+	–	–	–	–	–	–	–
Granocardium productum	+	–	+	+	+	–	+	+
Linearia costulata	+	+	+	+	–	–	–	–
Icanotia impar	+	–	–	–	+	–	–	+
Proveniella testacea	+	–	–	–	–	–	–	–
Ambocardia planidorsata	+	?	–	+	–	–	–	–
Pitar s. l. *matheroni*	+	–	–	–	–	–	–	–
Cytherea cf. *polymorpha*	+	–	–	–	–	–	–	–
Cyprimeria ? discus	+	–	+	+	–	–	+	–
Legumen martinianus	+	–	+	+	–	?	+	–
Cyclorisma ? dubiosa	+	–	–	–	–	–	–	–
Corbula ? angustata	+	–	?	–	–	–	–	–
Pholadomya nodulifera	+	–	+	+	–	–	+	+
Cercomya ? producta	+	–	–	–	–	–	+	–
Poromya frequens	+	–	–	?	?	–	?	–
	46	6	22	20	14	8	25	17

Table 2. Quantitative comparison.

Total number of bivalve species at Bibereck:	46	
Number of "endemic" Gosau species:	8	17.4%
Number of Tethys species (total)	31	67.4%
Tethys species: S. E. France:	22	47.8%
Tethys species: India	14	30.4%
Tethys species: other	17	37 %
Number of temperate species (total)	28	60.9%
Temperate species: Aachen	20	43.5%
Temperate species: other	25	54.3%
Cosmopolitan species:	3	6.5%

ZITTEL (1865–1866) and FELIX (1908) already compared the faunas from the Gosau deposits with those from other regions of relatively similar age. The knowledge of stratigraphy was less precise at that time than it is to-day and therefore I have not compared their results in detail with those which I obtained.

The conclusions are summarised in Table 2. (For this discussion occurrences marked with a questionmark are taken as equivalent to definite occurrences). Of 46 species recognised, 8 are "endemic" to the Gosau Basin s. s. (i. e. only known from the Santonian Gosau strata near Gosau), 3 are cosmopolitan *(Camptonectes virgatus, Pycnodonte vesiculare, Astarte similis)*. The number of Tethys species outnumbers that of species from temperate deposits, despite the fact that more data are available for temperate deposits (temperate deposits have been studied more often in Europe, and the fauna at Aachen is one of the best preserved known). However, the temperate faunas which have been compared with the Hochmoos Fm. fauna come from shallow deposits: with deeper facies (from White Chalks f. i.) far less common species would be found. Hence, the fauna from the Hochmoos Fm. is a Tethys fauna with some northern European influence, generally showing a shallow depositional environment. This agrees with results previously obtained by KOLLMANN (1980) for gastropods, by SUMMESBERGER (1979, 1980) for ammonites and summarised in KOLLMANN & SUMMESBERGER (1982, p. 48) ". . . the Gosau basin in Upper Santonian times was a marginal part of the circumpacific realm with connections to the North and West".

It is obvious when comparing the Hochmoos Fm. bivalves with those from geographically near but younger faunas (Table 1, column 2: Neue Welt and column 6: Bavarian Alps) that identity of species is virtually non-existing between these two regions and the Hochmoos Fm.

Taxonomy: Descriptions of the bivalve fauna from the Hochmoos Fm.

The taxonomic classification used in this paper is mainly that of the "Treatise on Invertebrate Paleontology" (Ed. R. C. MOORE). Among the higher taxa the subfamily is not taken into consideration, the subgenus is generally not used.

The bivalves from the Hochmoos Fm. are relatively poorly preserved and often strongly deformed. This explains that so many species have been only identified with cf., with questionmarks etc. Furthermore the results for some of the groups, mainly belonging to the Heterodonts, are only tentative: the specimens from the Hochmoos Fm. often do not show such essential parts as the hinges. For such taxa the identification was based on ZITTEL (1865–1866), but an "updating" of his systematic interpretation is attempted. However, when better material should become available, changes will undoubtedly have to be made in the identifications presented herein.

The results of this taxonomic revision and those from the classic monograph of ZITTEL are surprisingly similar for the "Gosau" s. s. region: among the taxa described by ZITTEL, apart from the inoceramids, only two recognised in the present paper were not mentioned by him at all (i. e. *Gervillaria neptuni* and *Plagiostoma cretaceum*).

Phylum MOLLUSCA
Class BIVALVIA
Subclass PALAEOTAXODONTA
Order NUCULOIDA
Superfamily Nuculacea
Family Nuculidae
Genus *Nucula* LAMARCK, 1799

Nucula concinna SOWERBY, 1832
(Pl. 1, fig. 1)

1832 – *Nucula concinna* SOWERBY – J. SOWERBY in SEDGWICK & MURCHISON, p. 418, pl. 38, fig. 1.
(1850) – *Nucula concinna,* SOW. – d'ORBIGNY, p. 243, nº 652.
v. 1865 – *Nucula concinna* ZITT. – ZITTEL, p. 163, pl. 9, figs. 7 a–d.
(1867) – *Nucula concinna,* SOWERBY – PICTET & CAMPICHE, p. 419.
(1871) – *Nucula concinna,* SOW. – STOLICZKA, p. 326.
(1955) – *Nucula concinna* SOWERBY – VAN DE POEL, p. 8.

Type-material: The original of *Nucula concinna* SOWERBY *in* SEDGWICK & MURCHISON has not been definitely recognised among the specimens housed in the BM (NHM) in London (written communication of R. J. CLEEVELY, 10. VII. 1985). ZITTEL's original (pl. 9, figs. 7 a–d) is in the NHMW.

Locus typicus, stratum typicum: "Gosau" designated herein. ZITTEL's specimen came from the Hofergraben in the Gosau area (OÖ), Upper Santonian.

Description and discussion:

Material from the Hochmoos Fm.: 4 external moulds.

Measurements: Best preserved specimen: H: 4.3 mm, W: 5.5 mm; largest specimen: W: 9 mm.

Diagnosis: Small nuculid bivalve with pronounced radial ribbing.

The material is not well enough preserved for further description. In how far *Nucula redempta* ZITTEL (see below) and *N. concinna* are specifically different cannot be ascertained with the present material.

The strong radial ribbing on *N. concinna* makes it probable that it belongs in the subgenus *Pectinucula* QUENSTEDT, 1930.

Occurrence and distribution: Upper Santonian of the Gosau: Hochmoos Fm. at Bibereck, Hofergraben (OÖ), also Scharrergraben near Piesting (NÖ). SOWERBY also mentioned Hinterreut.

Nucula redempta ZITTEL, 1865

1854 – *Nucula decussata* m. – REUSS, p. 146, pl. 28, fig. 11.
(non *N. decussata* G. B. SOWERBY, 1831, nec. *N. decussata* MUENSTER, 1835 – *fide* SHERBORN)
v. 1865 – *Nucula redempta* ZITT. – ZITTEL, p. 164, pl. 9, figs. 5 a–d.
(1870) – *Nucula redempta* ZITTEL – PICTET & CAMPICHE, p. 419.
(1871) – *Nucula redempta* ZITT. – STOLICZKA, p. 326.
(1955) – *Nucula redempta* ZITTEL – VAN DE POEL, p. 8.

Type-material: The original specimen figured by ZITTEL on pl. 9, fig. 5 a (not fig. 3 as stated on p. 164) is herein designated as the lectotype of *Nucula redempta* ZITTEL. It is housed in the NHMW.

Locus typicus, stratum typicum: Hofergraben, Gosau (OÖ), Upper Santonian.

Description:

Material from the Hochmoos Fm. at Bibereck: 2 specimens (external moulds).

ZITTEL's type series from Hofergraben: 5 specimens.

Measurements:

	Hofergraben type series					Hochmoos Fm.	
H (mm)	8.2	8.3	8.6	9.6	9.9	10.0	10.6
W (mm)	10.3	11.3	11.8	13.4	14.9	12.7	13.8

Diagnosis: Small nuculid bivalve with strong rib-like radial ornamentation, especially on moulds; on better preserved specimens the shell surface appears to be almost smooth.

Discussion: The relatively poor preservation state makes a detailed description pointless. As stated above the difference between *Nucula redempta* and *N. concinna* could be below specific level, but the nature of the available material makes definite conclusions impossible.

N. redempta can also be compared to *N. renauxiana* d'ORBIGNY, 1843 (p. 179, pl. 304, figs. 7–9) from Uchaux (Vaucluse), and of upper Turonian age.

N. renauxiana is somewhat smoother but this might be the result of different preservation.

Occurrence and distribution: Hofergraben, Wegscheidgraben, Bibereck in the Gosau-type-area, Billmannsgraben am Wolfgangsee (OÖ), Scharrergraben b. Piesting (NÖ), all of Santonian age.

Nucula spec. cf. *Nucula stachei* ZITTEL, 1865

1861 – *Nucula pectinata* – GÜMBEL, p. 571.
(non *Nucula pectinata* J. SOWERBY, 1818, p. 209)
v. 1865 – *Nucula Stachei* ZITT. – ZITTEL, p. 163, pl. 9, figs. 6 a, b.
(1867) – *Nucula Stachei,* ZITTEL – PICTET & CAMPICHE, p. 419.
(1871) – *Nucula Stachei,* ZITT. – STOLICZKA, p. 326.
(1955) – *Nucula stackei* ZITTEL – VAN DE POEL, p. 8.

Type-material: GBAW 3183.

Locus typicus, stratum typicum: Tiefengraben, Gosau (OÖ), Santonian.

Description and discussion: One incomplete valve in steinkern preservation from the Hochmoos Fm. at Bibereck might represent this species. H: 16.7 mm, W: 22.6 mm. It is possible that the specimens described by REUSS (1846), GEINITZ (1872) and FRIČ (1877) as *Nucula pectinata,* from the Saxonian and Bohemian Upper Cretaceous deposits also belongs to *Nucula stachei.* The steinkern preservation of most of these specimens makes definite conclusions impossible. *Nucula tenera* J. MUELLER, 1847 from the lower Campanian near Aachen (G. F. R.) also seems close to *N. stachei,* but once again, poor preservation makes comparison difficult.

Occurrence and distribution: Tiefengraben and Bibereck, Gosau (OÖ), Upper Santonian.

Subclass PTERIOMORPHIA
Order ARCOIDA
Superfamily Arcacea
Family Arcidae
Genus *Arca* LINNÉ, 1758
Subgenus *Eonavicula* ARKELL, 1929

Arca (Eonavicula ?) aquisgranensis J. MUELLER, 1859
(Pl. 1, figs. 3, 4)

1859 – *Arca aquisgranensis* – J. MÜLLER, p. 10, pl. 7, fig. 19.
v. 1865 – *Cucullaea Gosaviensis* ZITT. – ZITTEL, p. 174, pl. 10, figs. 4 a–c.
(1870) – *Arca Gosaviensis,* ZITTEL – PICTET & CAMPICHE, p. 478.
(1871) – *Arca Gosaviensis,* ZITTEL – STOLICZKA, p. 344.
(1871) – *Arca Aquisgranensis,* MÜLLER – STOLICZKA, p. 344.
. 1889 – *Arca aquisgranensis* MÜLL. – HOLZAPFEL, p. 204, pl. 17, figs. 7, 8.
? 1897 – *Arca vendinensis,* d'ORB. – FRIČ, p. 57, textfig. 63 a, b.
? 1943 – *Arca carteroni* d'ORBIGNY – VAN DER WEIJDEN, p. 31, pl. 1, fig. 7.
1956 – *Arca (Eonavicula ?) aquisgranensis* MÜLLER – VAN DE POEL, p. 6.

Type-material:

Arca aquisgranensis: Probably in the Technische Universität, Aachen (G. F. R.).

Cucullaea gosaviensis: Original specimens of ZITTEL: pl. 10, fig. 4 b: GBAW 3176; pl. 10, fig. 4 c: NHMW (lectotype, designated herein); pl. 10, fig. 4 a: has not been found.

Locus typicus, stratum typicum:

Arca aquisgranensis: Grünsandbänke am Königsthor, Aachen (G. F. R.), Campanian.

Cucullaea gosaviensis: Wegscheidgraben, Gosau (OÖ), Santonian.

Description and discussion:

Material from the Hochmoos Fm.: 9 strongly deformed specimens, none complete, with only partial shell preservation; only one with partial hinge.

Measurements: Because of the taphonomic deformation the measurements are only indicative, they cannot be used for proportional values.

H varies from 7.0 mm to 16.8 mm, av. 10.57 mm (n = 10).

W varies from 15.7 mm to 35.5 mm, av. 25.96 mm (n = 10).

All specimens seem to have two strongly developed posterior radial costellae.

Elongate, subequivalve arcid with one or two strongly developed costellae at the posterior umbonal slope, and fine costae over the complete valve. These fine costae of primary and secondary order, crossed by commarginal lines form a not always regular sculpture.

The hinge is very long, but none of the specimens show details of dentition. Distortion, probably due to taphonomic deformation makes it impossible to state with any degree of accuracy the proportions H/W.

VAN DE POEL (1956, p. 7) indicated the probable identity of *Arca aquisgranensis* and *Cucullaea gosaviensis*. His assumption is totally justified and the "differences" between the two taxa result from the rigid typological approach of older authors. As far as I can ascertain from the material available these differences fall within the specific variability.

Arca filistriata STOLICZKA, 1871 (p. 357, pl. 17, fig. 37, pl. 50, fig. 6) from the Upper Cretaceous of India shows undoubted affinities with *A. aquisgranensis*.

Occurrence and distribution: Gosau Beds (Bibereck, Tiefengraben, Wegscheidgraben, OÖ): all Santonian. Lower Campanian Beds around Aachen (G. F. R.).

Genus *Barbatia* GRAY, 1842

Barbatia ? inaequidentata **(ZITTEL, 1865)**

(Pl. 1, figs. 5, 6, 7)

v. 1865 – *Arca inaequidentata* ZITT. – ZITTEL, p. 175, pl. 10, figs. 8 a–c.
v. 1865 – *Arca Schwabenaui* ZITT. – ZITTEL, p. 174, pl. 10, figs. 7 a–b.
v? 1865 – *Arca Lommeli* ZITT. – ZITTEL, p. 176, pl. 9, figs. 11 a–b.
(1867) – *Arca inaequidentata,* ZITTEL – PICTET & CAMPICHE, p. 478.

(1867) – *Arca Lommelii,* ZITTEL – PICTET & CAMPICHE, p. 478.
(1867) – *Arca Schwabenaui,* ZITTEL – PICTET & CAMPICHE, p. 478.
(1871) – *Arca Schwabenaui,* ZITTEL – STOLICZKA, p. 344.
(1871) – *Arca inaequidentata,* ZITTEL – STOLICZKA, p. 344.
(1871) – *Arca Lommelii,* ZITTEL – STOLICZKA, p. 344.
. 1883 – *Arca Schwabenaui* ZITTEL – FRIČ, p. 103, textfig. 68 a, b.
? 1890 – *Arca inaequidentata* ZITT. – COLLOT, p. 101.

Type-material: *Arca inaequidentata:* GBAW 3173 (pl. 10, figs. 8 b, c).
A. schwabenaui: GBAW 3179 (pl. 10, fig. 7 a); GBAW 3175: non-figured paratype from Wegscheidgraben.
A. lommeli: NHMW.

Locus typicus, stratum typicum:
A. inaequidentata: Gosau, Santonian?
A. schwabenaui: Tiefengraben (OÖ), Santonian.
A. lommeli: Hofergraben (OÖ), Santonian (on the label of the type specimen Stöcklhof, Russbachtal is marked).

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: *B. inaequidentata* morphotypes: 3, *B. lommeli* morphotypes: 4, *B. schwabenaui* morphotypes: 5.

Measurements:
Given by ZITTEL: for *'Arca' schwabenaui:* W: 25–45 mm, H: 12–20 mm;
for *'A.' inaequidentata:* W: 25 mm, H: 11 mm;
for *'A' lommeli:* W: 30 mm, H: 20 mm.

On the morphotypes from the Hochmoos Fm.:

'B. inaequidentata'	W max	H max	W/H	
(1)	20.7 mm	17.5 mm	1.183 (deformed)	
	26.8 mm	18.8 mm	1.423	
(2)	19.2 mm	11.2 mm	1.714	av. 1.542
(3)	14.6 mm	9.8 mm	1.490	
'B. lommeli'				
(1)	31.4 mm	(20 mm)	1.570	
(2)	(24 mm)	15 mm	(1.6)	
	15 mm	9.4 mm	1.596	av. 1.546
(3)	34.7 mm	26.0 mm	1.335	
(4)	22.8 mm	14.0 mm	1.629	
'B. schwabenaui'				
(1)	32.4 mm	19.5 mm	1.662	
(2)	30.8 mm	19.7 mm	1.563	
(3)	35.3 mm	20.6 mm	1.714	av. 1.572
(4)	35.2 mm	22.2 mm	1.586	
(5)	(20 mm)	15.0 mm	1.333	

Diagnosis: Small to medium-sized, elongated *"Barbatia"* species with well developed radial and concentric ornamentation.

The ZITTEL types of *Barbatia inaequidentata, B. lommeli* and *B. schwabenaui* and the specimens available from the Hochmoos Fm. at Bibereck are all relatively poorly preserved, often incomplete, "Skulptursteinkern" preservation. On many specimens the hinges are lacking, which gives the specimens a more elongated appearance, and creates the impression of widely different shapes within the same group. There is no real reason to consider that more than one species is present: the differences in shell shape (higher versus more elongated) are

a) preservational (incomplete versus complete shells)

b) due to different ontogenetic stages (the position of the umbo varies during ontogeny in arcids);

the differences in ornamentation are preservational: – "well" preserved specimens have an ornamentation consisting of radial and commarginal lines forming a trellis-like ornamentation; – on worn specimens the shell surface appears at least partly smooth (such as on the morphotype *A. lommeli,* where this state can be demonstrated with partial shell preservation).

Assigning this Gosau material to a precise genus is extremely difficult, too many necessary characteristics are not known. *Barbatia* seems the most likely genus, but *Striarca* CONRAD, 1862 could also be used.

The Gosau taxa have almost been forgotten by later authors. It is possibly because *Barbatia geinitzi* (REUSS, 1844, pl. 34, fig. 31) from the Coniacian deposits near Prague is very similar to the ZITTEL taxa. WOODS (1899) has figured a *B.* sp. cf. *geinitzi* (pl. 7, figs. 10, 11) from the Chalk Rock (Turonian – Coniacian) which is also very similar. The specimens available from the Gosau do not allow a conclusion to be drawn as to their possible identity with *B. geinitzi.*

Also morphologically close is the species *B. (B.) forchammeri* (LUNDGREN, 1888) as described and figured by HEINBERG 1978 (p. 107, fig. 3).

Occurrence and distribution: *B? inaequidentata* as interpreted herein has been recorded from the Santonian of the Gosau s. s. and possibly from Coniacian strata in Czechoslovakia.

Family Cucullaeidae

Genus *Cucullaea* LAMARCK, 1801

Cucullaea cf. *matheroniana* (d'ORBIGNY, 1844)

(Pl. 1, fig. 10)

? 1843 – *Cucullaea glabra* SOW. – GEINITZ, p. 14, pl. 3, figs. 4–7.
1844 – *Arca Matheroniana,* d'ORBIGNY – d'ORBIGNY, p. 238, pl. 325, figs. 1–4.
(1850) – *Arca Matheroniana,* d'ORB. – d'ORBIGNY, p. 196, n° 136.
v. 1865 – *Cucullaea Chiemiensis* GÜMB. sp. – ZITTEL, p. 169, pl. 10, figs. 3 a–g.
(non 1861 *Arca Chiemiensis* – GUEMBEL, p. 571)
1875 – *Cucullaea (? Trigonarca) Matheroniana* d'ORBIGNY – BRAUNS, p. 385.

. 1889 – *Cucullaea Matheroniana* d'ORB. – HOLZAPFEL, p. 208, pl. 22, figs. 2, 4, 8.
? 1890 – *Cucullaea Orbignyana* MATH. – COLLOT, p. 101.
? 1920 – *Cucullaea Matheroniana* d'ORBIGNY – ROMAN & MAZERAN, p. 82, pl. 7, fig. 9.
1943 – *Cucullaea matheroniana* (d'ORBIGNY) – VAN DER WEIJDEN, p. 33, pl. 1, figs. 11, 12.
1956 – *Trigonarca (Trigonarca) matheroniana ?* – VAN DE POEL, p. 13.
1959 – *Trigonarca matheroniana* (d'ORBIGNY) – FRENEIX, p. 187 etc.

Type-material:

Arca matheroniana: Probably in the d'ORBIGNY Coll., Muséum National d'Histoire naturelle, Paris, France.

ZITTEL specimens: GBAW: 3180 from Hofergraben: pl. 10, figs. 3 a; 3178 from Hofergraben: pl. 10, figs. 3 b; NHWM: originals of pl. 10, figs. 3 c, e, g and possible of 3 d.

Locus typicus, stratum typicum:

Arca matheroniana: Uchaux (Vaucluse, France), Upper, Turonian – Santonian.

ZITTEL material: Hofergraben, Gosau (Upper Santonian).

Description and discussion:

Material: *Cucullaea chiemiensis* sensu ZITTEL occurs very frequently in the Hochmoos Fm.: more than 150 specimens. The preservation is not always satisfying, and many specimens are badly crushed and deformed.

Measurements: Because of the strong deformation measuring the specimens from the Hochmoos Fm. is difficult. A sample was measured only for indicative purposes:

H max: varies from 34.6 mm to 95 mm, average: 55.8 mm (N = 18).

W: varies from 38.2 mm to 56.7 mm, average: 45.9 mm (N = 18).

Hinge length: varies from 21.2 mm to 33.2 mm, average: 27.8 mm (N = 16).

Diagnosis: Small to medium-sized *Cucullaea* species, generally strongly oblique and with very thick shell, shell smooth except for faint radial lines.

The available specimens are almost all steinkern preservation, so detailed description is pointless.

The *Cucullaea* specimens from the 'Gosau' were considered by ZITTEL as identical with those described by GUEMBEL in 1861 from Siegsdorf in Bavaria. The deposits in Siegsdorf are of Early Maastrichtian age, considerably younger than the Hochmoos Fm. and other Santonian Gosau localities from which ZITTEL mentioned *'Cucullaea chiemiensis'*. J. BOEHM (1891, p. 79, pl. 3, fig. 27) pointed out that ZITTEL's Gosau specimens belong to another species. COLLOT (1890) identified the Gosau specimens with *C. orbignyana* MATHÉRON. I thought that the oblique form and the strongly overlapping beaks of the Gosau specimens make them more similar to *C. matheroniana* as figured by d'ORBIGNY. The figure in ROMAN & MAZERAN is not convincing in this connection. The general poor preservation and strong deformation of the Hochmoos Fm. specimens makes a definite conclusion impossible, hence the tentative identification.

Occurrence and distribution: Upper Turonian to Campanian. S. E. France, Gosau (OÖ), Harz and near Aachen (G. F. R.).

Superfamily Limopsacea
Family Limopsidae

Genus *Limopsis* SASSI, 1827

Limopsis calva (SOWERBY, 1832)
(Pl. 1, fig.2)

. 1832 – *Pectunculus calvus* SOWERBY – J. SOWERBY *in* SEDGWICK & MURCHISON, p. 417, pl. 38, fig. 2.
(1850) – *Pectunculus calvus,* SOW. – d'ORBIGNY, p. 243, n° 660.
(1861) – *Pectunculus calvus* SO. – GUEMBEL, p. 571.
v. 1865 – *Limopsis calvus* SOW. sp. – ZITTEL, p. 165, pl. 9, figs. 8 a–d.
1867 – *Limopsis calva,* ZITTEL – PICTET & CAMPICHE, p. 424.
(1871) – *Limopsiss calva,* SOW. – STOLICZKA, p. 341.
? 1890 – *Limopsis calvus,* SOW. – COLLOT, p. 101.
? 1892 – *Limopsis calva* SOW. sp. var. *subcalva* – J. BOEHM, p. 78, pl. 3, fig. 23 a.

Type-material:

SOWERBY types: Cannot be found in the collection of the BM (NHM) at present (written communication of R. J. CLEEVELY, 10. VII. 1985).

ZITTEL specimens: NHMW: from Hofergraben; GBAW 3181: from Edelbachgraben (unfigured specimen).

Locus typicus, stratum typicum: Gosau, designated herein; probably Santonian.

Description and discussion:

Material from the Hochmoos Fm.: 6 specimens of poor, almost steinkern preservation.

Measurements: one specimen was measured: H: 5.3 mm, W: 2.3 mm.

Diagnosis: Very small limopsid species with smooth shell (on the Hochmoos Fm. material details of the hinge cannot be seen).

The Hochmoos Fm. specimens do not show the 'Bandgrube' mentioned by ZITTEL, but they show the auricle-like structures which ZITTEL figured but stated not to be present. Further details cannot be seen on the material available.

Occurrence and distribution: Santonian of the Gosau (OÖ), possibly in S. E. France (Coniacian) and in Bavaria (L. Maastrichtian).

Family Glycymeridae

Genus *Glycymeris* DA COSTA, 1778
Subgenus *Glycymerita* FINLAY & MARWICK, 1937

Glycymeris (Glycymerita) marrotianus (d'ORBIGNY, 1844)
(Pl. 2, fig. 1)

. 1844 – *Pectunculus Marrotianus,* d'ORBIGNY – d'ORBIGNY, p. 192, pl. 307, figs. 13–16.
(1850) – *Pectunculus Marrotianus,* d'ORB. – d'ORBIGNY, p. 243, n° 659.
v. 1865 – *Pectunculus Marrotianus,* d'ORB. – ZITTEL, p. 167, pl. 9, figs. 10 a–d.

(1867) – *Pectunculus Marrotianus,* d'ORB. – PICTET & CAMPICHE, p. 427.
(1871) – *Axinaea Marrotiana,* d'ORB. – STOLICZKA, p. 341.
1959 – *Glycymeris (Veletuceta) marrotiana* (d'ORBIGNY) – FRENEIX, p. 191.

Type-material:

Glycymeris marrotianus (d'ORBIGNY): Possibly in the Muséum National d'Histoire naturelle in Paris (France).

ZITTEL figured specimens: NHMW: pl. 9, fig. 10 a; GBAW 3182: dubious as figured specimen, from Hofergraben.

Locus typicus, stratum typicum: Designated herein: Royan (Charente-Maritime, France), Late Campanian age.

Material from the Hochmoos Fm.: One specimen.

Measurements: H: 32.4 mm, W: 31.8 mm.

Description: One orbicular almost smooth not very convex glycymerid is identified as belonging to *G. marrotianus.*

Occurrence and distribution: Santonian and Campanian, S. W. France and Gosau (OÖ).

Glycymeris spec. cf. *Glycymeris noricus* (ZITTEL 1865)

v. 1865 – *Pectunculus Noricus* ZITT. – ZITTEL, p. 167, pl. 9, figs. 9 a–c.

Type specimens: NHMW: possible original of pl. 9, fig. 9 a. GBAW: probable originals of pl. 9, figs. 9 b, 9 c.

Locus typicus, stratum typicum: Muthmansdorf (NÖ), Maastrichtian (SUMMESBERGER 1985).

Description and discussion of the material from the Hochmoos Fm.: Two very convex glycymerid steinkerns are tentatively identified as close to *Glycymeris noricus.* The main difference between *G. noricus* and *G. marrotianus* (d'ORBIGNY) lies in the convexity of the shells. Whether this difference is of specific nature or falls within the variability of the species remains to be checked, but this problem is outside the scope of the present faunal study.

Occurrence and distribution: Maastrichtian of E. Austria, possibly Santonian of the Gosau.

Order MYTILOIDA
Superfamily Mytilacea
Family Mytilidae

Genus *Inoperna* CONRAD in KERR, 1875

Inoperna flagellifera (FORBES, 1846)
(Pl. 1, figs. 11, 12, 13)

1843 – *Inoceramus siliqua* MATH. – MATHÉRON, p. 174, pl. 25, fig. 6.
v. 1846 – *Mytilus (Modiolus) flagelliferus,* sp. nov. – FORBES, p. 152, pl. 16, fig. 9.
(1850) – *Mitylus flagelliferus* FORBES – d'ORBIGNY, p. 247.
1863 – *Mytilus (Modiolus) flagelliferus* E. FORBES – STUR, p. 55.
v. 1866 – *Modiola flagellifera* FORBES – ZITTEL, p. 82, pl. 12, figs. 2 a–c.

(1867) – *Modiolus flagelliferus,* FORBES – PICTET & CAMPICHE, p. 513.
. 1871 – *Modiola flagellifera* FORBES – STOLICZKA, p. 379, pl. 24, figs. 1, 2.
1875 – *Mytilus (Modiola) flagellifera* FORBES sp. – GEINITZ, p. 55, pl. 15, fig. 5.
. 1888 – *Modiola flagellifera* FORB. sp. – G. MUELLER, p. 418.
. 1897 – *Modiola flagellifera,* FORBES – FRIĆ, p. 59, fig. 69.
v. 1900 – *Modiola flagellifera,* FORBES – WOODS, p. 99, pl. 17, figs, 1, 2.
. 1906 – *Modiola flagellifera* FORBES – PETHÖ, p. 236, pl. 16, figs. 17, 18.
1907 – *Modiola flagellifera* FORBES em. ZITTEL – RÉPELIN, p. 52.
. 1913 – *Modiola flagellifera* FORB. – SCUPIN, p. 198.
1917 – *Modiola flagellifera* FORBES – WOODS, p. 24, pl. 20, fig. 5.
. 1934 – *Modiola flagellifera* FORBES – ANDERT, p. 203, pl. 10, figs. 31 a, b.
1948 – *Modiola flagellifera* FORBES – TAVANI, p. 90.
. 1957 – *Modiolus (Inoperna) flagelliferus* (FORBES) – FRENEIX, p. 47 (cum syn.).
. 1959 – *Inoperna flagellifera* (FORBES) – FRENEIX, p. 195.
? 1976 – *Modiolus flagelliferus* (FORBES, 1845) – POJARKOVA, p. 91, pl. 46, fig. 3.

Type-material:

Inoceramus siliqua: Muséum d'Histoire naturelle de Marseille.

Modiolus flagelliferus FORBES: BM (NHM): 10631, a, b (formerly coll. of Geological Society).

ZITTEL figured specimens: NHMW 4454, pl. 12, fig. 2 a from Abtenau; NHMW 1859/L/565, pl. 12, fig. 2 b from Brunnsloch; GBAW 3503, pl. 12, fig. 2 c from Stollhof.

Locus typicus, stratum typicum:

"I." siliquus: Craie ligno-marneuse, Plan d'Aups.

M. flagelliferus: ? Arrialoor Group, Pondicherry (India) (fide STOLICZKA 1871).

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: 16 specimens, mainly only fragmentary, but often bivalved; most specimens preserved as moulds but easy to recognise because of the very specific ornamentation.

Description: Elongated and slightly curved modiolid, ventral and dorsal margins converge very lightly towards the umbo: they are subparallel (angle about 15°), only near the umbo is there a wider angle for the initial stages. Valves are covered with fine ridges, parallel to growth lines; the dorsal part of the shell (½ to ⅓) is covered with strong folds which are more or less parallel with the growth ridges, and are strongest near the margin. Near the umbo the strong folds seem to bundle the growth ridges, but further on the shell they cross them.

Valves are subequal: right valve is more flattened than the left valve.

WOODS has given a detailed description of the species which applies to the specimens from the Hochmoos Fm., except that the carina which he mentioned is very faint in the Hochmoos specimens.

The North American species *Inoperna carolinensis* (CONRAD) figured in the Treatise (p. N277, textfig. C 20,11) from the Campanian strata of the Gulf Coast is poorly preserved but could possibly be synonymous with *I. flagellifera.*

Occurrence and distribution: (? Albian) Cenomanian to Santonian (Campanian ?) of warm temperate and Tethys deposits from England to India.

Genus *Modiolus* LAMARCK, 1799

Modiolus typicus (FORBES, 1846)

(Pl. 2, fig. 4)

v. 1846 – *Mytilus (Modiolus) typicus,* sp. n. – FORBES, p. 152, pl. 14, fig. 4.
(1850) – *Mitylus typicus* FORBES, 1846 – d'ORBIGNY, p. 247.
v. 1866 – *Modiola typica* FORBES – ZITTEL, p. 78, pl. 11, figs. 5 a–c.
(1867) – *Modiola typicus,* FORBES – PICTET & CAMPICHE, p. 513.
. 1871 – *Modiola typica* FORBES – STOLICZKA, p. 377, pl. 23, figs. 12–15.
? 1875 – *Mytilus (Modiola) siliqua* – GEINITZ, p. 55, pl. 15, fig. 4, pl. 19, fig. 10 (non MATHÉRON, 1843).
. 1883 – *Modiola typica* FORBES sp. – FRIČ, p. 106, textfigs. 73 a, b, c.
1888 – *Modiola typica* FORB. sp. – G. MUELLER, p. 418.
1897 – *Modiola typica,* FORB. – FRIČ, p. 59.
. 1906 – *Modiola typica* FORBES – PETHŐ, p. 235, pl. 16, fig. 16.
? 1917 – *Modiola* sp. cf. *typica* FORBES – WOODS, p. 23, pl. 9, fig. 7, pl. 10, fig. 4.
? 1932 – *Modiola typica* FORBES – BASSE, p. 26, pl. 5, fig. 1, 1 a.
. 1934 – *Modiola typica* FORBES – ANDERT, p. 198, pl. 10, figs. 26 a, b.
. 1948 – *Modiola typica* FORBES – TAVANI, p. 89, pl. 1, fig. 9.
. 1957 – *Modiolus typicus* (FORBES) var. *concentrica* DARTEVELLE var. nov. – DARTEVELLE & FRENEIX, p. 43, pl. 6, figs. 3, 4.
1959 – *Modiolus typicus* (FORBES) – VAN DE POEL, p. 18 etc.

Type-material:

FORBES: BM (NHM): coll. of the Geol. Soc. 10630.

ZITTEL: GBAW: without N°: figured: pl. 11, figs. 5 c and ? b; 3133, not figured. NHMW: 4455, pl. 11, figs. 5 a and ? b.

Locus typicus, stratum typicum: Trichinopoly group, Anapaudy (India).

Description and discussion:

Material: 8 mainly bivalved specimens of generally poor preservation.

Measurements:

N°	max. L	max. W	convexity
1	65.2 mm	20.2 mm	(23) mm
2	83.2 mm	(40) mm	(26) mm
3	73.4 mm	–	–
4	91.5 mm	37.5 mm	–
5	43.5 mm	18.2 mm	18.1 mm

The description given by ZITTEL is satisfactory. The radial ornamentation mentioned by ZITTEL is faintly visible on one of the specimens from Bibereck, showing strongly developed commarginal growth lines, which form almost ridges. The poor preservation of the Bibereck specimens explains the difficulty in seeing the specific ornamentation of *Modiolus typicus.* Also the absence or presence of radial lines on these specimens seems to be largely a matter of preservation. It is not impossible that this also applies on the specimens which ZITTEL studied and that therefore *M. typicus* and *M. oppeli* might well be conspecific.

Occurrence and distribution: Cenomanian to Campanian, from England to New Zealand, many Tethys occurrences.

Modiolus capitatus (ZITTEL, 1866)
(Pl. 2, figs. 2, 3)

v. 1866 – *Modiola capitata* ZITT. – ZITTEL, p. 80, pl. 12, figs. 1 a–d.
(1867) – *Modiola capitatus,* ZITTEL – PICTET & CAMPICHE, p. 513.
(1871) – *Modiola capitata,* ZITTEL – STOLICZKA, p. 373.
v? 1875 – *Mytilus (Modiola) capitata* ZITT. – GEINITZ, p. 55, pl. 16, figs. 9, 10 (non pl. 19, fig. 10).
. 1877 – *Modiola capitata* ZITTEL – FRIČ, p. 123, textfig. 97.
· 1883 – *Modiola capitata* ZITTEL – FRIČ, p. 105.
? 1889 – *Modiola* cf. *capitata* v. ZITTEL – HOLZAPFEL, p. 221, pl. 25, fig. 14.
(1893) – *Modiola capitata,* ZITTEL – FRIČ, p. 95.
? 1898 – *Modiola capitata* ZITT. – G. MUELLER, p. 47, pl. 7, fig. 1.
? 1911 – *Modiola capitata,* ZITT. – FRIČ, p. 36, textfig. 165.
. 1912 – *Modiola capitata* ZITTEL – PERVINQUIÈRE, p. 124, pl. 8, figs. 10 a, b.
? 1959 – *Modiolus capitatus* ZITTEL – FRENEIX, p. 194 etc.
1959 – *Modiolus capitatus* ZITTEL – VAN DE POEL, p. 18.

Type-material:

NHMW: Original to pl. 12, fig. 1a from Stöckwaldl, Russbachtal (designated herein as the lectotype).

GBAW 3134: Original to pl. 12, fig. 1 b and probably also to pl. 12, fig. 1 c. Original to pl. 12, fig. 1 d: not found.

Locus typicus, stratum typicum: Stöckwaldl, Russbachtal, Gosau (OÖ), Lower Santonian (SUMMESBERGER 1985).

Description and discussion:

Material from the Hochmoos Fm.: One bivalved specimen and one incomplete right valve probably belong to this species.

Measurements: Max. L: 49.5 mm, max. H: 26.2 mm, max. convexity: 25.8 mm.

Diagnosis: Typical medium-sized modioliform species with subterminal incurved umbones and no radial ornamentation.

The specimens available from Bibereck do not allow a detailed description, but agree with the description of ZITTEL and later authors.

Modiola fabacea HOLZAPFEL, 1889 is relatively similar with *Modiolus capitatus,* but the former shows a strong surface ornamentation which seems to be lacking in the latter.

Occurrence and distribution: In the Gosau deposits *M. capitatus* is recorded from Lower and Upper Santonian strata; outside the Gosau from Coniacian to Lower Campanian strata in central Europe, S.E. France and near Aachen and the Harz (Germany).

Modiolus cf. *siliquus* (MATHÉRON, 1843)
(Pl. 1, figs. 8, 9)

1843 – *Modiola siliqua,* MATH. – MATHÉRON, p. 178, pl. 28, figs. 5, 6.
1844 – *Mytilus siliqua,* d'ORBIGNY – d'ORBIGNY, p. 274, pl. 339, figs. 3, 4.
1866 – *Modiola siliqua* MATH. – ZITTEL, p. 81, pl. 11, figs. 3 a–c.

Discussion: One poorly preserved bivalved specimen from the Hochmoos Fm. might belong to *Modiolus siliquus,* but it seems somewhat less convex than the descriptions and figures in MATHÉRON and d'ORBIGNY.

L_{max}: 57.3 mm; H anterior: 13.2 mm, H posterior: 16.6 mm; convexity: 6.7 mm.

Occurrence and distribution: Coniacian and Santonian from S. E. France and the 'Gosau'.

Superfamily Pinnacea
Family Pinnidae

Genus *Pinna* LINNÉ, 1758

Pinna cf. *cretacea* (SCHLOTHEIM, 1813)
(Pl. 5, fig. 8)

1803 – *"Pinne"* – FAUJAS-SAINT-FOND, p. 144, pl. 22, figs. 1, 3.
. 1813 – *Pinnites cretaceus* FAUJ. – SCHLOTHEIM, p. 113.
v. 1866 – *Pinna cretacea* SCHLOTH. sp. – ZITTEL, p. 87, pl. 13, figs. 1 a, b.

From Late Cretaceous European strata two very similar pinnid taxa have been described: *Pinna cretacea* (SCHLOTHEIM, 1813) and *P. decussata* GOLDFUSS, 1837 (p. 166, pl. 128, fig. 1). Though numerous, pinnid specimens from such strata are rarely well preserved. The 'differences' between the two taxa are slight and have never been clearly defined.

The preservation of the pinnid specimens from the Hochmoos Fm. does not allow, a detailed description, hence the addition of a synonymy which cannot solve the problem of the specific characterisation seems pointless. The name given to the species is simply the oldest available name.

Occurrence and distribution: Widely distributed in European Cenomanian to Upper Maastrichtian deposits. In the 'Gosau' from Coniacian to Maastrichtian.

Order PTERIOIDA
Superfamily Pteriacea
Family Bakevelliidae

Genus *Gervillia* DEFRANCE, 1820

Gervillia solenoidea DEFRANCE, 1820
(Pl. 3, figs. 6, 7)

. 1820 – *"Gervillie solénoïde"* – DEFRANCE, p. 502, pl. 12, figs. 2 a–d, pl. 86, fig. 4.
1824 – *Gervillia Solenoides* (DE FRANCE) – EUDES-DESLONGCHAMPS, p. 129.
. 1826 – *Gervillia solenoides* – J. de C. SOWERBY, p. 14, pl. 510, fig. 4 (non figs. 1–3).
. 1835 – *Gervillia solenoides* DEFR. – GOLDFUSS, p. 124, pl. 115, figs. 10 a, b.
1836 – *Gervillia solenoides,* DEFR. – DESHAYES in LAMARCK, p. 82.
? 1843 – *Gervillia solenoides* DEFR. – GEINITZ, p. 15, pl. 1, fig. 33, pl. 3, figs. 9, 10.

. 1846 – *Gervillia solenoides* DEFR. – REUSS, p. 23, pl. 32, figs. 13, 14.
v p.p. 1846 – *Gervilia aviculoides* – d'ORBIGNY, p. 489, pl. 397, fig. 2.
1850 – *Gervilia Solenoides* DEFRANCE – d'ORBIGNY, p. 250, n° 811.
v. 1866 – *Gervillia solenoides* DEFR. – ZITTEL, p. 91, pl. 13, figs. 2 a, b.
1870 – *Gervilia solenoides,* DEFR. – PICTET & CAMPICHE, p. 92.
? 1871 – *Gervillea solenoides* DEFRANCE – STOLICZKA, p. 409, pl. 50, fig. 5.
? 1872 – *Gervillea solenoides* DEFR. – GEINITZ, p. 209, pl. 48, fig. 19.
? 1875 – *Gervillea solenoides* DEFRANCE – GEINITZ, p. 53, pl. 11, fig. 1.
. 1877 – *Gervillia solenoides* DEFR. – FRIČ, p. 128, textfig. 109.
1883 – *Gervillia solenoides* DEFR. – FRIČ, p. 109.
1888 – *Gervillia solenoides* DEFR. – G. MUELLER, p. 410.
1889 – *Gervillia solenoides,* DEFR. – FRIČ, p. 81.
. 1889 – *Gervillia solenoides* DEFR. – HOLZAPFEL, p. 223, pl. 24, figs. 11, 12.
? 1889 – *Gervillia* sp. – HOLZAPFEL, p. 224, pl. 24, fig. 13.
1893 – *Gervillia solenoides,* DEFR. – FRIČ, p. 99.
? 1898 – *Gervillia Holzapfeli,* FR. n. sp. – FRIČ, p. 65, textfig. 84.
. 1898 – *Gervillia solenoides* DEFR. – G. MUELLER, p. 41, pl. 5, fig. 6.
. 1902 – *Gervilleia solenoides* DEFR. – FRECH, p. 615.
? 1902 – *Gervilleia glaciana* n. sp. – FRECH, p. 615, textfig.
. 1906 – *Gervillia solenoides* DEFRANCE – BIGOT, fiche n° 95, 95 a, 95 b.
1907 – *Gervilleia solenoides,* DEFRANCE – RÉPELIN, p. 51, pl. 7, figs. 8, 9.
. 1911 – *Gervillia solenoides,* DEFR. – FRIČ, p. 41, fig. 186.
. 1913 – *Gervillia solenoides* DEFR. – SCUPIN, p. 215, pl. 12, fig. 4.
1920 – *Gervilleia solenoïdes* DEFRANCE – ROMAN & MAZERAN, p. 92.
? 1932 – *Gervilleia* aff. *solenoides* DEFRANCE – BASSE, p. 112.
? 1933 – *Gervillia* cf. *solenoides* DEFR. – WOLANSKY, p. 25.
1959 – *Gervillia solenoides* DEFRANCE – FRENEIX, p. 200.
. 1969 – *Gervillia (G.) solenoidea* DEFRANCE – COX in MOORE, p. N308, fig. C41, 4.
1985 – *Gervillia solenoides ?* DEFRANCE – DHONDT, p. 37

Type-material:

DEFRANCE 1820: Lost; specimens well figured by BIGOT 1906: Paleontologia universalis fiche 95, 95 a, 95 b.

ZITTEL figured specimens: NHMW, pl. 13, figs. 2 a, b: from St. Wolfgang (Upper Santonian).

Locus typicus, stratum typicum: Calcaire à Baculites du Cotentin, France (Upper Campanian – Maastrichtian).

Description and discussion:

Material from the Hochmoos Fm.: One almost complete mould of a RV with shell fragments and parts of the hinge; 8 incomplete or fragmentary specimens.

Measurements: Of almost complete specimen: L: 158 mm, L of hinge: 39.5 mm, auricular margin: 62.5 mm.

Diagnosis (adapted from Treatise): Small to medium-sized, longitudinally elongated, narrow, ensiform, slightly curved, with terminal umbones, posterior wing short and obtuse; narrow, unequal transverse crenulations present along each end or all of hinge margin, with elongate posterior teeth.

The specimens from the Hochmooss Fm. are not well enough preserved for further comments.

The preservation of *Gervillia* specimens in the Upper Cretaceous deposits of Europe is generally poor. The generic characteristics are easily recognised even on steinkern material. Specific characteristics have never really been differentially described.

Occurrences and distribution: In the Gosau restricted to the Santonian; very widely distributed from (Turonian?) Coniacian to Maastrichtian in warm temperate and Tethys deposits.

Genus *Gervillaria* Cox, 1951

Gervillaria neptuni (Goldfuss, 1837)
(Pl. 2, figs. 5, 6)

. 1837 – *Cardium Neptuni* nobis – Goldfuss, p. 221, pl. 144, figs. 9 a, b.
1840 – *Cardium Neptuni* Goldf. – Geinitz, p. 53.
1843 – *Cardium Neptuni* Goldf. – Geinitz, p. 14.
1846 – *Pinna nodulosa* Reuss – Reuss, p. 14.
? 1847 – *Pinna Neptuni,* d'Orbigny – d'Orbigny, p. 255, pl. 333, figs. 1–3.
1850 – *Mytilus Neptuni* (Goldf.) – Geinitz, p. 168.
1870 – *Avicula Neptuni,* Pict. et Camp. – Pictet & Campiche, p. 72.
. 1872 – *Mytilus (Modiola) Neptuni* Goldf. sp. – Geinitz, p. 213, pl. 47, figs. 1, 2.
? 1877 – *Mytilus Neptuni* Goldf. sp. – Frič, p. 120, textfig. 87.
? 1893 – *Pinna nodulosa,* Reuss – Frič, p. 95, textfig. 111 A et B.
. 1898 – *Avicula (Pseudoptera) Neptuni* Goldf. sp. – G. Mueller, p. 40, pl. 6, figs. 4, 5.
. 1934 – *Avicula neptuni* Goldf. sp. – Andert, p. 87, pl. 1, fig. 4.
? 1959 – *Plesiopinna neptuni* (d'Orbigny) – Freneix, p. 213.

Type-material:

'Cardium' neptuni: If still extant, in the Palaeontologisches Institut der Rheinische Friedrichs-Wilhelms Universität, Bonn (G. F. R.).

Pinna nodulosa Reuss: Type specimen not found.

Locus typicus, stratum typicum: According to Goldfuss: "Grünsande" Waldenburger Gebirges in Schlesien. This very broad localisation is difficult to interprete: Waldenburg is to-day in Poland, and the area in which it is mainly palaeozoic. It cannot be excluded that the indication of Goldfuss is based on an error.

Description and discussion:

Material: An incomplete, somewhat crushed, bivalved specimen from Bibereck (Hochmoos Fm.) and fragments from the same locality, and one in the Skoumal Collection specimen from Nussenseebach (Coniacian, personal communication of H. Summesberger, May 1985).

Measurements: H on the Bibereck specimen: 85 mm, on the Nussensee specimen: 115 mm.

Description: The preservation is not perfect, but the following elements can be seen: small anterior triangular extension covered with commarginal lines and a large smooth posterior extension; the main part of the shell is covered with

radial plications of variable width and these are crossed with fine commarginal ridges. The height of the shell is somewhat superior to the width.

Discussion: The preservation makes it difficult to see the strong inflation of the left valve; the shell of which only the nacreous layer remains shows the hinges.

Radial plications are also known on other *Gervillaria* species from Lower Cretaceous strata: *G. alaeformis* (SOWERBY, 1819) on young specimens from Aptian beds (figured in WOODS, 1905: pl. 11, figs. 9 a, 10 a), *G. carteroni* (d'ORBIGNY, 1847, p. 472, pl. 390) from Neocomian beds, on all stages.

The poor preservation of most specimens described as belonging to this taxon explains why the generic attribution has been so inconsistent among the previous authors. It requires complete lateral extensions to allow the recognition of *Gervillaria* in the specimens, those are often incomplete or steinkern preservation.

Occurrence and distribution: Coniacian – Santonian in the Gosau; Turonian to Campanian in Central Europe, and also in E. France. Generally a rare species.

Genus *Pseudoptera* MEEK, 1873

Pseudoptera raricosta (REUSS, 1854)
(Pl. 3, fig. 1)

v. 1854 – *Avicula raricosta* m. – REUSS, p. 147, pl. 28, fig. 16.
? 1859 – *Avicula Beisseli* – J. MUELLER, p. 9, pl. 7, fig. 9.
v. 1866 – *Avicula raricosta* REUSS – ZITTEL, p. 90, pl. 13, figs. 6 a, b.
(1870) – *Avicula raricosta,* REUSS – PICTET & CAMPICHE, p. 72.
(1871) – *Avicula raricosta,* REUSS – STOLICZKA, p. 399.
? 1889 – *Avicula Beisseli* MÜLL. – HOLZAPFEL, p. 227, pl. 27, figs. 16, 17.
? 1891 – *Avicula Beisseli* MÜLL. – J. BOEHM, p. 82, pl. 4, fig. 1.
? 1904 – *Avicula raricosta* REUSS – SOLGER, p. 224.
? 1957 – *Pteria raricosta* (REUSS) – DARTEVELLE & FRENEIX, p. 65

Type-material: REUSS and ZITTEL described the same specimen, which is now in the collections of the NHMW.

Locus typicus, stratum typicum: Billmansgraben, Wolfgangsee (OÖ), (Upper Santonian).

Description and discussion:

Material and measurements: One internal mould of H: 25 mm and a hinge line of 15 mm from the Hochmoos Fm.; type specimen: height: 20 mm, hinge line: 11 mm.

Diagnosis: Small *Pseudoptera* species with one or two strongly developed beaded radial riblets.

The specimen from the Hochmoos Fm. is an internal mould, but it does show the strongly developed almost beaded radial line drawn in REUSS, but which ZITTEL assumed to be exaggerated.

"Avicula" beisseli MUELLER, 1859 is very similar to *Ps. raricosta,* but somewhat less oblique according to HOLZAPFEL. I doubt that those differences are specific, but not having seen the original of *A. beisseli* I cannot draw definite conclusions as to the conspecificity of the two taxa.

Occurrence and distribution: Santonian of the Gosau (OÖ), Santonian to Campanian of Bavaria and the area around Aachen (G. F. R.), Upper Cretaceous West African deposits.

Genus *Aguileria* WHITE, 1887

Aguileria ? falcata (ZITTEL, 1866)
(Pl. 6, fig. 5)

v. 1866 – *Perna falcata* ZITT. – ZITTEL, p. 92, pl. 13, figs. 4 a–c.
v? 1866 – *Perna expansa* ZITT. – ZITTEL, p. 93, pl. 13, figs. 5 a, b.
(1870) – *Perna expansa,* ZITTEL – PICTET & CAMPICHE, p. 103.
(1871) – *Melina expansa,* ZITTEL – STOLICZKA, p. 400.
(1871) – *Melina falcata,* ZITTEL – STOLICZKA, p. 400.
(1890) – *Perna falcata,* ZITTEL – COLLOT, p. 101.

Type-material:

P. falcata: GBAW 3130: pl. 13, figs. 4 a, b, c from Wegscheidgraben, Gosau (OÖ).

P. expansa: NHMW 4401, pl. 13, figs. 5 a, b.

Locus typicus, stratum typicum: Wegscheidgraben, Gosau (OÖ), Santonian.

Description and discussion:

Material from the Hochmoos Fm.: Occurs frequently, about 30 specimens; all specimens are nacreous and bivalved and generally very incomplete; hinges are rarely preserved; specimens often occur together (possibly in nests ?).

Measurements: For definition of height, width, and hinge margin see textfig. 1.

H varies from 38.2 mm to 75 mm, average 55.3 mm (n = 25).

W varies from 21 mm to 40 mm, average 30.7 mm (n = 25).

HM varies from 15.5 mm to 30 mm, average 22.6 mm (n = 24).

AA varies from 30° to 65°, average 47° (n = 24).

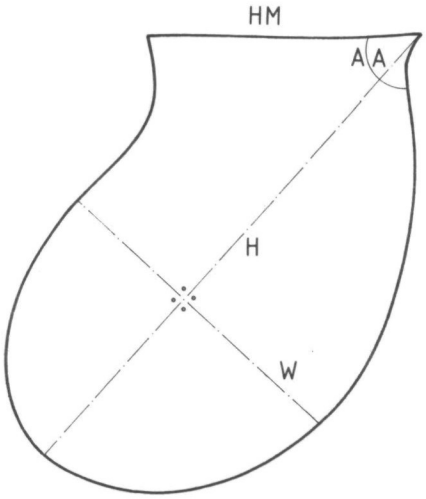
Diagnosis: Medium-sized, oblique bakevellid species with longish hinge, up to 8 irregular transverse crenulations and wide posterior wing.

Discussion: None of the specimens known described by ZITTEL or from the Hochmoos Fm. has a complete shell. So the exterior is unknown to us.

ZITTEL described two taxa *Perna falcata* and *P. expansa,* which are similar except in width: *P. expansa* seems much wider. The study of the type of *P. expansa* shows it to be very poorly preserved; it is an incomplete specimen of a species which was probably much longer and more oblique than the figure in ZITTEL leads one to believe. ZITTEL records *P. expansa* from Piesting, and the only specimen

ever mentioned in literature was that rather incomplete type specimen, which is stratigraphically of the same age as the type locality of *P. falcata.*

Among the specimens from the Hochmoos Fm. the variability H/W is wide (1.22 to 2.24, average 1.844 [n = 23]). This wide variability represents a change in shape which might easily include both *"P. falcata"* and *"P. expansa"* morphotypes. It is not impossible that *Perna zimmermanni* SCUPIN (1912–1913, p. 214, pl. 12, fig. 17) from the Lower Senonian of Silesia is very closely related to *Aguileria* ? *falcata.*



Textfig. 1. Measuring of *Aguileria* ? *falcata:* W. is perpendicular to H. which is taken as the maximum length between AA and the umbopallial margin.

The irregular dental crenulations of *P. falcata* ZITTEL distinguish them from *'Perna'* (i. e. *Isognomon*), and make a bakevellid relationship probable. The hinge structure reminds one of that of *Aguileria cumminsi* (WHITE), type – species of the genus, but is not identical with it.

Occurrence and distribution: Recorded with certainty only from Santonian 'Gosau' deposits in Austria.

Family Inoceramidae

Genus *Inoceramus* J. SOWERBY, 1814
Subgenus *Cordiceramus* HEINZ, 1932

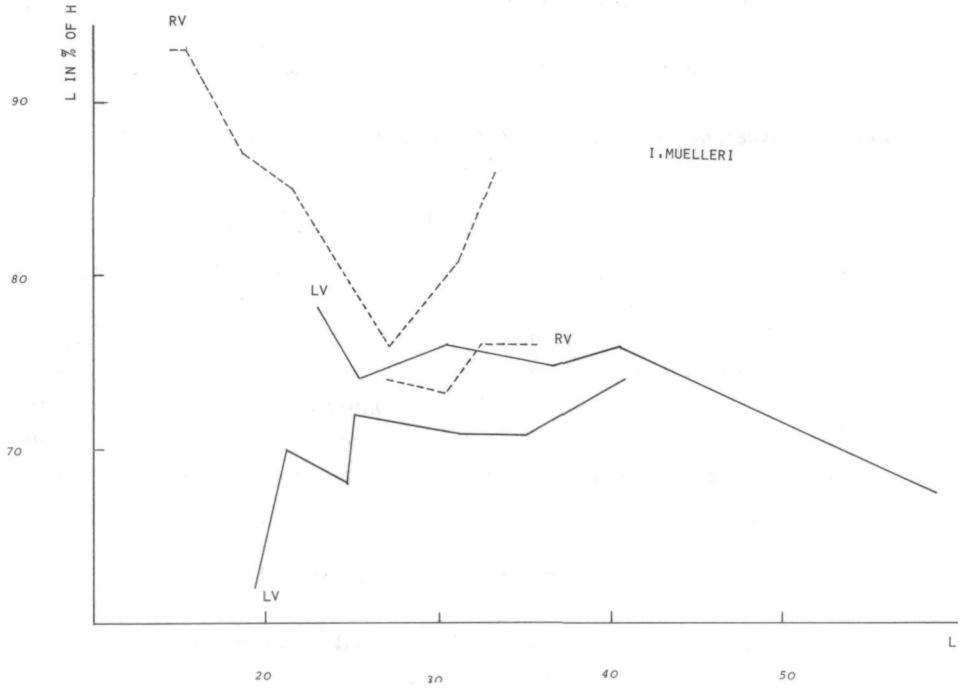
Inoceramus (Cordiceramus) muelleri PETRASCHECK, 1906
(Pl. 3, figs. 4, 5 and textfig. 2)

v. 1866 – *Inoceramus Cripsi* MANT. var. *regularis* d'ORB. – ZITTEL, pl. 14, fig. 3, pl. 15, fig. 5.
v. 1906 – *Inoceramus Mülleri* nov. spec. – PETRASCHECK, p. 160, textfig. 1, pl. 6, figs. 1 and 2.
. 1961 – *Inoceramus (Cordiceramus) mülleri* PETRASCHECK – SEITZ, pp. 123–140, pl. 7, figs. 2, 5, 6, 7, pl. 15, figs. 1, 2, textfigs. 27–32 (with detailed description and synonymy-list).

. 1967 – *Inoceramus (Cordiceramus) mülleri* PETRASCHECK – SEITZ, pp. 45–48, pl. 1, fig. 4.
. 1967 – *Inoceramus (Cordiceramus) mülleri* PETRASCHECK – SEITZ, pp. 126–131, pl. 23, fig. 3, pl. 25, fig. 1, pl. 26, figs. 4, 5, pl. 27, figs. 1, 3, 4, 6.

Locus typicus, stratum typicum: Hofergraben bei Gosau (OÖ), (Late Santonian).

Type specimens: PETRASCHECK: pl. 6, fig. 1: in GBAW; pl. 6, fig. 2: in Paläontologisches Institut der Universität Wien.



Textfig. 2. *Inoceramus muelleri:* graph showing proportions at different growthstages. L: length (here = W), H: height, LV: left valve, RV: right valve. In these specimens H and L of *I. muelleri* vary very strongly.

Discussion: SEITZ in 1961 subdivided *I. muelleri* in four subspecies; two of these (*I. muelleri muelleri* and *I. muelleri gosauensis*) were stated to occur in the same Gosau beds. In 1967 SEITZ discussed the deformation in some inoceramids a. o. in *I. (Cordiceramus) muelleri;* he concluded that *I. (Cordiceramus) muelleri gosauensis* was based on a deformed specimen of *I. (Cordicermus) muelleri muelleri.*

From the Hochmoos Fm. at Bibereck 23 specimens of *I. (Cordiceramus) muelleri* have been collected, some of which are undoubtedly strongly deformed, but others do not seem to be so. Measuring 5 of these specimens has shown a wide variability of the H/L index, falling within the variability of *I. muelleri* (textfig. 2) but differing strongly from specimen to specimen, and according to the valves (see

also SEITZ 1967). Where the results of SEITZ and those found for the Hochmoos Fm. at Bibereck differ, the measuring techniques and the preservation of the specimens could be partly responsible. Also I would like to suggest that the differences stated to exist by SEITZ between the 'subspecies' of *I. muelleri* are probably simply due to normal biological variability, found in any species, combined with a deformation factor. Precision in measuring on these inoceramids is almost impossible to achieve because of the preservation.

Occurrence and distribution: Recorded from Upper Santonian and possibly lowermost Campanian deposits.

Subgenus *Platyceramus* HEINZ, 1932

Inoceramus (Platyceramus) spec. cf. *Inoceramus (Platyceramus) cycloides ahnesensis* SEITZ, 1961

. 1961 – *Inoceramus (Platyceramus) cycloides ahnesensis* n. nom. – SEITZ, pp. 63–68, pl. 1, figs. 3, 7, 9, 10, textfigs. 12, 13.

. 1967 – *Inoceramus (Platyceramus) cycloides ahnesensis* SEITZ – SEITZ, pp. 81–84, pl. 1, figs. 2, 3, pl. 11, figs. 1, 2, pl. 13,, figs. 3, textfigs.

Several, somewhat deformed, incomplete specimens of large flattened inoceramids have been found in the Hochmoos Fm. Their concentric ornamentation is similar to that of *I. (Platyceramus) cycloides ahnesensis,* but the nature of the material does not allow a completely definite specific identification. *I. (Platyceramus) cycloides ahnesensis* has been recorded from Upper Santonian strata in northern Germany.

Subgenus *Sphenoceramus* J. BOEHM, 1915

Inoceramus (Sphenoceramus) angustus ? (BEYENBURG, 1936)

(Pl. 3, fig. 2)

. 1965 – *Inoceramus (Sphenoceramus) angustus* BEYENBURG – SEITZ, pp. 96–104, pl. 17, fig. 2, pl. 18, figs. 1, 2, pl. 19, fig. 1, pl. 20, fig. 4, pl. 22, figs. 1, 3, pl. 24, fig. 3 (with detailed description and synonymy-list).

One specimen from the Hochmoos Fm. is a juvenile (H = 28 mm), probably of *I. (Sphenoceramus) angustus,* but it is too small to allow definite identification. According to SEITZ *I. angustus* indicates uppermost Santonian and Lower Campanian.

Superfamily Pectinacea
Family Pectinidae

Genus *Entolium* MEEK, 1865

Entolium ? species

From the Hochmoos Fm. one half disk, smooth and with a typical *Entolium* auricle, has been collected. The only ornamention consists in some commarginal

growthlines. It belongs probably to an *Entolium* species and can be compared to the *'Pecten membranaceus'* specimen figured by ZITTEL (1866, pl. 17, fig. 3) kept in the GBAW 3123.

Genus *Camptonectes* AGASSIZ in MEEK, 1864

Camptonectes virgatus (NILSSON, 1827)
(Pl. 3, fig. 3)

v. 1827 – *Pecten virgatus* n. – NILSSON, p. 22, pl. 9, fig. 15.
v. 1866 – *Pecten virgatus* NILS. – ZITTEL, p. 109, pl. 17, figs. 8 a–c.
v. 1972a – *Camptonectes virgatus* (S. NILSSON, 1827) – DHONDT, pp. 18–33, pl. 2, fig. 1 (with detailed description and synonymy).
v. 1984 – *Camptonectes virgatus* (NILSSON, 1827) – DHONDT, p. 849.
. 1985 – *Camptonectes (Camptonectes) virgatus* (NILSSON)) – FRENEIX & VIAUD, p. 206, pl. 1, fig. 10.

Type-material:

NILSSON: Holotype: LO 74 t, Originalsamling, Paleontologiska Institutionen, Lund University, Sweden.

ZITTEL: *Pecten virgatus:* GBAW 3125 ?; *Pecten fraudator:* GBAW 3473 (for discussion: DHONDT 1972 a).

Locus typicus, stratum typicum: Mörby (Sweden), Campanian.

Description and discussion:

Material from the Hochmoos Fm.: 5 somewhat crushed specimens.

The diverging camptonectid ornamentation is of the 'fine type': the camptonectid lines are separated by narrow portions of the shell. The specimens reach a largish size for the species: largest specimen has a UPD of about 30 mm. No other characteristics differentiate the Hochmoos specimens from the description given in DHONDT (1972 a).

Occurrence and distribution: *C. virgatus* is a cosmopolitan species and occurs from the Cenomanian to the uppermost Maastrichtian.

Genus *Merklinia* SOBETSKI, 1960

Merklinia septemplicata (NILSSON, 1827)

v. 1827 – *Pecten septemplicatus* – NILSSON, p. 20, pl. 10, fig. 8.
v. 1866 – *Pecten septemplicatus* – ZITTEL, p. 37, pl. 18, figs. 3 a–c.
v. 1972b – *Lyropecten ? septemplicatus* (S. NILSSON, 1827) – DHONDT, pp. 59–65, pl. 3, fig. 3 (with detailed synonymy and description).
v. 1984 – *Merklinia septemplicata* (NILSSON, 1827) – DHONDT, p. 851, pl. 1, fig. 6.
v. 1985 – *Merklinia septemplicata* (NILSSON, 1827) – DHONDT, p. 40.

Type-material:

NILSSON: Lectotype: LO 64 t, Originalsamling, Paleontologiska Institutionen, Lund University, Sweden.

ZITTEL: *Pecten septemplicatus:* GBAW 2674 ?.

Locus typicus, stratum typicum: Balsberg (Sweden), Campanian.

Description and discussion:

Material from the Hochmoos Fm.: 6 specimens in steinkern preservation, incomplete, but occasionally with shell fragments showing ornamentation details.

Measurements: UPD of largest specimen: 35 mm.

Diagnosis: Valves prosocline, disks suborbicular, slightly higher than wide, with 5 to 9 straight ribs, which are often subdivided.

Discussion: I would like to add the following to what I wrote in 1972: the rib ornamentation varies according to the preservation state (or the growth stage on some specimens): from almost smooth near the umbo, the ribs, especially near the pallial margin, become often strongly subdivided into riblets. This applies equally to the intercostal intervals. This can clearly be seen on a specimen from near Lérida (Spain) figured in 1984 (p. 864, pl. 1, fig. 6) and on an incomplete specimen from the Hochmoos Fm.

Merklinia septemplicata has an interesting distribution: from Santonian to Maastrichtian beds it has been found in shallow (relatively warm) temperate European and Northern Tethyan exposures. The related species *M. catalaunica* (VIDAL) (≡ *M. perornata* [COTTREAU]) has been found in more southern Tethyan exposures at about the same stratigraphic levels. Only in Northern Spain are both species found in the same region.

Occurrence and distribution: Santonian of Austria and Denmark, Campanian of Germany (Harz), and Sweden, Campanian – Maastrichtian of Belgium – the Netherlands, Bulgaria, S.W. France, Spain.

Genus *Neithea* DROUET, 1824

Neithea coquandi (PÉRON, 1877)

(Pl. 4, figs. 1, 2)

. 1862 – *Janira tricostata* H. COQ. – COQUAND, p. 219, pl. 13, figs. 3, 4
(non *Pecten tricostatus* BAYLE, 1848).

v. 1866 – *Janira quadricostata* SOW. sp. – ZITTEL, p. 115, pl. 18, figs. 4 b–h
(non fig. 4 a = *Neithea alpina* [d'ORBIGNY])
(non *Neithea quadricostata* [SOWERBY] ≡ *N. gibbosa* [PULTENEY], nec *N. quadricostata* [d'ORBIGNY] ≡ *N. regularis* [SCHLOTHEIM]).

. 1877 – *Janira coquandi* PÉRON – PÉRON, p. 501, pl. 7, figs. 2, 2 a.

v. 1973 – *Neithea (Neithea) coquandi* (PÉRON) – DHONDT, pp. 26–29, pl. 3, figs. 1 a–c (with detailed description and synonymy).

Type-material:

Janira tricostata COQUAND: probably in MAFI, Budapest.

ZITTEL specimens: GBAW 3122 ?

Locus typicus, stratum typicum: Tenoukla (Algeria), Cenomanian ('Rhotomagien').

Description and discussion:

Material from the Hochmoos Fm.: About 50 specimens, generally preserved as steinkern, mainly concave (flattened) valves.

Measurements: Large specimen: UPD = 35 mm.

Description: Medium-sized *Neithea* species; convex right valves with beak inwardly curved; UPD > W, valve has very narrow and convex appearance; flattened to concave left valves, UPD = W, subcircular.

Auricular areas especially on right valves inwardly bent, auriculae and areas smooth; auricles very small and equal.

Ornamentation consists of a combination of six principal radial ribs, with between each two of these three unequally developed intercalary ribs. The principal ribs are generally more or less smooth. The intercalary ribs in the intercostal intervals vary, and often amongst each three one is only developed as a fila, especially on left valves. Total ribnumber: 21.

In 1973 I have discussed the specific placing of *Neithea* specimens from the Gosau deposits. The material from the Hochmoos Fm. seems to belong to one species, and the only difference with *N. coquandi* specimens from other localities is that the intercalary ribs vary only slightly in thickness.

Occurrence and distribution: Restricted to the Tethys: Cenomanian of Algeria, Angola, Egypt, France (S.E.), Iraq, Israel, Lebanon, Syria, Turonian of S.E. France, Santonian of Algeria, Austria, France, Iraq, Somalia, Tunisia, Turkey, Yugoslavia.

Family Spondylidae

Late Cretaceous attached spondylids from Tethys deposits have not been revised recently. A large number of taxa have been illustrated by d'ORBIGNY (1847) from various French strata varying in age from Cenomanian to Campanian (*Spondylus coquandianus* d'ORBIGNY, p. 663, pl. 452, figs. 9, 10, from Martigues, Bouches-du-Rhône, Turonian – Coniacian; *Sp. globulosus* d'ORBIGNY, p. 667, pl. 458, fig. 1, from Saintes, Charente-Maritime, Coniacian – Santonian; *Sp. hippuritarum* d'ORBIGNY, p. 664, pl. 455, from Montagne des Cornes, Carcassonne, Aude, ? Turonian; *Sp. hystrix* sensu d'ORBIGNY non GOLDFUSS, p. 661, pl. 454, from Uchaux, Vaucluse, Turonian – Coniacian; *Sp. striatus* (SOWERBY), p. 660, pl. 453, from Normandy, Cenomanian; *Sp. truncatus* (LAMARCK), p. 668, pl. 459, from the Coniacian-Santonian of Touraine). It is not certain that these taxa are really all specifically different: the preservation varies, hence a specimen found as a steinkern may seem to represent an almost smooth "species", whereas a very similar specimen with spines and shell preserved will be considered as belonging to a similar but different species. The attached right valve varies greatly in shape because of the nature of the attachment area. This attachment scar influences the shape of both valves.

From the Gosau deposits several spondylid species have been described by ZITTEL. In the material from the Hochmoos Fm. two species have tentatively been recognised.

Genus *Spondylus* LINNÉ, 1578

Spondylus cf. *coquandianus* d'ORBIGNY, 1847

. 1847 – *Spondylus Coquandianus,* d'ORBIGNY, 1846 – d'ORBIGNY, p. 663, pl. 452, figs. 9, 10.
? 1866 – *Spondylus striatus* SOW. sp. – ZITTEL, p. 118, pl. 18, figs. 7 a, b, c (non *Spondylus striatus* SOWERBY, 1815).
(1870) – *Spondylus Coquandianus,* d'ORB., 1846 – PICTET & CAMPICHE, p. 261.

Type-material: Probably in MAFI, COQUAND Coll. (Budapest).

ZITTEL specimens: In NHMW: figured specimens fig. 7 b, c.

Locus typicus, stratum typicum: Martigues, Bouches-du-Rhône (France), Coniacian.

Description and discussion:

Material from the Hochmoos Fm.: One bivalved and three single valved specimens, all of steinkern preservation.

Measurements: UPD of the left valve of the bivalved specimen: 28 mm.

The large right valve is attached, the smaller left valve is not; on some specimens the latter is orbicular, on others subovate and oblique. The variation is probably due to differently shaped attachment scars, on the other valve. The ornamentation consists of many, narrow, radial ribs which follow the growth direction. The preservation state does not allow further information.

The specimens from the Hochmoos Fm. are very similar to those which ZITTEL erroneously attributed to the Cenomanian species *Sp. striatus* (SOWERBY, 1815). They probably belong to *Sp. coquandianus,* but their poor preservation does not allow any definite specific attribution.

The differences between *Sp. coquandianus,* as understood herein, and *Sp. requienianus* MATHERON are slight. More material might prove them to be only different ontogenetic stages of one and the same species.

Sp. calcaratus FORBES, 1846 (p. 155, pl. 18, fig. 2) of which the type is in the B. M (N. H. M.) is very close to *Sp. coquandianus,* but may be somewhat larger. The Indian species is reported from the Trichinopoly group. Also *Sp. truncatus* GOLDFUSS, 1835, p. 97, pl. 106, fig. 4, from the Coniacian-Santonian of Touraine, might after the study of a large suite of specimens prove to be identical with *Sp. coquandianus.*

Occurrence and distribution: Coniacian – Santonian of the Northern Tethys in Europe.

Spondylus requienianus MATHERON, 1843
(Pl. 4, fig. 9)

. 1843 – *Spondylus Requienianus* MATH. – MATHERON, p. 189, pl. 32, fig. 3.
pp. 1847 – *Spondylus hystrix* GOLDFUSS – d'ORBIGNY, p. 661, pl. 454, figs. 1–4 (non figs. 5–9). (non *Spondylus hystrix* GOLDFUSS, 1837).
v. 1866 – *Spondylus Requienianus* MATH. – ZITTEL, p. 118, pl. 18, figs. 6 a, b.

(1870) – *Spondylus Requienianus,* MATHERON – PICTET & CAMPICHE, p. 261.
. 1920 – *Spondylus Requienianus* MATHERON – ROMAN & MAZERAN, p. 86, pl. 8, figs. 9, 10.

Type-material:

MATHERON specimen: Probably in the Renaux Coll., University of Montpellier, France.

ZITTEL specimen: NHMW.

Locus typicus, stratum typicum: Uchaux, Vaucluse (France), Upper Turonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: Two right attached valves, inside exposed (one from the SKOUMAL Coll., Vienna).

Description: The attached valves seen from the inside show numerous, narrow radial ribs, not always straight and not all of the same width. The valves are much wider than height.

Discussion: As stated above it is plausible that the Hochmoos Fm. specimens of *Spondylus requienianus* are large valves of *Sp. coquandianus.* Ontogenetic series of Cretaceous attached spondylids are not generally available. On the valves from Bibereck only the inside is exposed, so it is not possible to judge the ontogenetic shape changes, which would prove the hypothesis on conspecificity of the two species of *Spondylus* identified from the Hochmoos Fm.

Occurrence and distribution: *Spondylus requienianus* has been recorded from Santonian Gosau deposits and from Coniacian S. E. French deposits.

Superfamily Limacea
Family Limidae

Genus *Plagiostoma* J. SOWERBY, 1814

Plagiostoma cretaceum (WOODS, 1904)
(Pl. 4, figs. 10, 11, 12)

v. 1847 – *Lima Mantellii,* GOLDFUSS – d'ORBIGNY, p. 568, pl. 426, figs. 3–5.
v. 1904 – *Lima (Plagiostoma) cretacea,* nom. nov. – WOODS, p. 22, pl. 4, figs. 13–15, pl. 5, figs. 1–4 (with synonymy and description).
1934 – *Lima cretacea* WOODS var. n. *bohemica* – ANDERT, p. 144, pl. 8, figs. 4, 5.
1959 – *Lima (Plagiostoma) cretacea* WOODS – FRENEIX, p. 220.

Type-material:

d'ORBIGNY type: Probably 7574 d'ORBIGNY coll. in the Muséum National d'Histoire naturelle in Paris (France).

WOODS figured specimens: in BM (NHM) and SM (Cambridge).

Locus typicus, stratum typicum: Ablois, Marne (France), Senonian.

Description and discussion:

Material from the Hochmoos Fm.: 42 specimens of poor, often steinkern, preservation.

Measurements:

UPD varies from 22 mm to 57 mm, average 37.7 mm (n = 13).

W varies from 15 mm to 51 mm, average 32.5 mm (n = 10).

AA varies from 72° to 93°, average 84° (n = 9).

Diagnosis: Medium-sized *Plagiostoma* species with radial grooves, narrow umbo, a developed lunule.

Punctae in the grooves were not noticed on the Hochmoos Fm. specimens, the number of grooves is relatively high, but varies.

Generally limids from the Gosau deposits with radial rib-like ornamentation and subovate shape are identified as *Lima marticensis* MATHERON, 1843. This species does occur in the Gosau beds as is proven by specimens from Hofergraben GBAW 3126 and 3127, which are the originals of ZITTEL's pl. 16, figs. 1, 1 a, 1 b ?, 1 d. The characteristics of *L. marticensis* are similar to those of the genus *Limaria* LINK or a closely related genus: it has real radial ribs (even with spines) and two subequal auricles. The specimens from the Hochmoos Fm. at Bibereck are more oblique than *Limaria? marticensis* and have a well developed lunule and no real ribs, but grooves which are visible as lines on the steinkern specimens, and were probably punctate. The auricles cannot be seen on any of the *Plagiostoma cretaceum* specimens from the Hochmoos Fm.

It is possible that *Lima pichleri* ZITTEL (1866, p. 104, pl. 17, figs. 1 a–d) (GBAW 3402: orig. of pl. 17, fig,. 1 d) is conspecific with the specimens from the Hochmoos Fm., but the preservation of ZITTEL's type is too poor to allow to draw a conclusion.

The study of the original of ZITTEL's pl. 16, fig. 1 c, in the NHMW, shows the specimen to be of poor preservation and crushed. The auricles drawn on the figure are not present and the ribs are not as strongly developed as the figure leads one to assume. It could be that this specimen from Hofergraben is also a *Plagiostoma cretaceum.*

Occurrence and distribution: Santonian of the Gosau (Austria); Turonian to Lower Maastrichtian of northern and western Europe.

Suborder OSTREINA
Superfamily Ostreacea
Family Gryphaeidae

Genus *Pycnodonte* FISCHER de WALDHEIM, 1835

Pycnodonte (Phygraea) vesiculare (LAMARCK, 1806)

From the Hochmoos Fm. at Bibereck about 40 large, unusually thick shelled generally bivalved specimens which probably belong to *Pycnodonte (Phygraea) vesiculare,* have been collected. Though preserved with shell the specimens are rarely complete.

This species is generally well known and a synonymy list is somewhat pointless, partly because in this widely distributed long-lived species many morphotypes have been recognised, whose biological significance is not clearly understood so far.

From the Gosau deposits SOWERBY in SEDGWICK & MURCHISON described two taxa (1832, p. 418, pl. 38, fig. 5: *Gryphaea expansa,* and p. 418, pl. 38, fig. 6: *G. elongata*). ZITTEL considered (1866) both as belonging to *Pycnodonte vesiculare.* I agree with ZITTEL that SOWERBY'S taxa belong in the *P. vesiculare* species group. Among the specimens from the Hochmoos Fm. at Bibereck one belongs to the *'elongata'* type described by SOWERBY. The others could be compared to the *'expansa'* type.

P. (Ph.) vesiculare is an extremely variable and long-lived species. In 1985 I have tentatively subdivided the morphotypes of Late Cretaceous specimens of the species from the Charente deposits (DHONDT 1985). According to that subdivision the *'elongata'* type of SOWERBY belongs to *P. (Ph.) vesiculare proboscideum* (d'ARCHIAC, 1837), a 'subspecies' known from Santonian and Lower Campanian Tethys deposits.

The other Hochmoos Fm. specimens characterised by very heavy shells (? *'expansa'* type of SOWERBY), are not easily assigned to any of the subdivisions introduced for the Charente *P. (Ph.) vesiculare* specimens: they are heavier than any of the *P. (Ph.) vesiculare vesiculare* specimens from the N.W. European temperate Upper Cretaceous strata, but are generally attached by a relatively small attachment area, which differentiates them from *P. (Ph.) vesiculare hippopodium* (sensu COQUAND, non NILSSON). With a good complete specimen from the Hochmoos Fm. possibly a 'subspecific' assignment could be made.

Occurrence and distribution: *Pycnodonte (Phygraea) vesiculare* is distributed worldwide; it occurs from the (Albian ?) Cenomanian to the latest Maastrichtian (Danian ?).

Genus *Ceratostreon* BAYLE, 1878

Ceratostreon spec.

From the Hochmoos Fm. at Bibereck one flat, elongated, exogyrine valve, exposed on its inside, has been collected. It probably belongs to *Ceratostreon* and might be a concave valve of *Ceratostreon pliciferum* (DUJARDIN, 1837) (= *Ostrea Matheroniana* d'ORB. in ZITTEL, 1866, p. 121, pl. 19, figs. 3 a–e, figs. 4 a–b).

Family Ostreidae

Genus *Rastellum* FAUJAS SAINT FOND, 1799 (1803 ?)

Rastellum spec.

ZITTEL (1866, p. 121) in his introduction to *Ostrea* mentioned the presence of ". . . eine dritte grosse gerippte Art, von der jedoch nur unvollständige Exempla-

ren vorhanden sind.". Herewith he undoubtedly meant specimens belonging to *Rastellum* spec.

In the material collected from the Hochmoos Fm. at Bibereck four very incomplete specimens of the same taxon are present. The genus and species group are in need of revision, and therefore no attempt at specific identification is made herein.

Subclass PALAEOHETERODONTA
Order TRIGONIOIDA
Superfamily Trigoniacea
Family Trigoniidae

Genus *Pterotrigonia* VAN HOEPEN, 1929

***Pterotrigonia* ? spec.**

About 25 often bivalved trigonids of poor preservation (steinkern) have been collected from the Hochmoos Fm. at Bibereck. They probably belong to *Pterotrigonia* VAN HOEPEN, and seem close to *Trigonia scabra* sensu ZITTEL (1865, p. 161, pl. 9, figs. 2 a–c), renamed *T. vaelsensis* by J. BOEHM (1885, pp. 99–107, pl. 2; fig. 1) and beautifully illustrated by HOLZAPFEL (1889, p. 198, pl. 21, figs. 1–6).

The specimen in the NHMW of *Trigonia limbata* (figured by ZITTEL, 1865, pl. 9, fig. 1) is not really different: the smoothness of the ribs mentioned as a differential characteristic by ZITTEL are partly an artefact of preservation, and on some the 'Körnelung' which should be lacking is undoubtedly present. *Trigonia vaelsensis* is known from Late Santonian and Early Campanian strata in Europe.

Subclass HETERODONTA
Order VENEROIDA
Superfamily Lucinacea
Family Fimbriidae

Genus *Mutiella* STOLICZKA, 1871

***Mutiella* ? spec. cf. *Mutiella coarctata* (ZITTEL, 1865)**
(Pl. 4, fig. 8)

v. 1865 – *Fimbria coarctata* ZITT. – ZITTEL, p. 148, pl. 7, figs. 5 a–g.

Type-material:
GBAW 3426: pl. 7, figs. 5 a–c: probable figured specimen.
GBAW 3158: pl. 7, fig. 5 d.
NHMW: possibly pl. 7, figs. 5 e, f, g.

Locus typicus, stratum typicum: Hofergraben (designated herein), Santonian (Gosau IV of SUMMESBERGER 1985).

Discussion: One specimen from the Hochmoos Fm. at Bibereck, preserved as a "Skulptursteinkern", is tentatively identified as being close to *Mutiella coarctata*. H = 17.7 mm, W = 21.8 mm.

M. coarctata is not well known and has not been recorded from outside the Gosau.

Occurrence and distribution: Coniacian – Santonian in the Eastern Alps.

Superfamily Crassatellacea
Family Astartidae

Genus *Astarte* J. SOWERBY, 1816

Astarte s. l. *similis* (MUENSTER in GOLDFUSS, 1837)

pp. 1837 – *Astarte similis* MÜNSTER – GOLDFUSS, p. 193, pl. 134, fig. 22 a (non fig. 22 b, fide J. BOEHM, 1891).
1839 – *Astarte laticostata,* DESH. – DESHAYES, p. 145, pl. 22, figs. 16, 17.
. 1847 – *Astarte caelata* MÜLLER – J. MÜLLER, p. 22, pl. 2, fig. 3.
v. 1865 – *Astarte laticostata* DESH. – ZITTEL, p. 156, pl. 8, figs. 5 a–c.
v. 1865 – *Astarte similis* MÜNST. – ZITTEL, p. 157, pl. 8, figs. 6 a–f.
. 1869 – *Astarte similis* MUNSTER – FAVRE, p. 115, pl. 12, fig, 7.
? 1871 – *Gouldia planissima,* FORBES – STOLICZKA, p. 289, pl. 10, fig. 3.
. 1885 – *Freia caelata* JOS. MÜLLER – J. BOEHM, p. 112.
1889 – *Astarte (Eriphyla) similis* v. MÜNSTER – GRIEPENKERL, p. 59.
. 1889 – *Astarte similis* MNSTR. – HOLZAPFEL, p. 194, pl. 19, figs. 11–15.
. 1891 – *Astarte similis* MÜNSTER – J. BOEHM, pl. 3, fig. 9.
? 1891 – *Astarte subsimilis* sp. n. – J. BOEHM, p. 74, pl. 3, fig. 8.
. 1892 – *Astarte similis* MÜNSTER – VOGEL, p. 79.
. 1912 – *Astarte similis* MÜNSTER – PERVINQUIÈRE, p. 246, pl. 19, figs. 1–7.
? 1934 – *Astarte similis* MNSTR. – ANDERT, p. 242, pl. 11, fig. 44.
1943 – *Astarte similis* MÜNSTER – VAN DER WEIJDEN, p. 43, pl. 2, figs. 12, 13.
. 1957 – *Astarte similis* MÜNSTER – DARTEVELLE & FRENEIX, p. 132, pl. 23, fig. 5.

Type-material:

A. similis: Probably, if still extant in the MÜNSTER Coll., in the Paläontologische Staatssammlung of the University of Munich, GFR.

A. laticostata: Unknown.

ZITTEL figured specimens: *A. laticostata:* GBAW 3148 from Hofergraben.

A. similis: Definite specimens originals of the figures not found.

Locus typicus, stratum typicum:

A. similis: Haldem, Westphalia, GFR, Upper Campanian.

A. laticostata: "Gosau" (? Santonian).

Description and discussion:

Material: From the Hochmoos Fm. at Bibereck about 30 specimens have been collected, generally of poor preservation (shell disintegrating), or 'Skulptursteinkern'. Hinges are not preserved on any of the specimens.

Measurements:

H (both valves): from 6.4 mm to 14.5 mm, average 10.6 mm (n = 21).
W (both valves): from 6.6 mm to 14.4 mm, average 11.3 mm (n = 21).
Ribnumber (both valves): from 5 to 10, average 7.5 (n = 21).
AA: from 87° to 115°, average 101° (n = 9).

Diagnosis: Small, triangular, flattened *Astarte* species with 5 to 12 strong commarginal plications (= ribs).

The preservation makes a more detailed description pointless.

Discussion: Variability: specimens from the Hochmoos Fm. show a wide variability both in size and in commarginal ribnumber (other characteristics cannot be seen). The result of this variability is that the taxa *Astarte laticostata* and *A. similis* as described by ZITTEL are obviously conspecific, but different ontogenetic stages in the variability series: ZITTEL specimens:

A. similis	W 5.5	H 4.5	R 9–11
A. laticostata	W 14–18	H 12–16	R 7–10

ZITTEL records *A. laticostata* from deposits of Coniacian to Lower Maastrichtian age and *A. similis* of Santonian to Lawer Maastrichtian age. From some of ZITTEL's localities both species are reported. Such co-occurrence of very closely related taxa does definitely suggests conspecificity.

Generic attribution: CHAVAN (1952) in his discussion of the Astartidae placed *A. similis* in the genus *Astartemya* STEPHENSON, 1941. The material from the Hochmoos Fm. at Bibereck does not show well preserved hinges, hence no arguments for or against CHAVAN's opinion. It seemed preferable here to use as generic attribution *Astarte* s. l.

Occurrence and distribution: Turonian ? to Maastrichtian from northern, western and central Europe, also recorded from Tunisia and West Africa.

Family Crassatellidae

Genus *Crassatella* LAMARCK, 1799

Crassatella spec. cf. *Cr. macrodonta* (J. SOWERBY, 1832)

v. 1832 – *Astarte macrodonta* SOWERBY – J. SOWERBY in SEDGWICK & MURCHISON, p. 417, pl. 38, fig. 8.
pp v. 1865 – *Crassatella macrodonta* SOW. sp. – ZITTEL, p. 150, pl. 8, fig. 3.
pp v? 1865 – *Crassatella macrodonta* var. *sulcifera* – ZITTEL, p. 150, pl. 8, figs. 2 a–f.

Type-material:

Astarte macrodonta: BM (NHM): L 19574.

ZITTEL: GBAW 3137: original pl. 8, fig. 3: *C. macrodonta,* GBAW 3429: original pl. 8, fig. 2: *C. macrodonta sulcifera.*

Locus typicus, stratum typicum: Gosau (OÖ), Santonian?

Description and discussion:

Material from the Hochmoos Fm.: about 25 medium-sized *Crassatella* steinkerns, half of them bivalved; one of the specimens show a complete hinge, and many are deformed by tectonic activities.

Measurements:

H varies from 7.5 to 39.4 mm, average 30.5 mm (n = 16).

W varies from 8.2 to 51.5 mm, average 34.7 mm (n = 16).

AA varies from 76° to 118°, average 93.3° (n = 15).

Despite their incomplete preservation is seems probable that the *Crassatella* steinkern specimens from the Hochmoos Fm. at Bibereck belong to *C. macrodonta* or are very close to that species, but the specimens bring no new information. The differences indicated by J. BOEHM (1885) between the hinges of *C. macrodonta* and *C. arcacea* ROEMER seem difficult to interpret. To give a final answer in these differentiation a study on the variability of crassatellid hinges during ontogeny and within the same population is needed. FRENEIX (1972) gave indications in that direction.

Occurrence: So far *C. macrodonta* has only been reported from the Gosau beds in Austria (probably only of Santonian age).

Superfamily Cardiacea
Family Cardiidae

Genus *Granocardium* GABB, 1869

Granocardium productum (J. SOWERBY, 1832)
(Pl. 4, figs. 5, 6)

v. 1832 – *Cardium productum* SOWERBY – SOWERBY in SEDGWICK & MURCHISON, p. 417, pl. 39, fig. 15.
1837 – *Cardium productum* (SEDGWICK et MURCH.) – DUJARDIN, p. 223.
? 1837 – *Cardium bispinosum,* DUJ. – DUJARDIN, p. 223, pl. 15, figs. 7 a–c.
? 1837 – *Cardium tubuliferum* nobis – GOLDFUSS, p. 221, pl. 144, fig. 7.
? 1841 – *Cardium tuberculiferum* GOLDF. – ROEMER, p. 71.
? 1843 – *Cardium goldfussi,* MATH. – MATHERON, p. 156, pl. 17, figs. 5, 6.
. 1843 – *Cardium guttiferum* MATH. – MATHERON, p. 156, pl. 18, figs. 1, 2.
? 1843 – *Cardium productum,* SOWERBY – d'ORBIGNY, p. 31, pl. 247, figs. 1–7.
? 1843 – *Cardium alternatum,* d'ORBIGNY – d'ORBIGNY, p. 30, pl. 246, figs. 1–4.
? 1843 – *Cardium Moutonianum* d'ORB. – d'ORBIGNY, p. 34, pl. 248, figs. 1–4.
? 1845 – *Cardium alternans,* REUSS – REUSS, p. 1, pl. 35, figs. 15, 16.
1847 – *Cardium tubuliferum* GOLDF. – J. MUELLER, p. 21.
1859 – *Cardium productum,* SOW. – J. MUELLER, p. 12.
v. 1865 – *Cardium productum* SOW. – ZITTEL, p. 141, pl. 6, figs. 1 a–f.
1870 – *Cardium productum,* SOWERBY – PICTET & CAMPICHE, p. 271.
. 1871 – *Cardium (Trachycardium) productum,* SOWERBY – STOLICZKA, p. 213, 217, pl. 11, fig. 16.
? 1875 – *Cardium deforme* GEIN. – GEINITZ, p. 64, pl. 18, fig. 8.
1883 – *Cardium productum* SOW. – FRIČ, p. 98.

? 1885 – *Criocardium tubuliferum* GFS. – J. BOEHM, p. 118.
1888 – *Cardium productum* SOW. – G. MUELLER, p. 425.
? 1888 – *Cardium alutaceum* GOLDF. – G. MUELLER, p. 425.
? 1888 – *Cardium deforme* GEIN. – G. MUELLER, p. 426.
. 1889 – *Cardium deforme,* GEIN. – FRIČ, p. 76, fig. 56.
? 1889 – *Granocardium productum* SOW. – HOLZAPFEL, p. 179, pl. 17, figs. 1–5.
1890 – *Cardium subproductum* THOMAS et PÉRON – THOMAS & PÉRON, p. 273, pl. 28, figs. 13–14.
. 1898 – *Cardium (Granocardium) productum* SOW. – G. MUELLER, p. 63, pl. 9, figs. 13, 14.
1901 – *Cardium (Granocardium) productum* SOW. – STURM, p. 78.
. 1906 – *Cardium pseudoproductum* PETHÖ; nov. sp. – PETHÖ, p. 292, pl. 24, figs. 11, 12.
1906 – 1907 – *Cardium (Acanthocardia) productum,* SOW. – REPELIN, p. 62, pl. 10, fig. 15.
1909 – *Granocardium productum* SOW. sp. – ROGALA, p. 700.
1911 – *Cardium alternans,* REUSS – FRIČ, p. 31, figs. 136 a, b.
1911 – *Cardium productum,* SOW. – FRIČ, p. 31, figs. 136 c, 137.
. 1912 – *Cardium (Trachycardium) productum,* J. de C. SOWERBY – PERVINQUIÈRE, p. 259, pl. 19, figs. 25–27.
. 1912–1913 – *Granocardium productum* SOW. – SCUPIN, p. 168, textfig. 25.
? 1912–1913 – *Granocardium Beyschlagi* nov. sp. – SCUPIN, p. 170, pl. 7, fig. 12.
. 1920 – *Cardium (Granocardium) productum* SOWERBY – ROMAN & MAZERAN, p. 96, pl. 8, figs. 17–19.
. 1934 – *Granocardium productum* SOW. sp. – ANDERT, p. 254, pl. 12, figs. 10, 11.
? 1937 – *Granocardium productum* (SOWERBY, 1832) – LEHNER, p. 139.
. 1943 – *Granocardium productum* (SOWERBY) – VAN DER WEIJDEN, p. 54, pl. 4, figs. 1, 2.
. 1957 – *Granocardium (Granocardium) productum* (SOWERBY) – DARTEVELLE & FRENEIX, p. 168, pl. 28, figs. 8–10.
? 1974 – *Cardium productum,* SOWERBY, 1835 – SAVCHINSKAJA, p. 107, pl. 38, figs. 8–10.
. 1976 – *Cardium (Trachycardium) exulans* STOLICZKA, 1871 – POJARKOVA, p. 109, pl. 55, figs. 1–5.
? 1981 – *Granocardium (Granocardium) productum* (SOWERBY, 1832) – TZANKOV, p. 138, pl. 58, figs. 1–4.
non 1985 *"Cardium" productum* SOWERBY – DHONDT, p. 64 = *Granocardium* cf. *proboscideum* (SOWERBY, 1817).

Type-material:

SOWERBY lectotype: L 24629, figured on pl. 39, fig. 15 in BM (NHM), London.

ZITTEL material: NHMW: one specimen from Hofergraben (Schausammlung), dubious figured specimens: GBAW 3423 from Strobl – Weissenbach, GBAW 3140.

Locus typicus, stratum typicum: Gosau – Wegscheid Graben (OÖ), Santonian.

Description:

Material from the Hochmoos Fm. at Bibereck: About 20 poorly preserved (i. e. steinkern with small shell fragments) and strongly deformed specimens.

Measurements: The largest relatively uncrushed specimen: H: 95 mm, W: 67 mm.

Diagnosis: Medium to large, subovate and highly convex *Granocardium* species with numerous ribs of unequal development. Strongly developed ribs and

less developed intercalary ribs alternate irregularly; spines or similar structures are present on the ribs in well preserved specimens.

Ornamentation: Each large rib should alternate with two smaller intercalary ribs, but this situation is not consistent on all shells, nor from one part of the rib to another. Strength of rib development and number of ribs vary in an irregular way. All ribs bear spines or spine-like structures of varying development.

The preservation of almost all specimens from the Hochmoos Fm. and of other specimens, previously described from the topotypical Gosau deposits, is unsatisfactory. Hence, based on them, precise rib characteristics for *G. productum* cannot be given.

The variability of the ribstructure and sculpture seems to be broader than it actually is, because there are several types of 'steinkern' preservation:

– the shell has been completely eroded or dissolved, the steinkern seems to be covered with numerouss almost equal ribs, generally seemingly without spines, but often with holes, which represent the spine-bases;

– the shell has been partially preserved (similar to composite mould preservation), several rib-types can be distinguished and spine-bases are visible as rounded holes.

– partial shell preservation on the steinkern show that all ribs bear spine-like structures.

Discussion: Poor preservation makes the study of cardiids from many Cretaceous deposits tedious. For recent species is has been shown that cardiids have a broad variability (*Cerastoderme edule* (L.) from the North Sea and Baltic Sea is a good example of this). Often closely related recent species such as *Acanthocardia aculeata* (L.), *A. echinata* (L.), *A. tuberculata* (L.), are difficult to distinguish with fresh shells. It needs no further explanation then that incomplete generally steinkern cardiid shells of Cretaceous age are virtually impossible to identify with any precision.

The taxa described in literature and listed above in the synonymy list of *Granocardium productum* refer almost exclusively to steinkern specimens: out of 44 citations, 26 refer to normal steinkern specimens, 11 to composite moulds, 4 cannot be judged, and 3 refer to good specimens. Of these latter specimens one comes from India and the two others are from Vaals (near Aachen, silicified material). The specimens of excellent preservation described by HOLZAPFEL from Vaals are more rounded than the topotypical *Granocardium productum* specimens from the Gosau. I would like to suggest that the Vaals specimens are almost identical with *Cardium kuemmeli* (WELLER, 1907) as illustrated by WADE (1926, pl. 26, figs. 5, 6) from Coon Creek, Tennessee, USA (Late Campanian).

Cardium (Granocardium) bowenae STEPHENSON (1941, p. 198, pl. 34, figs. 10–12) from the Nacatoch Sands, Navarro Group (Maastrichtian) in Texas and Arkansas is possibly a well preserved *Granocardium productum,* or at least very close to it. Some of the other *Granocardium* taxa described by STEPHENSON in the same article on less well preserved specimens might also belong in *G. productum.*

Occurrence and distribution: *G. productum* has been recorded from the (Cenomanian ?) Turonian to Campanian (Maastrichtian ?) in the Tethys and warm temperate strata from Europe, North and central Africa, Central Asia, India and possibly from North America.

'Cardium' spec.
(Pl. 6, figs. 3, 4)

In the Hochmoos Fm. numerous finely ribbed steinkern specimens with a cardiid appearance have been collected. They are largish and seem to belong to a different species than *Granocardium productum:* no traces of spines or spine bases can be seen and the ribs seems to be uniformly fine. They do not resemble species previously described from the Gosau, yet are too poorly preserved to warrant a further description and discussion.

Superfamily Tellinacea
Family Tellinidae

Genus *Linearia* CONRAD, 1860

Linearia costulata (GOLDFUSS, 1841)
(Pl. 4, fig. 7)

. 1841 – *Tellina costulata* nobis – GOLDFUSS, p. 235, pl. 147, figs. 19 a–d.
? 1843 – *Venus semiradiata,* MATH. – MATHÉRON, p. 153, pl. 15, fig. 6.
? 1845 – *Arcopagia radiata,* d'ORBIGNY – d'ORBIGNY, p. 412, pl. 378, figs. 11–13.
? 1845 – *Arcopagia gibbosa,* d'ORBIGNY – d'ORBIGNY, p. 413, pl. 378, figs. 14, 15.
v? 1865 – *Arcopagia semiradiata* MATH. sp. – ZITTEL, p. 118, pl. 2, figs. 9 a, b.
v? 1865 – *Arcopagia biradiata* ZITT. – ZITTEL, p. 118, pl. 2, figs. 8 a–c.
v? 1865 – *Arcopagia fenestrata* ZITT. – ZITTEL, p. 119, pl. 2, figs. 7 a, b.
. 1889 – *Tellina costulata* GLDF. sp. – HOLZAPFEL, p. 162, pl. 11, figs. 11–16 (cum synon.).
? 1906 – 1907 – *Arcopagia Zitteli,* REPELIN – REPELIN, p. 71.
. 1906 – 1907 – *Arcopagia Matheroni,* REP. – REPELIN, p. 71, pl. 7, fig. 11.
. 1943 – *Tellina (Linearia) costulata* GOLDFUSS – VAN DER WEIJDEN, p. 64, pl. 4, figs. 18, 19.

Type-material:

Tellina costulata: If still extant, probably in the Paläontologisches Institut der Rheinische Friedrichs Wilhelms Universität in Bonn (GFR).

Venus semiradiata: Coll. RENAUX, in the University of Montpellier (France).

ZITTEL specimens: *A. semiradiata:* GBAW 3488 (pl. 2, fig. 9 b).

A. biradiata: GBAW 3425 (pl. 2, figs. 8 a, c).

A. fenestrata: GBAW 3157 (pl. 2, fig. 7 b ?).

Arcopagia matheroni REPELIN: Musée Longchamp, Marseille.

Locus typicus, stratum typicum:

Tellina costulata: Aachen (GFR), Grünsand (Lower Campanian).

Venus semiradiata: Uchaux, Vaucluse (France), Upper Turonian.

Arcopagia biradiata: Strobl-Weissenbach (designated here), (Coniacian).

A. fenestrata: Wolfgangsee (OÖ), (Santonian).

A. zitteli = *A. semiradiata* in ZITTEL: Netting, Neue Welt (NÖ), (Maastrichtian).

A. matheroni: Plan d'Aups. La Pomme, Var (France), (Lower Senonian).

Description and discussion:

Material from the Hochmoos Fm.: 4 small specimens (Sculpturstein-kernen).

Measurements:

H	W	S
10.0 mm	13.7 mm	bivalved sp.
14.2 mm	22.3 mm	?
15.8 mm	23.2 mm	L
17.3 mm	27.8 mm	L ?

Description: Beaks are situated centrally, slight 'carina' on posterior side; pallial margin invisible: hinges invisible also on the specimens available.

Ornamentation: Radial and commarginal lines over the whole disk; radial fine striae are more pronounced towards the anterior and posterior sides, commarginal lines are more pronounced on the central parts of the valve; on fresh surfaces the difference in ornamentation development between parts of the valve is less pronounced. The specimens from the Hochmoos Fm. do not show the bead-like ribs which can be seen on specimens from Vaals (The Netherlands, Lower Campanian) (coll. KBIN) and which were figured by HOLZAPFEL. The ornamentation visible is very similar to that of *Linearia metastriata* CONRAD as described by GARDNER (1916, p. 699).

The specimens from the Hochmoos Fm. are noticeably smaller than any of the tellinid-like taxa described by ZITTEL from the 'Gosau' deposits. The strongest similarity exists with *Arcopagia semiradiata* (ZITTEL, 1865, p. 118 etc.) from Netting, Neue Welt, possibly of Maastrichtian age. The specimen described by ZITTEL of this species is about 1.3× the size of the largest specimen from the Hochmoos Fm.

The characteristics used by authors to differentiate taxa belonging to *"Tellina"* and *"Arcopagia"* are based on the striation and on the position of the beak. The position of the beak probably is a good characteristic, but the striation seems to be highly variable depending on the preservation. Most of the specimens described in literature are poorly preserved, and hence the striation described on them has a strong preservational bias. On the specimens of *Arcopagia semiradiata, A. biradiata, A. fenestrata* described by ZITTEL and on the specimens from the Hochmoos Fm. one gets the impression that fenestrate sculpture and simple radial or commarginal striae are only a different preservational state of the same sculpture. Hence, it seems quite plausible that *A. biradiata* and *A. fenestrata* are conspecific. In how far this is also true for *A. semiradiata* sensu ZITTEL is difficult to judge with the material at hand.

D'ORBIGNY'S description and figures of *A. gibbosa* make a very close relationship with the specimens from the Hochmoos Fm. probable, but once again the poor preservation makes definite conclusions impossible.

REPELIN renamed *A. semiradiata* sensu ZITTEL *A. zitteli,* considering it different from *Venus semiradiata* MATHÉRON. REPELIN'S description lacks clarity, and on top of that the figures which he stated as *A. zitteli,* belong to *A. biradiata* and not to *A. semiradiata;* the resulting situation is very confused. The specimen from the MATHÉRON collection which REPELIN figured (pl. 8, fig. 11) as the type of *A. matheroni* does not seem to differ much, if at all, from ZITTEL'S figures of *A. semiradiata* (if one takes into consideration that REPELIN figured the other valve than ZITTEL).

The difficulty which those various authors have had in differentiating the taxa to which they gave specific rank, may be simply due to the fact that these taxa all fall within the variability range of one and the same species.

Occurrence and distribution: From Coniacian to Maastrichtian in S.E. France, the 'Gosau' s. l. and the lower Campanian of Vaals – Aachen (The Netherlands – BRD).

Family Icanotiidae

Genus *Icanotia* STOLICZKA, 1871

Icanotia impar (ZITTEL, 1865)

(Pl. 4, figs. 3, 4)

v. 1865 – *Psammobia impar* ZITT. – ZITTEL, p. 16, pl. 2, fig. 4.
. 1871 – *Baroda (Icanotia) impar,* ZITT. sp. – STOLICZKA, p. 163, pl. 17, fig. 5.
. 1969 – *Icanotia impar* (ZITTEL) – KEEN in MOORE, p. N635, textfig. E 119.
. 1976 – *Baroda (Icanotia)* cf. *impar* (ZITTEL, 1864) – POJARKOVA, p. 117, pl. 77, figs. 1 a, b.

Holotype: In NHMW, not registered.

Locus typicus: Hofergraben, Gosau (OÖ), Austria.

Stratum typicum: Late Santonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: 4 internal moulds, one external mould.

Measurements:

H	W	H/W	Side	Locality
8.7 mm	23.5 mm	0.3702	R. V. inside	Bibereck, Hochmoos Fm.
9.3 mm	27.2 mm	0.3419	L. V. inside	Bibereck, Hochmoos Fm.
10.6 mm	27.3 mm	0.3883	R. V. outside	Bibereck, Hochmoos Fm.
12.8 mm	(39 mm)	0.3282	R. V. inside	Bibereck, Hochmoos Fm.
15.6 mm	48.6 mm	0.3203	L. V. inside	Bibereck, Hochmoos Fm.
20 mm	60 mm	0.3333	ZITTEL type	Hofergraben, Late Santonian.

Diagnosis: Ovate-elongate, anterior end short and narrower than posterior. Height about one third of width. Radial sculpture strongly developed and almost rib-like at posterior end. On the anterior end the commarginal ornamentation is often developed more strongly than the radial. Hinge and pallial line invisible on specimens from the Hochmoos Fm.

Discussion: *Icanotia impar* is rare in the Hochmoos Fm. at Bibereck, and its preservation is not entirely satisfactory. Yet it is obvious that the number of posterior rib-like structures varies strongly. Similar taxa occur in other Mid-Cretaceous strata: WOODS (1913, p. 431, pl. 62, fig. 14) described and figured *Tapes (Icanotia)* spec. from Blackdown (? Albian), d'ORBIGNY (1845, p. 423, pl. 381, figs. 1, 2) described and figured *Capsa elegans* from Le Mans (Cenomanian), a very probable *Icanotia* spec., DUJARDIN (1837, p. 223, pl. 15, fig. 2) and d'ORBIGNY (1845, pl. 381, figs. 3–5) described and figured *Capsa discrepans* (DUJARDIN) from the Turonian – Coniacian (and possibly younger) deposits of south west and southern France. From Indian Late Cretaceous strata STOLICZKA mentioned two *Icanotia* species. FRENEIX (1957, p. 197) described *Icanotia atlantica* and listed the known taxa. The group distribution of the genus as far as known from these references seems to be restricted to warm temperate deposits and Tethys in the Eurasian, African and American provinces.

Occurrence and distribution: *I. impar* has been recorded from the Santonian of Austria, the Campanian of Fergana (Central Asia, USSR) and closely related species from warm temperate and Tethys deposits. (Note: the references mentioned by POJARKOVA indicating Turonian to Senonian occurrences in the GFR and GDR I have not been able to trace in literature).

Superfamily Arcticacea
Family Arcticidae

Genus *Proveniella* CASEY, 1952

Proveniella ? testacea (ZITTEL, 1865)
(Pl. 5, fig. 2)

v. 1865 – *Cypricardia testacea* ZITT. – ZITTEL, pp. 136–137, pl. 4, figs. 8 a–f.

Type series: GBAW 3134: type specimens of pl. 4, figs. 8 b, c, d, e, f; (GBAW 3492 is not the type of 8 b, as erroneously stated on the label); the original of fig. 8 a should be in the collections of the NHMW, but could not be found.

Locus typicus and stratum typicum: Gosau (probably Hofergraben) – Santonian.

Description and discussion:

Material: From the Hochmoos Fm. 5 bivalved and 8 univalved specimens, all of steinkern preservation.

Measurements: H (in mm): 9.8; 11.2; 13.7; 13.8; 14.0; 15.0; 18.0; 20.1; 21.0 (n = 9), average: 15.2 mm.

W is not measured because too much deformation is seen.

These smallish, quadrate steinkern specimens with a strong posterior carina and a slight commarginal striation make a detailed description impossible; they are so similar to ZITTEL's type specimens of *Cypricardia* testacea that they can be assimilated to that species. The generic attribution herein is based on the figures

and types of ZITTEL and on those from the Treatise (1969, p. N649, figs. E 128 [12 a–c]). As already stated by STOLICZKA (1871, p. 194) the figures of ZITTEL are not totally satisfying, but *Proveniella* seems to have a hinge closely resembling the figures of ZITTEL.

It is surprising that no references have been found in palaeontological Cretaceous literature to *Proveniella ? testacea.* I think that some of the references to *Trapezium*-species and certainly to steinkern specimens attributed in Central European literature to *Crassatella tricarinata* ROEMER, 1841 actually are close, if not sometimes identical with *Proveniella ? testacea.* Since the comparison of seemingly similar bivalved moulds is a futile exercise, no conclusion can be attempted in connection herewith.

On the other hand *Pr.? testacea* is undoubtedly comparable and possibly related to *Veniella forbesiana* (STOLICZKA, 1871) from the Upper Cretaceous strata of India, North and Central Africa and Madagascar (described in DARTEVELLE & FRENEIX, 1957). The Gosau specimens of *Proveniella? testacea* are smaller than the average *Veniella forbesiana,* but they are close to the young (small) specimens such as figured by STOLICZKA (1871, pl. 9, figs. 2, 3).

Occurrence and distribution: *Proveniella? testacea* is only known from Austrian deposits, and with certainty only from those of Santonian age.

Superfamily Glossacea
Family Dicerocardiidae

Genus *Ambocardia* BERINGER, 1949

Ambocardia planidorsata (ZITTEL, 1865)
(Pl. 5, figs. 6, 7)

v. 1865 – *Isocardia planidorsata* ZITT. – ZITTEL, p. 140, pl. 5, figs. 4 a–c.
? 1889 – *Isocardia Zitteli* nov. sp. – HOLZAPFEL, p. 177, pl. 15, figs. 2–4
(non 1883 *Isocardia Zitteli* G. BOEHM, fide BERINGER 1949).
. 1949 – *Isocardia planidorsata* ZITT. – BERINGER, p. 208, pl. 18, figs. 4–6.
. 1949 – *Isocardia planidorsata* ZITT. var. *acutata* – BERINGER, p. 209, pl. 18, fig. 6.
? 1949 – *I. (Ambocardia) holzapfeli* n. nom. – BERINGER, p. 209.
. 1969 – *Ambocardia planidorsata* (ZITTEL) – COX in MOORE, p. N660, textfig. E135, 3.

Type-material:

ZITTEL types: GBAW 3496: figured specimen pl. 5, figs. 4 c, d, e (the original specimens of figs. 4 a, 4 b were not found).

HOLZAPFEL specimens: Technische Universität, Aachen.

Locus typicus, stratum typicum:

Isocardia planidorsata: "Gosauthal" designated herein (probably Santonian).

I. zitteli: "Grünsand van Vaals", Vaals, Zuid-Limburg, The Netherlands (very near to Aachen, GFR), (Lower Campanian).

Description and discussion:

Material: From the Hochmoos Fm. at Bibereck about 5 more or less certain *Ambocardia planidorsata* specimens and about 15 possible specimens have been collected. All are poorly preserved (steinkern), some are deformed, some are bivalved, and none of the specimens has a complete hinge.

The specimens from the Hochmoos Fm. seem less recurved at the umbo than shown on ZITTEL's figures, but this might be due to their insufficient preservation: also the sharpish folds drawn by ZITTEL are not clearly visible on specimens from the Hochmoos Fm. In fact, they more closely resemble the poorly preserved specimens figured by HOLZAPFEL as *Isocardia zitteli* (non G. BOEHM = *I. holzapfeli* BERINGER); despite the seemingly different hinges of the two taxa (see also FRENEIX 1972, p. 175), I do not consider conspecificity of *I. holzapfeli* and *I. planidorsata* impossible. The strong deformation of the Hochmoos Fm. specimens makes measuring pointless. The dimensions of the specimens fall within those indicated for *A. planidorsata* by ZITTEL.

Occurrence and distribution: Santonian of several localities of Oberösterreich (Austria), possibly Maastrichtian of Niederösterreich (Austria), Campanian near Aachen (GFR).

Superfamily Veneracea
Family Veneridae

Genus *Pitar* ROEMER, 1857

Pitar s. l. *matheroni* ? (ZITTEL, 1865)

v. 1865 – *Venus Matheroni* ZITT. – ZITTEL, p. 125, pl. 3, figs. 1 a, b.

Holotype: GBAW.

Locus typicus, stratum typicum: Hofergraben, Gosau (OÖ), Santonian.

Discussion: 6 poorly preserved, largely steinkern specimens collected from the Hochmoos Fm. are tentatively classified as belonging to *Pitar* s. l. *matheroni ?*. Only one specimen shows a partial hinge.

The nature of the material makes comparisons pointless.

Occurrence: Known from the Santonian strata of the Gosau (OÖ, Austria).

Pitar s. l. *polymorpha* (ZITTEL, 1865)

v. 1865 – *Cytherea polymorpha* ZITT. – ZITTEL, p. 126, pl. 3, figs. 6 a–d.

Holotype: GBAW 3147.

Locus typicus, stratum typicum: Hofergraben, Gosau (OÖ) (designated herein), Santonian.

Description and discussion: One fairly well preserved interior mould from the Hochmoos Fm. is tentatively classified as *Pitar* s. l. *polymorpha*. H: 29.1 mm, W: 33.8 mm, which is relatively less than the measurements indicated by ZITTEL.

Occurrence: Only described from the Santonian of the Gosau (OÖ, Austria).

Genus *Cyprimeria* CONRAD, 1864

Cyprimeria ? *discus* (MATHERON, 1843)

. 1843 – *Lucina discus* MATH. – MATHERON, p. 144, pl. 13, fig. 12.
? 1845 – *Arcopagia numismalis,* d'ORBIGNY – d'ORBIGNY, p. 415, pl. 379, figs. 1–5.
v. 1865 – *Circe discus* MATH. spec. – ZITTEL, p. 128, pl. 3, figs. 7 a–f.
. 1867 – *Circe discus,* ZITTEL – PICTET & CAMPICHE, p. 196.
. 1871 – *Cyprimeria discus,* MATH. sp. – STOLICZKA, p. 163.
. 1889 – *Cyprimeria Geinitzii* MÜLL. sp. – HOLZAPFEL, p. 174, pl. 12, figs. 1–4.
? 1897 – *Cyprimeria Geinitzii,* MÜLLER sp. – FRIČ, p. 53, textfig. 58.
1901 – *Cyprimeria Geinitzii,* MÜLL. sp. – STURM, p. 81.
. 1906 – 1907 – *Cyprimeria discus,* MATH., Sp. – REPELIN, p. 69, pl. 10, figs. 13, 14.
? 1912–1913 – *Cyprimeria discus* MATH. – SCUPIN, p. 163, pl. 7, figs. 1, 2.
. 1920 – *Cyprimeria discus* MATHERON – ROMAN & MAZERAN, p. 100, pl. 9, fig. 1.
? 1934 – *Cyprimeria discus* MATH. sp. – ANDERT, p. 273, pl. 12, figs. 33, 34, textfigs. 40–44.
? 1937 – *Cyprimeria discus* (MATHERON, 1842) – LEHNER, p. 145.
1943 – *Cyprimeria discus* (MATHÉRON) – VAN DER WEIJDEN, p. 56, pl. 4, fig. 4.
? 1981 – *Cyprimeria discus* (MATHERON, 1842) – TZANKOV, p. 142, pl. 70, figs. 1–3.

Holotype: MATHERON specimen: probably in Muséum d'Histoire naturelle, Marseille.

Locus typicus, stratum typicum: Uchaux, Vaucluse, France; Upper Turonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: About 20 fairly typical steinkern specimens.

Measurements: (in mm)

H varies from 19.9 to 40.9, average = 33.4 (n = 10).
W varies from 19.8 to 42.6, average = 34.3 (n = 10).
W/H varies from 0.90 to 1.24, average 1.02 (n = 10).

The preservation of the specimens from the Hochmoos Fm. does not show any characteristic not already mentioned by ZITTEL. Hence a description seems pointless.

Discussion: The specimens from the Hochmoos Fm. and those described by ZITTEL from the Gosau are undoubtedly conspecific with those described by HOLZAPFEL as *Cyprimeria geinitzii* from near Aachen.

The specimens described and figured by ANDERT from Saxony and Bohemia leave some doubt as to their identity with MATHERON'S species: I agree with ANDERT'S statement that H and W vary and this is automatically reflected in the values H/W or W/H. However, by using ANDERT'S own data:

H varies from 22 to 65 mm, average 37.9 mm (n = 25).
W varies from 26 to 70 mm, average 45.3 mm (n = 25).
W/H varies from 0.72 to 0.95, average 0.84 (n = 25).

ANDERT's results and mine may differ because of different measuring techniques, but they might also reflect real differences. ANDERT's specimens are stratigraphically older than those from Austria. If not due to measuring techniques the differences might tentatively be explained as an evolutionary change, but the data available are too scant to check this hypothesis.

Species similar to *Cyprimeria discus* occur in North America: f. i. *Cyprimeria patella* STEPHENSON, 1953 from the Cenomanian Woodbine Fm. in Texas. Also close is *Cyprimeria haueri* PETHÖ, 1906 from the Late Senonian strata of Fruška Gora (Yugoslavia), but its concentric ornamentation is more strongly pronounced.

Occurrence and distribution: Coniacian – Santonian – Campanian in S.E. France, Gosau (Austria), possibly Czechoslovakia and Saxony (GDR), near Aachen (GFR) and possibly Bulgaria.

Genus *Legumen* CONRAD, 1858

Legumen martinianus (MATHERON, 1843)
(Pl. 5, fig. 1)

. 1843 – *Venus Martiniana,* MATH. – MATHERON, p. 154, pl. 16, fig. 7.
v. 1865 – *Tapes Martiniana* MATH. sp. – ZITTEL, p. 123, pl. 3, figs. 2 a–g.
1871 – *Venus Martiniana,* MATH. – STOLICZKA, p. 161 (non synon.).
1906 – 1907 – *Tapes Martini,* MATH., sp. – REPELIN, p. 67, pl. 11, fig. 18.
? 1937 – *Tapes fragilis* (d'ORBIGNY, 1845) – LEHNER, p. 144.
? 1943 – *Tapes fragilis* (d'ORBIGNY) – VAN DER WEIJDEN, p. 61, pl. 4, figs. 13, 14.

Type-material:

MATHERON material: Muséum d'Histoire naturelle, Marseille, France.

ZITTEL original specimens: GBAW 3159: pl. 3, fig. 2 a: from Hofergraben, GBAW 3170, pl. 3, fig. 2 c: from Tiefengraben, GBAW 3490: pl. 3, fig. 2 f: from Stollhof; NHMW no N°: original of pl. 3, fig. 2 b, 2 d.

Locus typicus, stratum typicum: Martigues, Bouches-du-Rhône, France; Turonian – Santonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: 2 specimens preserved as composite moulds:

H: 11.7 mm, W: 22.3 mm;
H: 10.8 mm, W: 18.7 mm.

These specimens have no hinge preserved, but their general shape and commarginal ornamentation is identical with that described and figured by ZITTEL.

Occurrence and distribution: Santonian of the Gosau (Austria), Coniacian to Campanian in S.E. France, near Aachen (GFR) and possibly in Bavaria.

Genus *Cyclorisma* DALL, 1902

Cyclorisma ? dubiosa ZITTEL, 1865

v. 1865 – *Circe dubiosa* ZITT. – ZITTEL, p. 130, pl. 4, figs. 2 a–c.

Type series: GBAW 3154: several specimens from Nefgraben.

Locus typicus, stratum typicum: Nefgraben, Gosau, OÖ, Austria, Late Santonian.

Description and discussion: Two very convex, orbicular, probably venerid steinkern specimens are tentatively identified as *Cyclorisma? dubiosa.* The material does not allow a more precise taxonomic assignation nor a confirmation of STOLICZKA's opinion (1871, p. 163, n° 90) concerning its identity with *C. nuciformis* (J. MÜLLER).

Measurements:

H	W	convexity
21.7 mm	21.2 mm	8.7 mm
19.6 mm	18.8 mm	10.3 mm

Occurrence and distribution: Only mentioned from the Gosau deposits of Late Santonian age in Austria.

Order MYOIDA
Superfamily Myacea
Family Corbulidae

Genus *Corbula* s. l. BRUGUIÈRE, 1797

Corbula ? angustata J. SOWERBY, 1832
(Pl. 5, fig. 3)

. 1832 – *Corbula angustata* – J. SOWERBY in SEDGWICK & MURCHISON, p. 417, pl. 38, fig. 4.
? 1842 – *Corbula goldfussiana,* MATH. – MATHERON, p. 142, pl. 13, figs. 9, 10.
(1850) – *Corbula subangustata,* d'ORB. – d'ORBIGNY, p. 238.
(1864) – *Corbula subangustata,* d'ORB. – PICTET & CAMPICHE, p. 37.
v. 1865 – *Corbula angustata* SOW. – ZITTEL, p. 112, pl. 1, figs. 8 b–f (no fig. 8 a on pl. 1, but two figs. 8 b).
1871 – *Corbula angustata* – STOLICZKA, p. 41.

Type specimens:

SOWERBY type: L 19572 (BM [NHM]), London (G. B.) (not found July 1985, written communication of R. CLEEVELY).

ZITTEL: Figured specimens: GBAW 3149.

Locus typicus, stratum typicum: In SOWERBY: 'Gosau' (OÖ, Austria); ZITTEL specified this indication: his figured specimens come from Edelbachgraben, Gosau (OÖ), Lower Santonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: About 10, sometimes slightly crushed specimens of relatively poor preservation, clearly belonging to a corbulid species have been assigned to *Corbula ? angustata* J. SOWERBY, 1832.

The relatively pronounced commarginal ornamentation is visible even on steinkern specimens.

Measurements: The largest specimen measures 7.5 mm (H) by 11 mm (W) which is largish for the species, but already ZITTEL stated that in some localities *C. angustata* reaches larger sizes than in Edelbachgraben.

Discussion: The specimens from the Hochmoos Fm. are not well enough preserved to allow a more precise generic attribution than *Corbula* s. l. It should be noted that *C. angustata* has not been recorded since ZITTEL (STOLICZKA only discussed nomenclature). This might prove that *C. angustata* is synonymous with another species, but the poor preservation and insufficient illustration make it very difficult to compare this taxon with the other numerous *'Corbula'* taxa described from Late Cretaceous deposits.

Occurrence and distribution: Santonian deposits (Lower and Upper) from Austria. Possibly also at Uchaux, Vaucluse, France, in strata of roughly comparable age.

Subclass ANOMALODESMATA
Order PHOLADOMYOIDA
Superfamily Pholadomyacea
Family Pholadomyidae

Genus *Pholadomya* G. B. SOWERBY, 1823

Pholadomya nodulifera ? MUENSTER in GOLDFUSS, 1841
(Pl. 5, figs. 4, 5)

1841 – *Pholadomya nodulifera* MÜNSTER – GOLDFUSS, p. 273, pl. 158, figs. 2 a, b.
1841 – *Pholadomya albina* REICHE – ROEMER, p. 75, pl. 10, fig. 7.
? 1843 – *Pholadomya rostrata,* MATH. – MATHERON, p. 136, pl. 11, figs, 6, 7.
v. 1865 – *Pholadomya rostrata* MATH. – ZITTEL, p. 115, pl. 2, figs. 2 a–c.
1871 – *Pholadomya rostrata,* MATH. – STOLICZKA, p. 75.
1871 – *Pholadomya nodulifera,* MÜNST. – STOLICZKA, p. 75.
. 1875 – *Pholadomya Elisabethae,* MOESCH – MOESCH, p. 106, pl. 24, figs. 1 a–c.
? 1875 – *Pholadomya nodulifera,* MÜNSTER – MOESCH, p. 103, pl. 24, figs. 2 a–c.
. 1875 – *Pholadomya nodulifera* MÜN. – GEINITZ, p. 70, pl. 19, figs, 5 a, b.
? 1883 – *Pholadomya nodulifera* MÜNSTER – FRIČ, p. 107, textfigs. 75 a–c, 76.
? 1888 – *Pholadomya nodulifera* MSTR. – G. MÜLLER, p. 433.
. 1889 – *Pholadomya nodulifera* MNST. – HOLZAPFEL, p. 155, pl. 15, fig. 1.
1897 – *Pholadomya nodulifera,* MÜNST. – FRIČ, p. 60, textfigs. 71 a–c.
1897 – *Pholadomya nodulifera* MÜNST. – PETRASCHECK, p. 28.
? 1906 – *Pholadomya* cfr. *Elisabethae* MOESCH – PETHÖ, p. 312, pl. 26, fig. 8.
? 1906 – 1907 – *Pholadomya rostrata,* MATH. – REPELIN, p. 73, pl. 12, figs. 17, 18.

? 1912 – 1913 – *Pholadomya nodulifera* MÜNST. and var. *elliptica* MÜNST. – SCUPIN, p. 144, pl. 5, fig. 16.
1934 – *Pholadomya nodulifera* MÜNST. – ANDERT, p. 328, pl. 15, figs. 3, 4.
1934 – *Pholadomya nodulifera* MÜNST. var. n. *fritschi* – ANDERT, p. 332, pl. 15, fig. 5.
1934 – *Pholadomya nodulifera* MÜNST. var. n. *salzbergensis* – ANDERT, p. 333, pl. 15, figs. 6, 7.
1936 – *Pholadomya nodulifera* MÜNST. – BEYENBURG, p. 316.
? 1937 – *Pholadomya* cf. *nodulifera* MÜNSTER, 1840 – LEHNER, p. 159, pl. 21, fig. 14.
? 1961 – *Pholadomya albina* REICH in GEINITZ – BOBKOVA, p. 141, pl. 14, fig. 2.
? 1976 – *Pholadomya albina* REICH in GEINITZ – POJARKOVA, p. 125, pl. 60, figs. 9–10, pl. 61, fig. 7.
? 1977 – *Pholadomya salzbergensis* ANDERT, 1934 – SOBETSKI, p. 212, pl. 18, figs. 4, 5.
1977 – *Pholadomya micronodulifera* sp. nov. – SOBETSKI, pl. 18, figs. 4, 5 (sic).

Type-material:

Pholadomya nodulifera: If still extant in the Bayerische paläontologische Staatssammlung in Munich, GFR (Münster Coll.).

Ph. albina: The ROEMER Coll. is in the Roemer Pelizaeus Museum in Hildesheim, GFR.

Ph. rostrata: Muséum d'Histoire naturelle, Marseille, France.

Ph. elisabethae: Muséum d'Histoire naturelle, Geneva, Switzerland.

Locus typicus, stratum typicum:

Ph. nodulifera: Schandau, Saxony (GDR), Turonian – Coniacian.

Ph. albina: Schandau, id.

Ph. rostrata: Craie ligno-marneuse, le Plan d'Aups près de la Sainte Beaume, Var, France, Coniacian – Santonian.

Ph. elisabethae: Gosau, Austria (probably Santonian).

Description: From the Hochmoos Fm. at Bibereck one small well-preserved composite mould, H: 11.8 mm, W: 17.8 mm.

This typical *Pholadomya* specimen is covered with about 20 narrow radial riblets which are crossed by commarginal striae of almost equal width. These commarginal striae are more obvious near the umbo where they and the radial riblets form a cancellate ornamentation.

Discussion: The taxonomic interpretation of Cretaceous Pholadomyids is confused and difficult. The criteria used are purely typological; in shells which are usually deformed and often poorly preserved this results in many dubious taxa. Furthermore it is difficult to compare specimens of fairly good preservation such as those described and figured by HOLZAPFEL from near Aachen with the generally less well preserved steinkern specimens from Saxony and Czechoslovakia. I would tend to agree with STOLICZKA (1871, p. 75) that the precence or absence of granulations are not of specific importance on Cretaceous specimens: probably their presence is entirely due to the preservation.

The synonymy-list included here for *Pholadomya nodulifera* is based on a semi-typological concept of the species, allowing for some variation in the number of radial riblets, and not really taking into consideration the discussion of older authors on shape differences as specific characteristics (such differences were certainly largely due to preservational deformation).

Occurrence and distribution: Cenomanian ? – Turonian to Campanian in Central, North-western and South-western Europe and Central Asia (USSR).

Superfamily Pandoracea
Family Laternulidae

Genus *Cercomya* AGASSIZ, 1843

***Cercomya* ? *producta* (ZITTEL, 1865)**
(Pl. 6, figs. 1, 2)

v. 1865 – *Anatina producta* ZITT. – ZITTEL, p. 114, pl. 1, figs. 6 a–d.
1871 – *Cercomya producta* (ZITTEL) – STOLICZKA, p. 74.
? 1909 – *Anatina (Cercomya)*, sp. – WOODS, p. 240, pl. 39, fig. 6.

Lectotype: Designated herein: NHMW: the original of ZITTEL, pl. 1, fig. 6 a (from Tiefengraben); paratypes: NHMW: the originals of ZITTEL, pl. 1, figs. 6 b, c.

Locus typicus, stratum typicum: Tiefengraben, Gosau, OÖ, Austria, Santonian.

Description and discussion:

Material: From the Hochmoos Fm. at Bibereck: one fairly good composite mould and one dubious specimen.

Measurements: H: 8.8 mm, W: 25.7 mm.

Though less well preserved, the small specimen of *C.? producta* shows most of the characteristics which ZITTEL already described with good material. The punctuation is visible, but the punctae do not seem to lie on lines. As far as can be judged the valves gaped a little.

In literature no similar species has been described from Late Cretaceous deposits. The closest are specimens figured by WOODS from Cenomanian deposits of S.W. England and *Anatina (Cercomya) cymbula* PETHÖ (1906, p. 314, pl. 26, fig. 6) from Late Cretaceous deposits of N.E. Yugoslavia.

Generic attribution: *Cercomya ? producta* is difficult to assign with certainty into a genus. It has a number of characterics typical for *Cercomya:* it is elongate, subequilateral, compressed, and the commarginal ribbing is pronounced. The tapering is slight, but its umbo is near midlength and above the posterodorsal margin. It has minute granules but they do not seem to be aligned. It seems to be rather convexer than other *Cercomya* species from the Late Cretaceous such as *C. lanceolata* (GEINITZ, 1843) and *C. papyracea* (J. BOEHM, 1885) (which might be conspecific according to VAN DER WEIJDEN, 1943, p. 75).

Occurrence and distribution: Only recorded with certainty from the Gosau, OÖ, Austria, Santonian.

Superfaily Poromyacea
Family Poromyidae

Genus *Poromya* FORBES, 1844

Poromya s. l. _frequens_ (ZITTEL, 1865)
(Pl. 6, figs. 6 ?, 7)

v. 1865 – *Panopaea frequens* ZITT. – ZITTEL, p. 111, pl. 1, figs. 5 a–g.
(1907) – *Liopistha (Panopaea) frequens* ZITTEL – FUGGER, p. 517.

Type specimens:

NHMW: Originals to ZITTEL pl. 1, fig. 5 b, 5 c; 5 c lectotype of the species from Finstergraben.

GBAW 3161: pl. 1, fig. 5 f: Gosau.

GBAW 3485: pl. 1, figs. 5 a, 5 g: probably Stollhof.

GBAW 3162: not figured, from Windbach, Gosau.

Locus typicus, stratum typicum: Finstergraben, Gosau, OÖ, Austria, Santonian.

Description and discussion:

Material from the Hochmoos Fm. at Bibereck: About 60 generally bivalved steinkern specimens.

Measurements: Size and shape vary considerably, the shape mainly because of tectonic deformation; W of a large specimen: 54 mm, H of a large specimen: 33 mm.

Diagnosis: Suboval, convex equivalve, inequilateral valves, with prominent umbo to the anterior side; valves gaping slightly; ornamentation consists of numerous commarginal striae and of radial riblets with pustules. No hinges are visible on the specimens from the Hochmoos Fm.

ZITTEL gave an extensive description of *P. frequens* to which nothing can be added.

P. frequens is one of the most commonly occurring species in the Gosau, but is has not been recorded from outside the Gosau. Similar species have been recorded: From Turonian – Coniacian deposits of S.W. France: *"Pholadomya" ligeriensis* d'ORBIGNY (1847, p. 354, pl. 363, figs, 8, 9);

from Lower Campanian deposits of N.W. Germany: *Poromya obtusa* (MÜLLER) as figured and described by HOLZAPFEL, pl. 9, figs. 7–11;

from Blackdown (S. England) (Albian ?): *Liopistha (Psilomya) gigantea* (SOWERBY) in WOODS, p. 257; p. 143, figs. 3, 4, pl. 44, figs. 1, 2;

from the Trichinopoly Fm. in S. India: *Poromya globulosa* FORBES (in STOLICZKA, 1871, p. 47, pl. 3, fig. 8, pl. 16, fig. 16), *P. lata* FORBES (in STOLICZKA, 1871, p. 47, pl. 2, figs. 8, 9, pl. 16, fig. 17), *P. superba* FORBES (in STOLICZKA, 1871, p. 48, pl. 3, figs. 2–4) etc.

It is not certain that all those taxa represent different species. What they do show is a tendency for the species group to occur in warm temperate or Tethys deposits.

Family Clavagellidae

Several tubes probably from burrowing Bivalves have been collected from the Hochmoos Fm. Similar structures were described by ZITTEL as *Fistulana tubulosa* ZITTEL (1865, p. 108, pl. 1, figs. 1 a–f). The tubes from the Hochmoos Fm. are not well enough preserved to allow definite family assignment. Those from ZITTEL's taxon probably belong to the Clavagellidae (rather than to the Gastrochaenidae as interpreted by ZITTEL).

Conclusions

1. The bivalve fauna from the Hochmoos Fm. at Bibereck (Gosau, OÖ, Austria) is represented by 50 species. Compared with other faunas known from one locality and collected within one stratigraphic horizon this is a very diverse fauna.

When comparing the results obtained with the fauna from the Hochmoos Fm. at Bibereck with those of ZITTEL (1865–1866), which concern faunas from the Gosau s. s. or from beds of similar age, it becomes appearant that in the Hochmoos Fm. only four species have been identified which were not already recognised explicitly by ZITTEL (i. e. *Gervillaria neptuni, Inoceramus angustus, I. cycloides ahnesensis, Plagiostoma cretaceum*).

2. The inoceramids *(I. muelleri, I. cycloides ahnesensis, I. angustus)* indicate a Late (possibly latest) Santonian age, which agrees well with data published previously on Ammonites (SUMMESBERGER 1979, 1980; KOLLMANN & SUMMESBERGER 1982) from the same beds and locality.

3. The bivalve fauna from the Hochmoos Schichten at Bibereck represents a wide ecological assemblage typical for shallow water, relatively warm sea deposits. Infauna is present (deep and shallow burrowers) and epifauna is numerous (free living, byssate and attached species).

4. Palaeobiogeographical affinities of the fauna from the Hochmoos Fm. at Bibereck have previously shown (KOLLMANN 1980, KOLLMANN & SUMMESBERGER 1982, SUMMESBERGER 1979, 1980) to be found in the Tethys deposits, but also to lie in Northwestern Europe. These results also apply to the bivalves.

Abbreviations:

Institutions:

BM (NHM):	collections of the Mollusca Section in the Palaeontology Department of the British Museum (Natural History) in London, U. K.
GBAW:	type collections of the Geologische Bundesanstalt Wien, in Vienna, Austria.
LO:	Londini Gothorum (= Lund), Sweden.
MAFI:	collections of the Magyar Allami Földtani Intézet in Budapest, Hungary.
NHMW:	collections of the Naturhistorisches Museum Wien, Geologisch-Paläontologische Abteilung, Vienna, Austria.
SM:	palaeontological collections of the Sedgwick Museum, Department of Earth Sciences, Cambridge University, Cambridge, U. K.

Descriptive terms:

A. A.:	apical angle (= umbonal angle).
av.:	average.
H.:	height (umbo to pallial margin).
HM:	hinge margin.
L:	length (= H).
S.:	side (indicating the valve).
UPD:	umbo pallial diameter (= H) but used especially in pectinids and closely related groups.
W:	width (generally perpendicular to H.).

Acknowledgements: To Direktor Dr. H. A. KOLLMANN and to Dr. H. SUMMESBERGER I would like to express my sincere gratitude for having suggested the study of the Hochmoos Fm. bivalves, for guidance in the 'Gosau' beds and for having provided in the Naturhistorisches Museum in Vienna, the facilities for the research. For permission to study collections in their care and/or discussions on aspects of this papers my best thanks go to: R. J. CLEEVELY (London), G. CSÁSZÁR (Budapest), G. DE CAUWER (Brussels), Suzanne FRENEIX (Paris), J. M. HANCOCK (London), W. J. KENNEDY (Oxford), J. Ph. LEFRANC (Montpellier), H. LOBITZER (Vienna), N. J. MORRIS (London), H. PRESCHER (Dresden), the family SKOUMAL (Vienna), F. STOJASPAL (Vienna), L. VAN DE POEL (Brussels), H. WALTHER (Dresden). Travelgrants from the Ministerie van Onderwijs in Brussels are gratefully acknowledged.

Dr. O. SCHULTZ (Vienna) supplied much needed editorial assistance. Finally I would like to thank explicitly Brita and Heinz KOLLMANN and Lotte and Herbert SUMMESBERGER for their generous hospitality during my many visits to Vienna in connection with the Hochmoos Fm. fauna.

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Explanation of the plates

Plate 1

All specimens are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Nucula concinna* SOWERBY, 1832: right valve, steinkern, NHM 1985/43/1, (× 4).

Fig. 2. *Limopsis calvus* (SOWERBY, 1832): steinkern, NHM 1985/43/2, (× 4).

Fig. 3. *Arca (Eonavicula ?) aquisgranensis* J. MUELLER, 1859: right valve, steinkern, NHM 1985/43/3, (× 1).

Fig. 4. id., left valve, steinkern, NHM 1985/43/4, (× 1).

Fig. 5. *Barbatia ? inaequidentata* (ZITTEL, 1865): left valve, steinkern, NHM 1985/43/5, (× 1).

Fig. 6. id., right valve, steinkern, NHM 1985/3/6, (× 1).

Fig. 7. id., left valve, steinkern, NHM 1985/43/7, (× 1).

Fig. 8. *Modiolus* cf. *siliquus* (MATHERON, 1843): right valve, steinkern, NHM 1985/43/8, (× 1).

Fig. 9. id., left valve of preceding specimen, (X 1).

Fig. 10. *Cucullaea* cf. *matheroniana* (d'ORBIGNY, 1844): left valve, NHM 1985/43/9, (× 1).

Fig. 11. *Inoperna flagellifera* (FORBES, 1846): right valve, NHM 1985/43/10, (× 1).

Fig. 12. id., left valve of preceding specimen, (× 1).

Fig. 13. id., left valve, NHM 1985/43/11, (× 1).

Plate 2

Figs. 1–4 are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Glycymeris marrotianus* (d'ORBIGNY, 1844): right valve ?, NHM 1985/43/12, (× 1).

Fig. 2. *Modiolus capitatus* (ZITTEL, 1866): left valve, NHM 1985/43/13, (× 1).

Fig. 3. id., right valve of preceding specimen, (× 1).

Fig. 4. *Modiolus typicus* (FORBES, 1846): left valve, NHM 1985/43/14, (× 1).

Fig. 5. *Gervillaria neptuni* (GOLDFUSS, 1837): right valve ?, from Nussenseebach, Oberösterreich, Austria, SKOUMAL coll., Vienna, SK-NU-1984-II-1, (× 1).

Fig. 6. id., side view of preceding specimen, with left valve on right side, (× 1).

Plate 3

All specimens are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Pseudoptera raricosta* (REUSS, 1854): cast made from exterior mould of left valve, NHM 1985/43/15, (× 1.5).

Fig. 2. *Inoceramus* cf. *angustus* (BEYENBURG, 1936): cast made from exterior mould of small right valve, NHM 1985/43/16, (× 1).

Fig. 3. *Camptonectes virgatus* (NILSSON, 1827): ? right valve, steinkern, NHM 1985/43/17, (× 2).

Fig. 4. *Inoceramus muelleri* (PETRASCHECK, 1906): right valve, NHM 1985/43/18, (× 1).

Fig. 5. id., left valve, NHM 1985/43/19, (× 1).

Fig. 6. *Gervillia solenoides* DEFRANCE, 1820: left valve, NHM 1985/43/20, (× 0.75).

Fig. 7. id., right valve, inside, showing hinge, NHM 1985/43/21, (× 1).

Plate 4

All specimens are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Neithea coquandi* (PERON, 1877): right valve, steinkern, NHM 1985/43/22, (× 1).

Fig. 2. id., left valve, steinkern, NHM 1985/43/23, (× 1).

Fig. 3. *Icanotia impar* (ZITTEL, 1865): right valve, composite mould, NHM 1985/43/24, (× 1).

Fig. 4. id., right valve, composite mould, NHM 1985/43/25, (× 1).

Fig. 5. *Granocardium productum* (SOWERBY, 1832): side view, composite, mould, NHM 1985/43/26, (× 1).

Fig. 6. id., composite mould, NHM 85/43/27, (× 1).

Fig. 7. *Linearia costulata* (GOLDFUSS, 1841): left valve, composite mould, NHM 1985/43/28, (× 2).

Fig. 8. *Mutiella* spec. cf. *Mutiella coarctata* (ZITTEL, 1865): ? left valve, steinkern, NHM 1985/43/29, (× 2).

Fig. 9. *Spondylus requienianus* (MATHERON, 1843): attached, right valve, NHM 1985/43/30, (× 1).

Fig. 10. *Plagiostoma cretaceum* (WOODS, 1904): left valve, NHM 1985/43/31, (× 1).

Fig. 11. id., side view of preceding bivalved specimen, (× 1).

Fig. 12. id., right valve of preceding bivalved specimen, (× 1).

Plate 5

All specimens are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Legumen martinianus* (MATHERON, 1843): left valve, composite mould, NHM 1985/43/32, (× 1).

Fig. 2. *Proveniella testacea* (ZITTEL, 1865): left valve, steinkern, NHM 1985/43/33, (× 2).

Fig. 3. *Corbula angustata* SOWERBY, 1932: steinkern, NHM 1985/43/34, (× 4).

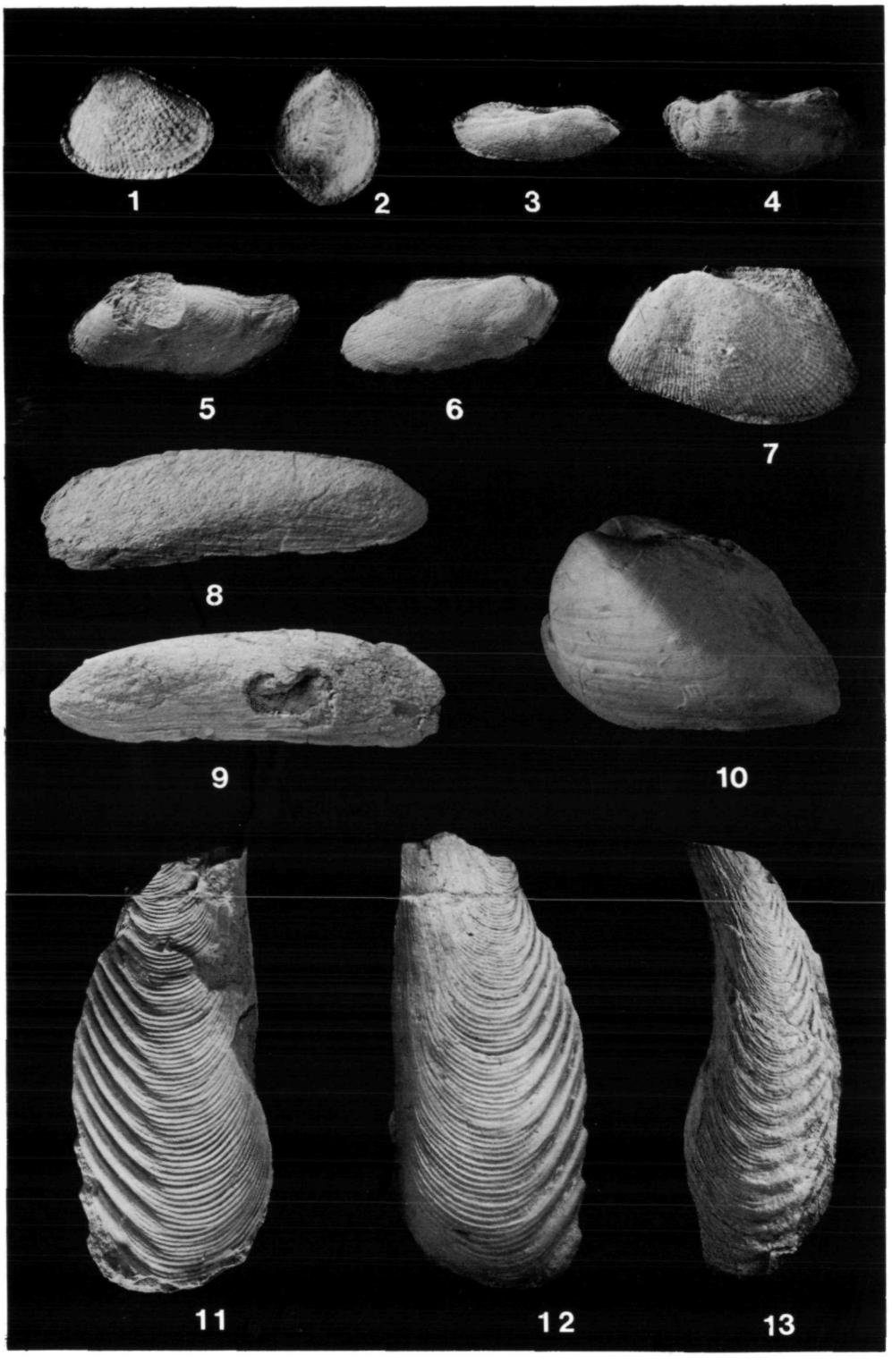
Fig. 4. *Pholadomya nodulifera* MUENSTER in GOLDFUSS, 1841: right valve, composite mould, NHM 1985/43/35, (× 1.5).

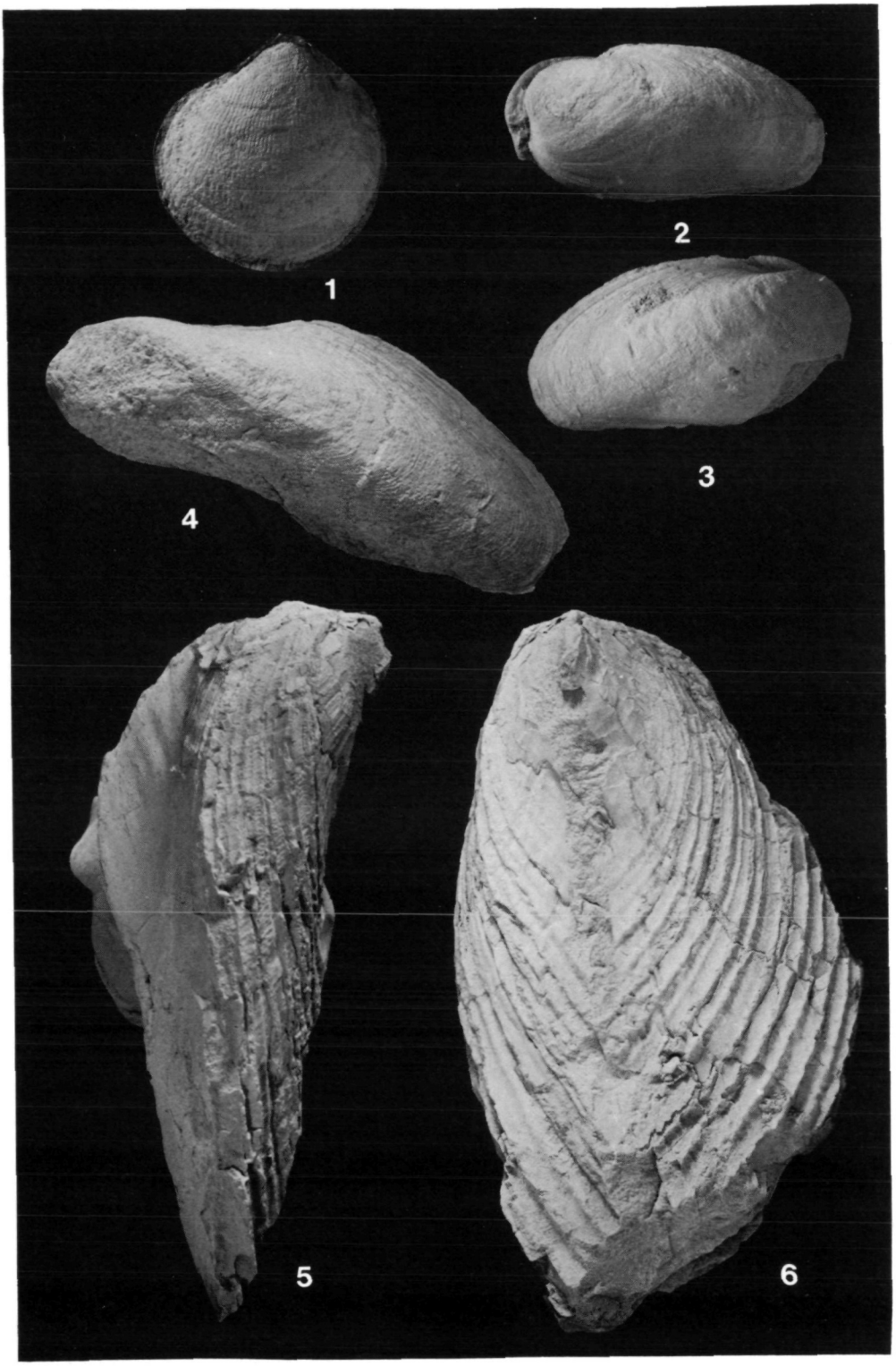
Fig. 5. id., umbonal view of preceding specimen, (× 1.5).

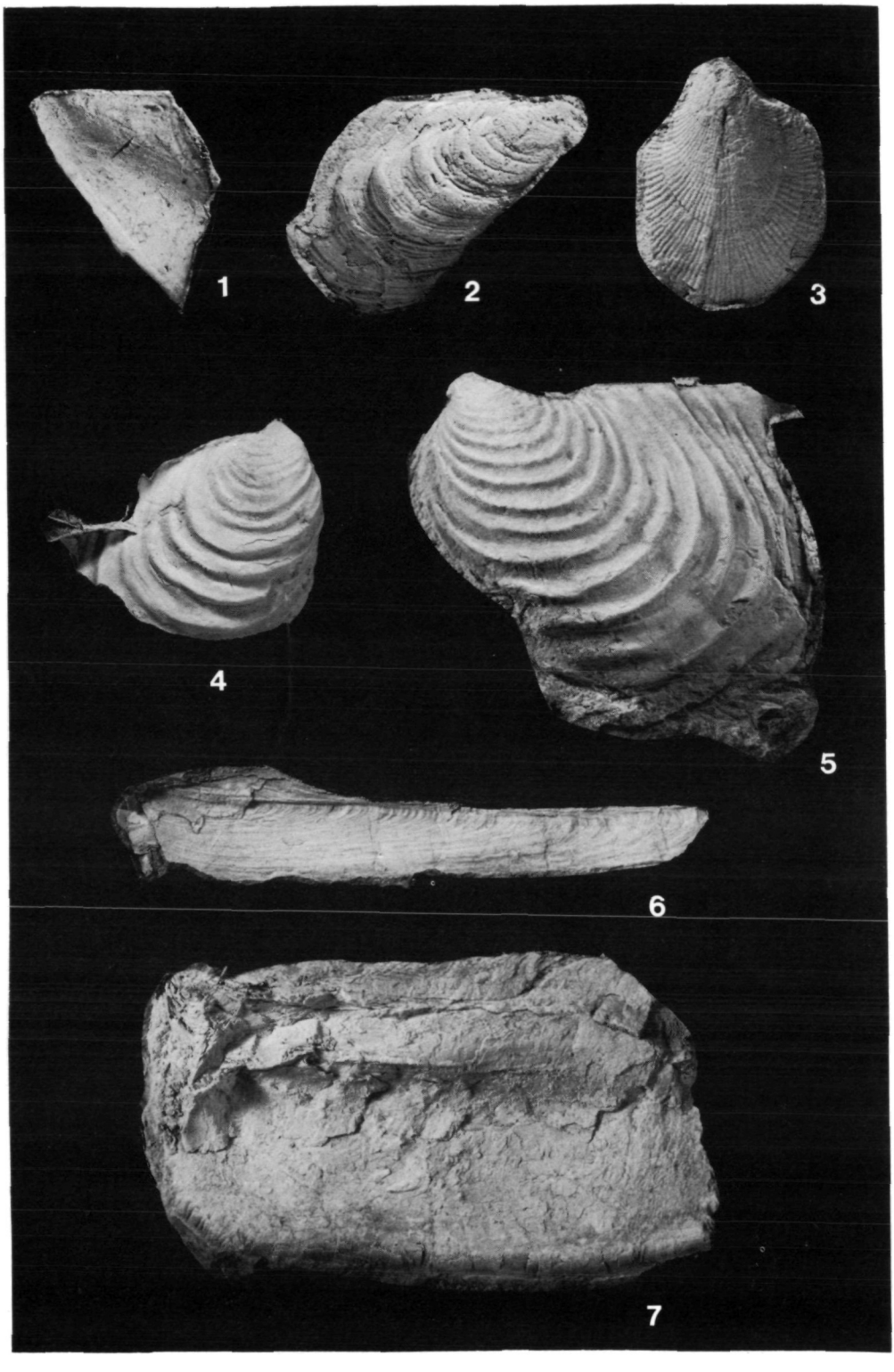
Fig. 6. *Ambocardia planidorsata* (ZITTEL, 1865): left valve, steinkern, bivalved specimen, NHM 1985/43/36, (× 1).

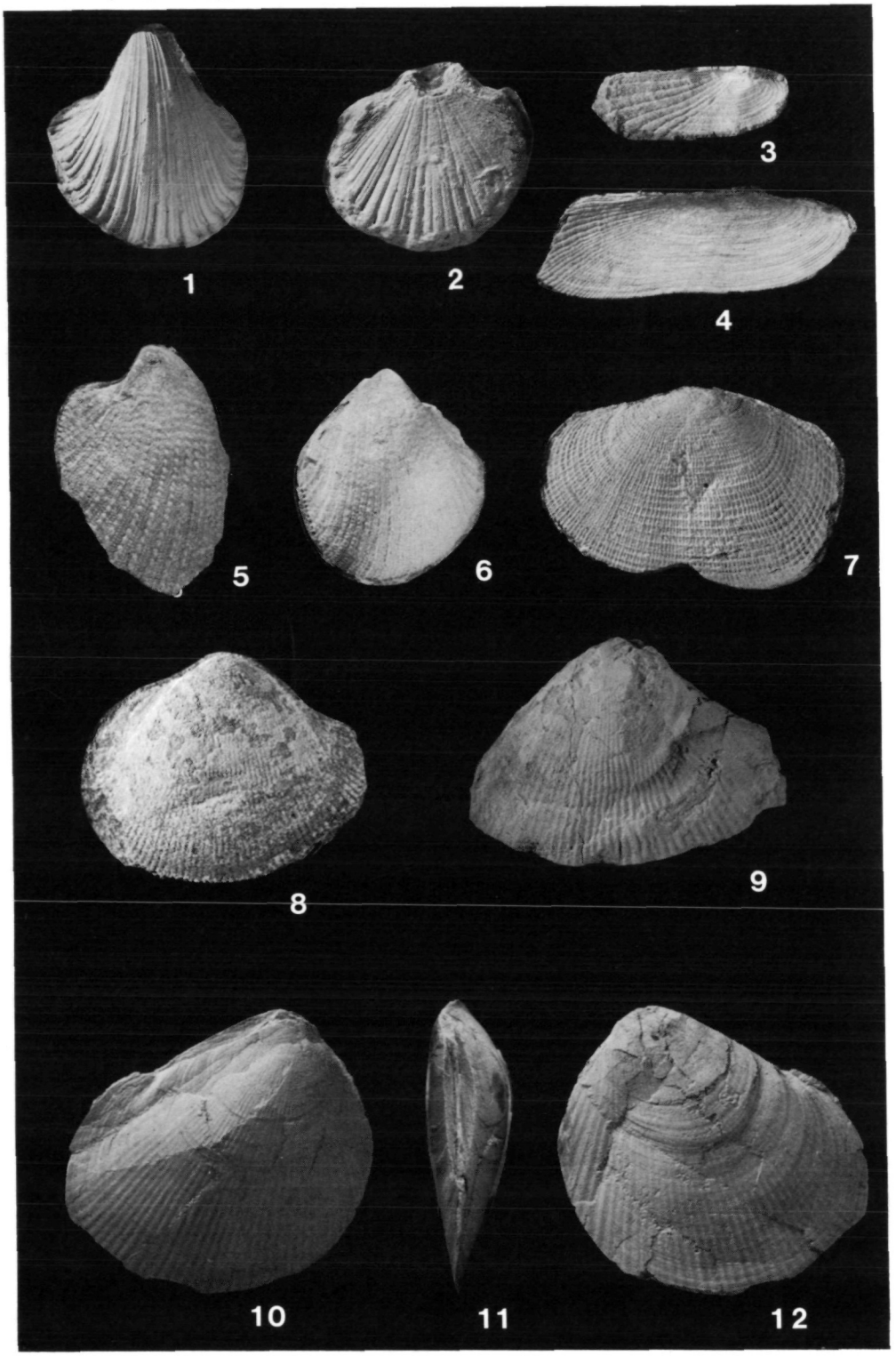
Fig. 7. id., lateral view of preceding specimen, (× 1).

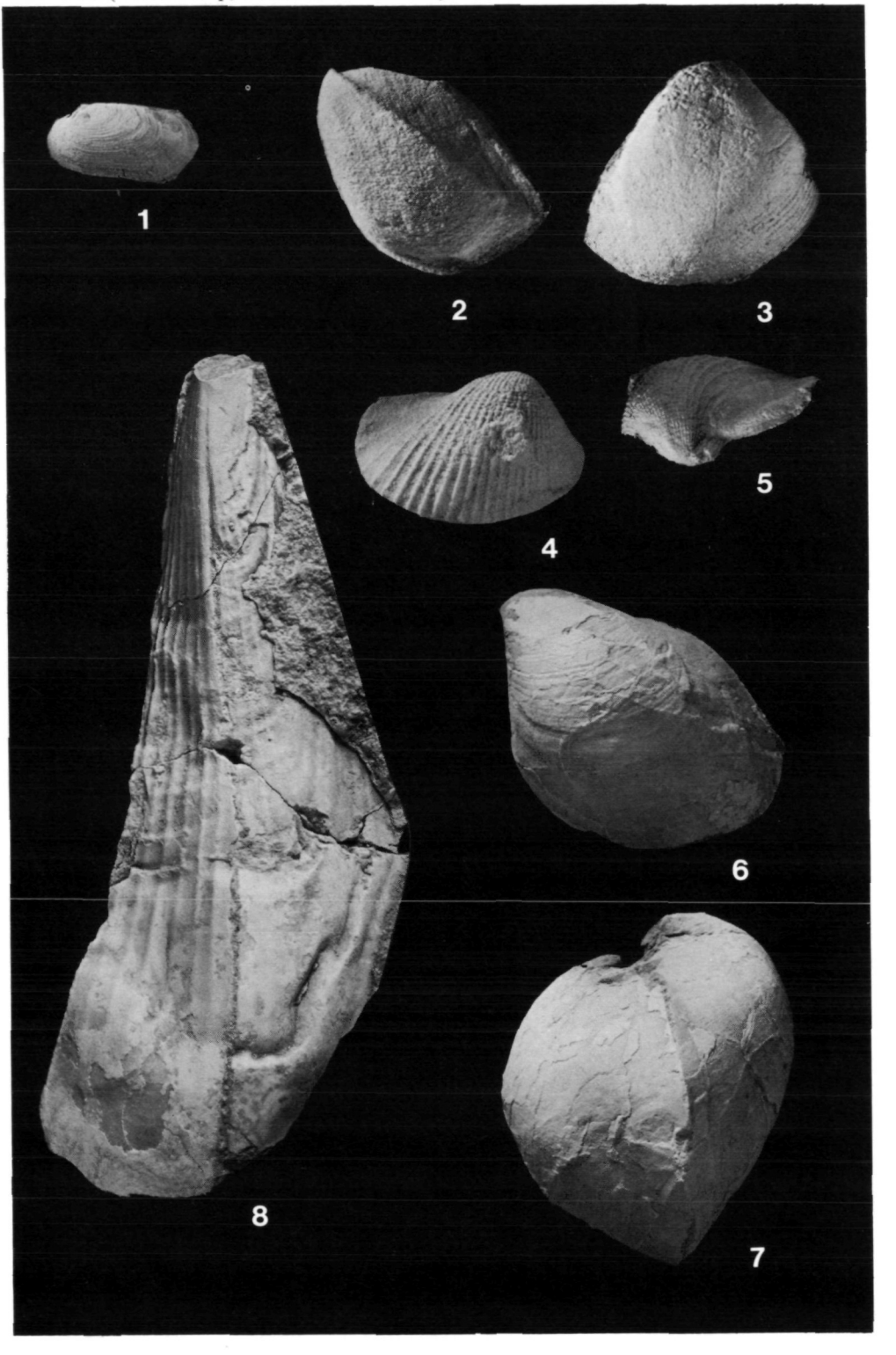
Fig. 8. *Pinna* cf. *cretacea* (SCHLOTHEIM, 1813): partial shell preservation, NHM 1985/43/37, (× 1).











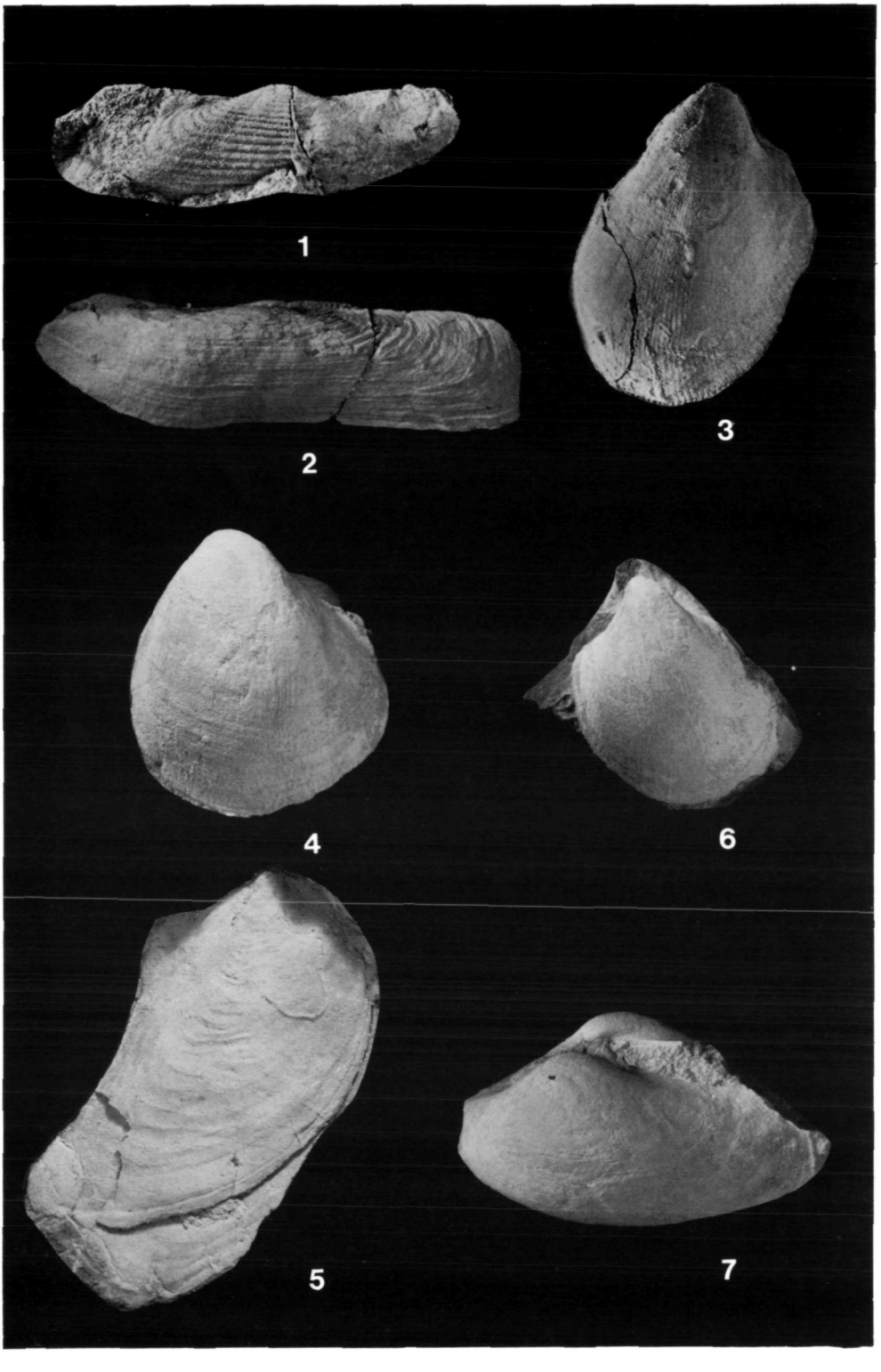


Plate 6

All specimens are from the Hochmoos Fm. (Upper Santonian) at Bibereck, Gosau, Oberösterreich, Austria.

Fig. 1. *Cercomya* ? *producta* (ZITTEL, 1865): left valve, composite mould, NHM 1985/43/38, (× 2).

Fig. 2. ? *Cercomya* ? *producta* (ZITTEL, 1865): right valve, composite mould, NHM 1985/43/39, (× 1).

Fig. 3. *"Cardium"* spec.: steinkern specimen with strong radial ribs, NHM 1985/43/40, (× 1).

Fig. 4. *"Cardium"* spec. or *"Poromya"* spec.: steinkern with shallow radial ribs, NHM 1985/43/41, (× 1).

Fig. 5. *Aguileria* ? *falcata* (ZITTEL, 1865): ? right valve, partial shell preservation, NHM 1985/43/42, (× 1).

Fig. 6. ? *Poromya* s. l. *frequens* (ZITTEL, 1865): left valve, partial steinkern, NHM 1985/43/43, (× 1).

Fig. 7. *Poromya* s. l. *frequens* (ZITTEL, 1865): left valve, NHM 1985/43/44, (× 1).

All specimens are kept in the NHMW except where stated otherwise.