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Non-rudistid bivalves from Late Cretaceous rudist limestones of NE Italy (Col dei Schiosi and Lago di S. Croce areas)

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This paper is dedicated to the memory of Tommaso Antonio Catullo (1782-1869), pioneer in the palaeontological study of the rudist limestones in the Venetian Prealps, and of Karl Futterer (1866-1906), who one century ago commenced the stratigraphical research on the Cretaceous formations of NE Italy.

ABSTRACT - The non-rudistid bivalves from the rudist limestones of the classic Col de Schiosi (Pordenone, western Carnic Prealps, Late Cenomanian) and Lago di S. Croce (Belluno, eastern Venetian Prealps, latest Coniacian-earliest Campanian) localities are studied systematically. Forty three species belonging to thirty genera are described and discussed (fifteen from Col dei Schiosi and twenty nine from the Lago di S. Croce area). The Autobranchia are represented by two mytiloids, three arcoids, three pterioids, eight limoids, and sixteen ostreoids. Palaeoheterodonta are represented by a trigonioid species, Heterodonta by eight veneroid species, and Anomalodesmata by two pholadomyoids. Three new taxa are erected: *Arca bellonii* sp. nov., *Mimachlamys catulloi* sp. nov., and *Neithea* (*N.*) *striatocostata robusta* subsp. nov. Special emphasis is given to the genus *Chondrodonta* Stanton, 1901, which is discussed extensively on the base of abundant material from almost its complete stratigraphical and geographical ranges. New biostratigraphical data are presented to prove the Late Cenomanian age of *Chondrodonta joannae* (Choffat, 1886). *Neithea* (*N.*) *zitteli* (Pirona, 1884) is redescribed on new, good topotypical material from the Upper Cenomanian of Col dei Schiosi. Two taxa from the uppermost Coniacian-lowermost Campanian of the Lago di S. Croce area, originally erected by Catullo, are redefined: for *Spondylus arcuatus* (Catullo, 1834) its holotype is illustrated and its wide variability documented, and for *Fimbria alpaghina* (Catullo, 1827) the lectotype is designated and the species redescribed using well preserved topotypes.

RIASSUNTO - È stato effettuato lo studio sistematico dei Bivalvi (rudiste escluse) che caratterizzano le formazioni calcaree neocretacee a rudiste dell'Italia nord-orientale, con particolare riguardo alle classiche località fossilifere di Col dei Schiosi (Pordenone, Prealpi Carniche occidentali, Cenomaniano superiore) e dei dintorni del Lago di S. Croce (Belluno, Prealpi Venete orientali, Coniaciano sommitale-Campaniano basale). Dopo i fondamentali lavori di Catullo (1827, 1834), Pirona (1884-1887), Futterer (1892, 1896), G. Boehm (1892-1897) e Parona (1908-1926) le associazioni faunistiche dei vari giacimenti non erano più state oggetto di studi particolari. L'occasione di una revisione delle faune a Bivalvi è stata fornita dalla disponibilità di un elevato numero di esemplari in buono stato di conservazione, frutto di raccolte ad opera di alcuni collezionisti. Questo nuovo materiale ha permesso di integrare ampiamente le informazioni desumibili dagli esemplari depositati nei vari musei italiani e stranieri. Le specie descritte e discusse, riferibili a 30 generi, sono 43, di cui 15 rappresentate a Col dei Schiosi e 29 nell'area di Pinei presso il Lago di S. Croce. Tra gli Autobranchia 2 specie appartengono ai mytiloidi, 3 agli arcoidi, 3 agli pterioidi, 8 ai limoidi, 16 agli ostreoidi. I Palaeoheterodonta sono rappresentati da una specie trigonioide, gli Heterodonta da 8 specie veneroidi. Due specie sono state attribuite agli Anomalodesmata pholadomyoidi. Vengono istituiti tre nuovi taxa, tutti provenienti dal giacimento di Pinei: *Arca bellonii* sp. nov., *Mimachlamys catulloi* sp. nov. e *Neithea* (*N.*) *striatocostata robusta* subsp. nov. Particolare attenzione è rivolta al genere *Chondrodonta* Stanton, 1901, che viene ampiamente discusso, anche dal punto di vista paleoecologico, sulla base di abbondante materiale di età albiana e cenomaniana proveniente da varie località italiane ed extraitaliane. Sono inoltre forniti nuovi elementi biostratigrafici per dimostrare l'età neocenomaniana di *Chondrodonta joannae* (Choffat, 1886). Per quanto riguarda il Cenomaniano superiore di Col dei Schiosi è ridescritta *Neithea* (*N.*) *zitteli* (Pirona, 1884) con l'ausilio di nuovo materiale topotipico. Sono inoltre ridefiniti due taxa del Coniaciano sommitale-Campaniano basale dei dintorni del Lago di S. Croce eretti da Catullo: di *Fimbria alpaghina* (Catullo, 1827), che è ridescritta mediante topotipi ben conservati, viene designato il lectotipo; di *Spondylus arcuatus* (Catullo, 1834) viene illustrato l'olotipo e viene documentata l'ampia variabilità.

K e y w o r d s: Bivalves (Mollusca), Late Cretaceous, NE Italy, rudist limestones, taxonomy, biostratigraphy, palaeoecology.

INTRODUCTION

The Cretaceous rudist limestones outcropping in the Col dei Schiosi (Pordenone, western Carnic Prealps) and Lago di S. Croce (Belluno, eastern Venetian Prealps) areas form a distinct feature in the landscape. Their fossil content (especially the rudists and nerineids) has been known since the first description of the fossils from the Lago di S. Croce localities made by Catullo (1827, 1834). After Catullo many scientists collected palaeontological material in the region; for example Ewald (1851), after an excursion in NE Italy, presented a series of Cretaceous fossils to the Berlin Museum. In the second half of the last century and at the turn of the century Austrian (Redlich, 1899, 1901; Hoernes, 1902; Schubert, 1903, 1912), German (G. Boehm, 1885, 1887, 1892, 1895, 1897, 1898; Futterer, 1892, 1896; Oppenheim, 1899), and Italian (Pirona, 1877, 1884, 1886, 1887; Marinelli, 1897, 1902; Longhi, 1902, 1903; Parona, 1908a, 1908b, 1911) geologists and palaeontologists all did fieldwork and published on the Cretaceous formations of Col dei Schiosi, of the Lago di S. Croce localities and also of other areas in Friuli, of the Gorizia and Trieste Karst and of Istria.

Some of them at first considered the Col dei Schiosi and Lago di S. Croce macrofaunas as more or less coeval, but progressively, especially after studying the rudists (Parona 1908b, 1926), a Turonian age for Col dei Schiosi and a "Senonian" age for the Lago di S. Croce faunas were generally accepted. Later it became obvious that the Cenomanian Col dei Schiosi fauna [formerly often considered as Turonian; this changed when the Cenomanian/Turonian boundary was, by international consensus (Copenaghen meeting on Cretaceous stratigraphy: Birkelund *et al.*, 1984) placed higher than previously] was widely distributed and taken as reference for biostratigraphic and chronostratigraphic correlations (such as "Schiosischichten" in Hoernes, 1902) in many areas of Italy, of Istria and Dalmatia (Pleničar, 1960, 1967; Polšak, 1967; Gušić and Jelaska, 1990). On the other hand the younger faunas of the Lago di S. Croce area are geographically much more restricted.

Almost no macropalaeontological research was undertaken in the Col dei Schiosi and Lago di S. Croce areas in the last 50 years. The occasion of the present paper arose when two new interesting collections were brought to the attention of I. D. The non-rudist bivalves from these and from other mainly Italian collections (among which the important Catullo collection housed in Padova University) are described and figured here. The purpose has been to update the taxonomic data existing in literature for the famous Col dei Schiosi and Lago di S. Croce faunas. Some interesting species are also interpreted from a palaeoecological point of view.

GEOLOGICAL AND STRATIGRAPHICAL SETTING (In collaboration with Dario SARTORIO*)

The fossil faunas from the Col dei Schiosi (Pordenone, western Carnic Prealps) and Pinei (Lago di S. Croce, Belluno, eastern Venetian Prealps) areas belong to two carbonate sequences of different age connected with the northwestern margin of the Friuli Platform.

The *Col dei Schiosi* fauna belongs to the Cretaceous sequence outcropping in the eastern part of the Altopiano del Cansiglio. The fossiliferous beds of Col dei Schiosi have been well known since the last century and were frequently studied (e.g. Taramelli, 1873, 1877, 1881; Pirona, 1877, 1884, 1886, 1887; G. Boehm, 1885, 1887, 1892, 1895; Futterer, 1892; Parona, 1908a, 1908b; Dainelli, 1911).

The famous fossiliferous locality is situated near "Casère S-ciòs", about 1350 m a.s.l., within the area designated with the "Col dei Scios" toponym in the recent official topographic map (I.G.M. Sheet 23, II S.E., Bosco del Cansiglio); its U.T.M. co-ordinates are 33TUM024031 (Text-fig. 1). Although the correct spelling of the site is "Col dei S-ciòs" (meaning "Hill of the snails" in the local dialect, because of the great abundance of fossils) we prefer to continue to use the Italianised name "Col dei Schiosi", as found in palaeontological literature since the last century. It must be pointed out that this toponym is not to be confused with the very similar "Col Sciosi" toponym, designating a hill located about 5.5 km SW of the classic fossiliferous locality, in an area almost devoid of fossils (see also Ferasin, 1958, footnote on pp. 9, 10).

The Col dei Schiosi fauna is especially important for its nerineid assemblage. Many fossils belonging to other groups considered in literature as typical for Col dei Schiosi, including the well known caprinid fauna (Parona, 1908a), come in reality from other outcrops in the vicinity (Dal Piaz, 1911, p. 430).

The Col dei Schiosi Limestone (Dal Piaz and Trevisan, 1956) is the lithostratigraphic unit including all these fossiliferous horizons. From a palaeontological point of view the formation is essentially characterised by corals, rudists and other bivalves, gastropods and foraminifera, most of them indicative of an open platform environment.

The Col dei Schiosi Limestone consists mainly of biointraclastic limestones, rudstones and grainstones and was deposited in a high energy environment. Indeed, many fossils show evidence of mechanical processes, including breakage, abrasion and shell orientation and the limestones consist almost entirely of rudist fragments, mainly from radiolitids. From a sedimentological point of view many horizons are characterized by depositional patterns suggesting hydraulic regimes typical for storm or hurricane episodes.

The rudist and nerineid faunas from the Col dei Schiosi Limestone, previously often referred to the Turonian, have been thought recently to be indicative of a Late Cenomanian age. They allow correlation with similar assemblages from central Italy (e.g. Carbone *et al.*, 1972; Praturlon and Sirna, 1977) and Croatia (Polšak, 1967).

The micropalaeontological association of the Col dei Schiosi Limestone includes *Orbitolina* (*Conicorbitolina*) *conica* d'Archiac, 1837 (see Cousin, 1981 and Sartorio, 1989); this suggests that the age of this unit cannot be younger than the "Middle" Cenomanian as defined by ammonites (Arnaud *et al.*, 1981).

The fossil faunas of *Pinei-Fadalto* (*Lago di S. Croce* area) belong to the Cretaceous sequence outcropping west of the Altopiano del Cansiglio. They were discussed by many authors (e.g. Catullo, 1827, 1834, 1842; de Zigno, 1850; Taramelli, 1881, 1882, 1883; Futterer, 1892; G. Boehm, 1885, 1895, 1898; Longhi, 1902, 1903; Parona, 1908b; Dainelli, 1911).

The fossils occur within resedimented limestones which were derived from the edge of the Friuli Platform and accumulated as tabular lithosomes in the pelagic sequence (Scaglia formation) of the adjacent Belluno Trough.

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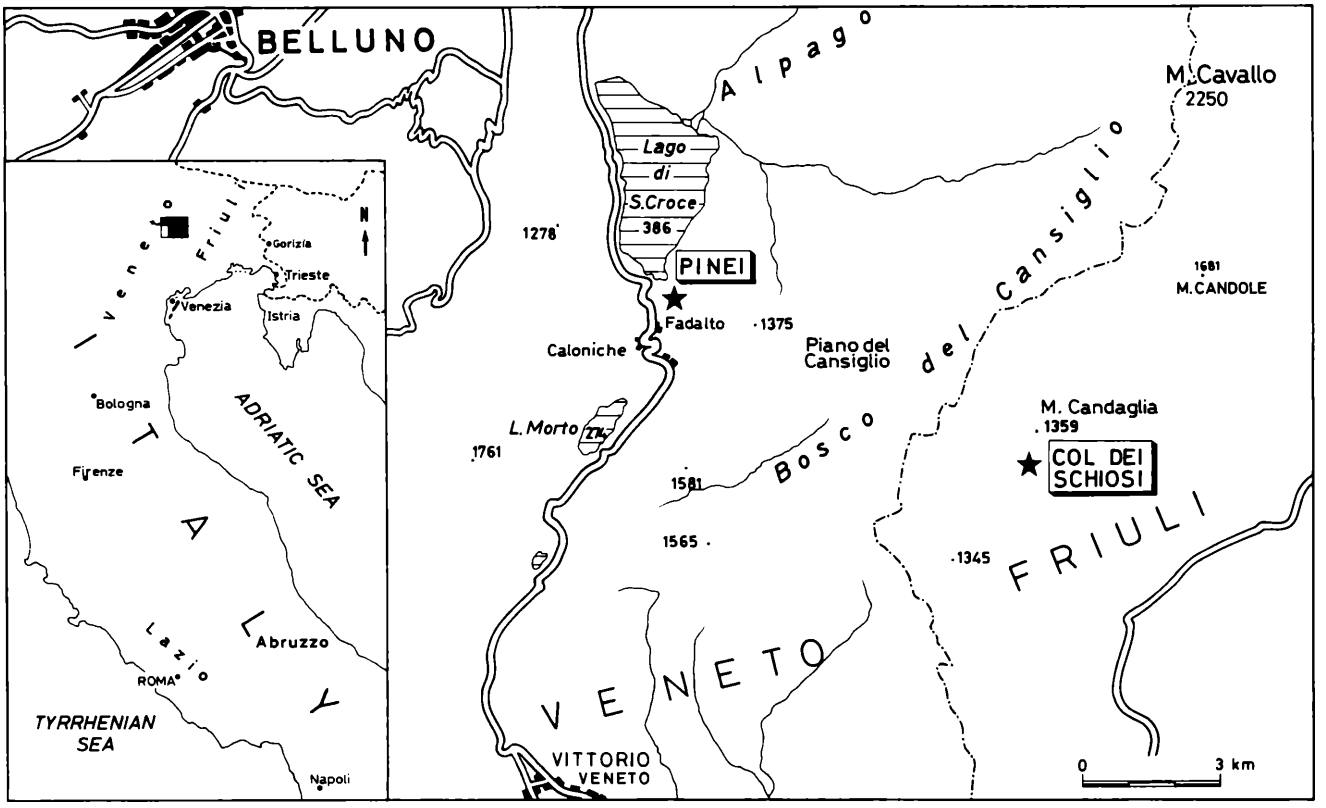


Text-fig. 1 - Sketch map with the localities at which the studied bivalves were collected.

The Fadalto Limestone (Ghetti and Cancian, 1989; Costa *et al.*, in press) is the stratigraphic unit that contains all these resedimented bodies. This new lithostratigraphic name has replaced that of Calloneghe Limestone previously introduced by Dal Piaz and Trevisan (1956). The lower part of this unit can be referred to the latest Albian-"Middle" Cenomanian interval, but the major part belongs to the "Senonian".

The resedimented lithosomes are composed of bio-intraclastic limestones, mainly grainstones and rudstones, consisting almost exclusively of well rounded molluscan grains with very abundant radiolitid fragments. Many fossils show the effect of mechanical processes typical of high energy environment, such as breakage, rounding and abrasion. This suggests that in the original platform environment many of the shells were subjected to reworking episodes.

The palaeontological assemblages of the Fadalto Limestone include bivalves, gastropods, corals, bryozoans and other organisms, characteristic of open carbonate platform environments. Rudists, especially radiolitids and hippuritids, and actaeonellid gastropods are the most typical fossils.

The faunas described for the Lago di S. Croce area come from two distinct localities: Pinei and Caloniche.

The first locality, known as "Pinè" or "Monte Pignè", very probably corresponds to Pinei of the recent topographical map (I.G.M. Sheet 23, II N.E., Puos d'Alpago), used herein. This locality (U.T.M. co-ordinates: 33TTM953072) is connected with the steep escarpment that overhangs the Fadalto area and the Lago Morto Valley west of the Altopiano del Cansiglio (Text-fig. 1).

The Fadalto Limestone is well exposed along this escarpment. At the top of the lithostratigraphic unit three main lenticular sedimentary bodies can be observed. They are interpreted as reef mounds (see Bosellini, 1991, fig. 7.21 on p. 177). We assume that the palaeontological material described in literature largely comes from the debris accumulated at the base of this cliff. The bulk of the fossils described from the Lago di S. Croce area in this paper comes from Pinei (Text-fig. 1).

The Fadalto Limestone is also well exposed in a limited area in the opposite side of the valley, corresponding to the morphological high of "Calloneghe" (= "Calloniche", or Caloniche as in the latest official topographical map). Nearby the second fossiliferous locality of the Fadalto Limestone is situated in an old quarry at "Calloneghe". It is mainly significant for actaeonellids (Futterer, 1892; Ferasin, 1958, p. 30).

The problems concerning the origin of the faunas described from the Lago di S. Croce area have been discussed already by Parona (1908b, p. 140). We have also noticed that specimens which Futterer (1892) said to come from "Calloniche" [such as the originals of *Lima* (*Acesta*) *subclypeiformis* and *Inoceramus cripsii*] bear older labels (in Catullo's handwriting) stating them to be from "Pinè". Thus it is often difficult to know from which precise locality actually come specimens described in literature as being from "Calloneghe".

The rudists described from the Fadalto area *s.s.* are in general indicative of an early "Senonian" age, but they are in need of revision. The rudists from "Calloneghe", in particular some specimens belonging to the *Vaccinites giganteus* (D'Hombre Firmas, 1838) group, suggest a Santonian age (see G. Boehm, 1895; Toucas, 1903-1904; Parona, 1908b). Planktic foraminifera (studied by D. S.) have been found in the Scaglia formation underlying and overlying the Fadalto Limestone at Caloniche. Those from the underlying "Scaglia bianca" indicate a Coniacian age and those from the overlying "Scaglia grigia" the *Globotruncanita elevata* Zone, which suggests an Early Campanian age. Therefore the "Calloneghe" fauna be-

longs to a chronostratigraphic interval ranging from the uppermost Coniacian to the lowermost Campanian.

Also the Fadalto Limestone exposed along the cliff above the Pinei area is overlain by Scaglia of Campanian-Maastrichtian age (Ferasin, 1958). This age assignment has been confirmed recently by new investigations carried out (by D. S.) in the Scaglia outcropping at the top of the cliff. The planktic foraminifera present at the base of the Scaglia immediately above the Fadalto Limestone indicate the *Globotruncanita elevata* and *Globotruncana ventricosa* Zones, suggesting an Early and middle Campanian age.

Thus most of the fossil faunas from the Fadalto Limestone of the Lago di S. Croce area are Santonian, but may range from the latest Coniacian to the earliest Campanian. This age assignment agrees well with the results obtained by Parona (1908b) and Dainelli (1911) through analysis of the rudist associations.

NON-RUDISTID BIVALVE FAUNAS FROM COL DEI SCHIOSI AND PINEI

The preliminary identification lists of the non-rudistid bivalves from Col dei Schiosi and the Lago di S. Croce areas (Dhondt and Dieni, 1991, 1992) are updated as follow:

Col dei Schiosi

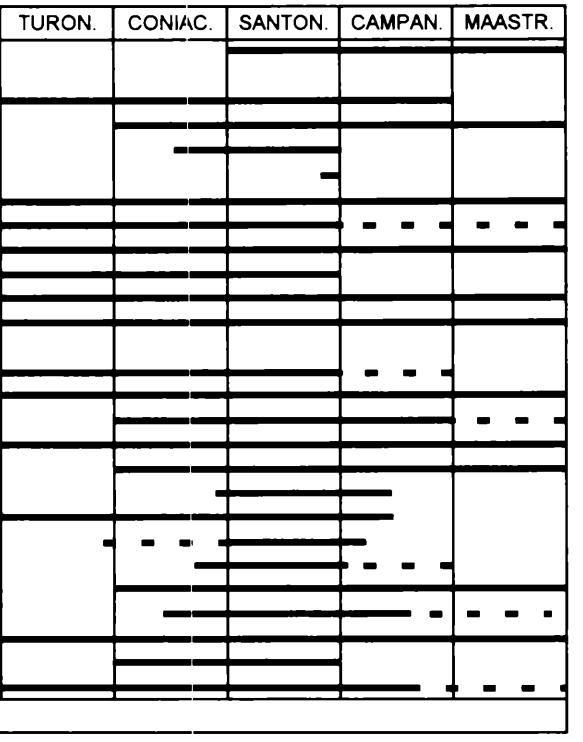
Botuloides intermedius (d'Orbigny, 1845)
Ctenoides tectus (Goldfuss, 1835)
Limaria elongata (J. de C. Sowerby, 1827)
Plagiostoma asperum Mantell, 1822
Lyriochlamys ternata (Münster in Goldfuss, 1833)
Chlamys? subacuta (Lamarck, 1819)
Neithea (*Neithea*) *aequicostata* (Lamarck, 1819)
Neithea (*Neithea?*) *fleuriausiana* (d'Orbigny, 1847)
Neithea (*Neithea?*) *inconstans* (Sharpe, 1850)
Neithea (*Neithea*) *zitteli* (Pirona, 1884)
Chondrodonta joannae (Choffat, 1886)
Pterotrigonia (*Scabrotrigonia*) *scabra* (Lamarck, 1819)
"Lucina" cf. *tenera* (J. de C. Sowerby, 1836)
Ludbrookia cf. *cottalaina* (d'Orbigny, 1844)
Icanotia impar (Zittel, 1865).

Pinei

* *Lithophaga alpina* (Zittel, 1866)
Arca bellonii sp. nov.
* *Cucullaea* (*Idonearca*) *matheroniana* (d'Orbigny, 1845)
* *Glycymeris* (*Glycymerita*) *marrotiana* (d'Orbigny, 1844)
* *Phelopteria* cf. *caudigera* (Zittel, 1866)
* *Inoceramus* (*Cordiceramus*) ex gr. *muelleri* Petrascheck, 1906
Inoceramus sp. cf. *I. pseudoregularis* Sornay, 1962
Ctenoides tectus (Goldfuss, 1835)
Limaria echinata (Etheridge, 1881)
Limatula sp.
Limea (*Pseudolimea*) *granulata* (Nilsson, 1827)
* *Plagiostoma hoernesi* (Zittel, 1866)
Plagiostoma hoperi Mantell, 1822
* *Camptonectes virgatus* (Nilsson, 1827)
Mimachlamys catulloi sp. nov.
Neithea (*Neithea*) *dutrugei* (Coquand, 1862)
Neithea (*Neithea*) *quinquecostata* (J. Sowerby, 1814)
Neithea (*Neithea*) *sexangularis* (d'Orbigny, 1847)
Neithea (*Neithea*) *sexcostata* (Woodward, 1833)
Neithea (*Neithea*) *striatocostata robusta* subsp. nov.
Spondylus arcuatus (Catullo, 1834)
* *Spondylus requienianus* Matheron, 1843
Fimbria alpaghina (Catullo, 1827)

Table 1 - Faunal affinities of the Pinei association and stratigraphical distribution of the taxa

Localities:	1	2	3	4	5	6	7
Lithophaga alpina	+	+					
Arca bellonii	+						
Cucullaea matheroniana	+	+		+	+		
Glycymeris marrotiana	+	+				+	+
Phelopteria caudigera	+		+	?			
Inoceramus muelleri	+	+					
Ctenoides tectus	+			+		+	
Limaria echinata	+						
Limea granulata	+			+		+	+
Plagiostoma hoernesi	+		+				
Plagiostoma hoperi	+			+		+	
Camptonectes virgatus	+	+		+	+		+
Mimachlamys catulloi	+						
Neithea dutrugei	+						
Neithea quinquecostata	+						+
Neithea sexangularis	+					+	
Neithea sexcostata	+			+	+	+	
Neithea striatocostata	+					+	
Spondylus arcuatus	+						
Spondylus requienianus	+	+			+		
Fimbria alpaghina	+						
Myoconcha dilatata	+		+				
Cyclocardia? ottonis	+	+		?			
Crassatella macrodonta	+	+		?			
Granocardium productum	+	+		+	+	+	
Pachymya? frequens	+	+		?			?
Platymyoidea? royana	+	+				+	
	27	*11*	*3*	*11*	*5*	*9*	*5*



1 = Lago di S. Croce (Pinei) (latest Coniacian-earliest Campanian) - 2 = Gosau: Santonian outcrops - 3 = Gosau: Strobl Weissenbach (Coniacian) - 4 = Aachen: Early Campanian - 5 = SE France: Turonian-Santonian - 6 = SW France: Santonian-Campanian - 7 = Vendée: Santonian-Early Campanian.

* *Myoconcha* (*Modiolina*) *dilatata* Zittel, 1865
* *Cyclocardia*? cf. *ottonis* (Geinitz, 1843)
* *Crassatella macrodonta* (J. de C. Sowerby, 1832)
* *Granocardium productum* (J. de C. Sowerby, 1832)
* *Pachymya*? *frequens* (Zittel, 1865)
* *Platymyoidea*? cf. *royana* (d'Orbigny, 1845).

(Asterisks indicate species recorded from the "Gosau" in Austria; see below).

AGE AND AFFINITIES OF THE FAUNAS

Chondrodonta joannae (Choffat) can be considered as a good marker of the Col dei Schiosi association, because elsewhere (see below, p. 219) this species has been dated by macroforaminifera and rudists as being of Late (but not latest) Cenomanian age. *Neithea* (*N.*?) *fleuriausiana* (d'Orbigny) and *N.* (*N.*?) *inconstans* (Sharpe), which very often accompany *Chondrodonta joannae* in the rudist facies, are also probably indicative of the same restricted age.

The studied Col de Schiosi non-rudistid bivalve fauna contains 15 species and shows strong affinities with other rudist-associated faunas known from the Tethys. *Neithea* (*N.*?) *fleuriausiana* (d'Orbigny), *N.* (*N.*?) *inconstans* (Sharpe), *N.* (*N.*) *zitteli* (Pirona) and *Chondrodonta joannae* (Choffat) are typical of this distribution (see also Text-figs 5, 17).

On the other hand *Botuloides intermedius* (d'Orbigny), *Ctenoides tectus* (Goldfuss), *Limaria elongata* (J. de C. Sowerby), *Lyriochlamys ternata* (Münster in Goldfuss), *Chlamys*? *subacuta* (Lamarck), *Neithea* (*N.*) *aequicostata* (Lamarck), *Pterotrigonia* (*Scabrotrigonia*) *scabra* (Lamarck), *Ludbrookia cottaldina* (d'Orbigny) and *Icanotia impar* (Zittel) are species which are known from the temperate province and especially from Late Cenomanian strata in the Sarthe (France) and southern England, which are generally coarse-grained and represent littoral environments.

The Pinei fauna, as stated above, can be dated as latest Coniacian-earliest Campanian.

Among the twenty nine specific taxa recognised three are new, one is in open nomenclature, two [*Spondylus arcuatus* (Catullo) and *Fimbria alpaghina* (Catullo)] are restricted to the rudist limestones of Italy.

Of the remaining twenty three species, fourteen (marked with an asterisk in the faunal list) have been recorded from the "Gosau" in Austria. The Gosau Group *s.s.* contains faunas of varying ages (Summesberger, 1985), but the fourteen taxa common between Pinei and the Gosau indicate no precise age (Table 1): three species [*Phelopteria caudigera* (Zittel), *Plagiostoma hoernesi* (Zittel), *Myoconcha* (*Modiolina*) *dilatata* Zittel] are originally described from mainly Coniacian beds at Strobl-Weissenbach, while the others are of Santonian or even Late Santonian age (see also Dhondt, 1987 for taxa from the Late Santonian Hochmoos Schichten).

The Pinei bivalve fauna has also five species in common with the Turonian-Santonian faunas from SE France [*Cucullaea* (*Idonearca*) *matheroniana* (d'Orbigny), *Camptonectes virgatus* (Nilsson), *Neithea* (*N.*) *sexcostata* (Woodward), *Spondylus requienianus* Matheron, *Granocardium productum* (J. de C. Sowerby)] and nine with the Santonian-Campanian faunas from SW France [*Glycymeris* (*Glycymerita*) *marrotiana* (d'Orbigny), *Ctenoides tectus* (Goldfuss), *Limea* (*Pseudolimea*) *granulata* (Nilsson), *Plagiostoma hoperi* Mantell, *Neithea* (*N.*) *sexangularis* (d'Orbigny), *Neithea* (*N.*) *sexcostata* (Woodward), *Neithea* (*N.*) *striatocostata* (Goldfuss), *Granocardium productum* (J. de C. Sowerby), *Platymyoidea royana* (d'Orbigny)].

The Early Campanian faunas from near Aachen described by Holzapfel (1889) contain not less than eleven taxa in common with Pinei [*Cucullaea* (*Idonearca*) *matheroniana* (d'Orbigny), (?) *Phelopteria caudigera* (Zittel), *Ctenoides tectus* (Goldfuss), *Limea* (*Pseudolimea*) *granulata* (Nilsson), *Plagiostoma hoperi* Mantell, *Camptonectes virgatus* (Nilsson), *Neithea* (*N.*) *sexcostata* (Woodward), (?) *Cyclocardia*? *ottonis* (Geinitz), (?) *Crassatella macrodonta* (J. de C. Sowerby), *Granocardium productum* (J. de C. Sowerby), (?) *Pachymya*? *frequens* (Zittel)].

From the Vendée, Formation du Soullandeau, from the beds with rudists Freneix (in Freneix and Viaud, 1985) presented an assemblage which is comparable with that of Pinei but not all the species are identical [after reinterpretation the following taxa can be considered as being also present in the Vendée: *Glycymeris* (*Glycymerita*) *marrotiana* (d'Orbigny), *Limea* (*Pseudolimea*) *granulata* (Nilsson), *Camptonectes virgatus* (Nilsson), *Neithea* (*N.*) *quinquecostata* (J. Sowerby), (?) *Pachymya*? *frequens* (Zittel)].

All these examples confirm once more that the fauna of Pinei lived in a very shallow warm environment and contains mainly species characteristic of coarse-grained bioclastic substrates.

SYSTEMATIC DESCRIPTIONS

The non-rudistid bivalves from the Col dei Schiosi and Pinei areas have herein generally been classified according to Moore (1969, 1971). For the Pteriomorphia the classification used follows that proposed by Waller (1978).

Abbreviations used:

H: height (distance between two planes parallel to cardinal axis and perpendicular to plane of commissure which just touch most dorsal and ventral parts of shell; Cox in Moore, 1969).
L: length (antero-posterior distance of the valves; Cox in Moore, 1969).
B: breadth (distance between two planes parallel to plane of commissure and touching outermost parts of two valves; = "inflation" according to Cox in Moore, 1969).
B': breadth of a single valve (distance between plane of commissure and a parallel plane touching the point of maximum convexity of the valve).
UA: umbonal angle.
F: fold number.
R: rib number.

Museum acronyms used for the studied material are as follows:

DGP: Museo del Dipartimento di Geologia, Paleontologia e Geofisica dell'Università, Padova.
FrB: Sammlung des Geologischen Institutes der Albert-Ludwigs-Universität, Freiburg im Breisgau.
GBAW: Geologische Bundesanstalt, Wien.
IGF: Museo di Geologia e Paleontologia dell'Università, Firenze.
IRSNB: Department of Palaeontology, Institut royal des Sciences naturelles de Belgique, Bruxelles.
MAFI: Magyar Állami Földtani Intézet, Budapest.

MB: Museum für Paläontologie, Museum für Naturkunde, Berlin.
MFU: Museo Friulano di Storia Naturale, Udine.
MGB: Museo di Geologia e Paleontologia "Giovanni Capellini" dell'Università, Bologna.
MPUR: Museo di Paleontologia dell'Università "La Sapienza", Roma.
MSP: Museo delle Scienze, Pordenone.
MSNT: Museo Civico di Storia Naturale, Trieste.
MTO: Museo del Dipartimento di Scienze della Terra dell'Università, Torino.
UNAM: Instituto de Geología, Universidad Nacional Autónoma de México, Mexico, D.F.
USNM: United States National Museum, Smithsonian Institution, Washington D. C.

The studied specimens indicated with numbers preceded by B refer to material collected by A. Belloni, which will be housed in the Museo del Dipartimento di Geologia, Paleontologia e Geofisica dell'Università, Padova; the specimens indicated with numbers preceded by P belong to the collection G. Palatini, which is deposited in the same museum together with the figured specimens of the Belloni collection.

Palaeogeographical distributions of some significant species are shown on maps in text-figures. The maps are based on Barron *et al.* (1981): 100 Ma for the Cenomanian (Col dei Schiosi) and 80 Ma for the Santonian-Early Campanian interval (Pinei). The maps have been chosen in accordance with the age of the studied specimens from NE Italy; in some instances they also include records from other areas which fall outside the considered time interval.

In the annotated synonymy lists the signs introduced by Richter (1948) and re-proposed by Matthews (1973) have been adopted.

Cl. BIVALVIA Linné, 1758
Subcl. AUTOBRANCHIA Grobben, 1894
Ord. MYTILOIDA Férussac, 1822
Superfam. MYTILACEA Rafinesque, 1815
Fam. MYTILIDAE Rafinesque, 1815

Botuloides intermedius (d'Orbigny, 1845)
Pl. I, figs 1-5; Pl. XVIII, fig. 1.

v + 1845 *Lithodomus intermedius*, d'Orbigny - d'Orbigny, p. 296, pl. 345, figs 9, 10.
. 1895 *Lithodomus avellana* d'Orbigny - G. Boehm, p. 98, pl. 8, figs 9, 10 (*non* d'Orbigny, 1845).
? 1898 *Lithodomus avellana* d'Orb. - De Angelis d'Ossat, p. 284.
? 1901 *Lithodomus avellana* D'Orb. - Redlich, p. 82.
? 1908 *Lithodomus intermedius* d'Orb. - Parona, p. 301.
1932 *Lithodomus* sp. - Parona, p. 99.
. 1932 *Lithodomus Boehmi* n. f. - Parona, p. 99.
. 1960b *Botuloides intermedius* (d'Orbigny) - Freneix, p. 202.
. 1976 *Lithophaga intermedia* (Orbigny) - Pojarkowa, p. 94, pl. 48, figs 4, 5.

Material: Fourteen bivalved specimens (B37-47, B184, DGP 26726) from Col dei Schiosi, of which one (B184) is preserved inside a nerineid shell and two (DGP 26726) inside a very thick right valve of *Chondrodonta joannae* (Choffat, 1886) (Pl. XVIII, fig.1).

Description: The valves are very convex and the breadth of the bivalved specimens is nearly equal to the height. The umbones are placed almost completely anteriorly. Ornamentation is restricted to growth lines on the thin shell. Some more strongly developed lines indicate growth interruptions.

Dimensions (mm):

	H	L	B	H/L	B/H
B43	14.6	20.9	12.4	0.70	0.85
B41	18.7	31.5	18.5	0.59	0.99
B37	19.8	33.6	18.9	0.59	0.95
B38	19.9	33.6	(20.0)	0.59	(1.00)
B39	19.9	(33.5)	18.2	(0.59)	0.91
B40	(22.0)	—	21.3	—	0.97
B42	24.0	30.2	18.8	0.79	0.78

Discussion: The figures of *Lithodomus intermedius* in the *Paléontologie française* (d'Orbigny, 1845) do not agree totally with the type specimens from the collections of the Muséum national d'Histoire naturelle in Paris. The specimens from the Campanian of Royan in the d'Orbigny collection agree well with those from Col dei Schiosi.

Many taxa from Lower and "Middle" Cretaceous literature have been referred to the genera *Lithodomus/Lithophaga*, but none of them seem to have the same proportions as *Lithodomus intermedius* d'Orbigny. Among Cenomanian species for instance *Lithodomus suborbicularis* d'Orbigny, 1845 is more rounded, and *Lithodomus carantonensis* d'Orbigny, 1845 is more elongate.

The shape of the specimens from Col dei Schiosi is close to that of *Lithodomus avellana* d'Orbigny, 1845, from the Barremian (Urgonian) of Orgon (SE France). Judging from the original figures of *L. avellana*, this taxon is, however, a little less elongate than *L. intermedius*.

Also the specimens from Col dei Schiosi identified as *Lithodomus avellana* by Boehm (1895) and renamed *Lithodomus boehmi* by Parona (1932) belong to *L. intermedius*.

Lithodomus tumidula (*sic*) Stoliczka, 1871 from the Ariyalur Group (Upper Cretaceous of India) is shorter than the specimens from Col dei Schiosi.

Lithophaga alpina (Zittel, 1866, p. 87, pl. 12, figs 11 a-c), from the Gosau in Oberösterreich (Santonian) and from near Vienna (Maastrichtian), is smaller and more elongate (see below).

Lithodomus suborbicularis d'Orbigny, 1845 (named *L. orbiculatus* on p. 293, but *L. suborbicularis* on pl. 345, figs 4-8; this latter name was confirmed in d'Orbigny, 1850), from the Cenomanian rudist banks at the Ile d'Aix (W. France), is proportionally more inflated and shorter than the coeval specimens from Col dei Schiosi.

Freneix (1960b) erected the genus *Botuloides* with *Lithodomus suborbicularis* d'Orbigny, 1845 as type species. The *Zoological Record*, Soot-Ryen in Moore (1969) and Kleemann (1983) forgot to mention this genus. Its definition makes it applicable for the species discussed here.

Distribution: Cenomanian to Campanian, in rudist associated faunas from SW France, NE Italy (western Carnic Prealps and Trieste Karst), central Italy (Latium), Croatia (Istria), Uzbekistan (Fergana and Tashkent provinces).

Lithophaga alpina (Zittel, 1866)
Pl. I, figs 6a-7b.

+ 1866 *Lithodomus alpinus* Zitt. - Zittel, p. 87, pl. 12, figs 11a-c.
v . 1902 *Lithophagus alpinus*, Zitt. - Pálfy, p. 281, pl. 20, fig. 9.

1983 *Lithophaga alpina* Zittel - Kleemann, p. 2.
v . 1992 *Lithophaga* sp. - Dhondt, Dieni, p. 214.

Material: Four specimens found free (B231-234) and many (B235) fossilised inside a small colony of *Actinastraea elongata* Alloiteau, 1954 (det. by H. Eliášová), from Pinei, Lago di S. Croce.

Dimensions (mm):

	H	L	B	B'	H/L	B/H
B233	5.00	10.60	(5.04)	—	0.47	1.01
B231	5.03	9.43	—	2.39	0.53	—
B232	5.91	10.43	4.78	—	0.57	0.81

Discussion: The specimens from Pinei agree well with figs 11a and 11c in Zittel (1866). The dimensions given by this author on p. 87 probably refer to the original specimen of fig. 11b, but definitely not to figs 11a and 11c.

Boring molluscs have few characteristics and are mainly identified by their shape. The substrate in which they live may assest the determination.

The specimens of *L. alpina* from Pinei, those from the Gosau beds and those from Alvinc (Romania) were boring into coral colonies.

From the Cenomanian at Le Mans d'Orbigny (1845) described two *Lithophaga* species, *L. aequalis* and *L. rugosa*; the latter was also found inside corals. Proportionally *L. alpina* is less inflated than *L. aequalis* and shorter than *L. rugosa*.

Very close is *L. subcylindrica* (Stoliczka, 1871, non Buvignier, 1852), from the Cenomanian Utatur Formation of India, which seems on average more elongate than *L. alpina*.

Lithodomus gauthieri Péron and Fourtau in Fourtau (1940) from the Santonian of Abu Roach, Egypt, is comparable but more elongate than *Lithophaga alpina*.

As far as we know the variability of Cretaceous *Lithophaga* species has not been studied. Our material does not allow us to draw decisions in this matter. Therefore, we have been obliged to use the old names, but we are aware of the fact that very likely they only represent morphospecies.

Distribution: Found boring into coral colonies; recorded from Santonian to Maastrichtian in Austria; uppermost Coniacian-lowermost Campanian of eastern Venetian Prealps, NE Italy; Santonian-Lower Campanian of Romania.

Ord. ARCOIDA Stoliczka, 1871
Superfam. ARCACEA Lamarck, 1809
Fam. ARCIDAE Lamarck, 1809

Arca bellonii sp. nov.
Pl. I, figs 8-11.

v . 1895 *Arca* sp. - G. Boehm, p. 137, pl. 14, figs 1a, b.

Material: Six right valves [FrB 530 (= *Arca* sp. in Boehm, 1895), B75, B80-82, P19)] and one left valve (B104) from Pinei, Lago di S. Croce. Some specimens are almost complete and others are more or less decorticated.

Holotype: Specimen B81 (right valve); Pl. I, figs 9a, 9b.

Paratypes: Specimens FrB 530, B80, B104 and P19.

Type locality: Pinei, Lago di S. Croce (Belluno, eastern Venetian Prealps, Italy).

Type horizon: Fadalto Limestone of latest Coniacian-earliest Campanian age.

Derivation of name: In honour of Antonio Belloni, who for many years and with great and continuous enthusiasm collected fossils at Pinei and Col dei Schiosi.

Diagnosis: Medium-sized to large, sub-rectangular and very inequilateral *Arca* species with a broad cardinal area, and a fine radial ornamentation.

Description: Shape of the valves sub-rectangular, very elongate, and fairly convex. Umbo not very prominent and very anteriorly situated. Cardinal area broad and radially striated. Ventral margin sinuous. Ornamentation consists of many radial, but unequally developed, riblets and of very fine commarginal striae. Growth interruptions are also present, at irregular intervals.

Dimensions (mm):

	H	L	B'	H/L
P19	(19)	(47)	—	(0.40)
B104	24	—	(13)	—
B82	(25)	(64)	(16)	(0.39)
B75	(27)	(64)	(16)	(0.42)
B80	(29)	61	—	(0.47)
B81	37	—	20	—
FrB 530	(41)	(77)	(20)	(0.53)

Discussion: The general shape of *Arca bellonii* sp. nov. is very close to that of the recent *A. noae* Linné, 1758, type species of the genus *Arca* Linné, 1758. As the hinge is not visible on the types from Pinei a subgeneric assignment of the new species is impossible.

Among the many Cretaceous arcid taxa described, we have not found any applicable to the species from Pinei. The specimen from the same locality, identified as *Arca* sp. by G. Boehm (1895), is poorly preserved but it undoubtedly belongs to the same species as the specimens collected more recently. *Arca galliennei* d'Orbigny, 1845, from the Cenomanian stratotype, is based on specimens which are generally poorly preserved (see also Woods, 1899, p. 42). As far as can be ascertained from the figures, *galliennei* is more *Barbatia*-like, and definitely does not have an equally broad cardinal area.

Arca carteroni d'Orbigny (1845, p. 202, pl. 309, figs 4-8) from the Neocomian of the Aube (France) is, as far as can be judged from the figures, similar but not identical to our species. It could be its ancestor.

Arca aquisgranensis J. Müller (1859, p. 10, pl. 7, fig. 18), from the Vaals Greensand (Lower Campanian) near Aachen (Germany) and well figured in Holzapfel (1889, pl. 17, figs 7, 8), is comparable to *A. bellonii* but its umbo is more prominent and not as anteriorly placed as in the Pinei species.

Later authors considered *Cucullaea gosaviensis* Zittel, 1865 as synonymous with *A. aquisgranensis*. Andert (1934) placed all the taxa mentioned above in the synonymy of *A. carteroni*. A relationship probably exists between them, but no certainty as to their precise generic placement can be reached as virtually none are known with complete hinge. In all of them the place of the umbo is more central than can be seen on *A. bellonii*.

Arca (*Eonavicula*) *bogaerti* Dartevelle and Freneix, 1957 (p. 18, pl. 1, figs 5-6), from the "Senonian" of Kimbamba, Zaïre, has an ornamentation which is comparable to that of *A. bellonii*. The former species has a general shape (as far as can be judged on the very poorly pre-

served African specimens) which is less elongate and more carinate than that of *A. bellonii*.

Distribution: Only recorded from its type locality (uppermost Coniacian-lowermost Campanian of Pinei, Lago di S. Croce, eastern Venetian Prealps, NE Italy).

Fam. CUCULLAEIDAE Stewart, 1930

Cucullaea (Idonearca) matheroniana (d'Orbigny, 1845)
Pl. I, figs 12-14b; Pl. II, fig. 8.

v + 1845 *Arca Matheroniana*, d'Orbigny - d'Orbigny, p. 238, pl. 325, figs 1-4.
? 1846 *Arca brahminica* sp. nov. - Forbes, p. 149, pl. 16, fig. 1.
? 1871 *Trigonarca Brahminica*, Forbes - Stoliczka, p. 354, pl. 18, fig. 13; pl. 20, figs 1, 3.
. 1889 *Cucullaea Matheroniana* d'Orb. - Holzapfel, p. 208, pl. 22, figs 2, 4, 8.
. 1889 *Cucullaea rugosa* n. sp. - Holzapfel, p. 208, pl. 22, figs 1, 6.
. 1920 *Cucullaea Matheroniana* d'Orbigny - Roman, Mazeran, p. 82, pl. 7, fig. 9.
? 1931 *Trigonoarca (sic) Brahminica* Forbes - Basse, p. 51, pl. 9, figs 11, 12.
1956b *Trigonarca (Trigonarca) matheroniana?* (d'Orbigny) - Van de Poel, p. 13.
. 1960b *Trigonarca matheroniana* (d'Orbigny) - Freneix, p. 187.
1974 *Cucullaea (Idonearca) matheroniana* (d'Orbigny) - Oekentorp, Siegfried, p. 125, pl. 1, figs 11a, b.
v . 1987 *Cucullaea* cf. *matheroniana* (d'Orbigny) - Dhondt, p. 52, pl. 1, fig. 10 (*cum syn.*).
v . 1992 *Trigonarca matheroniana* (d'Orbigny) - Callapez, p. 33, pl. 1, fig.1.

Material:
- Eight specimens, of which seven are right valves [B90, B92, B93, B127, P4, P5, DGP 7161a (labelled by Catullo as *Astarte trigona*, MS name)] and one is a left valve (P3), generally preserved with the shell, but usually slightly worn on the hinge side, from Pinei, Lago di S. Croce.
- One left and one right valve from Monrupino, Trieste (MGB/Fr 1 and 2).
- One left and one right valve from Rupinpiccolo, Trieste (MSNT 11853 and 11854).

Description: Medium to large-sized cucullaeid species with fairly strong carina. The posterior side forms an angle of about 90° with the median part of the valve, resulting in a strongly convex shape. The surface of the shell is covered with costellae. The hinge, as far as it can be seen, shows vertical median teeth and sub-horizontal lateral teeth; the hinge margin is longish, reaching two thirds of the length.

Dimensions (mm):

	H	L	B'	H/L
B127	(17)	(24)	(9)	(0.71)
MGB/Fr 1	35	43	16	0.81
MGB/Fr 2	38	44	(18)	0.86
P3	59	73	(31)	0.80
B92	62	(69)	(33)	(0.89)
P4	(67)	(67)	(41)	(1.00)
P5	70	(72)	34	(0.97)
B90	70	—	41	—

Discussion: Among the many cucullaeid taxa described from the Upper Cretaceous (generally under the generic name *Arca*) very few have been redescribed on the base

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EXPLANATION OF PLATE I

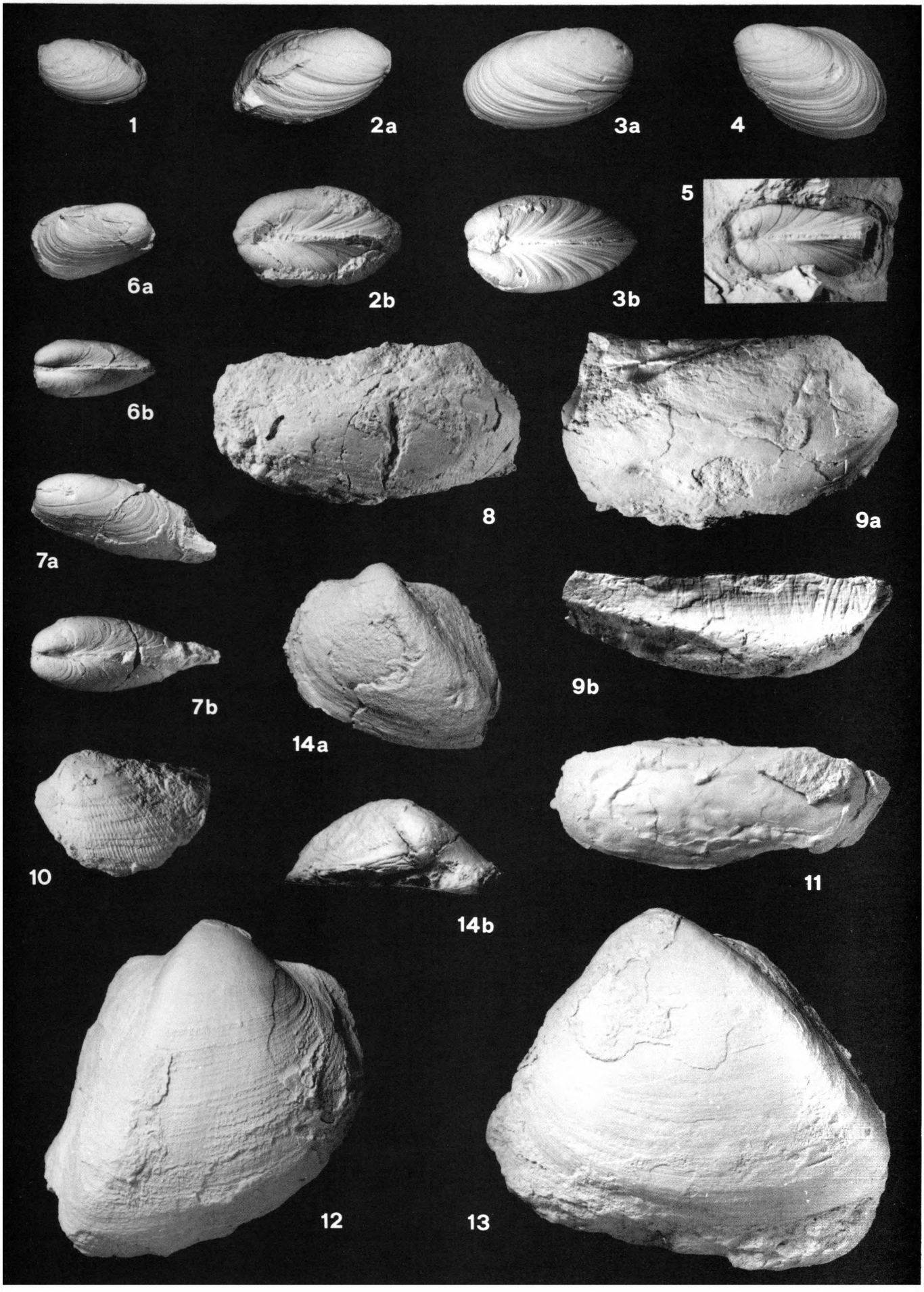
Figs 1-5 - *Botuloides intermedius* (d'Orbigny, 1845).
1, 4 - Left valves.
2a, 3a - Right valves.
2b, 3b - Dorsal views of both valves.
5 - Dorsal view of a specimen nested in a very thick right valve of *Chondrodonta joannae* (Choffat, 1886).
Upper Cenomanian, Col dei Schiosi (Pordenone); B43, B41, B37, B42, DGP 26726.

Figs 6a-7b - *Lithophaga alpina* (Zittel, 1866).
6a - Right valve.
7a - Left valve.
6b, 7b - Dorsal views of both valves.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B232, B233; x 2.5.

Figs 8-11 - *Arca bellonii* sp. nov.
8, 11 - Right valves.
8 - Paratype.
9a - Holotype; right valve.
9b - Holotype; dorsal view.
10 - Paratype; left valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B80, B81, B104, B75.

Figs 12-14b - *Cucullaea (Idonearca) matheroniana* (d'Orbigny, 1845).
12 - Right valve.
13 - Left valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P4, P3.
14a - Left valve.
14b - Dorsal view showing the ligament grooves of the cardinal area.
Santonian (?), Monrupino (Trieste); MGB/Fr 2.

All the specimens are whitened and, unless otherwise stated, natural size.


1
2a
3a
4
5
6a
2b
3b
6b
8
9a
7a
9b
7b
14a
10
11
14b
12
13

of complete specimens since the days of d'Orbigny. This is probably simply due to the fact that from many formations no complete specimens are available, and therefore many taxa shall remain insufficiently known.

Among the rare complete specimens known are the silicified shells from Uchaux (Turonian of Vaucluse, France) and from Vaals (Campanian of the Aachen area). Specimens from these two localities have been identified in the past as belonging to *Arca matheroniana* d'Orbigny. Their characteristics vary considerably during ontogeny (as is the case with all cucullaeids) but they agree generally with the specimens from the Lago di S. Croce area, and therefore we have identified them as belonging to that species. The preservation of the Pinei specimens is much better (undeformed, and with shell) than that of those from the Santonian Gosau deposits which Dhondt (1987) also considered as belonging to the d'Orbigny taxon.

Roman and Mazeran (1920) placed *Trigonarca brahminica* (Forbes, 1846), from the Upper Cretaceous of India, in the synonymy of *matheroniana*. Following the description of Stoliczka (1871) this is possible, but not having seen the Indian specimens, and considering the imperfections of the available illustrations, we cannot draw a definite conclusion.

Authors, since Stoliczka (*op. cit.*), have placed *Arca matheroniana* in the genus *Trigonarca* Conrad, 1862. With the more precise definition of this genus in the *Treatise* (Newell in Moore, 1969, p. N269) and the better illustrations available now, it strikes us as obvious that this d'Orbigny species is comparable to *Idonearca* Conrad, 1862, rather than to *Trigonarca*.

Distribution: Turonian to Campanian of Europe in warm water deposits: central Portugal, Uchaux (SE France), Aachen and Harz areas (Germany), Gosau (Austria), eastern Venetian Prealps and Trieste Karst (Italy). It also occurs possibly in India and Madagascar.

Fam. GLYCYMERIDIDAE Newton, 1922

Glycymeris (*Glycymerita*) *marrotiana* (d'Orbigny, 1844) Pl. II, fig. 6.

v + 1844 *Pectunculus Marrotianus*, d'Orbigny - d'Orbigny, p. 192, pl. 307, figs 13-16.
v . 1865 *Pectunculus Marrotianus*, d'Orb. - Zittel, p. 167, pl. 9, figs 10a-d.
? 1906 *Pectunculus hungaricus* Pethö - Pethö, p. 245, pl. 18, figs 7-9.
1953 *Pectunculus marrotianus* d'Orb. - Petković, p. 16, pl. 13, figs 4, 5.
1960b *Glycymeris* (*Veletuceta*) *marrotiana* (d'Orbigny) - Freneix, p. 191.
? 1981 *Glycymeris* (*Glycymerita*) *marrotianus* (d'Orbigny) - Tzankov in Tzankov *et al.*, p. 76, pl. 18, figs 7, 8.
? 1981 *Glycymeris* (*Glycymerita*) *hungaricus* Pethö - Tzankov in Tzankov *et al.*, p. 76, pl. 19, fig. 1.
v . 1987 *Glycymeris* (*Glycymerita*) *marrotianus* (d'Orbigny) - Dhondt, p. 54, pl. 2, fig. 1.

Material: One right [B162: H = (37.4) mm; L = (37.4) mm; B' = (10.5) mm] and one left (B119) valve from Pinei, Lago di S. Croce.

Discussion: The preservation of the Pinei specimens is not good, but they show the typical almost orthogyrate *Glycymeris* shape, have an external ornamentation of wide "ribs" separated only by shallow grooves, which where the external shell is peeled off seem to show an or-

EXPLANATION OF PLATE II

Figs 1a-4 - *Inoceramus* (*Cordiceramus*) ex gr. *muelleri* Petrascheck, 1906.
1a, 1b, 3 - Left valves, internal moulds.
1b - Dorsal view showing part of the preserved hinge.
2 - Right valve, internal mould.
4 - Right valve, internal mould with part of the shell.
Upper Santonian, Pinei (Belluno); B236, P27, B57, P26.

Fig. 5 - *Inoceramus* sp. cf. *I. pseudoregularis* Sornay, 1962.
Left valve, internal mould with parts of the shell.
Specimen identified by Futterer (1892, p. 80) as *Inoceramus cripsii* (*sic*).
?Upper Santonian, Pinei (Belluno); DGP 7292 (coll. Catullo); x 0.75.

Fig. 6 - *Glycymeris* (*Glycymerita*) *marrotiana* (d'Orbigny, 1844).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B162.

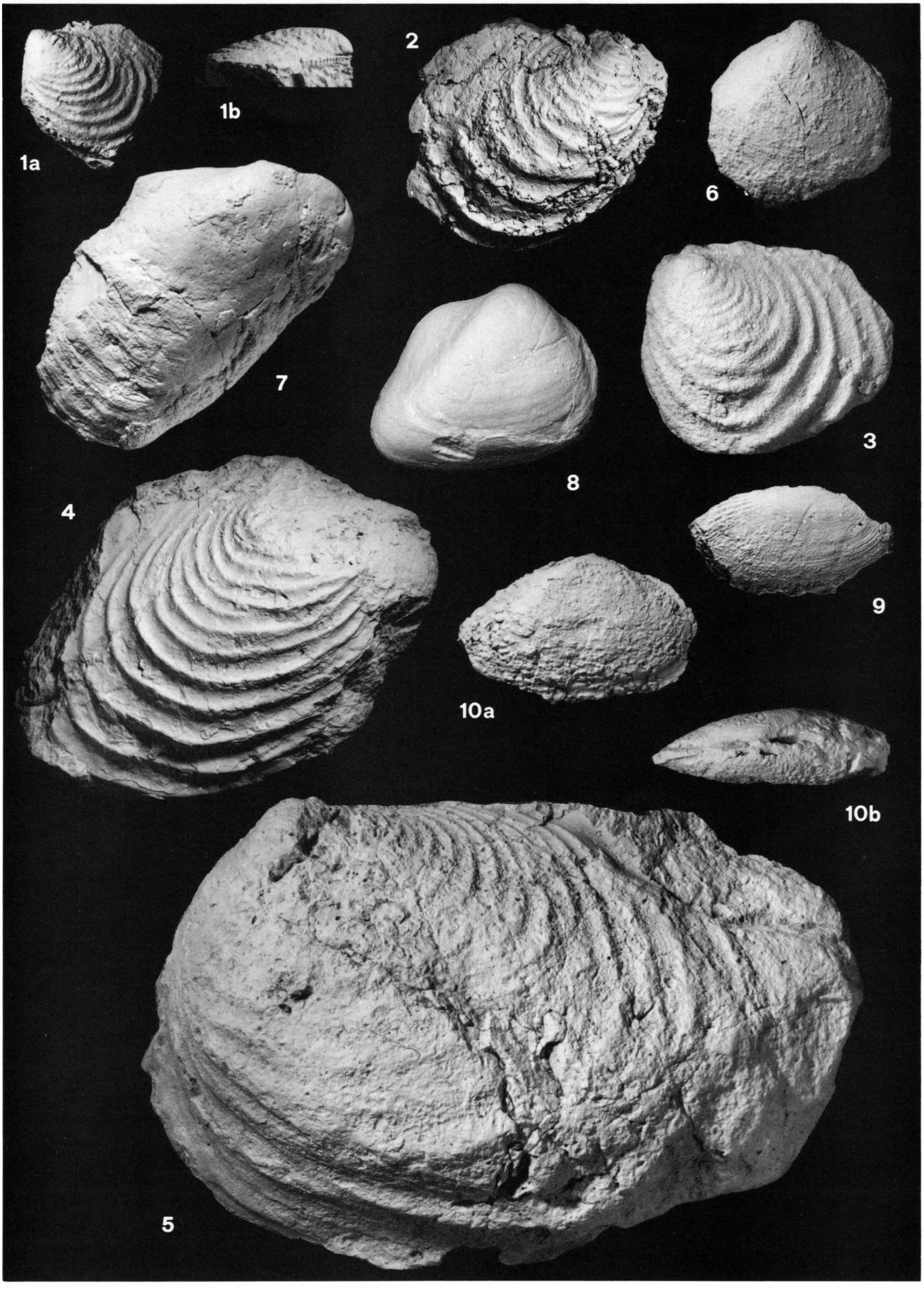
Fig. 7 - *Phelopteria* cf. *caudigera* (Zittel, 1866).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P21.

Fig. 8 - *Cucullaea* (*Idonearca*) *matheroniana* (d'Orbigny, 1845).
Right valve.
Santonian (?), Monrupino (Trieste); MGB/Fr 1.

Fig. 9 - *Icanotia impar* (Zittel, 1865).
Right valve.
Upper Cenomanian, Col dei Schiosi (Pordenone); B25.

Figs 10a, 10b - *Platymyoidea?* cf. *royana* (d'Orbigny, 1845).
10a - Right valve, internal mould.
10b - Dorsal view of both valves, internal mould.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B98.

All the specimens are whitened and, unless otherwise stated, natural size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namentation of numerous narrow internal ribs. The ventral margins are not visible. Such specimens seem to be nearest to the taxon described by d'Orbigny (1844) as *Pectunculus marrotianus* from Campanian-Maastrichtian beds in the Charente and in Dordogne, also found by Zittel in Gosau beds of Santonian age.

The identification of Upper Cretaceous glycymeridids is difficult because their preservation is generally poor in European deposits, the main exception being silicified specimens such as found in the Vaalser Greensand near Aachen in South-Limburg, The Netherlands. Many taxa other than *Glycymeris marrotiana* are found in literature:
- *Pectunculus lens* Nilsson, 1827 only known from a steinkern from the Campanian of S. Sweden;
- *P. renauxianus* d'Orbigny, 1844 and *P. requienianus* d'Orbigny, 1844, both from the Turonian of Uchaux (SE France) and probably synonymous;
- *P. geinitzii* d'Orbigny, 1850 from the Turonian-Campanian of northern and central Europe (see also Van de Poel, 1956a);
- *P. noricus* Zittel, 1865 from the Maastrichtian of eastern Austria.

Only Cenomanian taxa such as *Glycymeris subconcava* (Lamarck, 1819) from Le Mans, *G. umbonata* (Sowerby, 1817) and *G. sublaevis* (Sowerby, 1824), both from the Blackdown Greensand, specimens from the Vaalser Greensand generally assigned to *G. geinitzii*, some Uchaux specimens, and Serbian Campanian-Maastrichtian specimens from Fruska Gora described as *Pectunculus hungaricus* by Pethö (1906) are well preserved. All the other taxa from the European Upper Cretaceous have been erected only for moulds. Therefore it is extremely difficult (if at all possible) to define such taxa in sufficient detail.

From the material known to us it seems possible that *G. hungarica* from Fruska Gora and *G. marrotiana* from the coeval rudist formations in SW France are synonymous. However, we would have to see Serbian specimens to be able to confirm this.

Similarly it is at present impossible to ascertain whether *G. marrotiana* and *G. geinitzi*, taxa generally described from more northern regions (where rudists are generally absent), are identical. The types of both taxa need careful redescription, and furthermore a detailed statistical study of all Cretaceous glycymeridids would be necessary to determine the variability of the species in this group, which is not known at present.

Distribution: Known from Coniacian-Maastrichtian beds in SW and western France (including the Loire Basin), from Austria, NE Italy (eastern Venetian Prealps) and Serbia.

Ord. PTERIOIDA Newell, 1965
Subord. PTERIINA Newell, 1965
Superfam. PTERIACEA Gray, 1847
Fam. BAKEVELLIIDAE King, 1850

Phelopteria cf. *caudigera* (Zittel, 1866)
Pl. II, fig. 7.

Material: One incomplete right valve [P21: H = 60 mm; L = (66) mm], and the internal mould of a left valve (DGP 2506, coll. de Zigno) from Pinei, Lago di S. Croce.

Discussion: The right valve does not show the hinge and is somewhat decorticated. Both specimens from Pinei might belong to *Phelopteria caudigera* (Zittel, 1866, p. 9, pl. 12, figs 12a-c), originally described from Gosau localities (Plahberg-St. Gallen and Strobl-Weissenbach, Coniacian), but not all elements are preserved on them. Therefore, only a tentative assignment is presented.

Fam. INOCERAMIDAE Giebel, 1852

Inoceramus (*Cordiceramus*) ex gr. *muelleri* Petrascheck, 1906
Pl. II, figs 1a-4; Pl. IV, figs 18, 19.

v . 1866 *Inoceramus Cripsi* Mant. var. *regularis* d'Orb. - Zittel, pl. 14, fig. 3; pl. 15, fig. 5.
p ? 1891 *Inoceramus Cripsi*, Mant. - Tommasi, p. 1107, pl. 1, fig. 21 (not fig. 22).
\+ 1906 *Inoceramus Mülleri* nov. spec. - Petrascheck, p. 160, text-fig. 1, pl. 6, figs 1, 2.
. 1961 *Inoceramus* (*Cordiceramus*) *mülleri* Petrascheck - Seitz, p. 122, text-figs 27-32, pl. 7, figs 2, 5-7; pl. 15, figs 1, 2 (*cum syn.*).
. 1967 *Inoceramus* (*Cordiceramus*) *mülleri* Petrascheck - Seitz, p. 45, pl. 1, fig. 4.
. 1967 *Inoceramus* (*Cordiceramus*) *mülleri* Petrascheck - Seitz, p. 126, pl. 23, fig. 3; pl. 25, fig. 1; pl. 26, figs 4, 5; pl. 27, figs 1, 3, 4, 6.
1974 *Inoceramus* (*Cordiceramus*) *mülleri* Petraschek - Oekentorp, Siegfried, p. 137, pl. 7, fig. 3.
? 1981 *Inoceramus* gr. *muelleri* - Cousin, II, p. 80.
1981 *Inoceramus* (*Inoceramus*) *mülleri recklingensis* Seitz - Tzankov in Tzankov *et al.*, p. 87, pl. 37, figs 3, 4.
? 1982 *Inoceramus* (*Cataceramus*) *muelleri* Petrascheck - Maslennikova, p. 91, pl. 9, figs 4a, b.
. 1986 *Inoceramus* (*Cordiceramus*) *muelleri* Petrascheck - G. R. Scott *et al.*, p. 17, figs 13a, 15c.
v . 1987 *Inoceramus* (*Cordiceramus*) *muelleri* Petrascheck - Dhondt, p. 64, text-fig. 2, pl. 3, figs 3,4.
1989 *Inoceramus* (*Cordiceramus*) *mülleri* Petrascheck et subsp. - Tröger, p. 920.
1990 *Inoceramus* (*Cordiceramus*) *muelleri* Petrascheck - Lopez Sanjaume, p. 326, pl. 15, fig. 3 (subsp. *germanicus*).
v . 1991 *Inoceramus rotundatus* Fiege - Dhondt, Dieni, p. 197. (*non* Fiege, 1930).

Material: One bivalved specimen (B58), four right valves (B238, P26, P27, P38), seven left valves (B57, B59, B236, B237, P25, P28) of variable preservation (only P26 has a more or less complete shell and B236 has a partial hinge), from Pinei, Lago di S. Croce.

Dimensions (mm):

	H	L	B'
B236	(25.3)	(28.5)	—
B57	(45)	(51)	(12)
B58	(67)	(78)	—
B59	(95)	(110)	—

Discussion: From Pinei many inoceramid specimens have been collected. They are generally poorly preserved, but a dozen specimens are considered here as belonging probably to the same species.

The specimens are characterised by "rugae", with sharp summits, which change shape during ontogeny: on

the young part of the shell the rugae are more or less circular (Pl. II, figs 2, 3), whereas on the middle part they become obliquely oval (Pl. II, fig. 4). The change in shape of the rugae is the reflection of the change of the shell shape, which from orbicular becomes obliquely elliptical. The rugae are not always continuous and frequently incomplete rugae intercalate between those beginning at the margins (Pl. II, fig. 3).

The imperfect preservation of the specimens and the frequent deformation make measuring of the different characters pointless. Therefore the identification remains tentative. The specimens from Pinei are nearest to *I. (C.) muelleri* because their rugae are more rounded than pentagonal, and further apart from each other than described for *I. (C.) bueltenensis* (Seitz, 1961).

In how far the specimens from Early Campanian strata in Crimea and the Pre-caspian depression identified as *I. muelleri* really belong to the species is difficult to judge: for instance the Pre-caspian specimens figured in Maslennikova (1982) are somewhat poorly preserved but seem to have a different rib configuration to the specimens from the Gosau (type locality of the species).

Stratigraphically *I. (C.) muelleri* indicates the Upper Santonian (inoceramid Zones 28-29 in Tröger, 1989).

Distribution: Inoceramus (Cordiceramus) muelleri and its subspecies have been recorded from Late Santonian strata in Austria, Westphalia and Harz (Germany), Spain, eastern Venetian and southern Carnian Prealps (NE Italy), Bulgaria, Cameroon, Madagascar, Western Interior (USA).

Inoceramus sp. cf. *I. pseudoregularis* Sornay, 1962
Pl. II, fig. 5.

v p 1892 *Inoceramus Cripsii* Mantell - Futterer, p. 80 (*non* Mantell, 1822).

Material: One left valve (DGP 7292, coll. Catullo; H = ± 115 mm; L = > 180 mm; B'= ± 50 mm) as internal mould with parts of the shell preserved near the posterior hinge margin.

Description: Left valve of large inoceramid belonging to the cordiceramids or selenoceramids, probably not deformed but with poorly preserved ornamentation.

Umbo small, anterior, reaching just above the hinge line, somewhat incurved. Long straight posterior hinge margin; anterior margin short and probably straight.

Shell is at first relatively flat, but a fairly sudden fold at H = 93 mm places the later stages at an angle of about 60° to 80° in comparison to the initial stages. As a result the shell has a very inflated aspect at the anterior ventral side, but less so at the posterior ventral part of the valve.

The ornamentation is commarginal and on the initial stages consists in regular, more or less oval (not angular), closely set, probably narrow with a sharp summit, never very elevated plications. These plications reach the posterior hinge margin under an angle which becomes more acute with increasing age of the shell.

Older shell stages (after the folding) show a much more irregular and less dense commarginal ribbing.

Dimensions (progressive ontogenetic stages; mm):

H	L	L/H%	H/L%
17	17.3	102	98
(43)	52.7	120	82
54.7	64.8	118	84
63.2	78.5	124	80.5
74.7	93.2	124.5	80
96.2	113.2	118	85
104.4	136.8	131	76

(The ribs of the initial stages are partially eroded and therefore certain stages have not been measured)

Plication density:

- System of Sornay (1976): D = 9
- System of Seitz (1967):

0-20 mm	20-35 mm	35-45 mm	45-55 mm	>55 mm
2.5 mm	3 mm	4 mm	5 mm	~10 mm

Discussion: Futterer (1892) described two specimens from "Calloniche" as *Inoceramus cripsii.* The smaller of these two inoceramids is housed in the Museum für Naturkunde in Berlin: it is incomplete and cannot be identified specifically. The larger specimen is discussed here [DGP 7292; Futterer stated the specimen to be from "Calloniche" but its older label mentions "Pinè" (= Pinei)].

The large specimen cannot be assigned to a species with certainty because several elements needed for identification are not preserved.

Among the well described Santonian fauna from Germany (Seitz, 1961, 1967) we have not found any similar species, but selenoceramids such as *Inoceramus (Selenoceramus) gladbeckensis* Seitz, 1967 and *I. (S.) selenae* Seitz, 1967 have the same general aspect: a well developed almost flat to lightly convex, regularly ribbed initial stage, a strong fold between the initial and irregularly ribbed later stages. The rib pattern is somewhat different though and the ribs themselves are more prominent and wider than on the Pinei specimen.

On the other hand, a definite similarity exists with *Inoceramus (Haenleinia) pseudoregularis* Sornay, 1962 (p. 118, fig. 1A, pl. 7, fig. 1; reassigned by Sornay to the subgenus *Cordiceramus* in 1968, p. 32, figs 3-6, pl. D, figs 1, 2) described from the Lower Campanian of Madagascar. The specimen from Pinei has a shape, an ornamentation of the initial stages and a costulation density which are very near to those of *I. pseudoregularis.* The sudden fold between the initial stages and the later stages, a very prominent feature on the Pinei specimen, is not described for *I. pseudoregularis,* but is known from other taxa of similar general aspect, such as *I. (Cordiceramus) paraheberti* Sornay, 1968. This fold might represent only an ecologic adaptation which need not have taxonomic significance (Tröger and Röhlich, 1981).

Ord. LIMOIDA Waller, 1978
Superfam. LIMACEA Rafinesque, 1815
Fam. LIMIDAE Rafinesque, 1815

Ctenoides tectus (Goldfuss, 1835)
Pl. IV, fig. 1; Text-fig. 4.

v + 1835 *Lima tecta* nobis - Goldfuss, p. 91, pl. 104, fig. 7.
. 1871 *Radula (Ctenoides) tecta*, Goldfuss - Stoliczka, p. 420, pl. 30, fig. 12.

v .1895 *Lima* (*Ctenoides*) sp. - G. Boehm, p. 97, pl. 8, fig. 8.
v .1897 *Lima* (*Ctenoides*) *carnica* n. sp. - G. Boehm, p. 176.
.1901 *Lima* cfr. *rapa* d'Orb. - Schnarrenberger, p. 194, pl. 1, fig. 9.
.1902 *Lima* (*Ctenoides*) *carnica* Boehm - Marinelli, p. 172.
.1902 *Lima tecta*, Goldf. - Pálfy, p. 275, pl. 20, fig. 5.
?1903 *Lima* (*Limatula*) *calloneghensis* n. sp. - Longhi, p. 28, pl. 2, figs 10, 10a.
v .1904 *Lima* (*Ctenoides*) *tecta* Goldfuss - Woods, p. 42, pl. 7, figs 2, 3 (*cum syn.*).
?1904 *Lima insolita*, Péron et Fourtau - Fourtau, p. 316, pl. 3, figs 9, 10.
1909 *Lima* cfr. *rapa* d'Orb. - Parona in Parona *et al.*, p. 166.
1911 *Lima* (*Ctenoides*) *carnica* Boehm - Parona, p. 5.
1930 *Lima* (*Ctenoides*) *tecta* Goldfuss - Hägg, p. 33.
1932 *Lima* (*Ctenoides*) *tecta* Goldfuss - Wolansky, p. 21.
?1937 *Lima* (*Ctenoides*) *tecta* Goldfuss - Lehner, p. 173, pl. 22, fig. 16.
?1939 *Lima* (*Ctenoides*) *tecta* Goldf. - Dacqué, p. 199, pl. 17, fig. 15.
1947 *Lima* (*Ctenoides*) *tecta* Goldfuss - Hägg, p. 66.
1960b *Lima* (*Ctenoides*) *tecta* Goldfuss - Freneix, p. 223.
v ?1985 *Ctenoides tecta* (Goldfuss) - Dhondt, p. 46, fig. 3e.
non 1992 *Ctenoides tecta* Goldfuss - Metwally, p. 133, figs 4f, g.

Material: One incomplete right valve [B100: H = (39) mm] from Pinei, Lago di S. Croce, and one almost complete left valve (described by G. Boehm in 1897 as *Lima carnica*) from Col dei Schiosi (FrB 102, original of G. Boehm, 1895 and 1897: H = 53 mm; L = 40.5 mm; UA = 77°).

Discussion: Though incomplete, the specimen from the Lago di S. Croce area shows the specific ornamentation of *Ctenoides tectus* first figured by Goldfuss (1835) and later described in detail by Woods (1904).

Ornamentation consists of numerous radial riblets which increase in number through bifurcation on the young part of the valve; on the median part we counted 15 riblets per 10 mm. They diverge towards the side margins and continue onto the auricles. The riblets are interrupted by commarginal, imbricated growth lamellae (4 per 10 mm on the median part of the valve). The umbonal angle is narrow.

The specific variability of *Ct. tectus* is probably wide (Dhondt, 1985) but the material from Pinei and from Col dei Schiosi is insufficient to discuss this aspect here.

Lima (*Ctenoides*) *carnica* G. Boehm, 1897, from Col dei Schiosi and Bocca di Crosis near Tarcento (Udine, Friuli), is based on poorly preserved specimens of *Ct. tectus*.

Lima (*Limatula*) *calloneghensis* Longhi, 1903 from "Calloneghe" probably represents a small specimen of *Ctenoides tectus*. We have not been able to find the Longhi collection and therefore cannot totally confirm this hypothesis.

Similarly, *Lima insolita* Péron and Fourtau in Fourtau (1940) from the Campanian in Egypt very probably represents *Ctenoides tectus*.

Distribution: Recorded from Cenomanian to Upper Maastrichtian: southern England, western and SW France, Belgium-The Netherlands, southern Sweden, Germany (Rügen, Bavaria and Saxony), Czechia, NE (eastern Venetian and western Carnic Prealps) and central (Abruzzo) Italy, Romania, Egypt, India (Text-fig. 4).

Limaria echinata (Etheridge, 1881)
Pl. IV, figs 2, 3.

\+ 1881 *Lima echinata* Eth. - Etheridge in Penning, Jukes-Browne, p. 144, pl. 2, fig. 2.
. 1902 *Lima Schmeisseri* n. sp. - Wollemann, p. 55, pl. 7, fig. 9.
v . 1904 *Lima* (*Mantellum*) *elongata*, var. *echinata*, Etheridge - Woods, p. 36, pl. 6, figs 8, 9a-c.
1937 *Lima* (*Mantellum*) *elongata* Sow. var. *echinata* Etheridge - Lehner, p. 179.
? 1981 *Lima elongata echinata* Etheridge - Tzankov in Tzankov *et al.*, p. 114, pl. 51, fig. 7.

Material: Two left valves (B60, B118) from Pinei, Lago di S. Croce.

Dimensions (mm):

	H	L	R
B60	22.3	23.4	19
B118	32.0	—	19

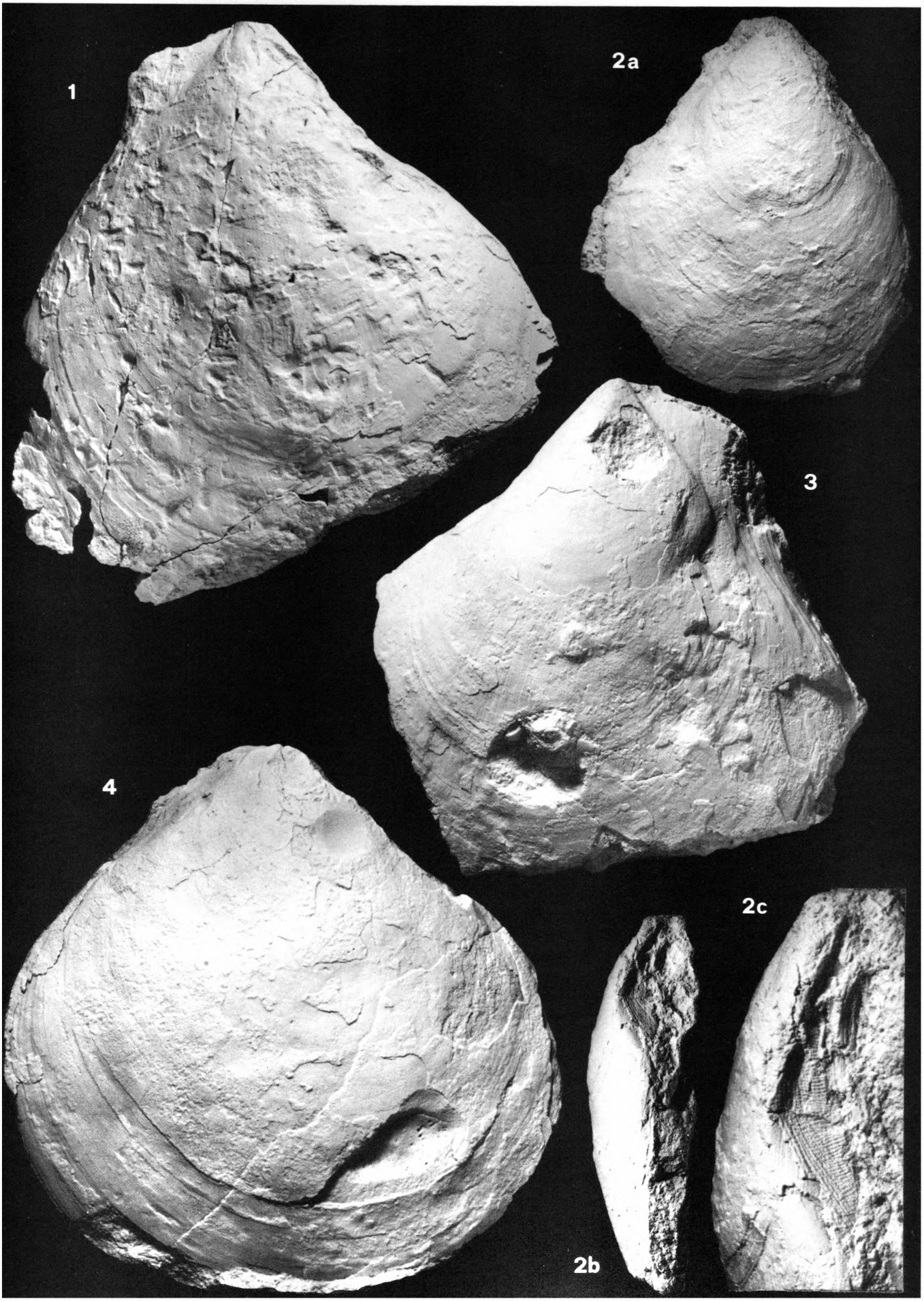
Discussion: Specimen B118 clearly shows the elaborate rib ornamentation described and figured by Woods (1904). This author also stated that *Limaria echinata* is very close to *L. elongata* (J. de C. Sowerby, 1827), where the number of ribs, the general shell shape etc. are concerned. Yet, the ornamentation of the ribs of *L. echinata* is very specific. So much, that we think it warrants to be considered as a separate species.

Its seemingly rare occurrence in literature is undoubt-

EXPLANATION OF PLATE III

Figs 1-4 - *Plagiostoma hoernesi* (Zittel, 1866).
1 - Right valve; x 0.75.
2a - Right valve.
2b - Anterior view.
2c - Detail of fig. 2b showing the typical *Plagiostoma* ornamentation at the antero-dorsal part of the valve; x 2.
3 - Left valve; x 0.75.
4 - Right valve [= holotype (by monotypy) of *Lima* (*Acesta*) *subclypeiformis* Futterer, 1892]; x 0.75.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B188, B53, P22, DGP 7162 (coll. Catullo).

All the specimens are whitened and, unless otherwise stated, natural size.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edly due to the scarceness of sufficiently well preserved specimens showing the typical ornamentation. It is not impossible that some of the *L. elongata* records refer in fact to *L. echinata*.

Distribution: Known so far from Cenomanian-Turonian of England, Germany (Bavaria, Lower Saxony), and from uppermost Coniacian-lowermost Campanian of eastern Venetian Prealps, NE Italy; Maastrichtian of Bulgaria?

Limaria elongata (J. de C. Sowerby, 1827)
Pl. IV, fig. 4.

v + 1827 *Plagiostoma elongata* - J. de C. Sowerby, p. 113, pl. 559, fig. 2.
. 1846 *Lima elongata* Sow. - Reuss, p. 33, pl. 38, figs 6, ?9.
v . 1904 *Lima* (*Mantellum*) *elongata* (Sowerby) - Woods, p. 34, pl. 6, figs 5-7 (*cum syn.*).
1909 *Lima elongata* Geinitz (*non* Sowerby) - Wanderer, p. 29, pl. 5, fig. 2.
. 1925 *Lima* (*Mantellum*) *Itieriana* Pict. et Roux - Ravn, p. 27, pl. 2, fig. 6.
? 1932 *Lima* (*Mantellum*) ex aff. *elongata* Sowerby - Wolansky, p. 22, pl. 3, fig. 9.
. 1934 *Lima elongata* Gein. (non Sow.) - Andert, p. 148, pl. 8, figs 7a, b.
1939 *Lima elongata* Rss. (non Sow.) - Dacqué, p. 39, pl. 1, fig. 6.
. 1939 *Lima* (*Mantellum*) *elongata* Reuss (non Sow.) - Dacqué, p. 121, pl. 12, fig. 9.

EXPLANATION OF PLATE IV

Fig. 1 - *Ctenoides tectus* (Goldfuss, 1835).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B100.

Figs 2, 3 - *Limaria echinata* (Etheridge, 1881).
Left valves.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B118, B60.

Fig. 4 - *Limaria elongata* (J. de C. Sowerby, 1827).
Right valve.
Upper Cenomanian, Col dei Schiosi (Pordenone); B33; x 1.5.

Fig. 5 - *Limatula* sp.
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B130; x 1.5.

Fig. 6 - *Limea* (*Pseudolimea*) *granulata* (Nilsson, 1827).
Left valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B123; x 1.5.

Fig. 7 - *Plagiostoma asperum* Mantell, 1822.
Right valve.
Upper Cenomanian, Col dei Schiosi (Pordenone); B28.

Fig. 8 - *Chlamys? subacuta* (Lamarck, 1819).
Left (?) valve.
Upper Cenomanian, Candaglia near Col dei Schiosi (Pordenone); DGP 26722; x 1.5.

Fig. 9 - *Plagiostoma hoperi* Mantell, 1822.
Left valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B115.

Figs 10, 11 - Oysters, right valves (= "*Ostrea coniacensis* Coqu.?" in Futterer, 1892, p. 77).
Cenomanian (?) to the west of "Calloniche" (Belluno); MB (coll. Futterer); fig. 10: x 1.5.

Fig. 12 - *Camptonectes virgatus* (Nilsson, 1827).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B88.

Figs 13, 14 - *Mimachlamys catulloi* sp. nov.
Left valves.
13 - Paratype.
14 - Holotype.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B79, DGP 7094 (coll. Catullo).

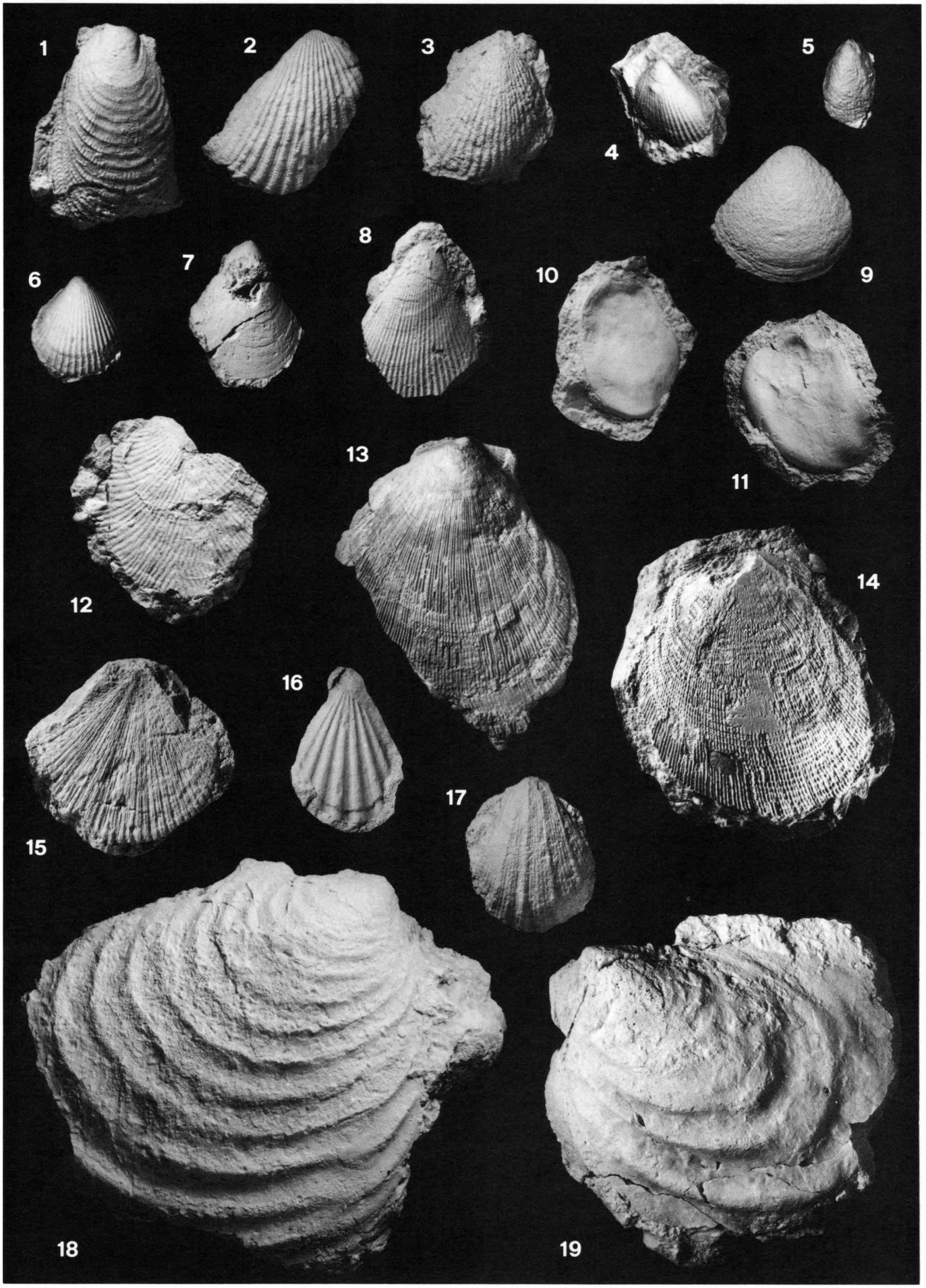
Fig. 15 - *Neithea* (*Neithea*) *aequicostata* (Lamarck, 1819).
Left valve, internal side.
Upper Cenomanian, Col dei Schiosi (Pordenone); B182.

Fig. 16 - *Lyriochlamys ternata* (Münster in Goldfuss, 1833).
Left valve.
Upper Cenomanian, Col dei Schiosi (Pordenone); DGP 26693.

Fig. 17 - *Neithea* (*Neithea*) *dutrugei* (Coquand, 1862).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); DGP 2507 (coll. de Zigno).

Figs 18, 19 - *Inoceramus* (*Cordiceramus*) ex gr. *muelleri* Petrascheck, 1906.
18 - Right valve, somewhat flattened internal mould.
19 - Left valve, internal mould.
Upper Santonian, Pinei (Belluno); B238, B237.

All the specimens are whitened and, unless otherwise stated, natural size.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. 1962 *Lima (Radula) cenomanensis* (nov. sp.) - Abbass, p. 48, pl. 8, figs 6, 7 [not *L. cenomanensis* d'Orbigny, 1847 = *Limea composita* (J. de C. Sowerby, 1836)].
? 1974 *Lima elongata* Sowerby - Kociubynskij, Savczinskaja, p. 95, pl. 28, fig. 10.
? 1976 *Lima (Mantellum) ferganica* Pojarkova sp. n. - Pojarkowa, p. 27, pl. 8, figs 1-5.
? 1981 *Lima elongata elongata* (Sowerby) - Tzankov in Tzankov *et al.*, p. 114, pl. 51, figs 5, 6.
. 1984 *Lima elongata* Sowerby - Cieśliński, Blaszkiewicz, p. 368, pl. 157, fig. 2.
v . 1987 *Limaria elongata* (J. de C. Sowerby) - Cleevely, Morris, p. 97, pl. 18, figs 1, 2.
v . 1988 *Limaria? elongata* (Sowerby) - Dhondt, Dieni, p. 37, text-fig. 17, pl. 7, fig. 9 (*cum syn.*).

Material: One right valve (B33) from Col dei Schiosi.

Description: Small, fairly convex, right valve with 22 ribs; in the intercostal intervals and on the sides of the ribs radial striae are present; the summits of the ribs are serrate; small anterior and somewhat larger posterior smooth auricles.

Dimensions (mm): H = 10.5; L = 9.2.

Discussion: The specimen from Col dei Schiosi agrees perfectly with the description given by Woods (1904).

German authors (Andert, 1934; Dacqué, 1939) have considered that Turonian specimens of *Lima elongata* described from Bavaria, Bohemia and Saxony were different from those described from western Europe because of a lower rib number. This "difference" is almost certainly due to the imperfect (steinkern) preservation of the fossils in central Europe. Indeed, steinkern preservation in limids often induces less clearly visible or partially obliterated shell ornamentation.

Lima (Radula) cenomanensis Abbass, 1962, from the Cenomanian of Egypt, is a junior homonym of a d'Orbigny species now considered to belong to the genus *Limea* Bronn, 1831 (see Dhondt, 1990, p. 109). Furthermore, the Egyptian taxon is undoubtedly synonymous with *Limaria elongata* (J. de C. Sowerby) as can be easily understood from the description, figures and discussion in Abbass.

No other *Limaria* species has been recorded from Col dei Schiosi; further limid taxa described in G. Boehm (1892, 1897) from the same locality belong to the genera *Ctenoides* and *Plagiostoma*.

Distribution: Recorded from Albian to Turonian, possibly to Campanian: southern England, France, Belgium, Switzerland, Denmark, Germany, Poland, Czechia, Bulgaria, Ukraine (Crimea, western Ukraine and Donbass), Moldavia, Georgia, western Carnic Prealps and eastern Sardinia (Italy), Egypt, ?Morocco, ?Somalia.

Limatula sp.
Pl. IV, fig. 5.

v ? 1892 *Lima (Limatula) semisulcata* Nilsson sp. - Futterer, p. 79, pl. 3, fig. 5.

Material: One small right valve [B130: H = 11 mm; L = (6.5) mm; R = about 9] from Pinei, Lago di S. Croce. One incomplete valve, original of Futterer (1892) [MB/M unreg.: H = (8.5) mm; L = (6.2) mm; R > 14], from "Calloniche", Lago di S. Croce.

Discussion: The two specimens are covered with worn ribs, no longer showing any detailed ornamentation, and therefore their specific identification is not possible.

Marquet (1982, p. 13) stated that *L. semisulcata* (Nilsson, 1827) occurrences older than Campanian have not been proved beyond doubt: generally the material upon which they are based is too poorly preserved to allow a definite specific attribution.

The specimen from Pinei and also that described by Futterer (1892), very probably from the same locality, are proportionally longer and more convex than the average *L. semisulcata*. Better material could possibly prove them to belong to *L. wintonensis* (Woods, 1904), described from Santonian-Maastrichtian beds in southern England, or to *L. orbignyi* Freneix (in Freneix and Viaud, 1985), from the Coniacian-Santonian of western France.

Limea (Pseudolimea) granulata (Nilsson, 1827)
Pl. IV, fig. 6.

+ 1827 *Plagiostoma granulatum* - Nilsson, p. 26, pl. 9, figs 4a, b.
v . 1904 *Lima (Limea) granulata* (Nilsson) - Woods, p. 54, pl. 7, figs 27-29 (*cum syn.*).
v . 1990 *Limea (Pseudolimea) granulata* (Nilsson) - Dhondt, p. 110, text-figs 2-4, pl. 1, figs 1-4, 6 (*cum syn.*).

Material: One left valve (B123) from Pinei, Lago di S. Croce.

Dimensions (mm): H = 12.7; L = 11.4; R = 30.

Discussion: The small valve from Pinei is mainly decorticated; nevertheless, on some parts the specific ornamentation of *Limea (Pseudolimea) granulata*, recently redescribed and refigured (Dhondt, 1990), can still be observed.

This species cannot be confused with the other small limids from Col dei Schiosi and Lago di S. Croce outcrops: it is more globose and has more ribs distributed over the complete disc than *Limatula* sp. (see above); it is less oblique, its ribs are more numerous and less pronounced than on *Limaria echinata* (Etheridge, 1881) and *L. elongata* (J. de C. Sowerby, 1827).

Distribution: The range is from Cenomanian (Plenus Zone) to latest Maastrichtian: southern England, France (Paris Basin, Aquitaine), Belgium-The Netherlands, Denmark, Sweden, Germany (Aachen area, Westphalia, Lower Saxony, Saxony, Harz, Brunswick, Rügen, Bavaria), Czechia, Poland (Silesia and Middle Vistula), NE Italy (eastern Venetian Prealps), Bulgaria, Ukraine (western Ukraine, Crimea, Donbass), Kazakhstan (Pre-caspian depression and Mangyshlak).

Plagiostoma asperum Mantell, 1822
Pl. IV, fig. 7.

+ 1822 *Plagiostoma? aspera* - Mantell, p. 129, pl. 26, fig. 18.
v . 1847 *Lima consobrina*, d'Orbigny - d'Orbigny, p. 556, pl. 422, figs 4-7 [not *L. consobrina* d'Orbigny in Murchison, de Verneuil and Keyserling, 1845, p. 477 (*fide* Chelot, 1909b)].
. 1847 *Lima abrupta*, d'Orbigny - d'Orbigny, p. 559, pl. 423, figs 6-9.
v . 1850 *Lima subconsobrina*, d'Orb. - d'Orbigny, p. 167.

v . 1895 *Lima* aff. *consobrina* d'Orbigny - G. Boehm, p. 97, pl. 8, figs 7a, b.
v . 1897 *Lima Marinellii* n. sp. - G. Boehm, p. 176.
1899 *Lima Marinellii* Böhm - Redlich, p. 150.
? 1899 *Lima* cfr. *consobrina* d'Orb. - Parona, p. 6.
1901 *Lima Marinellii* G. Böhm - Redlich, p. 81.
v . 1901 *Lima aquilensis* n. sp. - Schnarrenberger, p. 19, pl. 1, figs 4a, b.
. 1902 *Lima Marinellii* Boehm - Marinelli, p. 172.
? 1903 *Lima* sp. - Longhi, p. 28, pl. 2, figs 11, 11a.
v . 1904 *Lima aspera* (Mantell) - Woods, p. 8, pl. 2, figs 10, 11; pl. 3, figs 1-4 (*cum syn.*).
1909 *Lima aquilensis* Schnarr. - Parona in Parona *et al.*, p. 166.
. 1909a *Lima abrupta* d'Orbigny - Chelot, 7 figs.
. 1909b *Lima consobrina* d'Orbigny - Chelot, 8 figs.
1932 *Lima consobrina* d'Orb. - Parona, p. 97.
1960b *Lima* (*Acesta*) *subconsobrina* (d'Orbigny) - Freneix, p. 222.
1985 *Lima* (*Lima*) aff. *aspera* (Mantell) - Freneix in Freneix, Viaud, p. 206, pl. 1, fig. 21.
. 1987 *Lima aspera* (Mantell) - Cleevely, Morris, p. 93, pl. 18, fig. 9.
1992 *Plagiostoma asperum* Mantell - Callapez, p. 55, pl. 2, fig. 4.

Material:
- One left valve (B183), two right valves (B28, B240), and the type of *Lima marinellii* G. Boehm, 1897 (figured in G. Boehm, 1895 under *Lima* aff. *consobrina* d'Orbigny; FrB 103, right valve), from Col dei Schiosi.
- One specimen of *L. marinellii* (IGF 353E) from Bocca di Crosis near Tarcento (Udine, Friuli), mentioned by G. Boehm (1897).
- The holotype of *Lima aquilensis* Schnarrenberger, 1901 (FrB 106, right valve), from Monti d'Ocre, Abruzzo.

Dimensions (mm):

	H	L	UA
B240	26.6	18.6	—
B28	27.2	19.0	75°
FrB 103	(30.6)	(26.3)	76°
FrB 106	20.5	17.6	75°

Discussion: The specimens B28, B183 and B240 from Col dei Schiosi clearly belong to the taxon which G. Boehm described, figured (1895) and named (1897) *Lima marinellii*. G. Boehm (1895) considered his poorly preserved specimens to have a strong affinity to *L. consobrina* d'Orbigny, 1847. Yet, he mentioned differentiating "characteristics" between the Col dei Schiosi and the French specimens. These arguments are not valid: the two series of specimens have exactly the same proportions, and the punctae present on *L. consobrina* can clearly be seen on specimen B28.

L. aquilensis Schnarrenberger, 1901, described from the Monti d'Ocre area, is a small, somewhat incomplete specimen of *Plagiostoma asperum*.

Lima sp. in Longhi (1903), from "Calloneghe", is poorly preserved but could, judging from the figures (the whereabouts of the Longhi collection are at present unknown), also belong here.

Chelot (1909b) demonstrated, in his revision of d'Orbigny material, that *L. abrupta* d'Orbigny, 1847 is synonymous with *L. consobrina* d'Orbigny, 1847, which in turn is a junior homonym of *L. consobrina* d'Orbigny in Murchison, de Verneuil and Keyserling, 1845. Recent research on the d'Orbigny collection has shown that *L. consobrina* d'Orbigny, 1850 (= *L. consobrina* d'Orbigny, 1847, non 1845) is identical with *Plagiostoma asperum* Mantell, 1822 (Dhondt, in prep.).

Distribution: Recorded from Cenomanian and Turonian strata: England, Portugal, western France, NE (Friuli and Trieste area) and central (Abruzzo) Italy, Croatia (Istria), Moldavia and western Ukraine.

Plagiostoma hoernesi (Zittel, 1866)
Pl. III, figs 1-4.

v . 1834 *Plagiostoma gigantea*, Sowerby - Catullo, pp. 10, 17 (*non* J. Sowerby, 1814).
v . 1842 *Plagiostoma gigantaea* (*sic*) Sowerby - Catullo, p. 6 (*non* J. Sowerby, 1814).
v + 1866 *Lima Hoernesi* Zitt. - Zittel, p. 103, pl. 16, figs 3a, b.
. 1866 *Lima Haidingeri* Zitt. - Zittel, p. 104, pl. 16, figs 5a-e.
v . 1892 *Lima* (*Acesta*) *subclypeiformis* n. sp. - Futterer, p. 78, fig. 23.
1905 *Lima* cf. *subclypeiformis* Futterer - Kossmat, p. 40.
1920 *Lima* cf. *hoernesi* Zittel - Roman, Mazeran, p. 90.
1932 *Lima Haidingeri* Zitt. - Parona, p. 97.
? 1932 *Lima* ? (cfr. *Acesta clypeiformis* (d'Orb.)) - Parona, p. 98.

Lectotype: Specimen GBAW 3427 from the Coniacian of Strobl-Weissenbach, Gosau, figured by Zittel (1866, pl. 16, figs 3a, b) is formally designated herein as lectotype.

Material:
- Three right valves (B51, B53, B188) and one left valve (P22) with incomplete shell preservation, from Pinei, Lago di S. Croce.
- The holotype (by monotypy) of *Lima* (*Acesta*) *subclypeiformis* Futterer, 1892 (= "*Plagiostoma gigantea* Sowerby" in Catullo, 1834; DGP 7162, coll. Catullo, right valve: H > 140 mm).

Description: Medium to very large, equivalve, moderately inflated *Plagiostoma* species, with sharp, narrow umbo and semicircular ventral margin. No auricle but long lunule on the anterior side, and large posterior auricle. Ornamentation consists on well preserved specimens of striae which contain each one series of punctae. The striae lie very closely together (3 per mm on the median part of specimen B53). On valves from which the outer shell layer has been peeled off the striae can only vaguely be seen, more or less as wavy lines, imprinted on the lower remaining shell layer. On the whole the shell appears to be smooth, with commarginal growth lines.

Dimensions (mm):

	H	L	B'	H/L	UA
B51	40	(33)	7	(1.21)	68°
B53	72	(58)	12	(1.24)	66°
B188	(139)	122	31	(1.14)	72°
P22	(97)	(84)	—	(1.15)	77°
P22	—	(135)	—	—	77°
GBAW 3427	(111)	(107)	—	(1.04)	87°

[P22 has been measured twice: first along a growth line and secondly at its ventral margin, giving the total (incomplete) size; the Zittel figured type (GBAW 3427) is strong-

ly crushed and flattened, hence the wide umbonal angle and the lower value of H/L].

Discussion: When Futterer (1892) erected *Lima* (*Acesta*) *subclypeiformis* with as holotype (by monotypy) the specimen of " *Plagiostoma gigantea* Sowerby" in Catullo 1834 (*non* Sowerby, 1814; Catullo considered the fossils from Pinei to be of Jurassic age, hence his specific identification) he assumed that the type from the Lago di S. Croce area was closely related to the Cenomanian "*Lima*" *clypeiformis* d'Orbigny, 1847. This is not totally right: though both species are large, the d'Orbigny species is less convex, has a disc which is more or less equilateral, and has two auricles even if one is small. The discussion by G. Boehm (1895, p. 94) stating that the type of Catullo (1834) probably did not come ("fraglich") from Monte Pinè (= Pinei in this paper) is made redundant by the recovering of several specimens of the species under discussion from the locality indicated by Catullo and by the Catullo label of the large limid mentioning "Pinè".

The large specimen from Aurisina (Trieste) which was identified by Parona (1932) as close to *L. clypeiformis* probably also belongs in *Plagiostoma hoernesi*. This cannot be confirmed because we have not been able to study the original material of Parona from Aurisina (this material stated in the publication to be housed in the Geological Museum of the University of Bologna cannot be found at present).

Lima haidingeri Zittel, 1866 was erected for small *Plagiostoma* specimens which come from coeval stratigraphic horizons and seem to have the same characteristics as *Pl. hoernesi*; it is therefore placed in synonymy of that taxon.

Lima grenieri Coquand, 1862 (p. 214, pl. 14, figs 7, 8), from the Turonian of Algeria and Tunisia, is more or less coeval with *Plagiostoma hoernesi* (from the Coniacian at Strobl-Weissenbach, Gosau), and is also a large, flattened *Plagiostoma* species. After examining the Coquand specimens in MAFI (Budapest) and the detailed descriptions in Pervinquière (1912, p. 150, pl. 9, fig. 14) and in Dartevelle and Freneix (1957, p. 100, pl. 13, figs 1, 2; pl. 14, figs 10-12; pl. 15, fig. 1) the conclusion is obvious that the North African specimens are almost orbicular (H = L), and have a much wider umbonal angle.

Other large, roughly coeval *Plagiostoma* taxa such as *Lima maxima* d'Archiac, 1837 (p. 187, pl. 13, fig. 13), from the Campanian of Royan (SW France), and *L. santonensis* d'Orbigny, 1847 (p. 565, pl. 425, figs 1, 2), from the Santonian-Campanian of SW France, differ by their H/L proportions or by their more pronounced convexity.

Lima haidingeri in Scupin (1912-1913, p. 231, text-figs 42, 43, pl. 13, fig. 9; pl. 14, fig. 1), from the Cenomanian of Silesia, and *L. haidingeri* in Andert (1934, p. 156), from the Coniacian-Santonian of Czechia, are based on very poor steinkern material; they seem to have nothing in common with the Gosau species *L. haidingeri* Zittel, 1866 (= *Plagiostoma hoernesi* in this paper), except that they represent seemingly smooth limid taxa.

Distribution: Restricted to Turonian-Santonian rudist facies of Tethys (Uchaux, SE France; eastern Venetian Prealps and Trieste Karst, NE Italy; Monti d'Ocre, Abruzzo, central Italy; Gosau, Austria; western Slovenia).

Plagiostoma hoperi Mantell, 1822
Pl. IV, fig. 9.

+ 1822 *Plagiostoma Hoperi* - Mantell, p. 204, pl. 26, figs 2, 3, 15.

EXPLANATION OF PLATE V

Figs 1-3 - *Neithea* (*Neithea*) *quinquecostata* (J. Sowerby, 1814).
Right valves.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B62, B65, B50.

Fig. 4 - *Neithea* (*Neithea*) *sexangularis* (d'Orbigny, 1847).
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B128.

Figs 5, 6 - *Neithea* (*Neithea*) *sexcostata* (Woodward, 1833).
Right valves.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B69, B67.

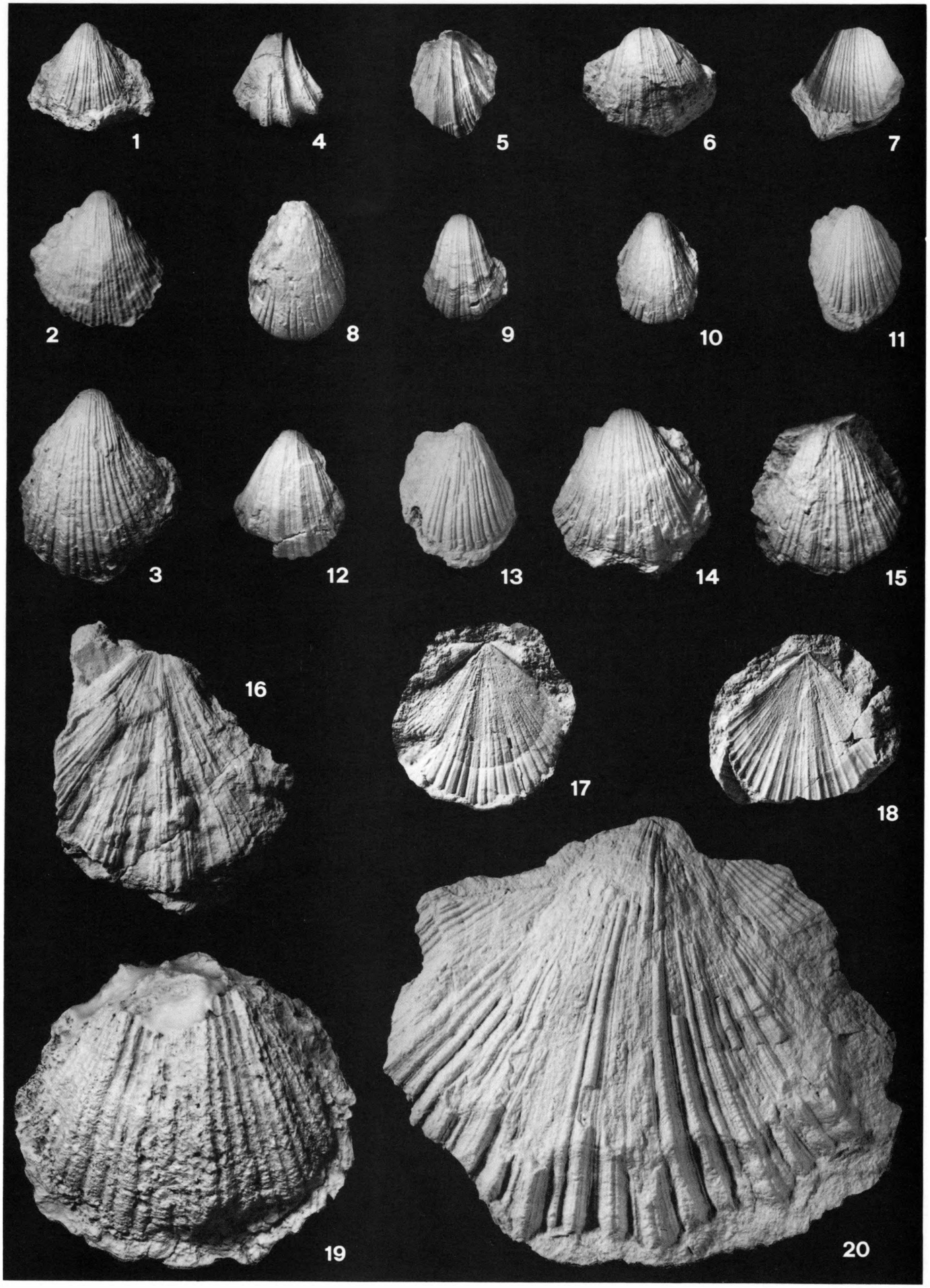
Fig. 7 - *Neithea* (*Neithea?*) *inconstans* (Sharpe, 1850).
Right valve.
Cenomanian, Sovinjak (=Sovignacco), Istria (Croatia); MSNT 11833.

Figs 8-18 - *Neithea* (*Neithea*) *striatocostata robusta* subsp. nov.
8-15 - Right valves.
8 - Holotype; x 2.
9-15 - Paratypes.
11, 13 - Magnification: x 1.5.
16-18 - Left valves; paratypes.
17 - Interior.
18 - Internal mould with part of the shell.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B129, B70, B66, MGB/Ve 801, B71, MGB/Ve 803, B54, DGP 26708, B96, B83, B84.

Fig. 19 - *Neithea* (*Neithea?*) *inconstans* (Sharpe, 1850).
Right valve.
Upper Cenomanian, Monte Candole area (Pordenone); DGP 26727.

Fig. 20 - *Neithea* (*Neithea?*) *fleuriausiana* (d'Orbigny, 1847).
Right valve; original of Parona, 1926, pl. 5, fig. 5a.
Upper Cenomanian, Monrupino (Trieste); MSNT 11830.

All the specimens are whitened and, unless otherwise stated, natural size.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v . 1904 *Lima* (*Plagiostoma*) *Hoperi*, Mantell - Woods, p. 17, pl. 4, figs 7-12 (*cum syn.*).
. 1932 *Lima* (*Plagiostoma*) *hoperi* Mantell - Wolansky, p. 20, pl. 3, fig. 2.
1934 *Lima hoperi* Mant. - Andert, p. 145.
v . 1968 *Lima* (*Plagiostoma*) *hoperi hoperi* (Mantell) - Pasternak in Pasternak *et al.*, p. 179, pl. 37, figs 3-5.
v . 1968 *Lima* (*Plagiostoma*) *hoperi sowerbyi* (Geinitz) - Pasternak in Pasternak *et al.*, p. 180, pl. 37, fig. 6.
? 1968 Lima (*Plagiostoma*) *hoperi* Mantell var. *bistriata* Lahusen - Pasternak in Pasternak *et al.*, p. 180.
. 1974 *Lima hoperi* Mantell - Kociubynskij, Savczinskaja, p. 95, pl. 28, fig. 11.
v . 1977 *Plagiostoma hoperi* Mantell - Sobetski, p. 101, pl. 6, fig. 18.
v ? 1977 *Plagiostoma naidini* Sobetski, sp. nov. - Sobetski, p. 105, pl. 6, fig. 21; pl. 7, fig. 1.
? 1981 *Plagiostoma hoperi* Mantell - Tzankov in Tzankov *et al.*, p. 118, pl. 52, fig. 9.
v . 1982 *Plagiostoma hoperi* Mantell - Sobetski, p. 124, pl. 12, fig. 8; pl. 32, figs 1, 2.
v . 1982 *Plagiostoma hoperi* Mantell - Dhondt, p. 89, pl. 4, fig. 1.
v . 1985 *Plagiostoma hoperi* Mantell - Dhondt, p. 49.
. 1986 *Plagiostoma hoperi* Mantell - Abdel-Gawad, p. 161, pl. 37, fig. 8.
v . 1987 *Plagiostoma hoperi* Mantell - Cleevely, Morris, p. 93, pl. 18, figs 6, 7.

Material: One worn left valve [B115: H = 26.8 mm; L = 27.3 mm; B'= (9.5) mm] from Pinei, Lago di S. Croce.

Discussion: The specimen from Pinei has a somewhat worn shell, but the proportions and general aspect are in agreement with the description and figures of Woods (1904). It is still possible to barely see a fine radial ornamentation on the posterior part and near the ventral margin of the valve. The specimen is fairly convex, which reminds one somewhat of the closely related *Plagiostoma globosum* (J. de C. Sowerby, 1836) from the Cenomanian of the Isle of Wight as figured and described by Woods (*op. cit.*, p. 16, pl. 4, figs 4-6).

Lima striatissima Reuss, 1854, from the Upper Santonian of Gams (Austria), is another comparable *Plagiostoma* species but its holotype (by monotypy) is much less convex than *Pl. hoperi* specimens generally are (see also Zittel, 1866, p. 105, pl. 16, figs 2a, b).

It could be that *L. striatissima* mentioned in Parona (1932, p. 98) from the rudist limestones of Aurisina (Trieste) belongs to the same species as that found in the Lago di S. Croce area. It is at present impossible to check because all the specimens studied by Parona from Aurisina, stated in his publication to be housed in the Geological Museum of the University of Bologna, are not to be found.

Plagiostoma cretaceum (Woods, 1904), from the Turonian-Maastrichtian of southern England, is very close to *Pl. hoperi* but is covered by many flat-topped ribs and generally has a narrower umbonal angle.

Distribution: Recorded from Lower Turonian to Maastrichtian in Eurasia. It is more common in white chalks of northern and western Europe than in coarser deposits, but it has also been collected in southern European chalks such as those known from the Charente and from Crimea. From rudist formations it has only rarely been recorded.

Ord. OSTREOIDA Férussac, 1822
Subord. OSTREINA Férussac, 1822
Superfam. OSTREACEA Rafinesque, 1815
Pl. IV, figs 10, 11.

1. From the Lago di S. Croce area Futterer (1892, p. 29) mentioned the occurrence of an oyster horizon ("Wenn man längs der Steilwand von Basso Fadalto nach Cima Fadalto emporsteigt, so findet man ungefähr unter Calloniche an der Basis der Rudistenkalke einen kleinen Steinbruch, ...in welchem weisse ... Kalke gewonnen werden, welche reich an Ostreen sind". Briefly on p. 29 and in more detail on p. 77 he discussed these oysters, stressing their poor preservation and tentatively assigning them to *Ostrea coniacensis* Coquand, 1869. This is a badly known taxon: the types figured in Coquand (1869, pl. 26, figs 8-10) belong to poorly preserved *Ceratostreon* species.

Some of the Futterer (*op. cit.*) oysters are housed in the Museum für Naturkunde, Berlin. They are indeed poorly preserved, though they retain a partial recrystallised shell. They belong to two different taxa:

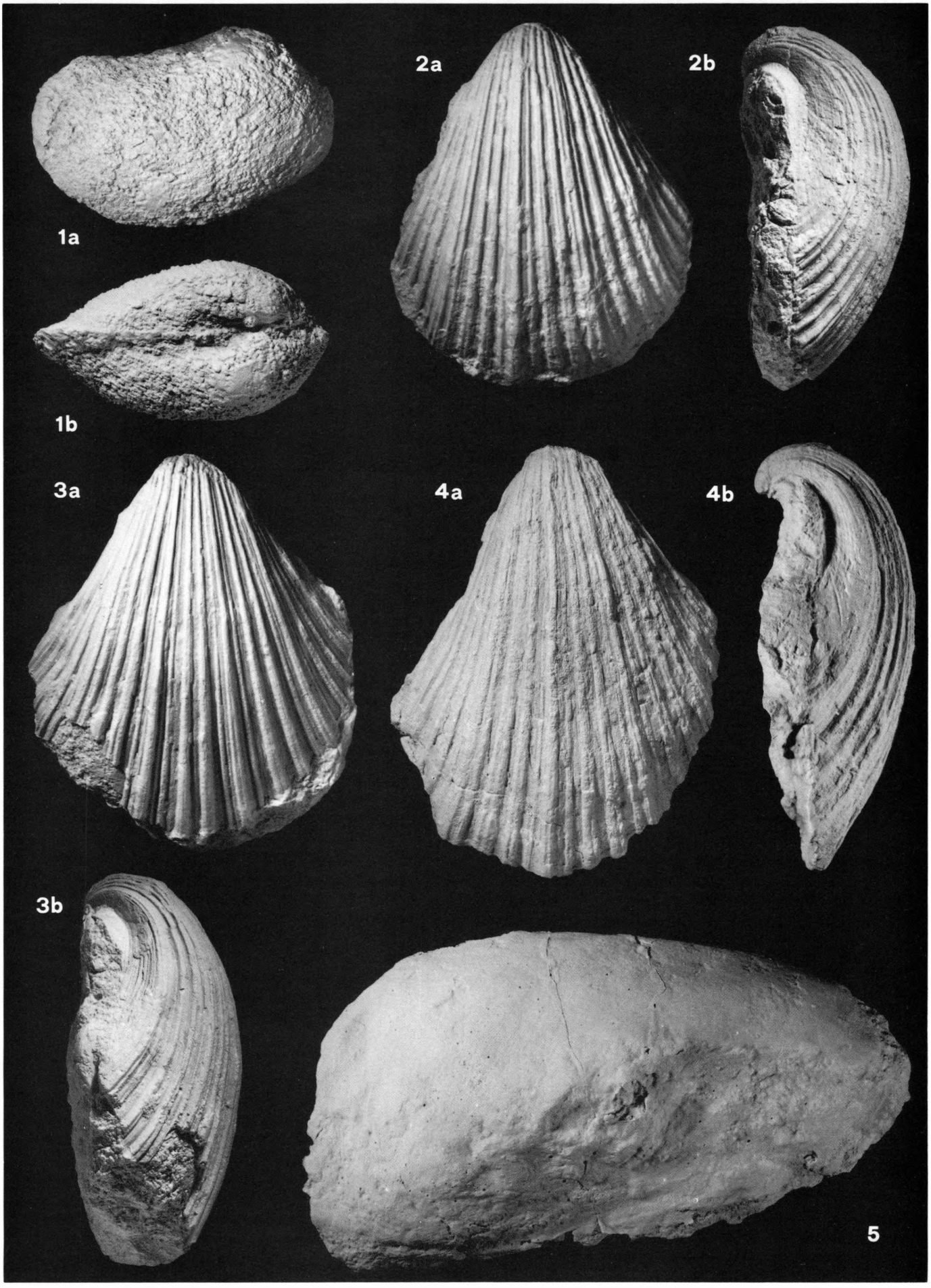
a) one is an internal mould, with partial shell near the ventral margin, of a small *Ceratostreon* valve, which cannot be specifically identified;

b) nine other specimens (three right valves and six left valves) probably represent one species. The squamose aspect of the best left valve could be compared to *Gyrostrea*

EXPLANATION OF PLATE VI

Figs 1a, 1b - *Pachymya? frequens* (Zittel, 1865).
1a - Right valve, internal mould.
1b - Dorsal view of both valves, internal mould.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B103.
Figs 2a-4b - *Neithea* (*Neithea*) *striatocostata robusta* subsp. nov.
Paratypes; right valves with differently eroded shells, showing subdivided principal ribs and a rib number higher than that which would be visible on well preserved specimens.
2b, 3b, 4b - Posterior views.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P16, P18, P17.
Fig. 5 - *Myoconcha* (*Modiolina*) *dilatata* Zittel, 1865.
Right valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P20.

All the specimens are whitened and natural size.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3a
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species such as *G. delettrei* (Coquand, 1862) or *G. roachensis* (Fourtau, 1914) and the somewhat elongate triangular shape could endorse this interpretation. The interior of other valves reminds one of that of *Pycnodonte* but none of the characteristics of this group are visible (Pl. IV, figs 10, 11). A definite assignment cannot be made by want of shell structure information. All that can be said is that below the rudist beds to the west of "Calloniche" (= Caloniche, see Text-fig. 1) an oyster horizon possibly of Cenomanian age is present.

2. Futterer (*op. cit.*, p. 77) also mentioned a second group of oysters which he compared to worn specimens of "*Ostrea semiplana*" as figured in Coquand (1869). Here it seems likely that Futterer referred to the very worn specimens of *Chondrodonta joannae* (Choffat, 1886) present in the Col dei Schiosi fauna (see below). For similar equally worn specimens G. Boehm (1895) erected the taxon *Ostrea schiosensis*.

3. Futterer (*op. cit.*, p. 77) mentioned a third group of oysters ("sehr grosse Austern") from Col dei Schiosi; these are most likely exceptionally large and dorsally thickened *Chondrodonta joannae* (Choffat, 1886) specimens such as that figured in Pl. XVIII, fig. 1.

Subord. PECTININA Waller, 1978
Superfam. PECTINACEA Rafinesque, 1815
Fam. PECTINIDAE Rafinesque, 1815

Camptonectes virgatus (Nilsson, 1827)
Pl. IV, fig. 12; Text-fig. 2.

v + 1827 *Pecten virgatus*, n. - Nilsson, p. 22, pl. 9, fig. 15.
. 1882 *Pecten dichotomus* n. sp.- Seguenza, p. 105, pl. 15, figs 4-4b.
1912 *Pecten* (*Camptonectes*) aff. *virgatus* - Schubert, p. 68.
. 1937 *Pecten* (*Camptonectes*) *dichotomus* Seg. - Trevisan, p. 58, pl. 3, fig. 4.
v . 1972a *Camptonectes* (*Camptonectes*) *virgatus* (S. Nilsson) - Dhondt, p. 18, pl. 2, fig. 1 (*cum syn.*).
1974 *Camptonectes virgatus* (Nilsson) - Oekentorp, Siegfried, p. 145, pl. 10, fig. 8.
. 1976 *Camptonectes virgatus* (Nilsson) - Pojarkowa, p. 21, pl. 6, figs 1-7.
v . 1977 *Camptonectes virgatus* (Nilsson) - Sobetski, p. 65, pl. 4, fig. 16.
v . 1977 *Camptonectes perlucidus* Sobetski, sp. n. - Sobetski, p. 66, pl. 4, figs 17a, b.
v . 1984 *Camptonectes virgatus* (Nilsson) - Dhondt, p. 849.
. 1985 *Camptonectes* (*Camptonectes*) *virgatus* (Nilsson) - Freneix in Freneix, Viaud, p. 206, pl. 1, fig. 10.
v . 1987 *Camptonectes virgatus* (Nilsson) - Dhondt, p. 67, pl. 3, fig. 3.
. 1992 *Camptonectes* (*Camptonectes*) *virgatus* (Nilsson) - Callapez, p. 40, pl. 2, fig. 1.

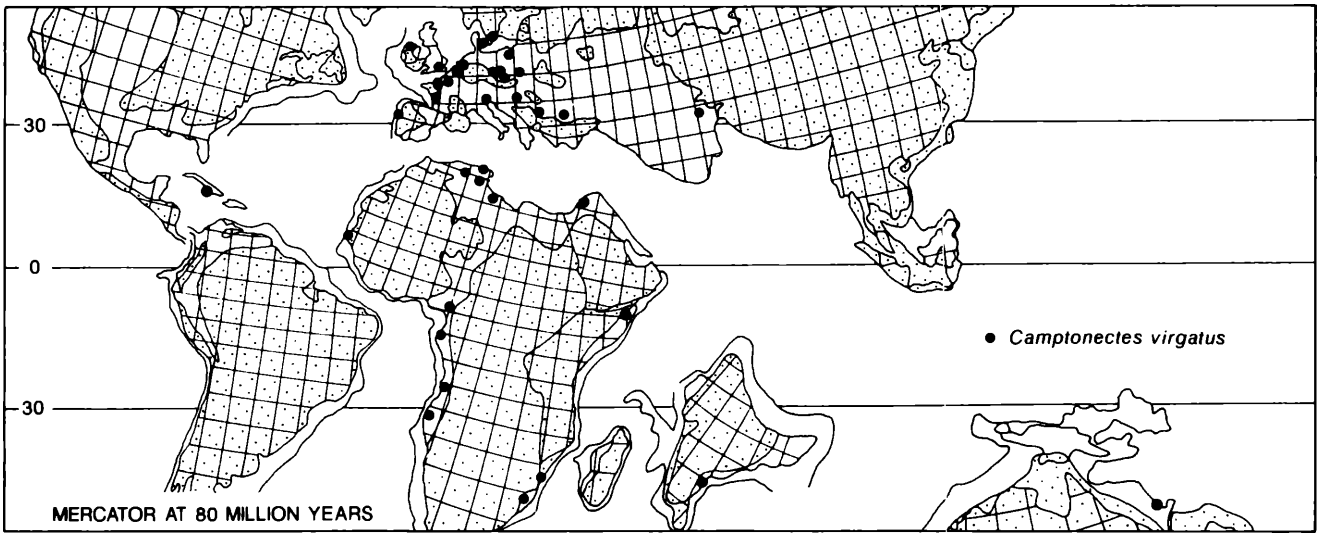
Material: One incomplete right valve (B88: L = 34 mm) from Pinei, Lago di S. Croce.

Discussion: The typical diverging camptonectid striae are clearly visible on the specimen, but the punctae are more difficult to recognize. As in the Gosau (Dhondt, 1987), the specimen from the Lago di S. Croce area is large for the species and the divergent and punctate striation (camptonectid ornamentation) is of the "fine" type, such as also found on African specimens (Dartevelle and Freneix, 1957).

Distribution: Generally more common in coarse deposits, and only rarely found in chalks. It occurs from Cenomanian to Maastrichtian and has a world-wide distribution, but has not previously been described from the latest Coniacian-earliest Campanian rudist formations of the eastern Venetian Prealps (Text-fig. 2).

Lyriochlamys ternata (Münster in Goldfuss, 1833)
Pl. IV, fig. 16.

v . 1833 *Pecten ternatus* Münster - Goldfuss, p. 52, pl. 91, fig. 13.
v . 1833 *Pecten decemcostatus* Münster - Goldfuss, p. 53, pl. 93, fig. 3.
. 1841 *Pecten Dujardini* N. - Roemer, p. 53.
v . 1847 *Pecten cenomanensis* d'Orbigny - d'Orbigny, p. 603, pl. 439, figs 5-11.
v . 1901 *Pecten De Giorgii* n. sp. - Dainelli, p. 685, pl. 12, fig. 4.



Text-fig. 2 - Palaeogeographic distribution of *Camptonectes virgatus* (Nilsson, 1827) including occurrences from Cenomanian to Maastrichtian.

v . 1972b *Lyropecten (Aequipecten?) ternatus* (G. von Muenster in A. Goldfuss) - Dhondt, p. 42, pl. 2, figs 3a, b; pl. 3, figs 1a-d (*cum syn.*).
. 1976 *Chlamys dujardini* (Roemer) - Pojarkowa, p. 18, pl. 5, figs 1-4.
. 1981 *Chlamys (Aequipecten) dujardini* (Roemer) - Tzankov in Tzankov *et al.*, p. 105, pl. 46, figs 5-7.
v ? 1982 *Chlamys (Lyriochlamys) decemcostata* Goldfuss - Sobetski, p. 110, pl. 11, fig. 15.
. 1986 *Chlamys (Lyriochlamys) septemplicata* (Nilsson) - Abdel-Gawad, p. 154, pl. 33, figs 4-5 (*non* Nilsson, 1827).

Material: One left valve [DGP 26693: H = (28) mm] from Col dei Schiosi.

Discussion: The *Lyriochlamys ternata* specimen from Col dei Schiosi is worn and therefore the ribs seem smooth. Only the anterior auricle shows the commarginal ornamentation which is typical for the species (Dhondt, 1972b).

In the Museo di Geologia e Paleontologia, University of Florence, we saw the holotype of *Pecten degiorgii* Dainelli, 1901 (IGF 423). This Cenomanian specimen from Lequile, Capo di S. Maria di Leuca (Apulia), undoubtedly belongs to *Lyriochlamys ternata*.

Distribution: Widely distributed from Cenomanian to Maastrichtian, frequent in coarse bioclastic deposits of temperate province. Rare in Tethys: Cenomanian of Friuli and Apulia (Italy), Maastrichtian of Uzbekistan and Egypt (Malchus, 1990, p. 39).

Chlamys? subacuta (Lamarck, 1819)
Pl. IV, fig. 8.

\+ 1819 *Pecten subacutus* - Lamarck, p. 181.
v . 1842 *Pecten acuminatus* m. - Geinitz, p. 84, pl. 21, fig. 7.
v . 1902 *Pecten (Chlamys) subacutus* Lamarck - Woods, p. 169, pl. 31, figs 7-9 (*cum syn.*).
v . 1908a *Pecten* sp. - Parona, p. 302.
? 1963 *Chlamys subacutus* Lam. - Gambashidze, p. 124.
v . 1973a *Chlamys? subacuta* (J.-B. Lamarck) - Dhondt, p. 28, pl. 4, figs 1a-e (*cum syn.*).
? 1981 *Chlamys (Aequipecten) acuminatus* (Geinitz) - Tzankov in Tzankov *et al.*, p. 106, pl. 46, figs 8-10.

Material: One worn valve [DGP 26722: H = (20.6) mm; L = 15.2 mm; R = 32; UA = 56°)], mentioned by Parona (1908a) as *Pecten* sp., from Candaglia, 200 m beyond the "cantoniera" on the road towards the fossiliferous locality Col dei Schiosi (information labelled by Parona).

Discussion: The specimen lacks auricles but its general shape and rib distribution remind one strongly of *Chlamys? subacuta*. The small fragment of shell preserved with rib ornamentation on the anterior (?) side of the valve confirms this identification. The rib number and umbonal angle fall within the variability of *Chl.? subacuta* established in Dhondt (1973a).

The presence of *Chl.? subacuta* in the Col dei Schiosi assemblage indicates a possible connection with temperate European areas.

Distribution: Rare in the Albian (southern England, Switzerland) but frequent in the Cenomanian [southern England, Belgium, western and SW France, Czechia, Germany (Saxony), NE Italy, Algeria, Tunisia, Israel, Jordan], mainly in coarse deposits (as in the western Carnic Prealps).

Mimachlamys catulloi sp. nov.
Pl. IV, figs 13, 14.

Holotype: Specimen DGP 7094, coll. Catullo (left valve); Pl. IV, fig. 14.

Paratype: Specimen B79 (left valve); Pl. IV, fig. 13.

Type locality: Pinei, Lago di S. Croce (Belluno, eastern Venetian Prealps, NE Italy).

Type horizon: Fadalto Limestone of latest Coniacian-earliest Campanian age.

Derivation of name: In honour of Tommaso Antonio Catullo (1782-1869), who was the first to describe fossils from the Cretaceous rudist limestones of the Lago di S. Croce area and collected the holotype.

Diagnosis: Medium-sized, somewhat opisthocline *Chlamys* species with numerous (about 125) straight or slightly undulating ribs, bearing small scales, regularly placed at the intersections with the growth lines. The ribs are separated by narrower interspaces. The camptonectid striae can be seen near the anterior and posterior margins of the disc. Auricles are relatively small and covered with radial riblets.

Description: The left valve is fairly convex for the genus and opisthocline; it has a wide umbonal angle. On well preserved parts of the shell the ribs are covered with small scales placed more or less on regular commarginal lines (Pl. IV, fig. 14); on parts of the shell where the external shell layer has been peeled off the ribs are more or less smooth and narrower than the interspaces (Pl. IV, fig. 13). The rib number increases irregularly by division.

The anterior auricle is small, triangular, acute-angled, with two visible radial riblets. The posterior auricle is larger, its outer margin reaching to about one third of the total height of the valve, and it bears eight radial riblets.

Dimensions (mm):

	H	L	B'	UA	R
DGP 7094	51.5	46.1	10.0	—	128
B79	58.0	—	10.5	110°	±125

Discussion: The obliquity, especially in the young stages of the valve, makes the generic assignment of the species under discussion difficult. It is similar in shape to a limid, yet its auricles belong definitely to a pectinid. Unusual obliquity in a pectinid has also been found to exist in *Pecten raduloides* Stoliczka, 1871 (p. 431, pl. 31, fig. 20; pl. 32, figs 2, 3; pl. 42, fig. 6) from the Ariyalur Formation, Upper Cretaceous of India. The Indian species, however, has a different ornamentation than that of *Mimachlamys catulloi* sp. nov.

Among the Cretaceous *Chlamys - Mimachlamys* species known, the ornamentation of *M. catulloi* is closest to that of *M. cretosa* (Defrance in Brongniart, 1822), Turonian to latest Maastrichtian, as figured in Woods, 1902 (under *Pecten cretosus*, p. 174, pl. 32, figs 4-6, pl. 33, figs 1-12), and discussed by Dhondt (1973a). It remains possible that specimens collected later shall prove that the types of *M. catulloi* represent an unusual morphotype of *M. cretosa*. At present we have to consider it as belonging to

a separate species, since its shape falls out of the known variability of *M. cretosa*.

Distribution: *Mimachlamys catulloi* sp. nov. has so far only been found in uppermost Coniacian-lowermost Campanian of Pinei, Lago di S. Croce, eastern Venetian Prealps, NE Italy.

Neithea (*Neithea*) *aequicostata* (Lamarck, 1819)
Pl. IV, fig. 15; Text-fig. 3.

\+ 1819 *Pecten aequicostatus* - Lamarck, p. 181.
. 1961 *Neithea aequicostata* Lamarck - Muromtsieva, Janin, p. 191, pl. 11, figs 13, 14.
? 1963 *Neithea gilletae* Fawzi - Fawzi, p. 30, pl. 2, fig. 3.
. 1971 *Janira aequicostata* (Lamarck) - Jerzykiewicz, p. 301, pl. 14, figs 5, 6; pl. 16, fig. 3; pl. 17, fig. 5.
v . 1973b *Neithea* (*Neithea*) *aequicostata* (J.B. Lamarck) - Dhondt, p. 10, pl. 1, figs 1a-c (*cum syn.*).
v non 1977 *Neithea aequicostata* (Lamarck) - Sirna in Praturlon, Sirna, p. 96 [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)].
v non 1981 *Neithea aequicostata* (Lamarck) - Carbone *et al.*, p. 202 [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)].
v non 1981 *Neithea aequicostata* (Lamarck) - Carbone, Sirna, p. 435. [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)].
? 1981 *Neithea* (*Neithea*) *aequicostata* (Lamarck) - Tzankov in Tzankov *et al.*, p. 106, pl. 47, figs 1, 2.
. 1992 *Neithea* (*Neithea*) *aequicostata* (Lamarck) - Callapez, p. 48, pl. 1, fig. 5.

Material: Interior of a left valve (B182: H = 36 mm; L = 35 mm) and incomplete exterior of a left valve (B230), both from Col dei Schiosi.

Remarks: Valve B182 shows about 35 equal ribs, hence its identification.

Discussion: The incomplete specimen (MPUR/ns 23-17) from Late Cenomanian strata in the Marsica mountains (Abruzzo, central Italy) identified by Sirna in Praturlon and Sirna (1977; see also Carbone *et al.*, 1981 and Carbone and Sirna, 1981) as *Neithea aequicostata* has (even when taking into consideration the missing parts) too few ribs to represent this species. It is very probably a specimen of *N.* (*N.*) *hispanica* (d'Orbigny, 1850). The latter taxon, which is close to *N.* (*N.*) *aequicostata* but has fewer ribs (20 against 24 to 35), is frequent in Tethyan outcrops. Therefore, these two species could probably be interpreted as vicariants (Text-fig. 3).

Distribution: Widely distributed in Albian-Cenomanian strata of temperate sea deposits. In Tethys, however, it is rare.

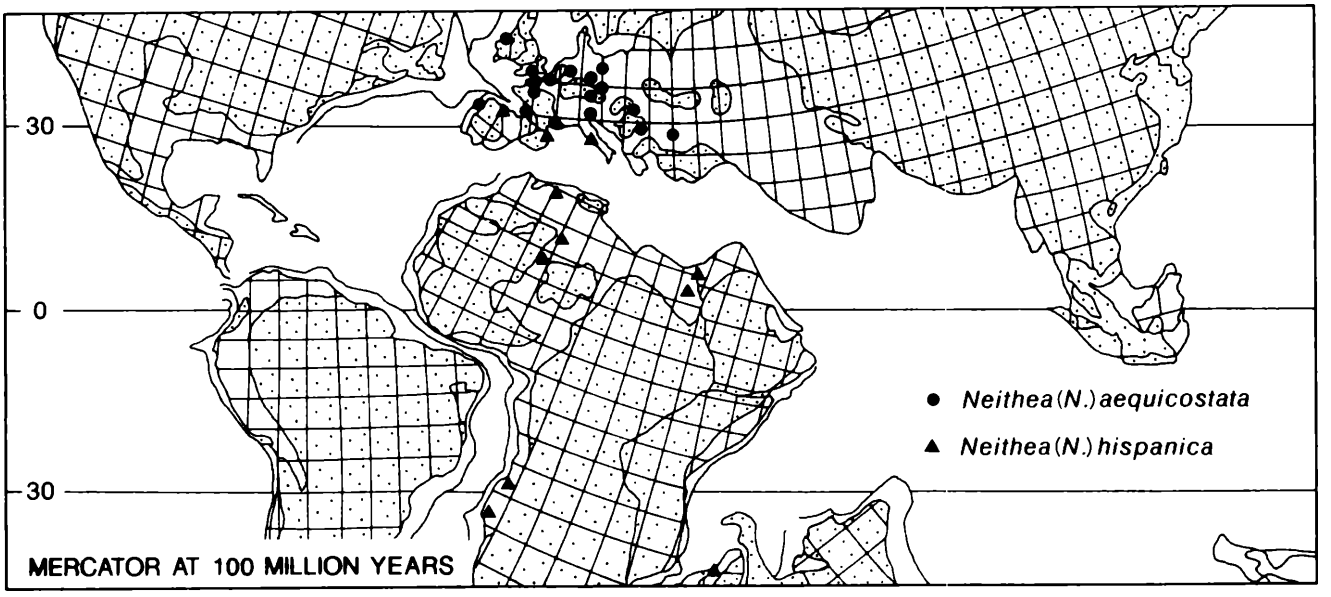
Neithea (*Neithea*) *dutrugei* (Coquand, 1862)
Pl. IV, fig. 17; Text-fig 4.

v + 1862 *Janira Dutrugei* H. Coq. - Coquand, p. 219, pl. 13, figs 1, 2.
1907 *Vola Dutrujei* Coq. var. *Beirensis* Choff. - Parona, p. 235.
1909 *Vola Dutrujei* Coq. var. *Beirensis* Choffat - Parona in Parona *et al.*, p. 36.
1926 *Neithea Dutrujei* Coq., var. *Beirensis* Choffat - Parona, p. 52.
v . 1973b *Neithea* (*Neithea?*) *dutrugei* (H. Coquand) - Dhondt, p. 59, pl. 4, fig. 3; pl. 5, figs 4a, b (*cum syn.*).
. 1992 *Neithea* (*Neithea*) *dutrugei* (Coquand) - Callapez, p. 51, pl. 1, fig. 4.

Material: One right valve from Pinei, Lago di S. Croce (DGP 2507, coll. de Zigno: H = 31.5 mm; L = 25.0 mm).

Discussion: The specimen has an incomplete shell, but the tripartite principal ribs, and the five intercalary ribs of which the middle one is more strongly developed, are clearly visible. It is thus very similar to the types of Coquand (housed in MAFI, Budapest).

Distribution: Typical Tethys species recorded from Cenomanian to (?) Campanian: Portugal, Italy (eastern Venetian Prealps and Abruzzo), Croatia (Istria), Morocco, Algeria, Tunisia, Libya, Egypt, Israel, Syria, Iraq (Text-fig. 4).



Text-fig. 3 - Palaeogeographic distribution of *Neithea* (*N.*) *aequicostata* (Lamarck, 1819) and *N.* (*N.*) *hispanica* (d' Orbigny, 1850).

Neithea (*Neithea?*) *fleuriausiana* (d'Orbigny, 1847)
Pl. V, fig. 20; Pl. VII, figs 1-4b; Text-fig. 5.

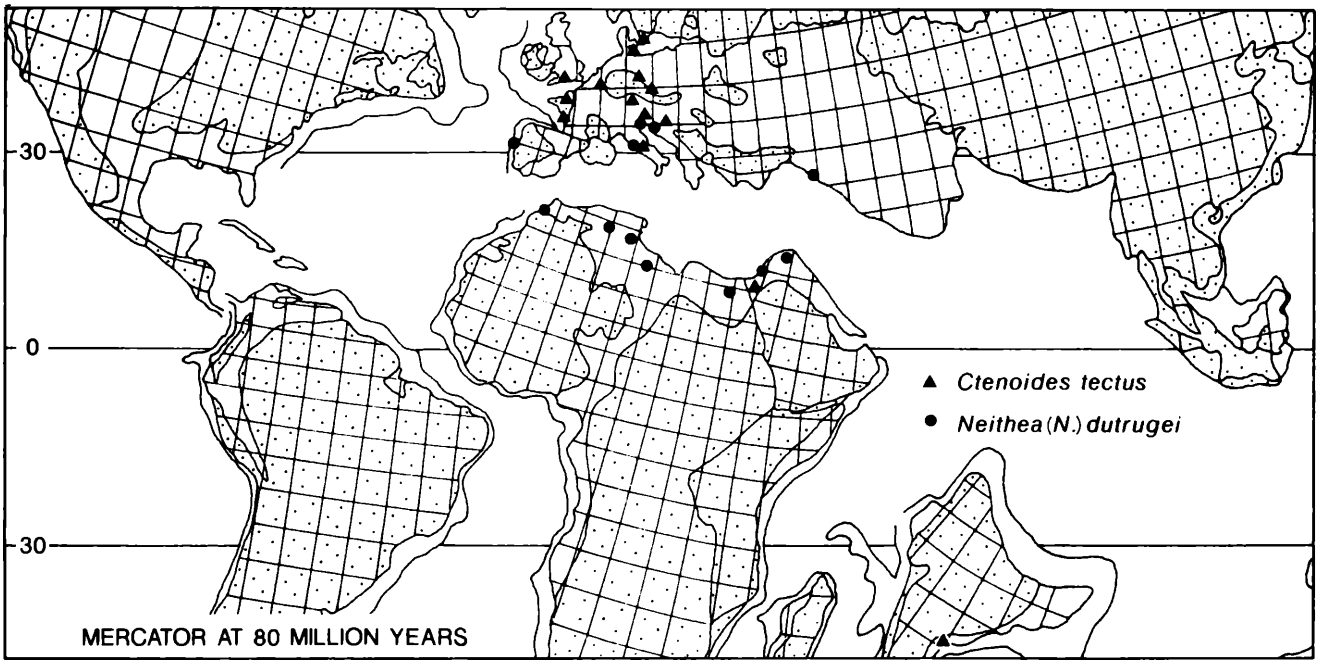
v + 1847 *Janira Fleuriausiana*, d'Orbigny - d'Orbigny, p. 631, pl. 443, figs 1, 2.
. 1892 *Neithea acuticostata* n. sp. - Futterer, p. 80, pl. 3, fig. 7.
v p 1897 *Neithea Zitteli* Pirona sp. - G. Boehm, p. 171.
v p 1897 *Neithea Zitteli* Pirona sp. - G. Boehm in Marinelli, p. 1030.
. 1901 *Neithea acuticostata* Futterer - Redlich, p. 76.
v . 1902 *Vola Lapparenti* Choffat - Choffat, p. 153, pl. Asiphonidae 3, figs 1-3.
v . 1902 *Vola Fleuriausiana* d'Orbigny - Choffat, p. 153, pl. Asiphonidae 3, fig. 4.
1903 *Vola Lapparenti* Choff. - Schubert, p. 266.
1907 *Vola Fleuriausiana* d'Orb. - Parona, p. 235.
v non 1908a *Pecten* (cfr. *Janira Fleuriausiana* d'Orb.) - Parona, p. 322 [= *Spondylus arcuatus* (Catullo, 1834)].
1909 *Vola fleuriausiana* d'Orb. - Parona in Parona *et al.*, p. 36.
1923 *Pecten* (*Neithea*) *Lapparenti* Choffat - Parona, p. 20.
1923 *Pecten* (*Neithea*) *Fleuriausianus* (d'Orb.) - Parona, p. 20.
v . 1926 *Neithea Lapparenti* (Choff.) - Parona, p. 53, pl. 5, figs 5a, b.
v . 1956a *Neithea fleuriausiana* (d'Orbigny) - Roger, figs 1-5.
1963 *Neithea lapparenti* Choffat - Pejović, Pašić, pp. 53, 59.
v ? 1967 *Neithea* cf. *lapparenti* (Choff.) - Pleničar, p. 150.
v . 1967 *Neithea acuticostata* Futterer - Polšak, p. 30, pl. 2, fig. 3.
v . 1967 *Neithea lapparenti* (Choffat) - Polšak, p. 32, pl. 2, fig. 2 (*cum syn.*).
v . 1973b *Neithea* (*Neithea?*) *fleuriausiana* (A. d'Orbigny) - Dhondt, p. 61, pl. 4, fig. 1 (not syn.).
. 1990 *Neithea lapparenti* Choff. - Galvani, fig. on p. 61.

Material:
- From Col dei Schiosi: external mould of an incomplete left valve (B181: H > 56 mm); a decorticated right valve (B179) is tentatively also assigned to the species under discussion.
- From Bocca di Crosis near Tarcento (Udine, Friuli): one small right valve (IGF 3090E).
- From (?) Monte di Medea, Cormons, Udine: one large right valve (MSNT 10823, coll. Renzi).
- From Aurisina, Trieste: one bivalved specimen (MSNT 11829) and one right valve (MGB/Fr 3).
- From Monrupino (= Repentabor), Trieste: about 25 usually bivalved and generally large specimens [MSNT 11830 and 11831, originals of Parona (1926); MSNT 11835-11840 and about 15 unregistered specimens, all from the Zolla quarry; MGB/Fr 4; DGP 26692].
- From Buzet (= Pinguente), Istria, Croatia: one right (?) valve (MSNT 11828).
- From Pula (= Pola), Istria, Croatia: one distorted bivalved specimen (MB, coll. Ewald).

Diagnosis: Large to very large, relatively not very inflated *Neithea* species, with a straight beak, very large auricles, and numerous irregularly distributed ribs, of which six are more strongly developed.

Dimensions (mm):

	H	L	B	B'
IGF 3090E	13	15	—	(5)
MGB/Fr 3	55	70	—	—
B179	(71)	(70)	—	—
MSNT 11830	84	96	21	—
MSNT 10823	103	115	—	(38)
MSNT 11829	108	120	20	—



Text-fig. 4 - Palaeogeographic distribution of *Neithea* (*N.*) *dutrugei* (Coquand, 1862) and *Ctenoides tectus* (Goldfuss, 1835) including occurrences from Cenomanian to Maastrichtian.

The specimens on which the value B has been measured have been flattened; therefore the original value in uncrushed specimens exceeded the measured quantity.

Discussion: The straight beak of *Neithea* (*Neithea?*) *fleuriausiana* results in a less convex right valve than that normally found in the nominal subgenus as shown by the type species *Pecten aequicostatus* Lamarck, 1819. Yet, the general aspect of the species is closer to *Neithea*, especially because of the ornamentation, than to any other Cretaceous pectinid genus.

The rib ornamentation can vary greatly. Some specimens have strongly subdivided ribs (primary and secondary), as in the *N.* (*N.?*) *fleuriausiana* specimen from the Ile Madame figured in Dhondt (1973b, pl. 4, fig. 1). Others have less divided ribs, which look as if there are fewer ribs, such as can be seen on specimens from the Trieste area figured herein (Pl. V, fig. 20; Pl. VII, fig. 2). An extreme reduction in the rib number can be seen on the specimen from Monte di Medea which has only 14 ribs (Pl. VII, fig. 4a). Likewise, relatively few ribs are found on *N. acuticostata* Futterer, 1892 which is based on an incomplete right valve said to have come from "Calloniche". The description and the figure of the specimen seem to indicate a close similarity with *N.* (*N.?*) *fleuriausiana*; the holotype and only specimen of the taxon was not found in the Museum für Naturkunde in Berlin. Very likely the locality of origin of the specimen is Col dei Schiosi rather than "Calloniche".

The description given by Dhondt (1973b) is accurate, but the synonymy is incorrect: *N.* (*N.?*) *fleuriausiana* (= *N. lapparenti*), characterised by a straight beak and a fairly flat right valve, is herein considered as a separate taxon from *N.* (*N.?*) *inconstans* (Sharpe, 1850) [= *N. stefanoi* (Choffat, 1902)?] (see below), which has a more convex right valve with a slightly incurved beak. Both taxa are roughly coeval and specific for rudist formations.

N. roemeri (Hill, 1893), from the Buda Limestone (Early Cenomanian, Austin, Texas), is very similar to *N. stefanoi*, and is also a species associated with rudists.

N. zitteli in G. Boehm [1897, and in Marinelli (1897)] is based on a right and a left valve from Bocca di Crosis near Tarcento (Udine, Friuli), housed in the Museo di Geologia e Paleontologia, University of Florence (IGF 3090E). The small right valve belongs undoubtedly to a young *N.* (*N.?*) *fleuriausiana* specimen.

Distribution: *Neithea* (*N.?*) *fleuriausiana* is sometimes found in mass occurrences in one bed. This is for example apparent in the Monrupino area (Trieste Karst), where numerous bivalved, very large and more or less flattened specimens occur together in what is a largely monospecific assemblage.

N. (*N.?*) *fleuriausiana* has only been recorded from Late Cenomanian rudist beds: Portugal, SW France (Ile Madame, Ile d'Aix, Angoulème), Italy (Friuli, Venezia Giulia and Abruzzo), Croatia (Istria, Dalmatia), western Slovenia, western Serbia, Greece, Libya (Text-fig. 5).

Neithea (*Neithea?*) *inconstans* (Sharpe, 1850)
Pl. V, figs 7, 19; Text-fig. 5.

v + 1850 *Pecten* (*Janira*) *inconstans* n. s. - Sharpe, p. 188, pl. 19, figs 3a, b.
v . 1902 *Vola inconstans* Sharpe - Choffat, p. 156, pl. 2, figs 4-6.
? 1918 *Neithea inconstans* (Sharpe-Choffat) - Parona, p. 1.
v . 1926 *Neithea inconstans* (Sharpe) - Parona, p. 53, pl. 35, fig. 4.
? 1951 *Vola inconstans* Sharpe - Gheorghiu, p. 18.
? 1959 *Vola inconstans* Sharpe - Gheorghiu, p. 116, pl. 4, figs 1, 2.
1963 *Neithea inconstans* Sharpe - Pejović, Pašić, pp. 54, 59.
1967 *Neithea inconstans* (Sharpe) - Polšak, p. 31.
non 1977 *Neithea incostans* (*sic*) (Sharpe) - Sirna in Praturlon, Sirna, p. 96, fig. 12 [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)?].
non 1981 *Neithea incostans* (*sic*) (Sharpe) - Carbone *et al.*, p. 202 [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)?].
non 1981 *Neithea incostans* (*sic*) (Sharpe) - Carbone, Sirna, p. 435 [= *N.* (*N.*) *hispanica* (d'Orbigny, 1850)?].

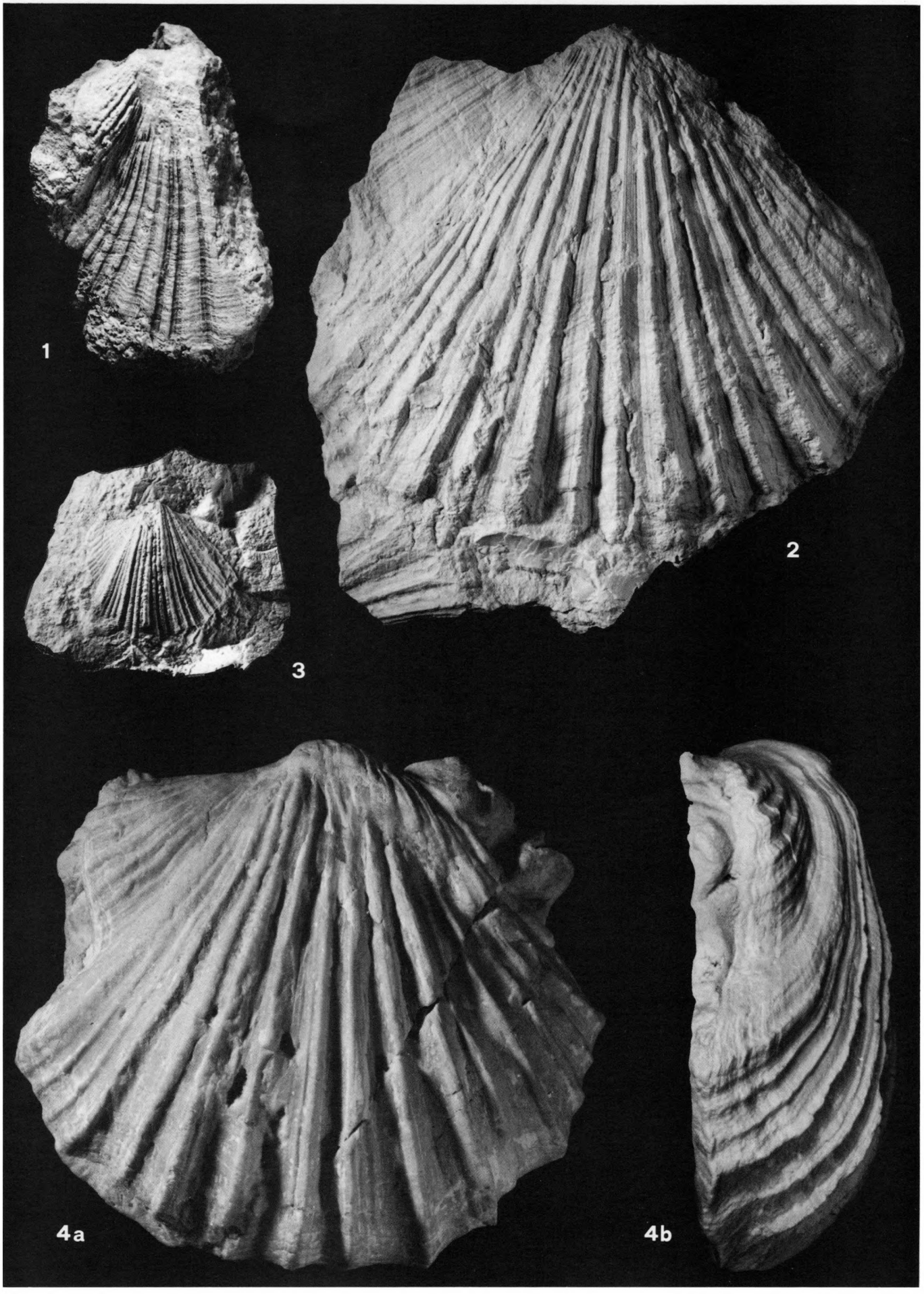
Material:
- One incomplete right valve from Monte Candole (southern side of the Monte Cavallo massif, 6 km NE of the Col dei Schiosi fossiliferous locality, western Friuli) [DGP 26727: H = 57 mm; L = 58 mm; B'= (18) mm].
- One poorly preserved right valve (MSNT 11832) from Groznjan (= Grisignana), Istria, Croatia, original of Parona (1926).
- One small incomplete bivalved specimen (MSNT 11833) from Sovinjak (= Sovignacco), Istria, Croatia.

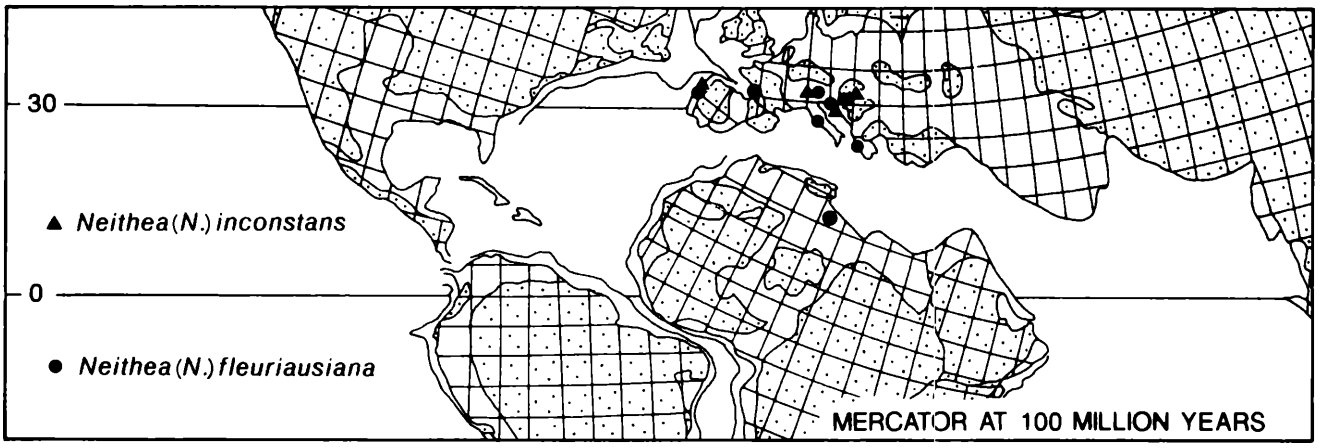
Discussion: The right valves are relatively convex; the left valve of the small bivalved specimen from Sovinjak is moderately concave. The rib distribution, as already noted by Parona (1926), is comparable to that figured by Choffat (1902, pl. 2, figs 5, 6). The material at our disposal does not warrant further comments.

EXPLANATION OF PLATE VII

Figs 1-4b - *Neithea* (*Neithea?*) *fleuriausiana* (d'Orbigny, 1847).
1 - Incomplete left valve, external mould.
Upper Cenomanian, Col dei Schiosi (Pordenone); B181.
2 - Right valve.
Upper Cenomanian, Aurisina (Trieste); MSNT 11829.
3 - Right valve [= "*Neithea zitteli* Pirona" *p.p.* in G. Boehm (1897) and in G. Boehm in Marinelli (1897; 1902)].
Upper Cenomanian, Bocca di Crosis, Tarcento (Udine); IGF 3090E; x 2.
4a, 4b - Right valve.
4b - Posterior view.
Upper Cenomanian, ?Monte di Medea, Cormons (Udine); MSNT 10823

All the specimens are whitened and, unless otherwise stated, natural size.


1
2
3
4a
4b



Text-fig. 5 - Palaeogeographic distribution of *Neithea* (*N.?*) *fleuriausiana* (d'Orbigny, 1847) and *N.* (*N.?*) *inconstans* (Sharpe, 1850).

The specimens from central Italy assigned to this taxon in literature have not been seen by us. The Parona (1918) specimen is neither described nor illustrated. A valve from the Lepini Mts. (Latium) is discussed and illustrated by Sirna in Praturlon and Sirna (1977) (data later re-used in Carbone *et al.*, 1981 and in Carbone and Sirna, 1981). Despite what is claimed, we think that because of its subequal ribs and of its shape, this specimen cannot be considered as belonging to *Neithea inconstans*. Its probable total rib number (20) and the distribution of the ribs make it a very likely *N.* (*N.*) *hispanica* (d'Orbigny, 1850), but without seeing the specimen we cannot at the present time be completely certain about its specific attribution.

Distribution: Described only from Cenomanian rudist formations [Portugal, NE Italy (Friuli), Croatia (Istria) and western Serbia, always associated with *N.* (*N.?*) *fleuriausiana*] (Text-fig. 5).

Neithea (*Neithea*) *quinquecostata* (J. Sowerby, 1814)
Pl. V, figs 1-3.

v + 1814 *Pecten quinquecostata* - J. Sowerby, p. 122, pl. 56, figs 4-8.
v non 1928 *Neithea quinquecostata* (Sow.) (Stoliczka) - Parona, p. 123 [= *N. regularis* (Schlotheim, 1813)].
v . 1961 *Neithea quinquecostata* (Sowerby) - Bobkova, p. 110, pl. 4, figs 1-3.
p 1962 *Neithea quinquecostata* (Römer) - Abbass, p. 52, pl. 6, fig. 10; not pl. 6, figs 9, 11, 14.
1967 *Neithea* (*Neitheops*) *quinquecostata* (Sowerby) - Polšak, p. 31, pl. 2, fig. 4.
v . 1973b *Neithea* (*Neithea*) *quinquecostata* (J. Sowerby) - Dhondt, p. 29, pl. 2, figs 2a-c (*cum syn.*).
1974 *Neithea quinquecostata* (Sowerby) - Kociubynskij, Savczinskaja, p. 87, pl. 25, figs 6-8.
v . 1977 *Neithea* (*Neitheops*) *quinquecostata* (Sowerby) - Sobetski, p. 69, pl. 5, figs 2, 3.
non 1979 *Neithea quinquecostata* (Sowerby) - Barbieri *et al.*, p. 13, fig. 6 [= *Neithea* (*N.*) *syriaca* (Conrad, 1852)].
1981 *Neithea* (*Neithea*) *quinquecostata* (Sowerby) - Tzankov in Tzankov *et al.*, p. 108, pl. 48, figs 1, 2.
. 1985 *Neithea* (*Neithea*) *quinquecostata* (Sowerby) - Freneix in Freneix, Viaud, p. 203, pl. 1, figs 14-16.
. 1987 *Neithea* (*Neithea*) *quinquecostata* (J. Sowerby) - Cleevely, Morris, p. 85, pl. 19, fig. 10.

Material: Five right valves (B50, B52, B62, B64, B65) from Pinei, Lago di S. Croce.

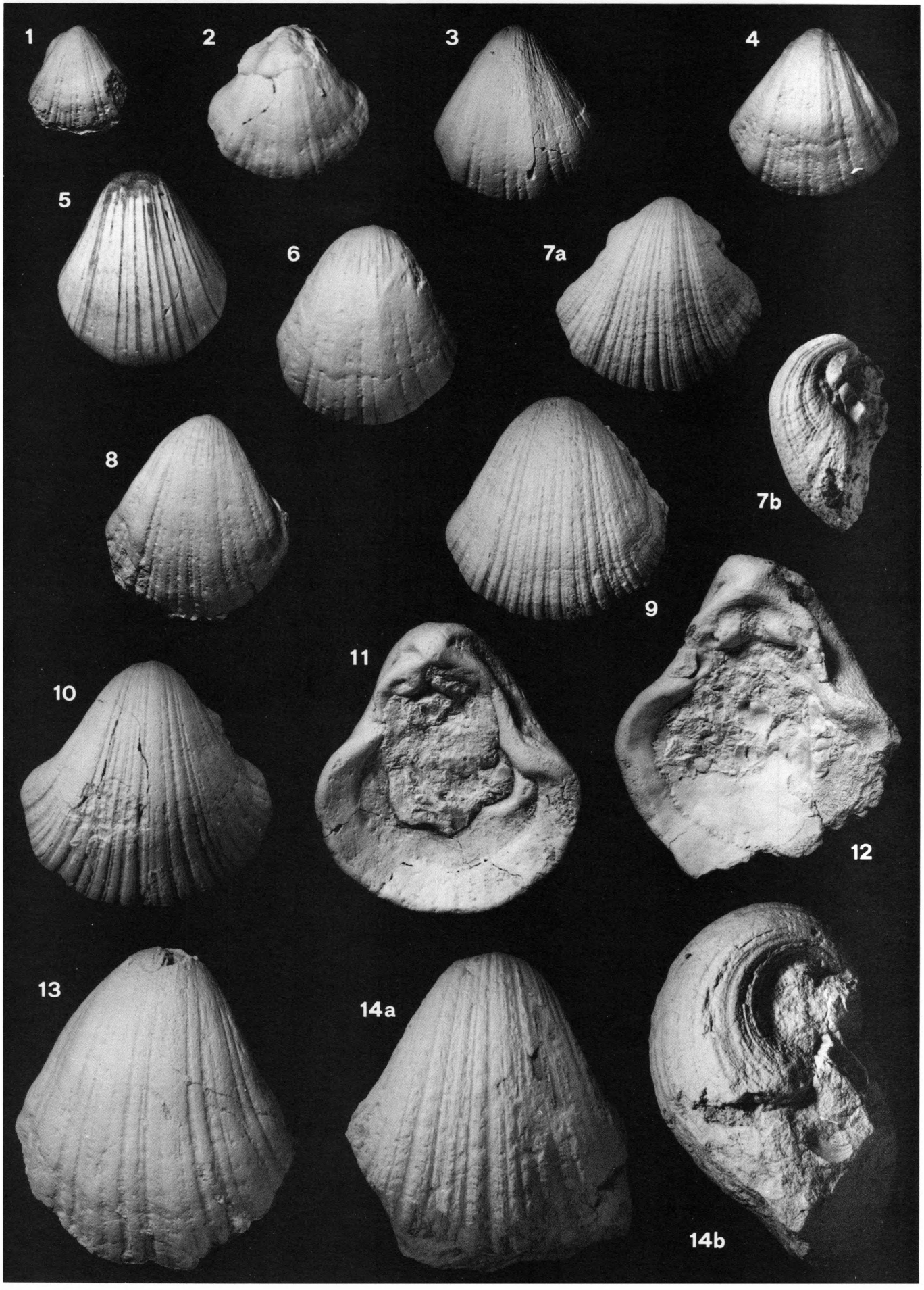
Dimensions (mm):

	H	L	L/H
B62	(19)	16.2	(0.85)
B65	27.0	24.8	0.92
B52	(35)	—	—
B50	36.4	—	—

EXPLANATION OF PLATE VIII

Figs 1-14b - *Neithea* (*Neithea*) *zitteli* (Pirona, 1884).
Right valves showing different rib patterns resulting from their different state of preservation.
1-13 - Topotypes.
5 - The worn surface of the unwhitened valve shows dark, radial lines representing "ribs" emerging from the coarsely recrystallized internal shell layer.
7b - Anterior view showing the strongly incurved umbo.
9 - Original of Parona, 1908a, p. 320.
11, 12 - Interior of the valves showing the pallial line, the large muscle scar delimited by a ridge, and the strong cardinal crura.
Upper Cenomanian, Col dei Schiosi (Pordenone); B32, B193, B199, B194, B201, P2, B204, B203, MTO (unreg.), B210, P1, B223, B221.
14b - Anterior view; note the strongly incurved umbo.
Upper Cenomanian, unspecified locality in Istria; DGP 26721.

All the specimens are natural size and, unless otherwise stated, whitened.


1
2
3
4
5
6
7a
7b
8
9
10
11
12
13
14a
14b

The values for B' have not been included because precise measuring is impossible since the commissure planes cannot always be correctly defined because matrix often partially covers the valves.

Discussion: The material from Pinei, though not well preserved, shows the typical shape and ornamentation of *Neithea* (*N.*) *quinquecostata* as described and discussed in Dhondt (1973b).

Parona (1928) described a "Senonian" fauna from the Karakoram range; the *Neithea* specimen which he identified as *quinquecostata* (IGF 3432E) is a typical *N.* (*N.*) *regularis* (Schlotheim, 1813) with three equal secondary ribs between the more prominent primary ribs. This latter species is known from Turonian to uppermost Maastrichtian; it has a very wide geographical distribution and is generally found in temperate water deposits.

Distribution: Barremian to latest Maastrichtian, worldwide.

Neithea (*Neithea*) *sexangularis* (d'Orbigny, 1847)
Pl. V, fig. 4.

v + 1847 *Janira sexangularis*, d'Orbigny - d'Orbigny, p. 648, pl. 448, figs 5-8.
v . 1956b *Neithea sexangularis* d'Orbigny - Roger, figs 1-8.
v . 1973b *Neithea* (*Neithea*) *sexangularis* (A. d'Orbigny) - Dhondt, p. 53, pl. 3, fig. 3 (*cum syn.*).
v . 1985 *Neithea sexangularis* (d'Orbigny) - Dhondt, p. 41, fig. 2d.

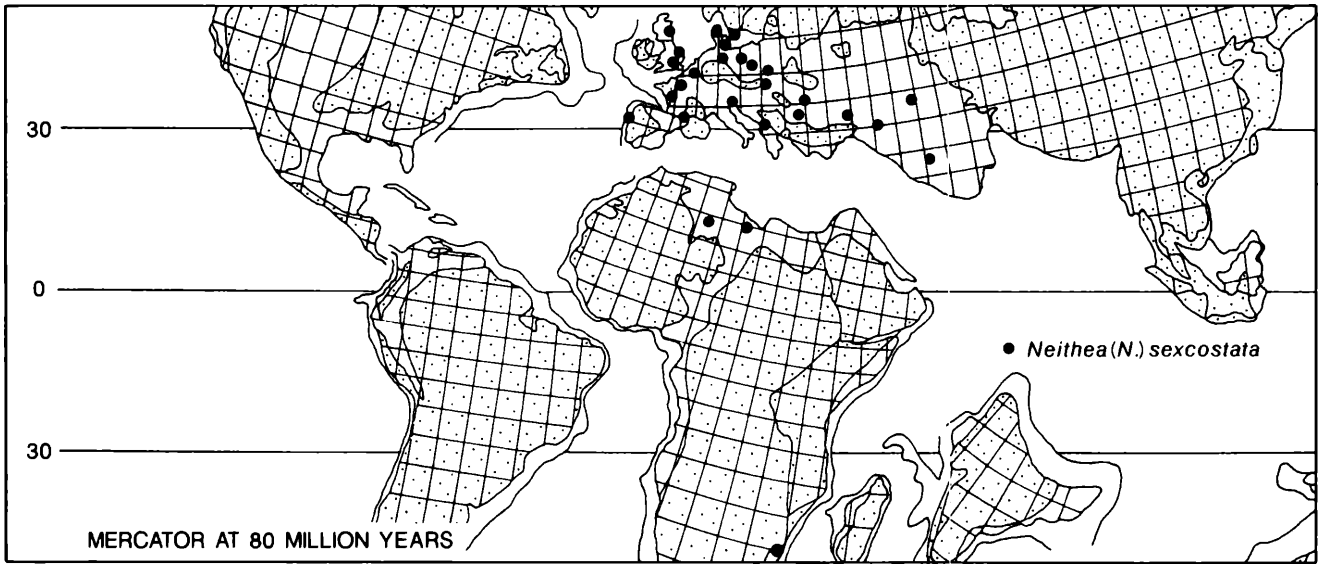
Material: One small specimen (B128: H = 19.5 mm; L = 17.9 mm.) from Pinei, Lago di S. Croce.

Discussion: Though somewhat distorted, the small specimen from Pinei shows typical characteristics of *N.* (*N.*) *sexangularis*: the wide angular, deeply subdivided principal ribs, the deep intercostal intervals which here seem smooth. As stated previously (Dhondt, 1985), it could be that *N.* (*N.*) *sexangularis* represents only an extreme variation of *N.* (*N.*) *striatocostata* (Goldfuss, 1833) but until transitions between the two are found it is preferable to describe them as distinct taxa.

Distribution: Recorded from Coniacian to Campanian (?Maastrichtian): SW France (Aquitaine), Spain, Germany (Bavarian Alps), NE Italy (eastern Venetian Prealps), ?India.

Neithea (*Neithea*) *sexcostata* (Woodward, 1833)
Pl. V, figs 5, 6; Text-fig. 6.

\+ 1833 *Pecten sexcostatus* - Woodward, p. 48, pl. 5, fig. 29.
v . 1903 *Pecten* (*Neithea*) *sexcostatus*, Woodward - Woods, p. 214, pl. 40, figs 10-15; pl. 41, figs 1-10.
. 1923 *Pecten* (*Neithea*) *Dutemplei* (d'Orb.) - Parona, p. 19.
v . 1973b *Neithea* (*Neithea*) *sexcostata* (S. Woodward) - Dhondt, p. 44, pl. 5, figs 2a, b (*cum syn.*).
. 1974 *Neithea sexcostata* (Woodward) - Kociubynskij, Savczinskaja, p. 87, pl. 25, figs 4, 5.
. 1974 *Neithea quinquecostata* (Sowerby) - Marcinowski, p. 124, pl. 22, fig. 4 (*non* Sowerby, 1814).
v . 1977 *Neithea* (*Neitheops*) *sexcostata* (Woodward) - Sobetski, p. 71, pl. 5, figs 4, 5.
v . 1977 *Neithea* (*Neitheops*) *subtilis* Sobetski, sp. nov. - Sobetski, p. 75, pl. 5, fig. 8.
? 1981 *Neithea* (*Neithea*) *sexcostata* (Woodward) - Tzankov in Tzankov *et al.*, p. 109, pl. 49, fig. 1.
v . 1982 *Neithea sexcostata* (Woodward) - Sobetski, p. 116, pl. 11, fig. 23.
v . 1982 *Neithea simbirskensis* (Orbigny) - Sobetski, p. 116, pl. 11, fig. 24.
v . 1982 *Neithea sexcostata* (Woodward) - Dhondt, p. 85, pl. 2, figs 7-11.
. 1986 *Neithea* (*Neithea*) *sexcostata* (Woodward) - Abdel-Gawad, p. 156, pl. 32, fig. 3.



Text-fig. 6 - Palaeogeographic distribution of *Neithea* (*N.*) *sexcostata* (Woodward, 1833) including occurrences from Cenomanian to Maastrichtian.

. 1987 *Neithea (Neithea) sexcostata* (S. Woodward) - Cleevely, Morris, p. 86, pl. 19, figs 7-9.
. 1992 *Neithea (Neithea) sexcostata* (Woodward) - Callapez, p. 49, pl. 2, fig. 2.

Material: Two right valves from Pinei, Lago di S. Croce [B67 (H = 19.4 mm; L = 21.2 mm) and B69 (H = 20.4 mm)].

Discussion: The *N. (N.) sexcostata* specimens from Pinei have not very salient principal ribs, and about five intercalary ribs in each interval between these primary ribs. They agree with "form α" in Woods (1903).

Distribution: Recorded from Cenomanian to uppermost Maastrichtian, mainly in chalks but also in biocalcarenites, in Europe and extending into Kazakhstan and North Africa (Text-fig. 6).

Neithea (Neithea) striatocostata robusta subsp. nov.
Pl. V, figs 8-18; Pl. VI, figs 2a-4b; Text-fig. 7.

. 1892 *Neithea quadricostata* Sowerby - Futterer, p. 80, pl. 3, fig. 6 [*non* J. Sowerby, 1814 = *N. gibbosa* (Pulteney, 1813)].
1932 *Pecten (Neithea) quadricostatus* Sow. - Parona, p. 98 [*non* J. Sowerby, 1814 = *N. gibbosa* (Pulteney, 1813)].

Holotype: Specimen B129 (right valve; Pl. V, fig. 8).

Paratypes: Twenty nine right valves (B48, B49, B54-56, B61, B63, B66, B68, B70-74, B77, B78, B94, B163, B 164, P16-18, P40, DGP 26708, five unregistered specimens, IGF coll. Meneguzzo), and three left valves (B83, B84, B96), all from Pinei. Three right valves from "Calloniche" (= Pinei, in this paper) identified by Parona (MS) as "*Neithea quadricostata* (Sowerby) (secondo Futterer)" (MGB/Ve 801-803).

Type locality: Pinei, Lago di S. Croce (Belluno, eastern Venetian Prealps, Italy).

Type horizon: Fadalto Limestone of latest Coniacian-earliest Campanian age.

Derivation of name: From *robustus*, *-a*, *-um* (lat.) = sturdy, because of the unusual thickness of the shell.

Diagnosis: Subspecies of *Neithea (Neithea) striatocostata* (Goldfuss, 1833) with very thick shell, subdivided on the outside by grooves in sixteen flat topped ribs: one wider major rib alternates with two narrower intercalary ones.

Description: Most specimens from Pinei are missing the outer shell layer and as a result are indistinguishable from the nominal subspecies. However, a few which have a complete shell preserved show a drastically different ornamentation of the right valve, which has an almost smooth look, only subdivided by very narrow grooves which individualise six wide radial very flat topped ribs, intercalated by two narrower ones. On the anterior and posterior areas in the same way numerous (up to eight have been counted) narrow radial grooves delimit riblets. Towards the ventral disc margin the wider radial ribs show on their sides indications of further subdivision.

Specimens with a less complete shell have the typical ornamentation of *N. (N.) striatocostata striatocostata*: six sharp major radial ribs with two smaller intercalary ribs, all of them subdivided in numerous riblets. The further the shell of *N. (N.) striatocostata robusta* is peeled off, the more numerous the subdivisions are (e.g. Pl. V, fig. 14 and Pl. VI, fig. 4a).

The auricles are relatively large and bear a few radial riblets on their lower half.

The left valves are flat and show the typical pronounced subdivision of the ribs.

Dimensions (mm):

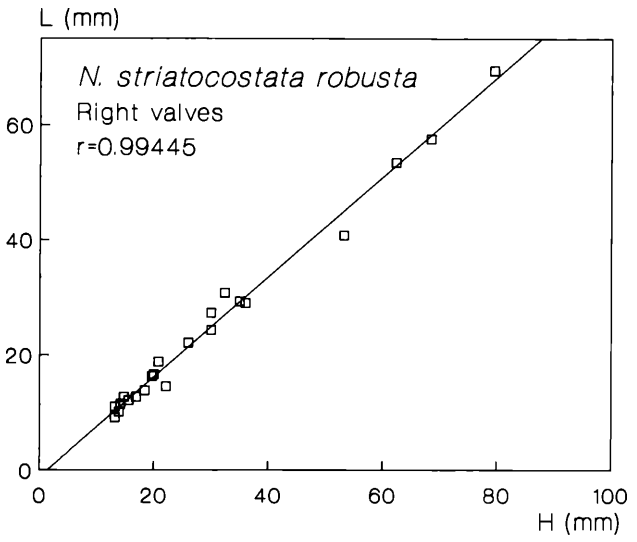
	H	L	L/H
Right valves			
B129	13.2	9.1	0.69
B74	13.2	11.0	0.83
B73	13.9	10.1	0.73
MGB/Ve 801	14.2	11.5	0.81
IGF	14.8	12.7	0.86
MGB/Ve 802	15.6	12.1	0.77
MGB/Ve 803	16.9	12.7	0.75
B163	18.4	13.8	0.75
B72	19.7	16.3	0.83
B70	20.0	16.6	0.83
B164	20.8	18.8	0.90
B66	22.1	14.5	0.66
B71	26.0	22.1	0.85
IGF	30.0	(24.3)	(0.81)
DGP 26708	30.0	27.3	0.93
B54	32.4	30.8	0.95
B77	35.0	29.3	0.84
B55	36.0	(29.0)	(0.81)
B48	53.2	40.8	0.77
B49	62.3	53.5	0.86
P16	68.4	57.6	0.84
P18	79.5	(69.5)	(0.87)
P17	84.3	—	—
Left valve			
B83	32.3	31.6	0.98

The specimens are often partially covered by matrix and therefore the value B' has been omitted because it is not possible to measure it accurately.

The variation of L/H in right valves is shown in the graph of Text-fig. 7, which illustrates that the ratio remains virtually constant during the adult ontogeny of this bivalve.

Discussion: As stated in the description, the new subspecies *Neithea (N.) striatocostata robusta* differs from the nominal subspecies mainly by its very thick shell. Similar very thick shells are found on *N. (N.?) deshayana* (Matheron, 1843) and on *N. (N.) zitteli* (Pirona, 1884), two species also described from rudist facies, but are not known in *Neithea* species generally. Therefore this thick shell is explained here as a special adaptation to a high energy environment.

N. (N.) striatocostata robusta subsp. nov. differs from other *Neithea* taxa by:
- fewer intercalary ribs between the major ribs when compared to *N. (N.) zitteli* (Pirona, 1884), *N. (N.) coquandi* (Peron, 1877), *N. (N.) regularis* (Schlotheim, 1813) (2 instead of 3), to *N. (N.) quinquecostata* (J. Sowerby, 1814) (2 instead of 4), to *N. (N.) sexcostata* (Woodward, 1833) (2 instead of 5);
- less recurved umbo than in *N. (N.) sexcostata*, but more recurved than in *N. (N.) alpina* (d'Orbigny, 1847), *N. (N.) regularis*, *N. (N.) quinquecostata*;
- with complete shell the intercalary ribs are much less marked, with incomplete shell they are subdivided and more marked than in *N. (N.) alpina*;



Text-fig. 7 - Length/Height graph and regression line for 22 right valves of *Neithea* (*Neithea*) *striatocostata robusta* subsp. nov. from the type locality Pinei.

- much less angular ventral margin than in *N.* (*N.*) *sexangularis* (d'Orbigny, 1847).

In his description of the Lago di S. Croce faunas, from the locality "Calloniche" Futterer mentioned and figured a "*Neithea quadricostata*" (1892, p. 80, pl. 3, fig. 6); this is almost certainly a reference to the taxon erected here.

The specimen of "*N. quadricostata*" from Aurisina briefly discussed by Parona (1932) is at present missing at the Museo di Geologia e Paleontologia dell'Università of Bologna where it was deposited. Therefore it is impossible to confirm the statement of Parona that his specimen closely resembles Futterer's figure.

Distribution: *Neithea* (*N.*) *striatocostata robusta* subsp. nov. is recorded here from the uppermost Coniacian-lowermost Campanian of NE Italy (eastern Venetian Prealps and possibly from the Aurisina area, Trieste).

N. (*N.*) *striatocostata striatocostata* (Goldfuss, 1833) has been recorded from Coniacian to uppermost Maastrichtian of Europe, North Africa and the Arabian Peninsula.

Neithea (*Neithea*) *zitteli* (Pirona, 1884)
Pl. VIII, figs 1-14b; Pl. IX, figs 1a-12b; Text-figs 8, 9.

\+ 1884 *Janira Zitteli* Pir. n. sp. - Pirona, p. 166, pl. 3, figs 1-15.
v . 1892 *Neithea Zitteli* Pirona sp. - Futterer, p. 79.
v p 1897 *Neithea Zitteli* Pirona sp. - G. Boehm, p. 171.
v p 1897 *Neithea Zitteli* Pirona sp. - G. Boehm in Marinelli, p. 1030.
? 1899 *Janira Zitteli* Pirona - Oppenheim, p. 45.
? 1899 *Neithea Zitteli* Pirona - Redlich, p. 150.
? 1901 *Neithea Zitteli* Pirona - Redlich, pp. 76, 81.
v p 1902 *Neithea Zitteli* Pirona - Marinelli, p. 137.
v . 1908a *Neithea Zitteli* Pir. - Parona, p. 320.
. 1926 *Neithea Zitteli* (Pir.) - Parona, p. 52, pl. 5, fig. 3.
v . 1960 *Neithea zitteli* Pirona - Pleničar, p. 29.
v . 1967 *Neithea zitteli* (Pirona) - Polšak, p. 31.
v . 1973b *Neithea* (*Neithea*) *zitteli* (G. A. Pirona) - Dhondt, p. 72.
v . 1992 *Neithea zitteli* (Pirona) - Dhondt, Dieni, p. 212, fig. 1.

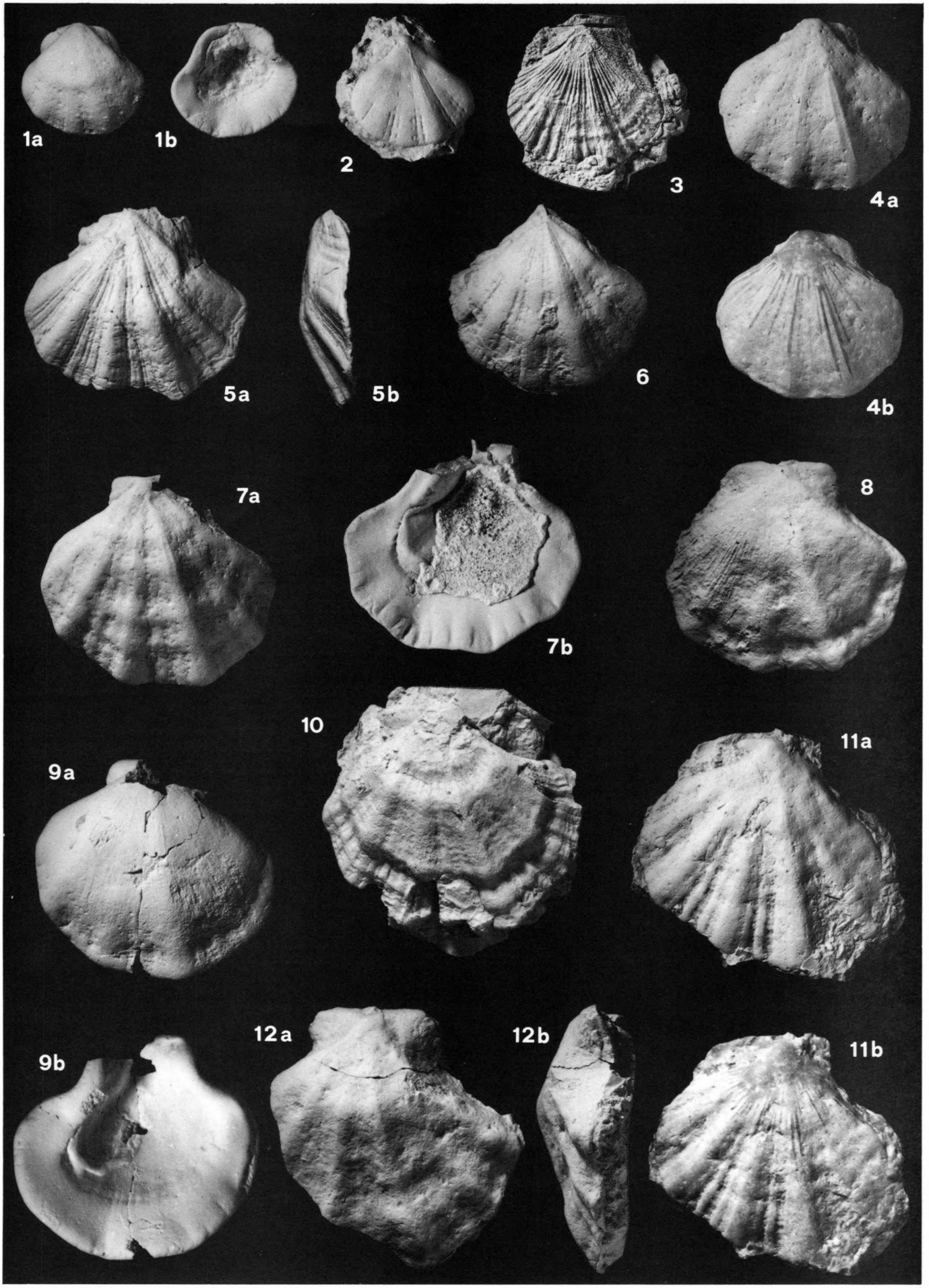
Type series: Pirona (1884, p. 159) stated that the syntypes "...stavano deposti nel gabinetto di storia naturale del R. Istituto tecnico di Udine e nel Museo di geologia della R. Università di Pavia..." It has been ascertained that no original specimens of *Janira zitteli* are present in the collections of the Museo Friulano di Storia Naturale at Udine (this museum contains what is left of the technical institute collections, which were burnt and looted during the War 1914-18; *fide* Parona, 1924, p. 143). In Pavia the collections of the Museo di Geologia of the University are being reorganised (G. Anfossi, written communications, 1990 and 1993). As a result, we are at present unable to designate a name-bearing type; a lectotype or neotype, depending on what shall be found when the Pavia collections become accessible, shall have to be chosen, because several interpretations have been given to the taxon.

Material:
- Seventy one right valves [B11, B30, B32, B193-223, P1, P2, DGP 12119, DGP 12126, DGP 26705-26707, DGP 26709-26718, original of Parona (1908a) housed in MTO (unregistered), MFU 1239 and 1240, MFU 1308-1312, MFU 1315, MB coll. Futterer (11 unreg. valves)], and twenty eight left valves [B1-B10, B20, B22, B24, B27, B31, B34, B224, DGP 12097, DGP 12177, DGP 26719 and 26720, MFU 1244, MFU 1313, MFU 1314, MB coll. Futterer (4 unreg. valves)], from Col dei Schiosi (topotypes).
- One right (DGP 15400a) and one left (DGP 15400b) valve from Travesio (Pordenone, Friuli).
- Two right valves from Istria, Croatia: MSNT 11842 from Sovinjak (= Sovignacco) and MSNT 11841 from Buzet (= Pinguente).
- One right valve (DGP 26721) from an unspecified Istrian locality.

EXPLANATION OF PLATE IX

Figs 1a-12b - *Neithea* (*Neithea*) *zitteli* (Pirona, 1884).
Left valves; topotypes.
1b - Interior of the valve; the muscle scar is faintly visible.
4b, 11b - The unwhitened worn surface of the valves shows dark, radial lines representing "ribs" emerging from the coarsely recrystallized internal shell layer.
5b, 12b - Posterior views which show an abrupt commarginal valve geniculation indicating an adaptation of the bivalve to a change in life position during its ontogeny.
7b, 9b - Interior of the valves; note the large muscle scars delimited by a ridge.
Upper Cenomanian, Col dei Schiosi (Pordenone); B224, B20, B8, B2, B31, B34, B6, B22, B10, DGP 12097, B9, B1.

All the specimens are natural size and, unless otherwise stated, whitened.


1a
1b
2
3
4a
5a
5b
6
4b
7a
7b
8
10
9a
11a
12a
12b
9b
11b

Description: Medium to large-sized, biconvex, somewhat oblique, thick-shelled *Neithea* species.

Right valve very convex especially in large specimens, higher than wide, with a strongly incurved umbo. Ornamentation varies depending on the preservation state:

- on well preserved shells (e.g. Pl. VIII, fig. 7a) not very salient principal and secondary ribs are present: generally, from anterior to posterior side, the following rib pattern can be observed: $P_1/1/P_2/1$ or $2/P_3/5/P_5/1/P_6$. P_2, P_3, P_5 are very wide (relatively), but low and can be subdivided over the entire length or over the lower part of the rib. P_4 is consistently poorly developed and not more salient than the secondary ribs. The posterior area is curved inwardly and with one rib and some riblets, the anterior area is convex and smooth. The total number of ribs is 14;
- on less well preserved specimens which have a worn shell surface but are not decorticated, the outside of the shell appears to be more or less smooth (e.g. Pl. VIII, fig. 6) and brown radial lines represent the "ribs" from the internal coarsely recrystallized shell layer (Pl. VIII, fig. 5; Text-fig. 8). Several specimens have their more worn shell part (near the umbo) as described here, and their less abraded parts (nearer the ventral margin) as described above and they show the transition from one type into the other (e.g. Pl. VIII, fig. 10);
- on specimens which have the external shell layer eroded, the valve left is thinner than in the previous stages and is covered with many narrow, almost equal ribs. They are more numerous than on well preserved valves because under the principal ribs the inside shell layers bear at least three "ribs"; on such an eroded valve the number of equal ribs varies from 21 to 26.

Certain well preserved specimens (e.g. B194, B204, B210, P1) have a proportionally broader valve and the ribs, principal as well as secondary, are subdivided over most or all of their length.

Thickness (T) of right valves is remarkable, as shown in the following examples:

	H (mm)	T (mm)
DGP 26706	34.9	3.9
B208	43.8	7.4
B213	52.0	8.5
P1	54.4	10.0
B222	63.0	11.2

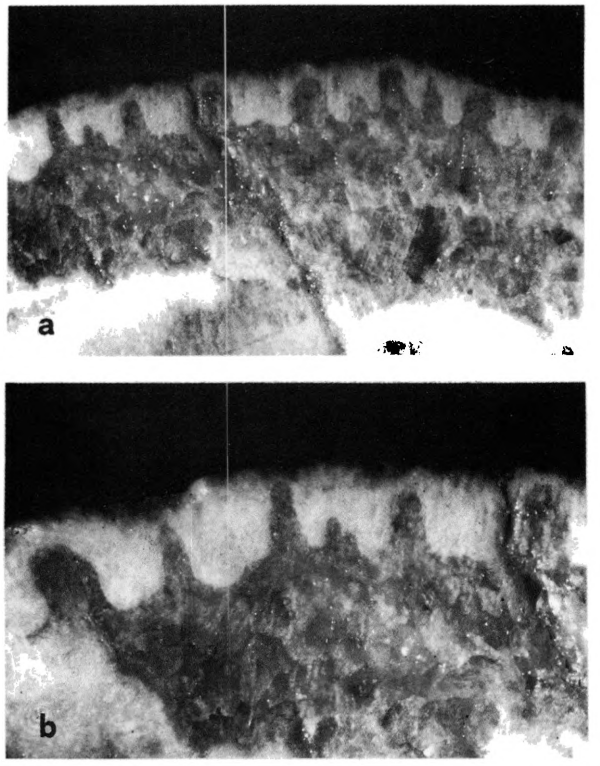
Growth lines are visible, mainly in the intercostal intervals, on some of the specimens and lie closely together.

On the internal side of the valve the pallial line is imprinted and the muscle scar is large, oval in dorso-ventral direction, and delimited by a ridge towards the ventral margin (Pl. VIII, fig. 11).

Cardinal crura are large and robust, but worn on the specimens available (Pl. VIII, figs 11, 12).

Ligament pit deep and elongate.

Left valve wider than high, from lightly convex to commarginally geniculated. An initial flat stage is followed at about one third of the total height by a sudden commarginal geniculation, which gives the valve a convex, gibbous aspect; on the most convex valves (B3, MB unreg.) the angle (α) between the initial flat stage and the geniculated part is about 120° (Pl. IX, figs 5a,b and 12a,b). On many specimens the initial stage is very worn, but on one specimen (Pl. IX, fig. 5a) it clearly shows the same ornamentation as on the shell parts near the ventral margin:



Text-fig. 8 - Polished transverse section through a naturally smoothened right valve of *Neithea* (*N.*) *zitteli* (Pirona, 1884) showing the "ornamentation" of the coarsely recrystallized internal shell layer (dark colour). When the external shell layer (light colour) wears off, "ribs" (wider for principal and narrower for intercalary external ribs) of the underlying inner layer emerge. Upper Cenomanian, Col dei Schiosi; DGP 26718; x 6 (a) and x 10 (b).

6 principal ribs of which the P_4 (from the anterior side) is the most strongly developed, being even the only angular extension on the ventral margin and the equivalent of the poorly developed P_4 on the right valve.

The rib pattern of the left valve is $P_1/2/P_2/2/P_3/2/P_4/2/P_5/1/P_6$; total number of ribs: 15.

Also worn left valves show ribs from the inner shell layers as brown lines on the outside of the shell (Pl. IX, figs 4b, 11b) and when the outer shell layers are peeled off they seem covered with more numerous ribs than when the shell is complete (Pl. IX, fig. 3).

As in the right valve, the left valve can reach remarkable thickness (T) of which the maximum lies beyond the geniculation. A few examples follow:

	H (mm)	T (mm)
B24	39.5	4.4
B10	42.4	5.4
B5	44.2	5.7

The presence of the commarginal valve geniculation indicates an adaptation of this species (which can be considered as a free-lying recliner) to a change in life position during ontogeny. To stabilize the shell resting on mobile substrate a weight increase in the umbonal part took place, which resulted in a toppling over of the shell and a simultaneous geniculation of the upper valve to keep the commissure plane sub-horizontal.

Growth lines can be seen on well preserved left valves. On some larger specimens several growth interruptions can be seen, which result in knob-like structures on the top of the radial ribs (DGP 12097; Pl. IX, fig. 10).

The anterior area of the left valve curves somewhat inwardly, and the auricle is thick but sharply delimited. The posterior area slants outwardly and the thick auricle, which is a continuation of the area without clear delimitation, is covered with a few riblets.

As on the right valve the muscle scar imprint is deep and delimited by a ridge, and the pallial margin is visible (Pl. IX, figs 7b, 9b).

Dimensions (mm):
Right valves

	H	L	B'	L/H
MFU 1309	17.6	16.7	—	0.95
DGP 26710	19.7	(18.2)	—	(0.92)
B32	20.6	19.6	—	0.95
MB unreg.	27.1	26.7	—	0.98
B11	27.5	26.5	—	0.96
B193	30.5	32.0	—	1.05
B194	34.0	34.4	—	0.99
DGP 26706	34.9	32.1	—	0.92
B199	35.2	33.5	(15.2)	0.95
B195	36.4	31.3	—	0.86
B198	37.1	33.6	—	0.90
B201	38.4	33.6	17.3	0.87
B196	38.8	33.5	18.1	0.86
B204	38.8	40.3	—	1.04
MFU 1312	39.2	35.1	—	0.90
B197	39.3	36.8	18.9	0.94
P2	39.6	36.1	19.2	0.91
B203	40.0	(36.0)	—	(0.90)
MFU 1240	41.0	35.7	—	0.87
B219	41.9	41.0	—	0.98
B206	42.3	38.3	19.3	0.90
B205	42.3	40.4	—	0.95
B218	42.7	38.0	—	0.89
DGP 26707	43.6	(38.0)	—	(0.87)
B208	43.8	38.8	19.6	0.88
MFU 1310	44.1	39.8	—	0.90
B207	45.0	39.4	21.0	0.87
MTO unreg.	45.3	43.5	22.4	0.96
B217	45.5	39.3	—	0.86
MSNT 11842	(47.5)	(41.0)	(19.0)	(0.86)
B214	48.0	41.8	—	0.87
B215	48.0	(43.0)	21.8	(0.89)
B211	(49.0)	46.1	—	(0.94)
B212	50.6	45.0	22.8	0.89
B210	51.7	51.0	—	0.99
P1	54.4	50.0	24.2	0.92
B30	55.0	46.0	24.1	0.84
DGP 26709	56.4	(48.0)	(26.0)	(0.85)
MFU 1239	57.0	55.3	—	0.97
DGP 12126	61.0	52.4	30.1	0.86
DGP 26721	61.8	56.0	(43.1)	0.91
B221	63.0	55.0	—	0.87
B223	(67.8)	(59.0)	32.3	(0.87)
B220	68.5	(62.3)	—	(0.91)

(B' has only rarely been measured because on many specimens it has been impossible to completely remove the matrix)

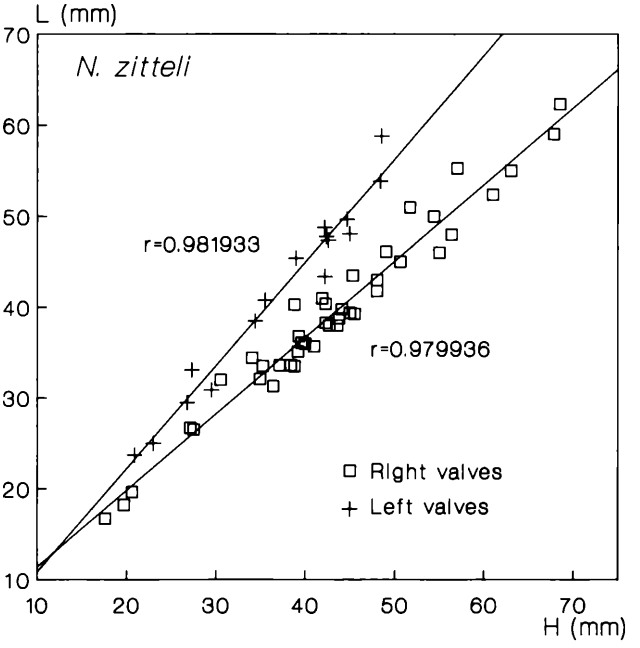
Left valves

	H	L	L/H	α
B20	20.9	23.7	1.13	—
B224	23.0	25.0	1.09	—
B7	26.8	29.5	1.10	—
MFU 1313	27.3	33.1	1.21	—
B8	29.5	30.9	1.05	—
B2	34.4	38.5	1.12	—
B34	35.5	40.8	1.15	135°
B31	39.0	45.4	1.16	138°
MB unreg.	42.2	(43.4)	(1.02)	120°
B22	42.2	48.8	1.16	145°
B10	42.4	(47.8)	(1.13)	—
B6	42.6	47.4	1.11	132°
B4	43.0	—	—	153°
DGP 12097	44.7	49.7	1.11	—
B9	(45.0)	(48.1)	(1.07)	158°
MFU 1244	48.4	53.9	1.11	—
B27	(48.5)	58.8	(1.21)	—
B1	54.0	—	—	137°

(α: angle of geniculation)

The specimens from Col dei Schiosi are often worn and somewhat incomplete, and therefore totally precise measuring has not always been possible.

On Text-fig. 9 the L/H ratios for right and left valves from the type locality are illustrated. They indicate that during ontogeny a slight shift towards a more elongate shell shape takes place in *Neithea* (*N.*) *zitteli*.



Text-fig. 9 - Length/Height graph and regression lines for 42 right valves and 16 left valves of *Neithea* (*Neithea*) *zitteli* (Pirona, 1884) from the type locality Col dei Schiosi.

Discussion: *Neithea* (*Neithea*) *zitteli* is an uncommonly complex *Neithea* species in as far that it has a biconvex, inequilateral, extremely thick and heavy shell and that its secondary ribs do not occur in constant number in the intercalary intervals. It was, however, described and figured very accurately by Pirona already in 1884. The broad variability of the species is widened by the different preservational stages which each have their own "ornamentation", including a different rib number. Yet, the tentative interpretation given by Dhondt (1973b) was based on too small a sample, and we no longer agree with the exposed similarity with *N.* (*N.*) *regularis* (Schlotheim, 1813).

As in other *Neithea* species associated with rudists such as *N.* (*N.*?) *deshayana* (Matheron, 1843) and *N.*(*N.*) *striatocostata robusta* subsp. nov., *N.* (*N.*) *zitteli* is characterized by a very thick shell.

N. (N.) zitteli is nearest to *N. (N.?) inconstans* (Sharpe, 1849), from the Cenomanian near Lisbon (Portugal). The state of preservation of the known material of these two taxa is very different and a precise comparison difficult, but with better (i. e. with complete shells) specimens of *N. (N.?) inconstans* they might in the future be shown to be synonymous.

N. zitteli in G. Boehm [1897 and in Marinelli (1897, 1902)], from Bocca di Crosis near Tarcento (Udine, Friuli), is based on two specimens housed in the Museo di Geologia e Paleontologia, University of Florence (IGF 3090E). The larger of the two is a left valve of *N. (N.) zitteli*, but the smaller right valve (Pl. VII, fig. 3) belongs to *N. (N.?) fleuriausiana* (d'Orbigny, 1847).

Distribution: *N. (N.) zitteli* has so far only been recorded from Late Cenomanian rudist formations of NE Italy, Croatia (Istria) and (?) western Slovenia.

Fam. SPONDYLIDAE Gray, 1826

Spondylus arcuatus (Catullo, 1834)
Pl. X, figs 1-4; Pl. XI, figs 1-5; Pl. XII, figs 1-9; Pl. XIII, fig. 16; Text-fig. 10.

v + 1834 *Podopsis arcuata* Nob. - Catullo, pp. 10, 17, pl. 2, fig. 6.
. 1842 *Podopsis arcuata* Cat. - Catullo, p. 6.
v . 1908a *Pecten* (cfr. *Janira Fleuriasiana* (*sic*) d'Orb.) - Parona, p. 322.

Material:
- Holotype (by monotypy): right valve (DGP 7095) figured by Catullo, 1834, pl. 2, fig. 6 (as mirror image), coll. Catullo, from Pinei, Lago di S. Croce (Pl. X, fig. 4).
- Topotypes: eleven right valves (B76, B167, B168, B170, B173, P7, P8, P11, P12, P15, P19) and twelve left valves (B86, B87, B89, B99, B105, B120, B165, B166, P9, P10, P13, P14).
- One right valve (DGP 26723) of Santonian-Early Campanian age (D. Sartorio, pers. comm., 1991) from Ponte Racli, Val Meduna (Friuli).
- One incomplete valve of Santonian-Campanian age from "Castro Alto presso il Castello", Capo di S. Maria di Leuca, Apulia (IGF 3433E) identified by Parona (1908a) as a right valve of "*Pecten* (cfr. *Janira Fleuriasiana* d'Orb.)".

Original diagnosis: *Testa longitudinali, cuneata, incurva, crassissima; striis longitudinalibus crebris; nate majore prominente, non inflexo.*

Emended diagnosis: Large *Spondylus* species, with elongate moderately convex right valve and suborbicular-suboval almost flat left valve. Ornamentation changes during ontogeny. On large specimens, superimposed on simple diverging ribs, strong radial folds are formed; they seem to consist of fasciculated ribs on the central part of the disc, but occasionally cross the diverging ornamentation obliquely towards the side margins.

Description: Left valve is generally flat but the initial stage is irregularly gibbous because it is adapted to the shape of the attached part of the right valve (Pl. XII, figs 2, 4, 5, 7, 8).

Early growth stages of left valve are suborbicular and covered with numerous subequal radial ribs of which some are more strongly developed than others, depending also on the preservation state. Ribs are unequal on the outside of the completely preserved shell, but on specimens with the outer shell layer removed every fourth or fifth rib is more strongly developed.

Somewhat later growth stages develop radial folds, with about 7 to 8 narrow ribs in between two folds. The folds irregularly increase in width and height on the oldest growth stages, and several ribs which were intercalated between two narrow folds on the previous growth stage are now included in the radial folds (on the median part of the disc; Pl. XII, fig. 8). On the anterior and posterior sides of the disc the folds sometimes obliquely intersect the ribs, which in turn on the sides of the disc diverge and are less strongly developed (Pl. XII, fig. 7). The number of ribs varies but on an average young left valve 80 to 85 were counted.

The diverging ornamentation is most clearly visible on the auricles. The anterior triangular and obtuse-angled auricle is small but clearly delimited from the disc, whereas the posterior auricle has a long side margin and continues seemingly without clear limit into the posterior marginal area.

Early stages of right valve were attached to the substrate and therefore have no specific ornamentation.

Further growth stages of this valve are, as on the left valves, ornamented with a diverging rib pattern, overlain by a radial ornamentation system. It consists mainly of 6-8 small ribs separated with a wider furrow from the next rib group. Such deeper furrows are present in equal number to the folds on the left valve. On the sides of the disc diverging ribs can be seen as on the left valves. No auricles are visible, but the triangular cardinal area is strongly developed.

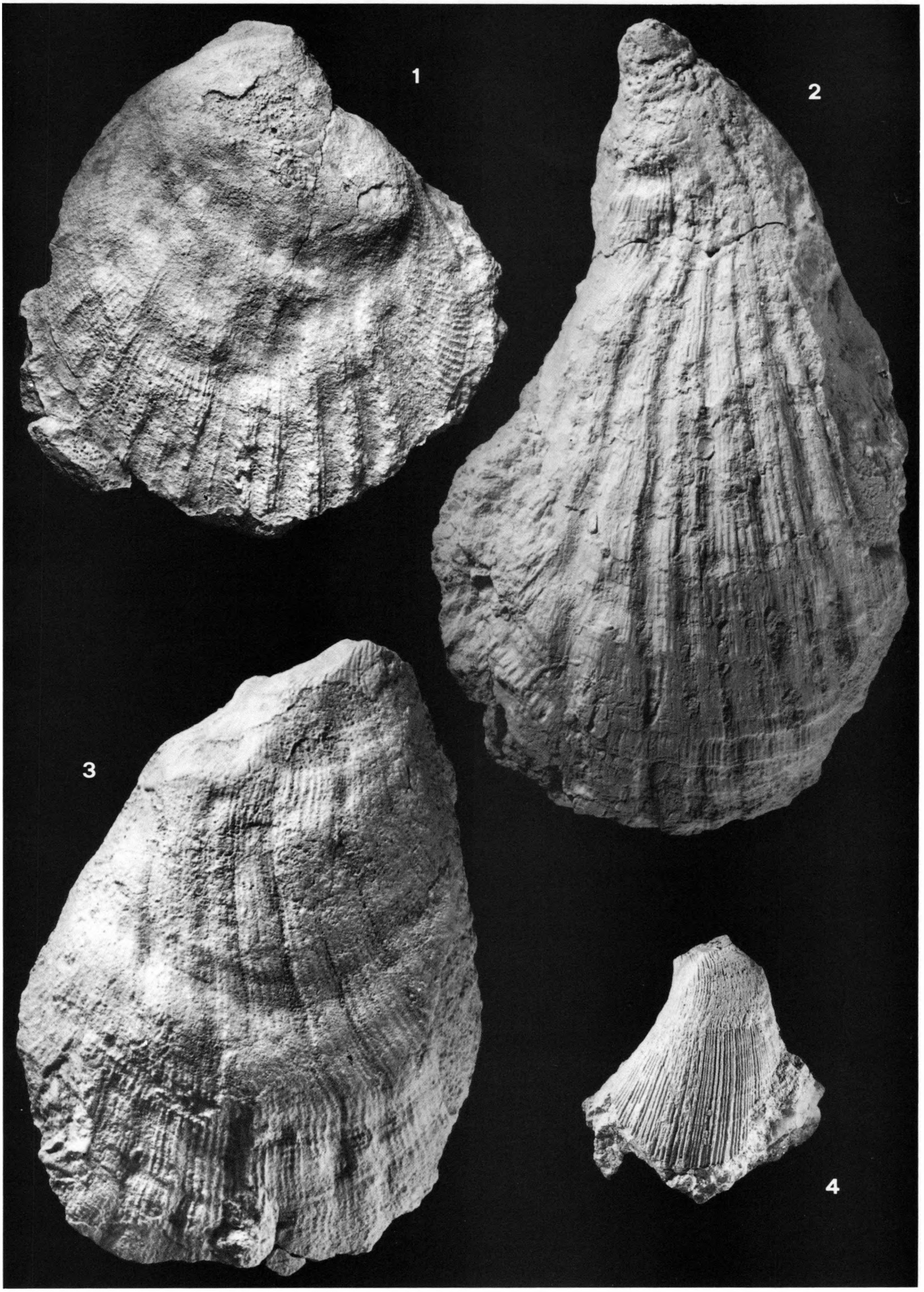
On the oldest growth stages - as described for the left valve - the right valve is covered by wide folds which assemble several small ribs and are of varying width.

On both valves occasional commarginal growth interruptions are seen; rarely they form small knobs at the intersection points with the radial ribs. Attachment scars on the right valve show different patterns; on some specimens the ornamentation of a hippuritid can clearly be recognised in the attachment area (Pl. XIII, fig. 16).

EXPLANATION OF PLATE X

Figs 1-4 - *Spondylus arcuatus* (Catullo, 1834).
Right valves.
1-3 - Topotypes.
Attachment scars are clearly visible on the dorsal part of the specimens of figs 1 and 3.
4 - Holotype (by monotypy).
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B166, P7, P11, DGP 7095 (coll. Catullo).

All the specimens are whitened and natural size.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Dimensions (mm):

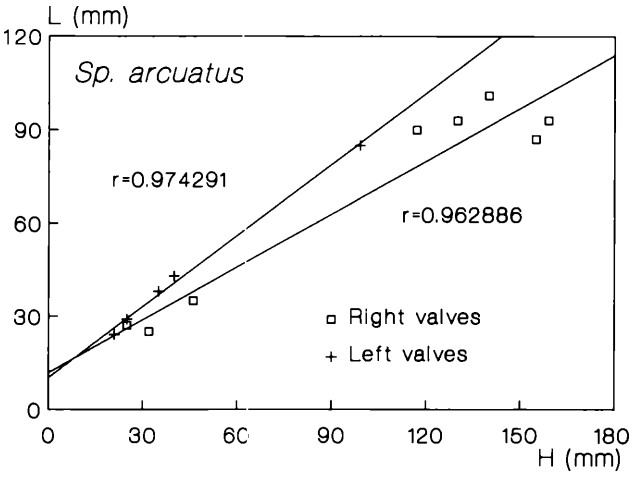
	H	L	B'	L/H	UA	F
Right valves						
P15	25	27	—	1.08	—	7
DGP 26723	(32)	25	—	(0.78)	—	—
Holotype	46	(35)	(24)	(0.76)	—	>8
P9	(117)	90	—	(0.77)	90°	8
B168	—	91	25	—	—	11
P11	(130)	93	—	(0.71)	—	9
B167	140	101	35	0.72	—	12
P12	(155)	87	—	(0.56)	—	12
P7	159	(93)	—	(0.58)	—	9
Left valves						
B120	21	24	7	1.14	104°	6
B105	25	29	7	1.12	105°	?7
B99	35	38	13	1.09	97°	—
P13	40	43	—	1.07	—	9
B87	—	61	15	—	90°	7
P10	67	—	(13)	—	97°	10
B166	99	85	22	0.86	90°	13
B165	105	—	12	—	105°	—

In Text-fig. 10 the L/H ratios for right and left valves from the type locality are illustrated. Considering the small size of the studied sample the regression lines are obviously only indicative.

Discussion: *Spondylus arcuatus* is an unusual spondylid, and we have not been able to find any Cretaceous species which resemble it. The only taxon found in literature which seems somewhat comparable in shape is *Sp. royanus* d'Orbigny, 1847 (from the Campanian at Royan); the holotype is a very poorly preserved specimen and it lacks any real similarity with the figure in the *Paléontologie française*; therefore *Sp. royanus* could at best be considered a *nomen dubium*.

Spondylus arcuatus differs from *Sp. requienianus* Matheron, 1843, found in the same association from Pinei (Pl. XIII, figs 4-15b), by its size and rib development: *Sp. arcuatus* can reach very large sizes and is covered with numerous unequal ribs and folds, whereas the generally much smaller *Sp. requienianus* only has numerous equal ribs. Yet, both seem to lack spines and the early growth stages of *Sp. arcuatus* could be taken for *Sp. requienianus* when the ribs are still more or less subequal. Despite Futterer (1892 (1), p. 78) who placed Catullo's species in the possible synonymy of *Sp. requienianus* Matheron, 1843, we think that this synonymy is untenable (anyway *Sp. arcuatus* would have priority over *Sp. requienianus*).

Other large spondylids such as *Sp. santonensis* d'Orbigny, 1847 (from the Coniacian-Santonian of Aquitaine), *Sp. truncatus* (Lamarck, 1819) (from the Coniacian-Santonian near Tours, Loire valley), *Sp. spinosus* (J. Sowerby, 1814) (from the Cenomanian-Maastrichtian of the European chalks), *Sp. fornii* Greco, 1917 [from the (?) Maastrichtian of Egypt], *Sp. likhatschevi* Bobkova, 1961 and *Sp. balakhanensis* Bobkova, 1961 (from the Turonian of the Tadzhik depression, Tadzhikstan) all have either strongly developed spines, or a different rib development, and/or a free life position throughout most of their adult life.



Text-fig. 10 - Length/Height graph and tentative regression lines for 8 right valves and 5 left valves of *Spondylus arcuatus* (Catullo, 1834) from the type locality Pinei.

Distribution: Only known from rudist limestones: uppermost Coniacian-lowermost Campanian of Lago di S. Croce, eastern Venetian Prealps, and Santonian-Lower Campanian of Val Meduna (Friuli, NE Italy) and of Capo di S. Maria di Leuca (Apulia, southern Italy).

Spondylus requienianus Matheron, 1843
Pl. XIII, figs 4-15b; Text-fig. 11.

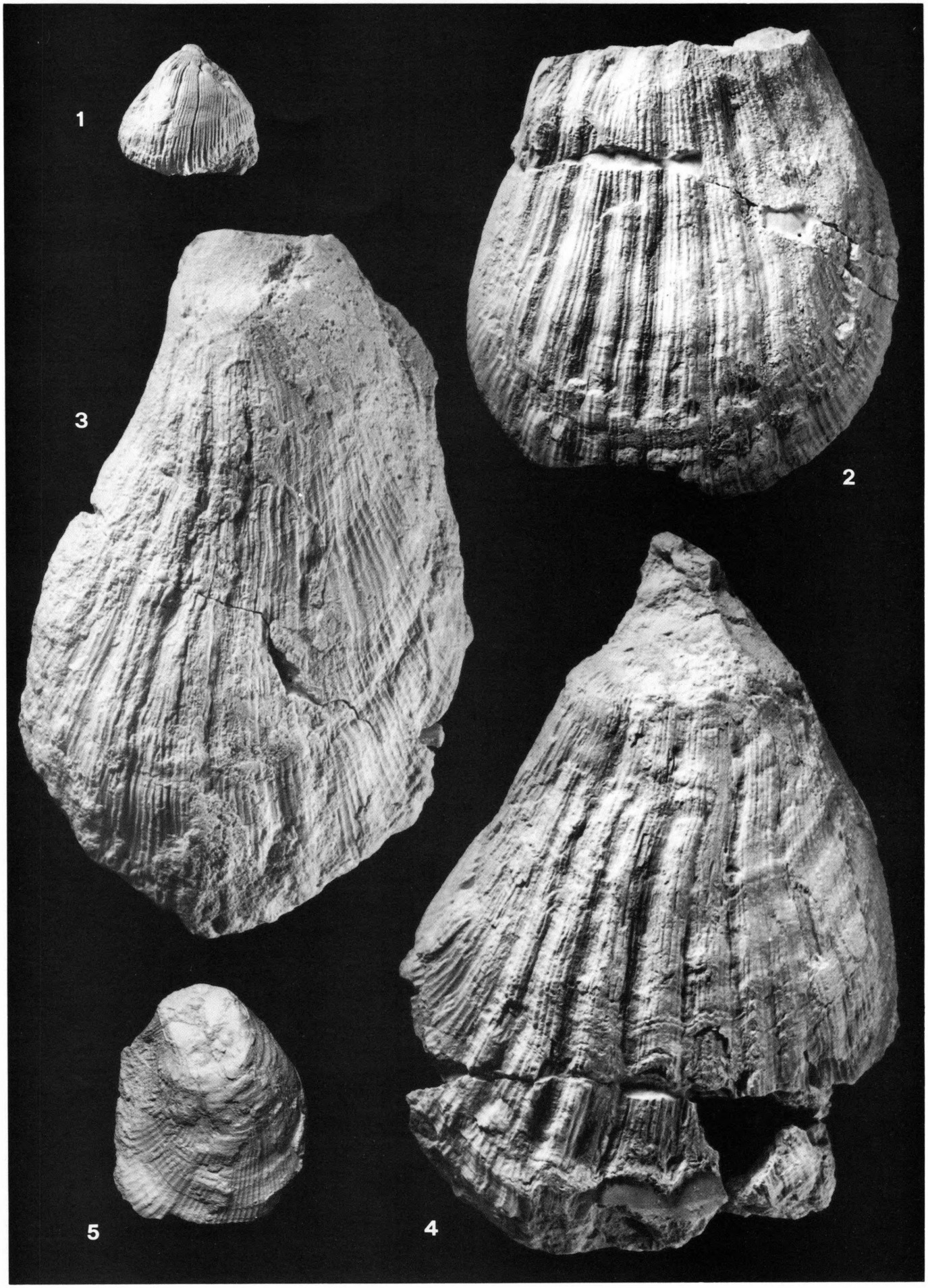
\+ 1843 *Spondylus requienianus*, Math. - Matheron, p. 189, pl. 32, fig. 3.
v p 1847 *Spondylus hystrix*, Goldfuss - d'Orbigny, p. 661, pl. 454, figs 1-4 (not figs 5-8).
v . 1866 *Spondylus Requienianus* Math. - Zittel, p. 118, pl. 18, figs 6a, b.
. 1892 *Spondylus Requienianus* Matheron - Futterer, p. 77, pl. 3, figs 3, 4.
? 1899 *Spondilus* (*sic*) cfr. *requienianus* Math. (in Futterer) - Parona, p. 6.
? 1902 *Lima Vallismontanae* nov. sp. - Marinelli, p. 171, pl. 3, figs 4, 5.
v . 1909 *Spondylus* sp. ind. - Parona in Parona *et al.*, p. 166.

(1) Futterer (*op. cit.*, p. 33) mentions a *Spondylus* sp. from rudist beds outcropping to the east of Lago di S. Croce (= Pinei?). This specimen is housed in the collections of the Naturkunde Museum in Berlin: it has all the characteristics of a neitheinid.

EXPLANATION OF PLATE XI

Figs 1-5 - *Spondylus arcuatus* (Catullo, 1834).
Right valves; topotypes.
1 - Decorticated specimen.
3-5 - Specimens clearly showing the attachment scars at their umbonal part.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P15, B168, P12, B167, B170.

All the specimens are whitened and natural size.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? 1911 *Lima Vallismontanae* Marin. - Dainelli, p. 27.
. 1920 *Spondylus Requienianus* Matheron - Roman, Mazeran, p. 86, pl. 8, figs 9, 10.
? 1932 *Spondylus striatus* Sow. - Parona, p. 96.
. 1967 *Spondylus requienianus* Matheron - Polšak, p. 32, pl. 2, fig. 5.
v . 1987 *Spondylus* cf. *coquandianus* d'Orbigny - Dhondt, p. 70.
v . 1987 *Spondylus requienianus* Matheron - Dhondt, p. 70, pl. 4, fig. 9.

Material:
- Ten right valves (B112, B169, B171, B172, B174, B175, B177, P39, IGF: two unregistered, coll. Meneguzzo) and twenty four left valves (B85, B97, B101, B102, B106-111, B113, B114, B116, B117, B121, B122, B176, B178, P19, DGP 26691, MGB/Ve 804, IGF: three unregistered, coll. Meneguzzo), complete or partially decorticated, from Pinei, Lago di S. Croce.
- One right (DGP 26724) and one left (DGP 26725) valve of Santonian-Early Campanian age (D. Sartorio, pers. comm., 1991) from Ponte Racli (Val Meduna, Friuli).
- One right valve (MSNT 11855) and twenty left valves (MSNT 11856-11875) of Turonian age (R. Galvani, pers. comm., 1992) from the rudist limestones of Rupinpiccolo (Trieste, NE Italy).

Description: Small to medium-sized *Spondylus* species with strongly convex, rounded to elongate, right valve and suborbicular left valve. The shape of the right valve depends on the morphology of the substrate, the umbo is prominent and often recurved with high triangular cardinal area (Pl. XIII, figs 12a-15b). The flat to fairly convex left valve has triangular and narrow auricles, covered with riblets which are almost perpendicular to the umbonal folds.

Ornamentation consists of numerous (40-75) ribs, which are relatively wide and divided by narrow interspaces when the shell is complete, but narrow with wide interspaces when the external layer has been peeled off. Ribs are straight on the median part of the valve, but diverge towards the anterior and posterior valve margins. The rib number increases by bifurcation.

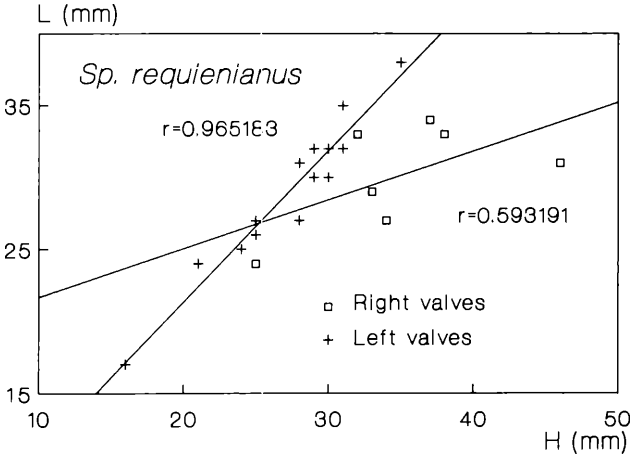
Neither spines, nor spine-bases have been observed.

Dimensions (mm):

	H	L	B'	L/H	UA	R
Right valves						
B174	25	24	12	0.96	—	62
B175	32	33	20	1.03	—	52
B171	33	29	(17)	0.88	—	—
B112	34	27	(20)	0.79	—	43
IGF	37	34	—	0.92	—	—
B172	38	33	(19)	0.89	—	75
B169	46	31	23	0.67	—	49
Left valves						
B122	16	17	6	1.06	—	48
B121	21	24	7	1.14	98°	49
B108	24	25	10	1.04	91°	50
B111	25	(27)	15	(1.08)	93°	45
B110	25	26	9	1.04	100°	49
B113	28	27	10	0.96	92°	46
B102	28	31	14	1.11	102°	45
B116	29	(30)	10	(1.03)	(90°)	40
B97	29	32	11	1.10	100°	48
B106	30	30	18	1.00	100°	48
B178	30	(32)	17	(1.06)	105°	53
P19	31	(32)	—	(1.03)	94°	45
B109	31	35	15	1.30	103°	54
B85	35	(38)	12	(1.08)	102°	56

In Text-fig. 11 the L/H ratios for right and left valves from Pinei are illustrated. The small studied sample shows that the values of the ratios of the irregular attached right valves are scattered and those of the free left valves are distributed more regularly.

Discussion: The specimens from the Lago di S. Croce area are somewhat smaller than those described from Provence or known from the Gosau in Austria. Smaller specimens are also known from the Gosau but they were generally given a different name (such as *Sp. coquandianus* d'Orbigny, 1847, originally described from Turonian-Senonian beds in SE France).



Text-fig. 11 - Length/Height graph and regression lines for 7 right valves and 14 left valves of *Spondylus requienianus* (Matheron, 1843) from Pinei.

By its lack of spines and by its subequal ribs, *Sp. requienianus* differs from *Sp. fimbriatus* Goldfuss, 1835 (= *Sp. dutempleanus* d'Orbigny, 1847; see Dhondt and Dieni, 1990), from the Cenomanian to Maastrichtian of Europe, and from *Sp. hippuritarum* d'Orbigny, 1847, from the Turonian-Coniacian of southern France; it has only half as many ribs, a larger attachment area, a more convex and less regular right valve than *Sp. latus* (J. Sowerby, 1815), from the Cenomanian to Campanian chalks of Europe. For the differentiation from *Sp. arcuatus* (Catullo, 1834), see above.

Lima vallismontanae Marinelli, 1902 from "Senonian" beds near Tarcento (Friuli) is not a limid, but a spondylid, as can be seen from the original description and figures. It is almost certainly synonymous with *Spondylus requienianus*, but we have not been able to definitely prove this synonymy because its types are at present missing from the collections of the Museo di Geologia e Paleontologia, University of Florence.

Distribution: All known occurrences of *Spondylus requienianus* (Uchaux, SE France; Gosau area, Austria; eastern Venetian and Carnic Prealps, Gorizia and Trieste Karst, NE Italy; Istria, Croatia) vary in age from Turonian to Early Campanian and are from Tethyan rudist formations.

Subord. uncertain
Fam. CHONDRODONTIDAE Freneix, 1960
(= LAMELLOTIDAE Horváth, 1966)

Previously various *Chondrodonta* species have been referred indifferently to the oysters, to the mytilids and to the pectinaceans depending on the interpretation of their unusual hinge features and the marks on the internal side of their shell.

Freneix (1960b) erected the family Chondrodontidae for this group. Freneix and Lefèvre (1968) discussed the morphology of the chondrodonts in detail, redefined the family and erected new subgenera on the base of hinge characteristics. Cox and Stenzel (in Moore, 1971) accepted the systematic innovations of Freneix and Lefèvre, but gave a confused and confusing description of the group, inspired mainly by earlier work of Douvillé (1902).

The basic problem in the systematic placement of the Chondrodontidae by previous authors was the interpretation of the markings visible on the internal sides of the shell. Stanton (1901, 1947) and Freneix and Lefèvre (1968) considered that Chondrodontidae are monomyarian (and hence placed them in the Pectinacea) and that the second very shallow marking situated near the umbo is an impression made by the ligament. Other authors took both markings as representing muscle scars. As a result Douvillé (1902), and more recently Dechaseaux (in Piveteau, 1952), thought *Chondrodonta* to be a mytilid, whereas Cox and Stenzel (in Moore, 1971) interpreted it as a doubtful oyster.

Our material allows us to confirm that *Chondrodonta* is monomyarian, as was demonstrated by Freneix and Lefèvre (1968), and also that the only muscle scar is situated clearly posteriorly (see for example Pl. XV, figs 1b, 3b, 6b). Further, as was already indicated by the same authors, the attached and convex valve is the right valve (and not the left as stated by Cox and Stenzel, *op. cit.*).

The precise phylogenetic relations of the Chondrodontidae remain unclear. The classification for the Pteriomorphia proposed by Waller (1978) does not mention this family.

The preservation of the material available to us does not allow a confirmation of the presence of all the characteristics cited for the order Ostreoida Férussac, 1822 emend. Waller, 1978. However, on two right valves of *Chondrodonta joannae* (Choffat, 1886) [one (DGP 26703b) from the Upper Cenomanian of Istria (Croatia) and one (MPUR/ns 23-21) from the Upper Cenomanian of the Cori area (Lepini Mts., Central Italy)] we noticed the presence of chomata-like ridgelets (Pl. XVIII, fig. 2b), a feature which, except in a few rare instances (Malchus, 1990, p. 81), is only known in oysters. Therefore we think that the affiliation of the Chondrodontidae with the oysters seems plausible.

Below the order level none of the taxonomic intermediate categories (whether suborders, or superfamilies) seem to fit the Chondrodontidae [2]. Further research has been started on the shell microstructure of the various representatives of the genus *Chondrodonta*; hopefully it shall bring a more precise answer to some of the problems mentioned above.

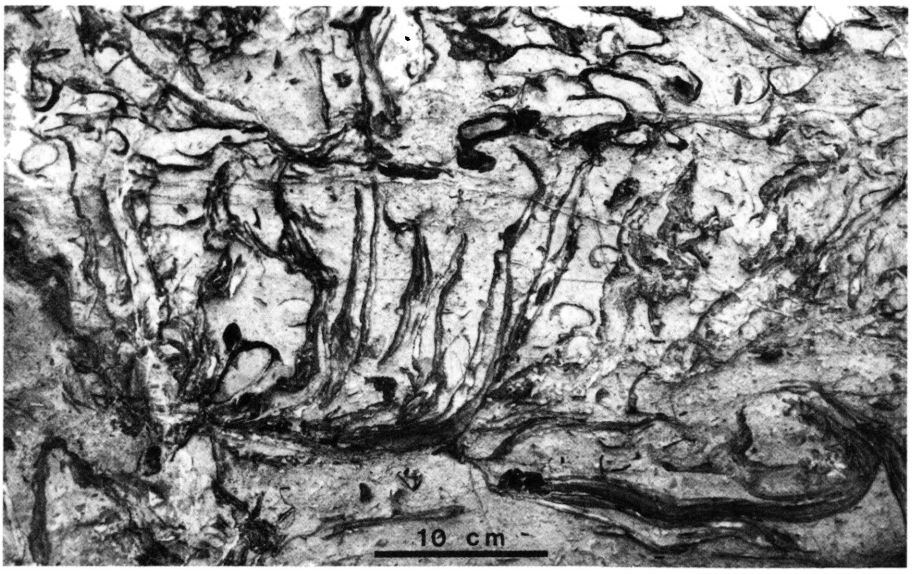
Genus *Chondrodonta* Stanton, 1901

Synonyms: *Ostreavicula* Blanckenhorn, 1934
Lamellotis Horváth, 1966 [3]
Grypheolamellotis Horváth, 1966
Kosmolamellotis Horváth, 1966
Tenuilamellotis Horváth, 1966

The genus *Chondrodonta* was erected by Stanton in 1901 with *Ostrea munsoni* Hill, 1893 [from the rudist-bearing Edwards Formation of Texas (Middle to early Late Albian; Scott R.W., 1990b, p. 43)] as type species. Stanton (*op. cit.*, p. 302) gave a detailed diagnosis of his genus and the main characteristics are quoted here: "Shell of rather large size, sessile, ostreiform, attached by the left (?) valve; texture, subnacreous; hinge plate greatly elongated, without proper teeth, but with a long chondrophore in each valve a little back of the median line, extending from the beak across the hinge plate and projecting considerably beyond it into the body cavity, the chondrophore of the attached valve forming the overhanging anterior wall of a deep, narrow groove into which is received the chondrophore of the upper valve in the form of a rather thin oblique lamella, whose free edge is slightly curved upward. Near their umbonal ends the chondrophores are nearly in contact, but toward their other extremities they are separated by a space of from 1 to 3 millimetres (according to the size of the shell). This space must have been filled by the resilium, which was evidently attached to the under side of the chondrophore in the lower valve and to the upper side of that in the free valve, the whole forming an interlocking arrangement that could allowed very little motion of the valves, and is effective even after the resilium has disappeared, for the two valves are almost invariably found firmly united... adductor muscle doubtless single, though its faint impression has not been positively recognised; lower valve, moderately convex; upper valve, flat or concave, so that the body cavity is very shallow; surface, either with radial, irregularly dichotomous plications, or nearly smooth, with only concentric growth lines".

([2]) The suborder Lamellotacea proposed by Horváth (1966) to include Chondrodontidae (as Lamellotidae Horváth, 1966; see further) and Lithiotidae Reis, 1903, is difficult to interpret mainly because the author followed a bivalve classification based on that of Neumayr (1883). If in future these bivalve families are proved to be related then the Horváth name must be retrieved from oblivion and placed in a more modern taxonomic context.

([3]) Formally the genus *Lamellotis* Horváth, 1966 is valid because the author has explicitly designated a type species, namely *Lamellotis* (*L.*) *hantkeni* Horváth, 1966. This is a formally valid species according to ICZN Art. 13 (a)(i): although the author did not designate a holotype, she described and figured a name-bearing specimen. Also, according to ICZN Art. 68 (d), by monotypy the subgenus *Grypheolamellotis* Horváth, 1966 [written *Grypheolamellotis* in the Hungarian text (p. 108) and *Gryphaeolamellotis* in the explanation of pl. 6 (p. 109) and in the German summary (p. 110)], based on *Lithiothis cretacea* Lörenthey, 1895, which is a valid species according to ICZN Art. 12 (a), is formally valid. On the contrary, the subgenera *Kosmolamellotis* Horváth, 1966 and *Tenuilamellotis* Horváth, 1966 are formally invalid because when erecting them Horváth did not respect the international rules of zoological nomenclature and specifically did not follow ICZN Art. 13 (b). In this case ICZN Art. 68 (d) on monotypy cannot be applied because the indicative taxa mentioned by her [*Lamellotis* (*Kosmolamellotis*) *transsylvanica* Horváth, 1966, and *Lamellotis* (*Tenuilamellotis*) *dichotoma* Horváth, 1966] are invalid as *nomina nuda*.



Text-fig. 12 - Specimens of *Chondrodonta glabra* Stanton, 1901 (in association with *Toucasia* sp.) in life position. Note how after an initial sub-horizontal growth stage the valves of *Chondrodonta* assume a sub-vertical position reached through a marked geniculation. Upper Mural Limestone (Early Albian; see Scott R.W., 1987, and Warzeski, 1987) at Grassy Hill in Mule Mountain northeast of Bisbee, southern Arizona, USA. Photograph by courtesy of R. Höfling.

Freneix and Lefèvre (1968) accepted Stanton's diagnosis but demonstrated that the "left (?)" valve of Stanton is in fact the right valve.

For the interpretation of the genus *Ostreavicula* Blanckenhorn, 1934, here placed in synonymy of *Chondrodonta*, see below.

Horváth (1966) in a preliminary paper on some unusual Cretaceous bivalves from Hungary and Transylvania (Romania) briefly described and illustrated a "new" group, which was partially known and illustrated by Lörenthey (1895) and by Lóczy (1913 and 1916) as *Lithiotis cretacea*. She erected the genus *Lamellotis* with as type species *Lamellotis* (*Lamellotis*) *hantkeni* Horváth (4), from the Zirc Limestone (early Late Albian; see Császár, 1986) of Urkút, Bakony Hills. The hinge of *L. hantkeni* illustrated by Horváth (*op. cit.*, fig. 1 on p. 107; see also Text-fig. 14 herein) is clearly a chondrodontid hinge. This fact demonstrates that *Lamellotis* Horváth, 1966 is a junior synonym of *Chondrodonta* Stanton, 1901, as was already stated by Czabalay (1984).

Horváth (*op. cit.*) included her genus *Lamellotis* (subdivided somewhat informally into four subgenera: *Lamellotis*, *Grypheolamellotis*, *Kosmolamellotis*, *Tenuilamellotis*; see footnote 2 on p. 207) in a new family Lamellotidae, placed together with the Lithiotidae Reis, 1903 in a new suborder Lamellotacea referred to the order Dysodonta Neumayr, 1883. Unlike what Czabalay (1984) thought, the family name Lamellotidae Horváth, 1966 is invalid as it is a junior synonym of Chondrodontidae Freneix, 1960. To our knowledge the term Lamellotacea has not been used again in literature.

From the Urgonian (Barremian-Aptian) at Orgon (SE France) Cossmann (1918) erected a species under the name *Chondrodonta barremica*. The characteristics of this taxon, as far as known, have prompted us (Dhondt and Dieni, 1991) to consider it as belonging to the genus *Turkmenia* Krimholtz, 1936 rather than to the genus *Chondrodonta*.

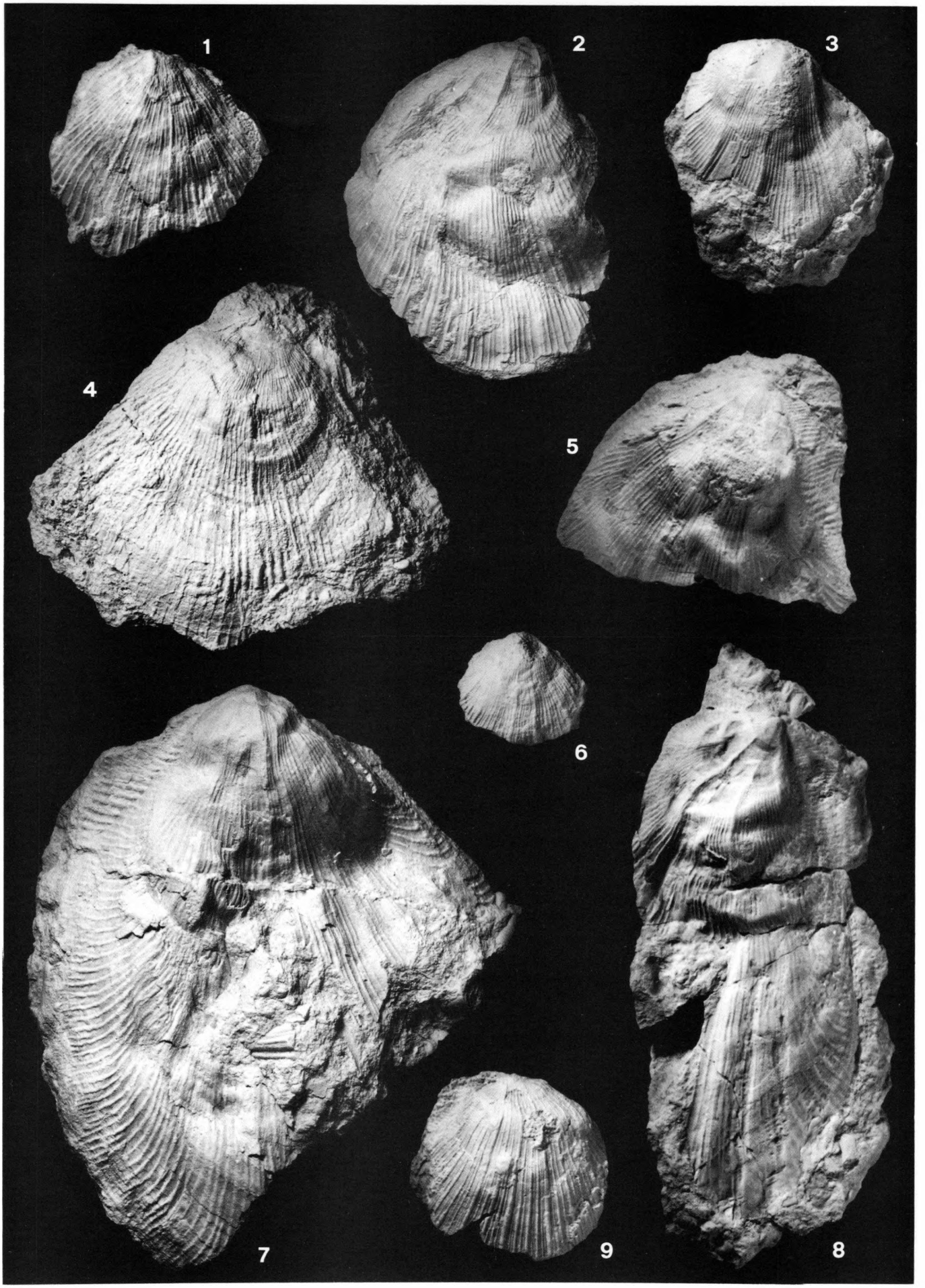
Mode of life: *Chondrodonta* species were cemented, epifaunal suspension feeders in lagoonal and perireef rudist shallow shelf environments. To adapt to the substrates available for attachment chondrodonts sometimes evolved an irregular sinuous shape (Pl. XV, fig. 9). Frequently they themselves became the substrate on which rudists settled; for example chondrodonts used as attachment bases for rudist clumps are recorded from the Ceno-

(4) Lörenthey in 1895 (p. 118, pl. 3) discussed and figured a Cretaceous bivalve from the Bakony Hills (Ajka and Urkút), considered it close to *Ostrea* and named it *Lithiotis cretacea*. Lóczy in 1913 and 1916 (fig. 108 in both papers) figured a specimen of the same species from Urkút as "*Lithiotis cretacea* Lörenth.". Horváth in 1966 erected once again from Urkút and Ajka, in addition to *Lamellotis hantkeni*, a second new taxon which she called "*Lamellotis* (*Grypheolamellotis*) *cretacea* Horváth". The figured syntype of this latter taxon is the very same specimen which had already been described and illustrated by Lóczy (1913 and 1916, fig. 108) as *Lithiotis cretacea* Lörenthey. This taxon of Lörenthey, 1895, considered by Horváth as a *nomen nudum* (this opinion was followed by Czabalay, 1984, p. 369), is undoubtedly valid [ICZN Art. 10 (f), 11 (a, b), 12 (b:7)]. Therefore *Lamellotis cretacea* Horváth, 1966, being clearly congeneric with *Lithiotis cretacea* Lörenthey, 1895 (both taxa belong to the genus *Chondrodonta*), is invalid as a secondary homonym. Furthermore, after studying the figured specimen (= "Holotypus" in the MAFI type catalogue) of *L. hantkeni* and abundant topotypical material of *L. hantkeni* and of *L. cretacea*, housed in MAFI, Budapest, there can be no doubt that all these specimens belong to only one species, which by reason of priority has to be named *Chondrodonta cretacea* (Lörenthey, 1895).

EXPLANATION OF PLATE XII

Figs 1-9 - *Spondylus arcuatus* (Catullo, 1834).
Left valves; topotypes.
The initial stage of the valves is irregularly gibbous in consequence of an adaptation to the shape of the cemented part of the opposite valve. This is especially clear on the specimens of figs 2, 4, 5, 7, 8.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B86, P10, B89, P14, B87, B120, P9, B165, B99.

All the specimens are whitened and natural size.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Text-fig. 13 - Antero-posterior polished section through the dorsal part of a bivalved specimen (H = 90 mm) of *Chondrodonta* cf. *munsoni* (Hill, 1893). Observe the particular hinge of the bivalve with the well developed, projecting chondrophores of the right ("lower", convex) and of the left ("upper", flat) valve. Because the chondrophores are dorso-ventrally very extended the bivalve maintains its valves interlocked even after a post-mortem transport. Albian, Mal Paso Formation, Iglesia Vieja, Huetamo, Michoacán, Mexico; UNAM/JP 91-245; peel, negative print; x 2.

manian of Israel by Ross (1992, p. 166). Such an association between *Chondrodonta joannae* (Choffat, 1886) and *Praeradiolites fleuriausus* (d'Orbigny, 1842) from the Upper Cenomanian of the Monfalcone area, NE Italy, was illustrated in Dhondt and Dieni, 1992, fig. 3; see also Pl. XVI, fig. 3.

Generally, after an initial horizontal stage, chondrodonts change their growth direction; gradually the commissural plane becomes more inclined and often reaches an almost vertical position. Between the umbonal shell stages and the ventral parts a geniculation indicates the change in life position (Pl. XV, fig. 5; Pl. XVI, fig. 4b; Pl. XVIII, fig. 7; Text-fig. 12). Such standing chondrodonts are found in many areas where specimens are fossilized in growth position. A few examples: *Ch. cretacea* (Lörenthey, 1895) in the Albian Zirc Limestone of Urkút (Bakony, Hungary) (Császár and Haas in Császár, 1989, p. 216, fig. 16), *Ch. glabra* Stanton, 1902 in the Early Albian Mural Limestone of southern Arizona (R. Höfling, pers. comm., 1990; see Text-fig. 12), *Ch. joannae* (Choffat, 1886) in the Upper Cenomanian of Gorizia-Trieste Karst, NE Italy (Pl. XVI, figs 1a-c); standing chondrodonts from the Upper Aptian of Spain are mentioned by Kade (1991) and chondrodonts forming erect, fanned clusters are recorded by Ross (1992, p. 166) from the Cenomanian af NW Israel.

Some almost monospecific *Chondrodonta* beds of N. America, NW Israel (Ross, 1992, p. 164), NE Italy (for instance at Pradis, Friuli; see Text-fig. 17) and central Italy (for instance at M. Ardicara, Latium; see Catenacci, 1977) clearly indicate that these molluscs were often uprooted from the substrate during storm or hurricane episodes. This is shown by their isoriented, parallel to the bedding, strongly packed bivalved shells locally with signs of cross-bedding [the chondrodontid hinge because of its dorso-ventrally extended chondrophores is so strongly interlocking (Text-figs 13, 14) that both valves normally remain connected even after a post-mortem transport, unlike what is normally observed in bivalve shells; when single chondrodontid valves are found they represent parts of bivalved specimens which were broken off just beyond their hinge]. These strata obviously do not represent autochthonous growth but are only the result of shell reworking as channel lags, point bars and/or depression fillings.

Distribution: *Chondrodonta* species and specifically unidentified chondrodontid bivalves have been recorded only from Tethys rudist formations: Upper Aptian in northern Spain (Kade, 1991), SE France (P. Skelton, oral comm., 1991), and southern Italy [?Matese Mts. (Accordi *et al.*, 1990, p. 20, under *Lithyoperna*) and Apulia (Luperto Sinni and Masse, 1993)]; Albian of northern Spain (Fernandez-Mendiola and Garcia-Mondejar, 1989; Neuweiler and Reitner, 1992), Hungary, Arizona, Texas and Mexico; Cenomanian in Eurasia and East Africa, from Portugal to western Pakistan (see Freneix and Lefèvre, 1968, and below) (Text-fig. 16). No certain Turonian nor Coniacian occurrences have been documented. ?Santonian in Turkey (Freneix and Lefèvre, 1968).

Chondrodonta [5] *joannae* (Choffat, 1886)
Pl. XIV, figs 1-3; Pl. XV, figs 1a-10; Pl. XVI, figs 1a-5; Pl. XVII, figs 1-5; Pl. XVIII, figs 1-7; Pl. XIX, figs 1-5; Text-figs 15-17.

\+ 1886 *Ostrea Joannae*, Choffat - Choffat, p. 34, pl. Ostreidae 1, figs 1-7; pl. Ostreidae 2, figs 8-9.
v . 1895 *Ostrea* aff. *Munsoni* Hill - G. Boehm, p. 96, pl. 8, figs 1, 2.
v . 1895 *Ostrea schiosensis* n. sp. - G. Boehm, p. 96, pl. 8, figs 3, 4.
v . 1895 *Terquemia forojuliensis* n. sp. - G. Boehm, p. 96, pl. 8, figs 5, 6.
. 1896 *Pinna ostreaeformis* n. sp. - Futterer, p. 259, pl. 38, fig. 1 and fig. 2 (*vidimus*).
v . 1897 *Ostrea* aff. *Munsoni* Hill - G. Boehm, p. 174, pl. 4, figs 1-3; pl. 5, fig. 2.
v . 1897 *Ostrea* aff. *Munsoni* Hill - G. Boehm in Marinelli, p. 1030.
1899 *Ostrea* aff. *Munsoni* Hill - Oppenheim, p. 46.
1899 *Ostrea* aff. *Munsoni* Hill - Redlich, p. 150.
1899 *Ostrea* cf. *schiosensis* Böhm - Redlich, p. 150.
1899 *Ostrea* cfr. *schiosensis* Boehm - Parona, p. 6.
1901 *Ostrea Joannae* Choffat - Virgilio, p. XXXI.
1901 *Ostrea Munsoni* Hill - Schnarrenberger, p. 19 (*non* Hill, 1893).
. 1901 *Ostraea* (*sic*) aff. *Munsoni* Hill - Redlich, pp. 75, 81.
1901 *Ostrea* cf. *schiosensis* Böhm - Redlich, p. 81.
. 1902 *Chondrodonta Joannae* Choffat (*Ostrea*) - Choffat, p. 157, pl. Ostreidae 6, figs 15, 16.
. 1902 *Chondrodonta Joannae* - Douvillé, p. 316, 1 text-fig.
v . 1902 *Ostrea* aff. *Munsoni* Hill - Marinelli, p. 171.
. 1902 *Chondrodonta* (*Ostrea*) *Joannae* Choffat - Hoernes, p. 667, etc., figs 1-3, pls 1, 2.
. 1903 *Ostrea* (*Chondrodonta*) *Joannae* Choffat - Schubert, p. 270, pl. 13, figs 2, 3.
. 1903 *Chondrodonta Joannae* var. *elongata* - Schubert, p. 271, pl. 13, fig. 4.
. 1903 *Chondrodonta Joannae* var. *angusta* - Schubert, p. 271, pl. 13, fig. 5.
. 1903 *Chondrodonta Joannae* var. - Schubert, p. 272, pl. 13, fig. 6.
1903 *Chondrodonta Joannae* var. *levis* - Schubert, p. 272.

[5] Because of the obviously very wide morphological variability and the still inadequate knowledge of the hinge particularities of the *Chondrodonta* species, we consider it premature, at this stage, to use the subgeneric taxa available in literature.

Text-fig. 14 - Natural erosion surface of the early Late Albian Zirc Limestone at Urkút (southern Bakony, Hungary) showing antero-posterior and oblique sections through the dorsal part of *Chondrodonta cretacea* (Lörenthey, 1895) specimens. Note how right (convex) and left (flat) valves are strongly interlocked by their pronounced chondrophores. MAFI K.1048.

. 1903 *Ostrea* (*Chondrodonta*) *Munsoni* Hill - Schubert, p. 270 (*non* Hill, 1893).
. 1903 *Chondrodonta Munsoni* var. *ostraeiformis* (*sic*) (Futterer) - Schubert, p. 273, pl. 13, fig. 1.
1905 *Ostrea* (*Chondrodonta*) *Munsoni* Hill - Kossmat, p. 41 (*non* Hill, 1893).
1907 *Terquemia forojuliensis* Boehm - Parona, p. 234.
1907 *Chondrodonta Joannae* (Choff.) - Parona, p. 235.
1909 *Chondrodonta Joannae* (Choffat) - Parona in Parona *et al.*, p. 35.
v . 1909 *Terquemia forojuliensis* Boehm - Parona in Parona *et al.*, p. 167, pl. 17, fig. 1; pl. 18, fig. 9.
? 1909 Gen. indet., spec. indet. - Vredenburg, p. 229, pl. 16, fig. 2.
1910 *Chondrodonta Joannae* Choffat - Douvillé, pp. 57, 61 etc.
v . 1911 *Chondrodonta Joannae* Choffat (= *Pinna ostreaeformis* Futt.) - Parona, p. 5.
? 1911 *Chondrodonta Bösei* - Vredenburg, p. 255.
v . 1912a *Chondrodonta sellaeformis* n. f. - Parona, p. 4, text-figs 1-3.
. 1912b *Chondrodonta sellaeformis* Par. - Parona, p. 279.
? 1917 *Chondrodonta Joannae*, Choffat - Fourtau, p. 13.
1920 *Ostrea* aff. *Munsoni* Hill - Zenari, p. 8.
v . 1921 *Chondrodonta sellaeformis* Parona - Checchia-Rispoli, p. 164.
. 1926 *Chondrodonta Joannae* (Choffat) - Parona, p. 48, pl. 6, figs 1-3.
. 1926 *Chondrodonta sellaeformis* Par. - Parona, p. 49.
v . 1926 *Chondrodonta* ? n. f. - Parona, p. 50, pl. 6, figs 4-7.
v . 1926 *Alectryonia Polae* n. f. - Parona, p. 51, pl. 6, fig. 8.
1930 *Chondrodonta Joannae* (Choff.) - Zuffardi-Comerci, p. 5.
1930 *Chondrodonta sellaeformis* Par. - Zuffardi-Comerci, p. 15.
. 1931 *Chondrodonta Joannae* Choffat - Uršić, p. 126, 1 fig.
. 1934 *Ostreavicula* n. g. *dayi* n. sp. - Blanckenhorn, p. 179, pl. 7, figs 3, 4.
1934 *Chondrodonta joannae* Choff. - Blanckenhorn, p. 204.
1934 *Chondrodonta munsoni* Hill sp. - Blanckenhorn, p. 204 (*non* Hill, 1893).
? 1934 *Chondrodonta* (?) *zemmarinensis* n. sp. - Blanckenhorn, p. 205, pl. 10, fig. 46.
1938 *Chondrodonta Joannae* Choffat - Pfender, p. 184.
1938 *Chondrodonta Joannae* variété *crassa* - Pfender, p. 186.
. 1942 *Chondrodonta Joannae* (Choffat) - Tavani, p. 12, pl. 1, figs 8-11.
. 1942 *Chondrodonta Delgadoi* (Choffat) - Tavani, p. 12, pl. 2, fig.1 (*non* Choffat, 1886 ?).
. 1948 *Chondrodonta Joannae* (Choffat) - Tavani, p. 88, pl. 1, fig. 14; pl. 2, fig. 2 (*vidimus*).
v . 1948 *Chondrodonta Delgadoi* (Choffat) - Tavani, p. 88, pl. 2, fig. 1 (*non* Choffat, 1886?).
? 1948 *Chondrodonta Bösei* Vredenburg - Tavani, p. 89.
. 1957 *Chondrodonta joannae* Chof. et varr. - Grubić, p. 246, pl. 2, fig. 4.
. 1957 *Chondrodonta munsoni* Hill - Grubić, p. 247, pl. 1, figs 1, 2 (*non* Hill, 1893).
. 1957 *Chondrodonta munsoni* v. *ostreaeformis* (Futterer) - Grubić, p. 248, pl. 2, fig. 3.
1959 *Ostrea villei* Coq. - Gheorghiu, p. 116, pl. 3, fig. 1 (*non* Coquand, 1869).
1960 *Ostrea* (*Chondrodonta*) *joannae* Choff. - Pleničar, p. 33.
1960 *Chondrodonta munsoni* Hill - Pleničar, p. 34 (*non* Hill, 1893).
1963 *Chondrodonta joannae* Choffat - Pejović, Pašić, pp. 53, 55, etc.
v . 1966 *Lamellotis* (*Kosmolamellotis*) *transsylvanica* - Horváth, p. 108, pl. 7, figs 3, 4.
v . 1966 *Lamellotis* (*Tenuilamellotis*) *dichotoma* - Horváth, p. 108.
? 1966 *Chondrodonta* sp. - Freund, p. 110.
. 1967 *Chondrodonta joannae* (Choffat) - Polšak, p. 27, p. 157, pl. 3, fig. 1.
. 1967 *Chondrodonta joannae angusta* Schubert - Polšak, p. 29, p. 157, pl. 3, fig. 6.
. 1967 *Chondrodonta levis* Schubert - Polšak, p. 29, p. 157, pl. 4, fig. 3.
. 1967 *Chondrodonta munsoni* Hill - Polšak, p. 29, p. 157, pl. 3, figs 2-5 (*non* Hill, 1893).
. 1967 *Chondrodonta munsoni ostreaeformis* (Futterer) - Polšak, p. 30, p. 158, pl. 4, fig. 2.

1970 *Chondrodonta* cf. *dayi* Blanck. - Saint-Marc, p. 383.
. 1971 *Chondrodonta* (*Chondrodonta*) *joannae* (Choffat) - Stenzel in Moore, p. N1198, figs J149, 1a (from Choffat, 1902), 1b (from Douvillé, 1902).
1971 *Chondrodonta joannae* (Choffat) - Slišković, pp. 22, 23, 27.
1971 *Chondrodonta joannae angusta* Schubert - Slišković, pp. 22, 23.
1971 *Chondrodonta joannae elongata* Schubert - Slišković, pp. 23, 27.
1971 *Chondrodonta munsoni* Hill - Slišković, pp. 22, 23, 27 (*non* Hill, 1893).
1971 *Chondrodonta munsoni ostreaeformis* (Futterer) - Slišković, pp. 22, 23, 27.
. 1972 *Chondrodonta* cf. *joannae* (Choffat) - Sirna in Carbone *et al.*, p. 139.
. 1972 *Chondrodonta munsoni* (Hill) - Sirna in Carbone *et al.*, p. 139, fig. 4 (*non* Hill, 1893).
1975 *Chondrodonta* - Alberti *et al.*, p. 12.
. 1977 *Chondrodonta joannae* (Choffat) - Sirna in Praturlon, Sirna, p. 95, fig. 10.
v . 1977 *Chondrodonta munsoni* (Hill) - Sirna in Praturlon, Sirna, p. 95, fig. 11 (*non* Hill, 1893).
1977 "Bivalves" - Catenacci, p. 876, fig. 1.
1978 *Chondrodonta joannae* - Philip, p. 156.
. 1979 *Chondrodonta joannae* (Choffat) - Barbieri *et al.*, p. 12, fig. 4.
. 1981 *Perna*? - Carbone, Sirna, p. 433, fig. 3b.
1981 *Chondrodonta joannae* (Choffat) - Carbone, Sirna, p. 435.
1981 *Chondrodonta munsoni* (Hill) - Carbone, Sirna, p. 435 (*non* Hill, 1893).
1982 *Chondrodonta* - Cousin, Fourcade, p. 118.
1988 *Chondrodonta joannae* - Scott R. W. *et al.*, p. 280.
1989 *Chondrodonta joannae* - Peza, p. 501.
. 1989 *Chondrodonta joannae* - Accordi, Carbone, Sirna, p. 167, pl. 3, fig. 6.
? 1989 *Chondrodonta* sp. - Luperto Sinni, Borgomano, p. 99.
. 1990 *Ostrea* (*Chondrodonta*) *joannae* Choff. - Galvani, fig. on p. 61.
. 1990 *Chondrodonta* - Zucchi, Vittori, fig. on p. 65.
1990a *Chondrodonta joannae* - Scott R. W., p. 95.
1991 *Chondrodonta joannae* (Choffat) - Russo *et al.*, p. 495.
v . 1992 *Chondrodonta joannae* (Choffat) - Dhondt, Dieni, p. 212, figs 2, 3.

Lectotype: Among the syntypes of Choffat (1886) we designate as lectotype the original of pl. Ostreidae 1, fig. 5. The other specimens figured by Choffat (*op. cit.*) are considered as paralectotypes. All the types are housed in the collections of the Serviços geológicos de Portugal, Lisbon.

Type localiy: Monte Serves, NNE of Lisbon, Portugal.

Type horizon: Upper Cenomanian.

Material:
- Thirteen bivalved topotypes from Monte Serves, Portugal [DGP 26728-26730; coll. P.-Y.Berthou, nine specimens; IRSNB IG 25729].
- Thirty one specimens, of which six bivalved, from Col dei Schiosi [B12-14, B16-19, B21, B23, B26, B29, B185, B225, B227, B239, DGP 15130, DGP 15202 a-c, DGP 26698-26700, 26726, two syntypes of *Ostrea schiosensis* G.Boehm, 1895 (FrB 171, 172), two syntypes of *Terquemia forojuliensis* G. Boehm, 1895 (FrB 42, 43), two specimens of *Ostrea* aff. *munsoni* in G. Boehm, 1895 (FrB 199, 224 and 225), two specimens identified by Futterer (1892) as *Ostrea* sp. (MB, unreg.)].
- Seven specimens from Casera Fassor, Travesio (Pordenone, Friuli) [DGP 26694, 26701, 26702 (quoted by Parona, 1911, p. 5) and a plaster cast of one of the two figured syntypes of *Pinna ostreaeformis* Futterer, 1896 (MB, unreg.), from the same locality].
- Six specimens from Bocca di Crosis, Tarcento (Udine, Friuli), original material from G. Boehm, 1897 (IGF 3422E-3426E, coll. Marinelli).

EXPLANATION OF PLATE XIII

Fig. 1 - *Ludbrookia* cf. *cottaldina* (d'Orbigny, 1844).
Right valve.
Upper Cenomanian, Col dei Schiosi (Pordenone); MFU 1316; x 1.5.

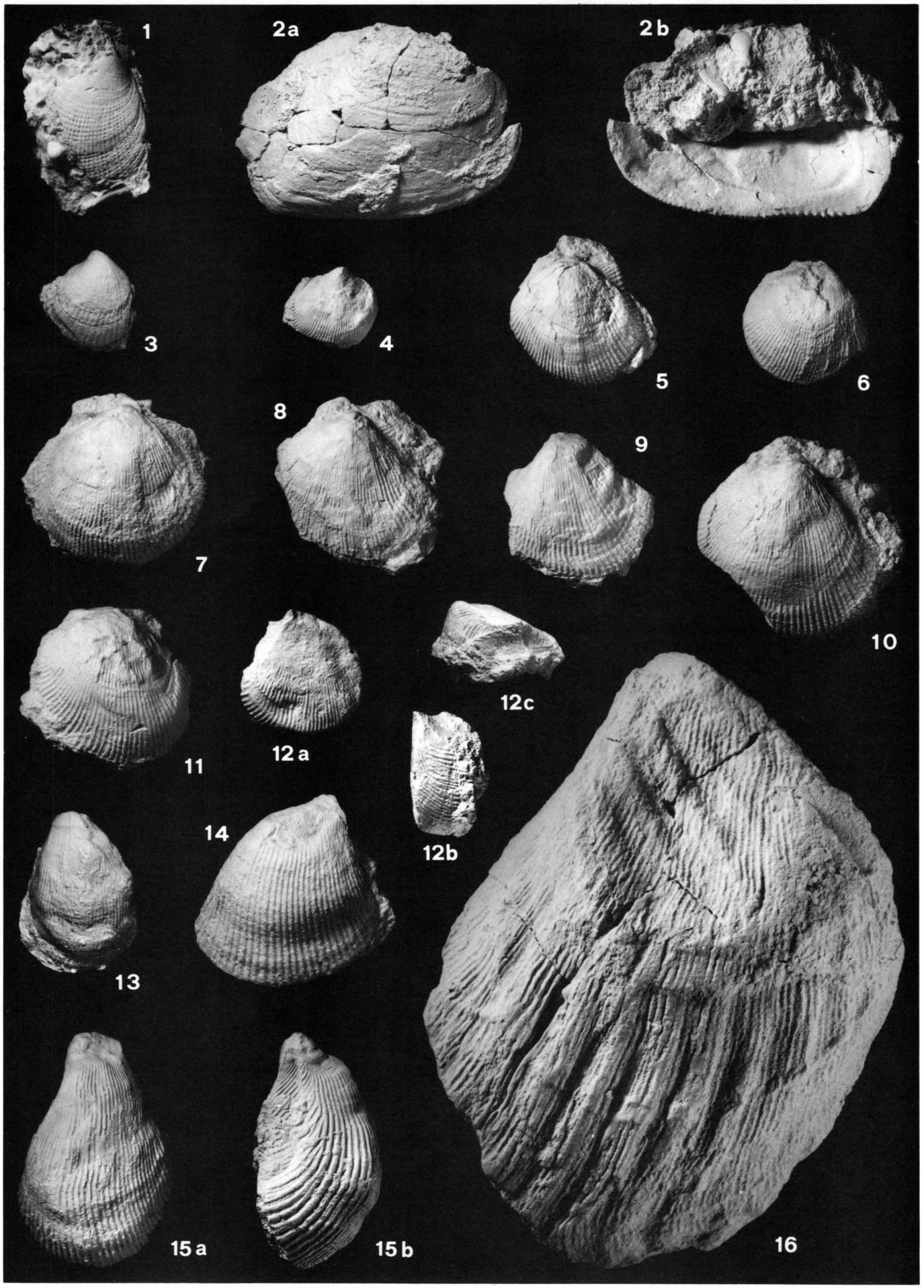
Figs 2a, 2b - *Crassatella macrodonta* (J. de C. Sowerby, 1832).
Right valve.
2a - Exterior.
2b - Interior.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B91.

Fig. 3 - *Cyclocardia*? cf. *ottonis* (Geinitz, 1843).
Left valve.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B124.

Figs 4-15b - *Spondylys requienianus* Matheron, 1843.
4-11 - Left valves.
12a-15b - Right valves.
12b, 12c - Anterior view (12b) and dorsal view showing the ligamental area (12c).
15b - Posterior view.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B122, B110, B108, B109, B97, B116, B85, B178, B174, B175, P39, B169.

Fig. 16 - *Spondylus arcuatus* (Catullo, 1834).
Topotype, right valve; the dorsal attachment area shows the imprint of a hippuritid.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); P8.

All the specimens are whitened and, unless otherwise stated, natural size.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2a
2b
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4
5
6
7
8
9
10
11
12a
12c
12b
13
14
15a
15b
16

- More than fifty specimens from Pradis (Pordenone), on a large slab of rock housed at the Museo Friulano di Storia Naturale in Udine.
- Three bivalved specimens from the locality Archi, Monfalcone (Gorizia Karst, NE Italy) (MSNT 11014a and 11014b, coll. Renzi; MSP 65]).
- Three specimens, of which two bivalved, from the locality Piemonte, Groznjan (= Grisignana), Istria (Croatia) (DGP 26695-26697).
- One specimen from Buzet (= Pinguente), Istria (Croatia), figured as "*Chondrodonta*? n. f." by Parona (1926) (MSNT 11826a, 11826b).
- Seven specimens, of which three bivalved, from Pula (= Pola), Istria (Croatia) [MSNT 11827, holotype of *Alectryonia polae* Parona, 1926; MB/M 555 (1-6)].
- Six specimens from an unknown locality in Istria (Croatia): DGP 26703 and 26704.
- One specimen from the Cori area (Lepini Mts., central Italy) collected by Praturlon and Sirna (1977) (MPUR/ns 23-21).
- The two figured syntypes of *Chondrodonta sellaeformis* Parona, 1912, from the Conca Anticolana, Latium (MTO, unreg.).
- The two specimens of *Terquemia forojuliensis* figured by Parona in Parona *et al.* (1909), from Monti d'Ocre, Abruzzo (MTO, unreg.).
- Some very incomplete valves from the Upper Cenomanian of San Marco in Lamis (Gargano, southern Italy) determined by Checchia-Rispoli (1921, on written suggestion of Parona) as *Ch. sellaeformis* Parona (MTO, Pu 19132).
- Five specimens from Bur Ghedud, Somalia: two identified as *Ch. joannae* (IGF 3435E) and three as *Ch. delgadoi* (IGF 3434E) by Tavani (1948).
- Four specimens from Cherghes-Deva, Transylvania (Romania), identified by Horváth (1966) under four different specific names (see below); some of them are mentioned and/or figured in Horváth (*op. cit.*) (MAFI K.1050, K.1057, K.1058, K.1060).

State of preservation: Few specimens are complete. Many are missing the umbonal region. This is related to their sessile life habit: the cemented part of the right valve generally remains attached to its substrate. Some specimens have well preserved shells, but on many only an incomplete shell is present, mainly as the result of desquamation during the extraction from the rock (Pl. XV, figs 8-10). All transitions are present between complete shell and steinkern. Some specimens from Col dei Schiosi, especially the incomplete ones with very thick umbonal region, are strongly worn by mechanical processes during post-mortem transport (Pl. XV, figs 2a-6b).

Diagnosis: Medium to large-sized *Chondrodonta* species of varying outline, with angular plications.

Description: S h a p e: umbonal part pointed, generally elongate to very elongate (see for example G. Boehm, 1897, pl. 4, fig. 3, under *Ostrea* aff. *munsoni* Hill); the major part of the shell can have all the kinds of outline from elongate-ovate to fan-shaped, but can also be triangular or subcircular.

The right valve is convex, and the somewhat smaller left valve is shallowly concave or flat.

The umbonal area is often deflected laterally.

On two right valves the presence of chomata has been observed in the umbonal area, near the anterior margin (the posterior margin of both specimens is poorly preserved; Pl. XVIII, fig. 2b).

The plane of commissure undulates slightly. The shells with elongate-ovate forms are sometimes dorso-ventrally sinuous (Pl. XV, fig. 9).

O r n a m e n t a t i o n : shell is plicated; the plicae start in the umbonal region; some are straight but most diverge laterally; their number increases through division or intercalation. On well preserved valves it is obvious that the profile of the plications is sharply angular, and that the intercostal areas are narrow and deep. This is easiest to observe at the "concentric" squamae which correspond to growth interruptions (Pl. XVIII, fig. 4). On less well preserved, decorticated specimens, plications are less angular (Pl. XV, figs 9, 10) and can in extreme cases even be almost invisible. The shell surface then gives the impression of being virtually smooth (Pl. XV, fig. 8).

The number of the "primary" plicae varies widely and from a few (less than 10, generally on specimens with elongate shape) it can reach as many as 70 (especially on subcircular, wide-angled morphotypes). In the median part of the shell the plicae remain straight or are slightly sinuous until the ventral margin; on the lateral sides they diverge at a variable angle towards the median ribs; they are almost radial on the semi-circular specimens. On some specimens a band (of about 25 mm width on a valve with H of about 180 mm) with narrow, very numerous riblets, perpendicular to the margin of the shell, appear after a

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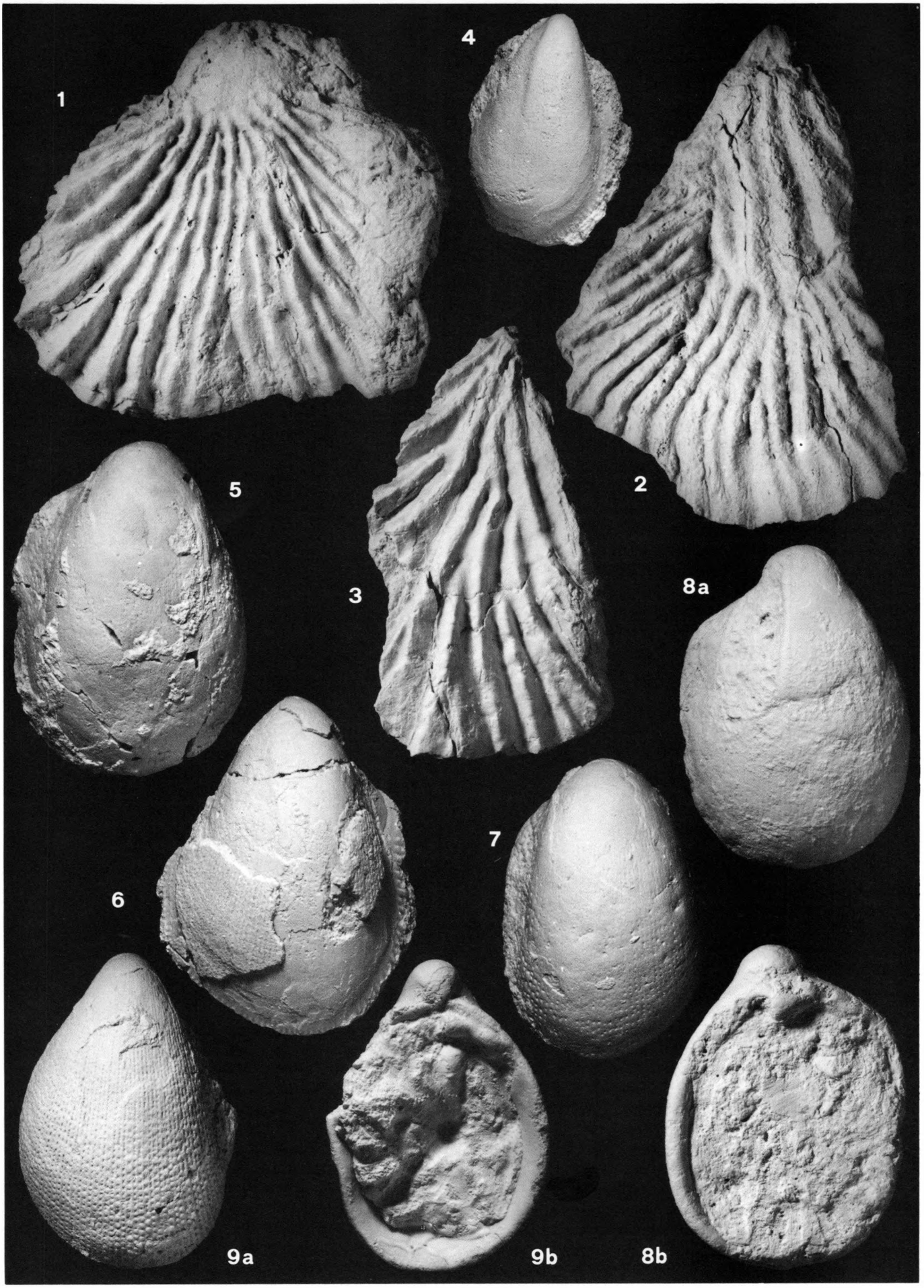
EXPLANATION OF PLATE XIV

Figs 1-3 - *Chondrodonta joannae* (Choffat, 1886).
Topotypes.
1 - Right valve.
2 - Left valve.
3 - Right (?) valve.
Upper Cenomanian, Monte Serves (Portugal); DGP 26728, 26729, 26730.

Figs 4-9b - *Granocardium productum* (J. de C. Sowerby, 1832).
4 - Left valve, internal mould.
5, 7-8b - More or less worn right valves.
6, 9 - Left valves in different state of preservation; typical small tubercles are visible on the ribs.
6 - Internal mould with partially preserved shell.
8b - Right valve, interior with partially visible hinge.
9b - Left valve, interior with partially visible hinge.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); B140, B137, P31, P35, P30, B138.

All the specimens are whitened and natural size.


1
4
2
5
3
8a
6
7
9a
9b
8b

growth interruption (Pl. XVIII, fig. 6). On other specimens similar riblets are wider (Pl. XIX, fig. 5) and thus automatically less numerous; they can even be almost as wide as the primary plicae.

Umbonal region of the right valve, cemented to the substrate, can be very thick (Pl. XV, fig. 5; Pl. XVIII, figs 1, 7). It has attachment scars of varying shape, depending on the nature of the substrate onto which it was fixed (e.g. Pl. XV, fig. 3a and Pl. XVI, figs 1a, 4a). Sometimes fragments of the substrate are still visible attached to the valve (Pl. XV, fig. 4a). The complex ligamental area with the chondrophores is rarely well preserved (Pl. XVI, fig. 2).

Valve thickness: the thickness in the umbonal region of right valves can reach high values: for example 23 mm on specimen B16, and 50 mm on valve DGP 27726 (Pl. XVIII, fig. 1). Beyond the umbonal area the shell becomes progressively thinner: for instance towards the ventral margin on the specimens DGP 26695-26697 (from Istria) and on MNST 11014a, b (from Monfalcone) the thickness of a single valve was measured as being less than 1 mm (Pl. XVI, figs 1a-2).

Dimensions: In the material studied all ontogenetic stages, from small to very large, are present. No dimensions are indicated because the variability in shape and the frequent incompleteness of the specimens make measuring pointless. Ontogenetic stages and various morphotypes are illustrated in the plates.

Discussion: The wide morphologic variability of *Chondrodonta joannae* has been recognised by many authors. Already Choffat described (1886) and discussed (1902) this variability further, including the width of the plicae, and the probable relation between the width and the nature of the substrate on which the bivalve lived. He used this criterion (a finer grained sediment being associated with more numerous plicae) to include into *Ch. joannae* specimens from different localities and with finer or coarser ornamentation.

The variation in shape is also beautifully illustrated by Schubert (1903) for specimens from Istria to which he gave varietal names (var. *angusta*, *elongata*, *levis*, etc.). Similarly, a saddle-like shape is seen in some cases, as for example in the specimens from the rudist limestones of central Italy (Latium) which Parona (1912a) described as *Ch. sellaeformis* (see Pl. XVIII, fig. 5).

G. Boehm in 1895 created two new taxa from Col dei Schiosi: *Ostrea schiosensis* and *Terquemia forojuliensis*. They were based on eroded right valves (mainly only umbonal or dorsal parts) of *Chondrodonta joannae*. Already Stanton (1901, p. 303) and Freneix and Lefèvre (1968) had placed these taxa of G. Boehm in *Chondrodonta*. In the series of specimens available to us all transitions are present between the pebble-like, smooth "*Ostrea schiosensis*", through the only vaguely ribbed "*Terquemia forojuliensis*" to the normal almost complete umbonal parts of *Chondrodonta joannae* (Pl. XV, figs 2a-6b). The thickness of "*O. schiosensis*" simply shows that the umbonal part of right valves of *Chondrodonta joannae* was sometimes very developed. This part of the valve is almost never preserved because it remained attached to the sub-

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EXPLANATION OF PLATE XV

Figs 1a-10 - *Chondrodonta joannae* (Choffat, 1886).

1a, 1b - Right valve; exterior (1a) and interior showing the monomyarian character of the genus and the chondrophore (1b).

2a, 2b - Umbonal part of a right valve strongly eroded by mechanical processes in a high energy environment (= "*Ostrea schiosensis* G. Boehm, 1895"). The posterior view (2b) shows the unusual thickness of the umbonal part originally cemented to the substrate. On the valve interior (2a) the chondrophore is partially preserved.

3a, 3b - Dorsal part of a right valve which was strongly eroded and polished by synsedimentary mechanical processes (= "*Ostrea schiosensis* G. Boehm, 1895"). On the top of the external side the valve still shows its original attachment area (3a, arrow) and on the ventral part some of the original, strong radial plicae are partially still recognizable. On the internal side (3b) the chondrophore and the well developed muscle scar are still clearly visible.

4a, 4b - Right valve (4a) and posterior view (4b) of a naturally polished, almost complete bivalved specimen; its original broad radial ornamentation is still partially recognizable. A fragment of its original substrate (another valve of *Ch. joannae*) is cemented to the umbonal part of the right valve (4a).

5 - Anterior view of a strongly eroded and naturally polished right valve ("*Ostrea schiosensis* G. Boehm, 1895") oriented according to the presumed life position of the bivalve. The flat base represents the originally cemented area of the strongly thickened umbonal part of the valve.

6a, 6b Exterior (6a) and interior (6b) of a strongly eroded and naturally polished right valve. Traces of the original broad plicae are visible at the periphery of the specimen (6a), which has a "morphology" similar to that of "*Terquemia forojuliensis* G. Boehm, 1895". Chondrophore and muscle scar are still visible.

7 - External mould of an incomplete left valve; part of the shell is preserved at the posterior area. Note the subcircular shape of the valve and the high number (around 70) of fine radial ribs.

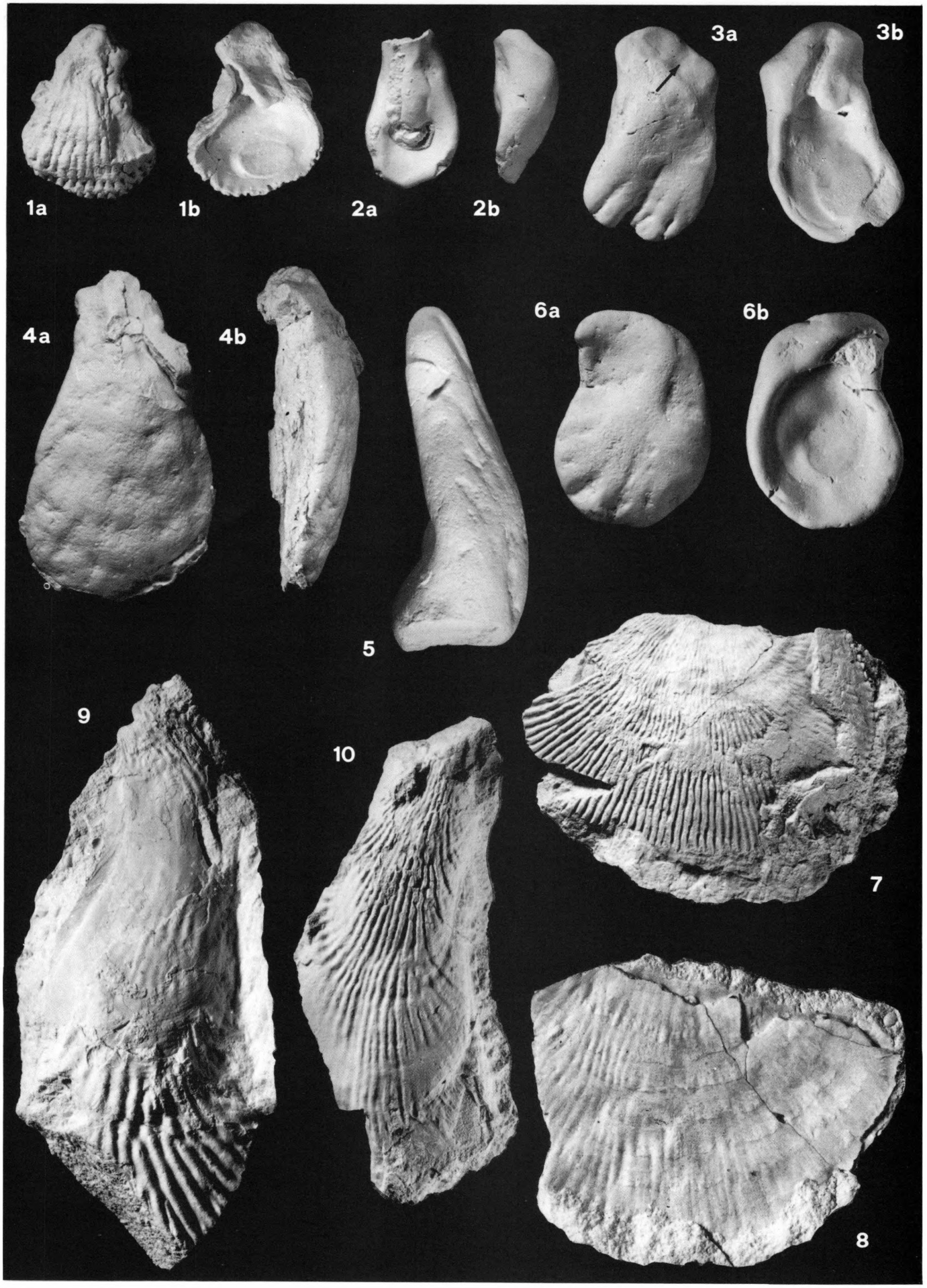
8 - Incomplete left valve which is almost smooth because strongly desquamated. The original ribs are visible only vaguely because the external shell layers were peeled off. This desquamated valve has a surface comparable to that of the syntype of *Chondrodonta "glabra"* figured by Stanton, 1901, pl. 26, fig. 1.

9 - Right valve in which the umbonal and dorsal parts are decorticated. The progressive exfoliation of the external shell layers results in more and more attenuated plicae, which can in places even disappear. Note the dorsoventrally sinuous shape of the shell, which has a morphology comparable to that of "*Pinna ostreaeformis* Futterer, 1896".

10 - Decorticated right valve with a morphology close to that of "*Pinna ostreaeformis* Futterer, 1896". Because of the shell desquamation the originally sharp plicae become rounded.

Upper Cenomanian, Col dei Schiosi (Pordenone); B227, DGP 15130, B21, B23, B16, B19, B185, B29, DGP 26699, B225.

All the specimens are whitened and natural size.


1a
1b
2a
2b
3a
3b
4a
4b
5
6a
6b
7
8
9
10

strate and as a result has been only rarely figured in literature.

Chondrodonta boesei Vredenburg, 1911, from a rudist-bearing limestone of (?) Turonian age in Baluchistan, western Pakistan, represents a very large *Chondrodonta* specimen (first described and illustrated but not named in Vredenburg, 1909) with a wide umbonal angle and numerous plicae. It seems very near to similar morphotypes of *Ch. joannae* from NE Italy. However, because we have not seen the Vredenburg types, we have here synonymized *Ch. boesei* only tentatively with *Ch. joannae*.

Chondrodonta sellaeformis Parona, 1912a, from the Upper Cenomanian [see Parona, 1926, p. 50; this chronostratigraphic assignment is confirmed here by the foraminiferal content of the matrix of the types examined by one of us (I. D.): *Biplanata peneropliformis* Hamaoui and Saint-Marc, 1970, *Merlingina cretacea* Hamaoui and Saint-Marc, 1965, *Nezzazata simplex* Omara, 1956, *Chrysalidina gradata* d'Orbigny, 1839, *Pseudorhapydionina dubia* (De Castro, 1965)] of the Conca Anticolana, Latium, is based on a faulty reconstruction of a fragmentary and worn left valve without umbonal part of a *Ch. joannae* specimen which originally, as far as can be judged from the growthlines which are still visible, had a subcircular shape (Pl. XVIII, fig. 5). The smoothness of the presumed outside of the shell results from a misinterpretation of the specimen: the visible face of the valve, still included in matrix, corresponds to the interior and not to the exterior, as was erroneously stated by Parona (1912a, p. 8).

Such saddle-shaped (*sellaeformis*) morphotypes are common in the populations of *Chondrodonta joannae* from different areas. In Italy, in addition to the occurrence in Latium and Apulia (Checchia-Rispoli, 1921), numerous similar specimens have been observed in outcrops of the Gorizia-Trieste Karst (for example near Monfalcone).

Alectryonia polae Parona, 1926, from the Upper Cenomanian of Pula, Istria, has, despite what Parona wrote, all the characteristics of *Ch. joannae*, recorded by him from the same beds. It represents simply a morphotype of the Choffat species with sub-circular shell shape (Pl. XVII, fig. 5). A similar specimen of *Ch. joannae* morphotype "*polae*" collected from Pula by Ewald and identified as "*Ostrea* aff. *munsoni*" is housed in the Naturkunde Museum in Berlin.

Ostreavicula dayi Blanckenhorn, 1934, described from the Cenomanian of Lebanon, was included by Freneix and Lefèvre (1968) in the genus *Chondrodonta* [this fact was not recognised in the *Treatise* (Cox in Moore, 1969, p. N865), where the genus *Ostreavicula* Blanckenhorn, 1934 (of which *O. dayi* is the type species by monotypy) is placed as being of uncertain affinities]. Blanckenhorn's illustrations, especially pl. 7, fig. 4, show a chondrodont hinge. The rib pattern shown on pl. 7, fig. 3 is almost certainly identical with that of *Ch. joannae*. The other new *Chondrodonta* species in Blanckenhorn (1934), *Ch.* (?) *zemmarinensis*, from other Cenomanian outcrops in Lebanon, is close to *Ch. joannae*, but very poorly preserved and based on only one specimen; therefore no definite decision as to its precise nature can be reached.

From Cenomanian beds in Cherghes-Deva, Transylvania (Romania), the MAFI type collections contain specimens labelled as "Holotypus" of four new taxa "erected" by Horváth (1966). One (MAFI K.1058) has been named and figured: *Lamellotis* (*Kosmolamellotis*) *transsylvanica*. Another (MAFI K.1060) has only been named: *L.* (*Tenuilamellotis*) *dichotoma* (Text-fig. 15 herein). Two taxa are hinted at in the publication (p. 108) but are not explicitly named nor figured. However, in the collections of MAFI the two specimens belonging to these taxa are named as follows: *Lamellotis* (*Lamellotis*) *hantkeni paucilamella* Horváth, 1964 (MAFI K.1050), and *Lamellotis* (*Grypheolamellotis*) *cenomana* Horváth, 1964 (MAFI K.1057; see Pl. XVIII, fig. 7). These latter two taxa are clearly only manuscript names and are invalid; the former two are not in agreement with ICZN Art. 13 and must be considered as invalid names. After examining the "holotypes" of the four Cenomanian "taxa" of Horváth (1966), it becomes obvious that all four represent, in different state of preservation (varying from well preserved to almost totally smoothened), only usual morphotypes of *Chondrodonta joannae* (Choffat). For instance "*L.* (*G.*) *cenomana*" represents the morphotype "*Ostrea schiosensis* G. Boehm" (Pl. XVIII, fig. 7); a very similar specimen from the same area of Cherghes-Deva has been determined as "*Ostrea villei* Coq." by Gheorghiu (1959, pl. 3, fig. 1).

The differentiation between *Ch. joannae* and *Ch. munsoni* (Hill, 1893), from the Middle to basal Upper Albian of Texas, was already discussed by Stanton (1901) and by Choffat (1902). Basically, as can be seen from the Stanton (1901, 1947) figured specimens housed in the USNM in Washington D. C., *Ch. munsoni* has generally more numerous, but less frequently divided, and less angular plications than is the case in *Ch. joannae*. On specimens of *Ch. munsoni* the commarginal growth lines are more obvious than on the specimens we studied of *Ch. joannae*. Also, plicae and growth lines of *Ch. munsoni* form a somewhat reticulated pattern originating from their intersections. Furthermore, the lateral deflection of the umbonal region, which is seen commonly in *Ch. munsoni*, is (as was already stated by Choffat, 1902, p. 159) less frequent in the specimens of the European species. The specimens of *Ch. joannae*, available to us seem, when they are deflected, to be so posteriorly (and not anteriorly as illustrated for *Ch. munsoni* in Stanton, 1947). This observation, however, needs to be confirmed by better material of *Ch. joannae*.

Ch. glabra Stanton, 1901, from the Lower Albian (Glen Rose Limestone) of Texas, is described as being smooth on the outside. The types, housed in the USNM in Washington D. C., seem mainly devoid of ornamentation, but for instance USNM 30180 shows a few real plicae in the middle of the valve; near the ventral margin the same specimen is clearly decorticated (6). The relative scarcity of specimens free from matrix makes the interpretation of this taxon somewhat uncertain. It strikes us that:

- either the smoothness of *glabra* types is an involuntary artefact from preparation, and that the taxon is very closely related with *Ch. munsoni*;
- either *glabra* only represents a particular ecomorphotype of *munsoni* without or with poorly developed ornamentation. However, more material needs to be studied before a decision can be reached.

(6) Close examination of this type convinced us that the statement of Stanton (*op. cit.*, p. 307) "the striations on the lower portion are accidental, due to slight slipping movements of the rocks" should be reconsidered. These striations are undoubtedly connected with the structure of the shell. This can clearly be seen in some decorticated, recrystallized specimens of *Chondrodonta joannae* (Choffat, 1886) from Col dei Schiosi, which have the same appearance.

Text-fig. 15 - Incomplete and strongly desquamated right valve of *Chondrodonta joannae* (Choffat, 1886) [= "Holotypus" of *Lamellotis (Tenuilamellotis) dichotoma* Horváth, 1966, *nomen nudum*]. Cenomanian of Cherghes-Deva, Transylvania (Romania); MAFI K.1060; x 1.

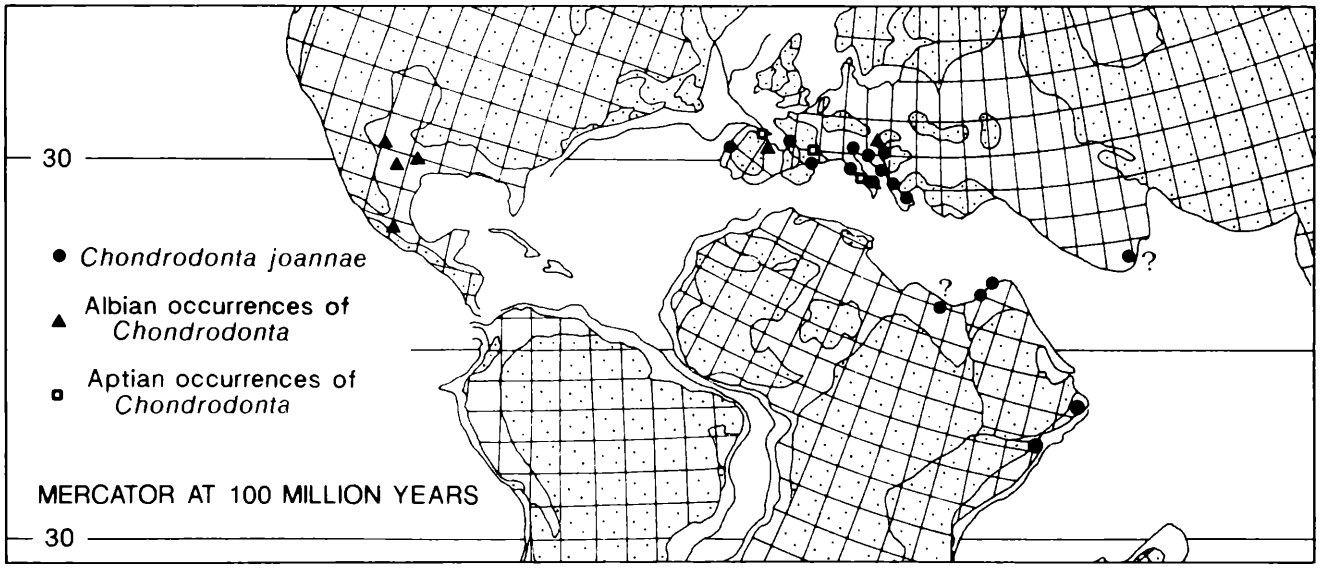
Ch. delgadoi (Choffat, 1886), from beds of "Middle" Cenomanian age (Berthou, 1984a; 1984b) in Portugal, is characterised by wide angled valves with numerous ribs. We have not seen the type specimens and cannot venture an opinion on the exact significance of this taxon. Outside Portugal the taxon has only been reported by Tavani (1942, 1948), who referred Late Cenomanian specimens from Somalia to *delgadoi*. After studying the Tavani material we have concluded that it represents morphotypes of *Ch. joannae*, of which species several specimens were found in the same beds (Pl. XVII, figs 3, 4). Whether a similar situation is present in Portugal we cannot prove at present but undoubtedly such a possibility should not be discarded without further investigation. If *Ch. delgadoi* and *Ch. joannae* represent the same species then the stratigraphic range of *Ch. joannae* must be extended further downwards than generally assumed.

Ch. desori (Coquand, 1869), from the Cenomanian near Angoulème (France), was erected on only one poorly preserved specimen kept in the MAFI coll. at Budapest. The knowledge of this taxon is generally based on the morphological description of topotypical specimens by Douvillé (1902). The differences between *Ch. desori* and *Ch. joannae* are not very pronounced, but on the whole *Ch. desori* seems to have fewer plicae and possibly a more subcircular shape. Stratigraphically *Ch. desori* is known from beds which are now considered as being of Late (but not latest) Cenomanian age (Moreau, 1978), which makes it more or less coeval with *Ch. joannae*. Therefore, it is not improbable that *Ch. desori* is only another morphotype of the highly variable *Ch. joannae*.

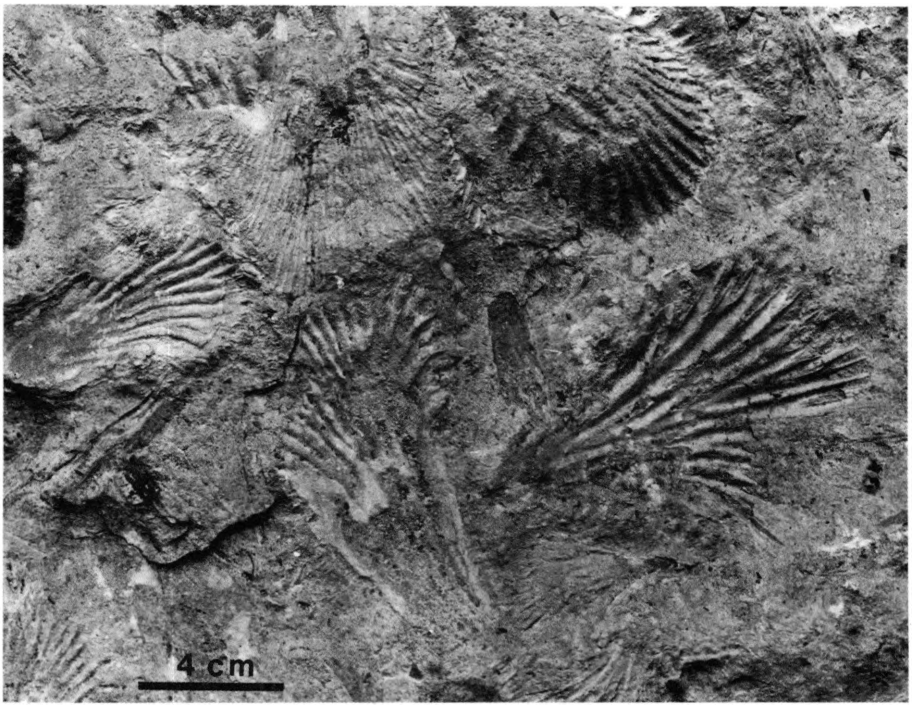
Freneix and Lefèvre (1968) erected *Chondrodonta (Cleidochondrella) elmaliensis* for specimens from the (?) Santonian of Turkey. This youngest known *Chondrodonta* species has aspects of the better preserved Cenomanian *joannae* specimens from Friuli, from the Trieste-Gorizia Karst and from Istria. It should be interesting to investigate the relationship between these two taxa.

After this discussion on the various synonyms and possible synonyms of *Chondrodonta joannae*, which reflect the extreme variability (Text-fig. 17) and complexity of the Choffat species, it becomes obvious that it must have had a special adaptive plasticity towards different environments (such as back-reef shoals or "reefs" themselves) and substrates (such as carbonate or marly sediment, with fine or coarse texture). Once again this also demonstrates the need for having modern species descriptions based whenever possible on populations and not on single specimens.

Distribution: According to the region, the rudist beds in which *Ch. joannae* occurs have been dated formerly as Late Cenomanian to Turonian. The stratigraphy in the Tethyan Realm is so far not always as precise as could be wished, and it is not impossible that all occurrences are coeval. Following the newer proposals of the Cenomanian-Turonian stage boundary (Birkelund *et al.*,1984) most of the "older" Turonian datings have been moved into the Late Cenomanian, and where new data on rudists and foraminifera exist this has been con-



Text-fig. 16 - Palaeogeographic distribution of *Chondrodonta joannae* (Choffat, 1886); also occurrences of Aptian and Albian chondrodonts are indicated.



Text-fig. 17 - Allochthonous bivalved specimens of *Chondrodonta joannae* (Choffat, 1886) in the Upper Cenomanian of Pradis (Pordenone, Friuli). Two ecomorphotypes can be easily recognised: that of "*Pinna ostreaeformis* Futterer, 1896" is abundant and it is accompanied by another morphotype with many fine ribs (upper left part of the photograph) very similar to a figured syntype of *Chondrodonta delgadoi* (Choffat, 1886, pl. Ostreidae 3, fig. 1a, b). Surface of a rock slab parallel to the bedding; Museo Friulano di Storia Naturale, Udine.

firmed (Berthou, 1984a, 1984b). For instance, in the western Portuguese Basin, where its type area lies, *Chondrodonta joannae* is associated with *Sauvagesia sharpei* (Bayle, 1857), *Radiolites lusitanicus* (Bayle, 1857), *Durania arnaudi intermedia* Choffat, 1900, among rudists, and with *Biconcava bentori* Hamaoui, 1965, *Pseudolituonella reicheli* Marie, 1965, *Chrysalidina gradata* d'Orbigny, 1839, *Pseudorhapydionina dubia* (De Castro, 1965), *Pseudorhipidionina casertana* (De Castro, 1965) (Choffat, 1886, 1902; Berthou and Philip, 1973; Berthou, 1984a, 1984b); in the Monfalcone area (Gorizia Karst, NE Italy) and in the Brač Island (Croatia) it is accompanied by *Praeradiolites fleuriausus* (d'Orbigny, 1842), *Chrysalidina gradata* d'Orbigny, 1839, *Pastrikella balcanica* (Cherchi, Radoičić and Schroeder, 1976), *Pseudorhapydionina dubia* (De Castro, 1965) (D. Sartorio, unpublished data; Gušić and Jelaska, 1990). For additional considerations on the Late Cenomanian age of the foraminiferal assemblages characterising the *Chondrodonta joannae* facies of the peri-mediterranean areas we refer to the paper of De Castro (1983) on the stratigraphical range of *Cisalveolina fraasi* (Gümbel) Reichel, 1941.

To conclude, we consider that it is almost certain that *Chondrodonta joannae* is present only in Late (but not latest) Cenomanian beds.

The Early-Middle Albian age of the *Chondrodonta joannae* beds of central Somalia recently proposed by Russo *et al.* (1991) and based on micropalaeontological data (orbitolinids) from underlying strata cannot be accepted. In fact, the rudists associated with *Ch. joannae*, and particularly *Eoradiolites liratus* (Conrad, 1852), unquestionably indicate a Cenomanian age (see Parona, 1909, 1926, 1942; Tavani, 1948).

Chondrodonta joannae has been recorded from Portugal, Provence and possibly Charentes (France), Friuli-Venezia Giulia, Latium, Abruzzo, Apulia (Italy), western Slovenia, Istria and Dalmatia (Croatia), Hercegovina, western Serbia, Albania, Transylvania (Romania), Ionian Islands and NE Peloponnese (Greece), Lebanon, Israel, Oman, Somalia, ?Egypt, ?western Pakistan (Text-fig. 16).

EXPLANATION OF PLATE XVI

Figs 1a-5 - *Chondrodonta joannae* (Choffat, 1886).

1a-1c - Right valve (1a), left valve (1b) and anterior view (1c) of a bivalved specimen. Note the attachment area on the umbonal part of the right valve (1a, 1c) and the geniculation of the shell (1c) indicating a change in life position of the bivalve during its ontogeny.

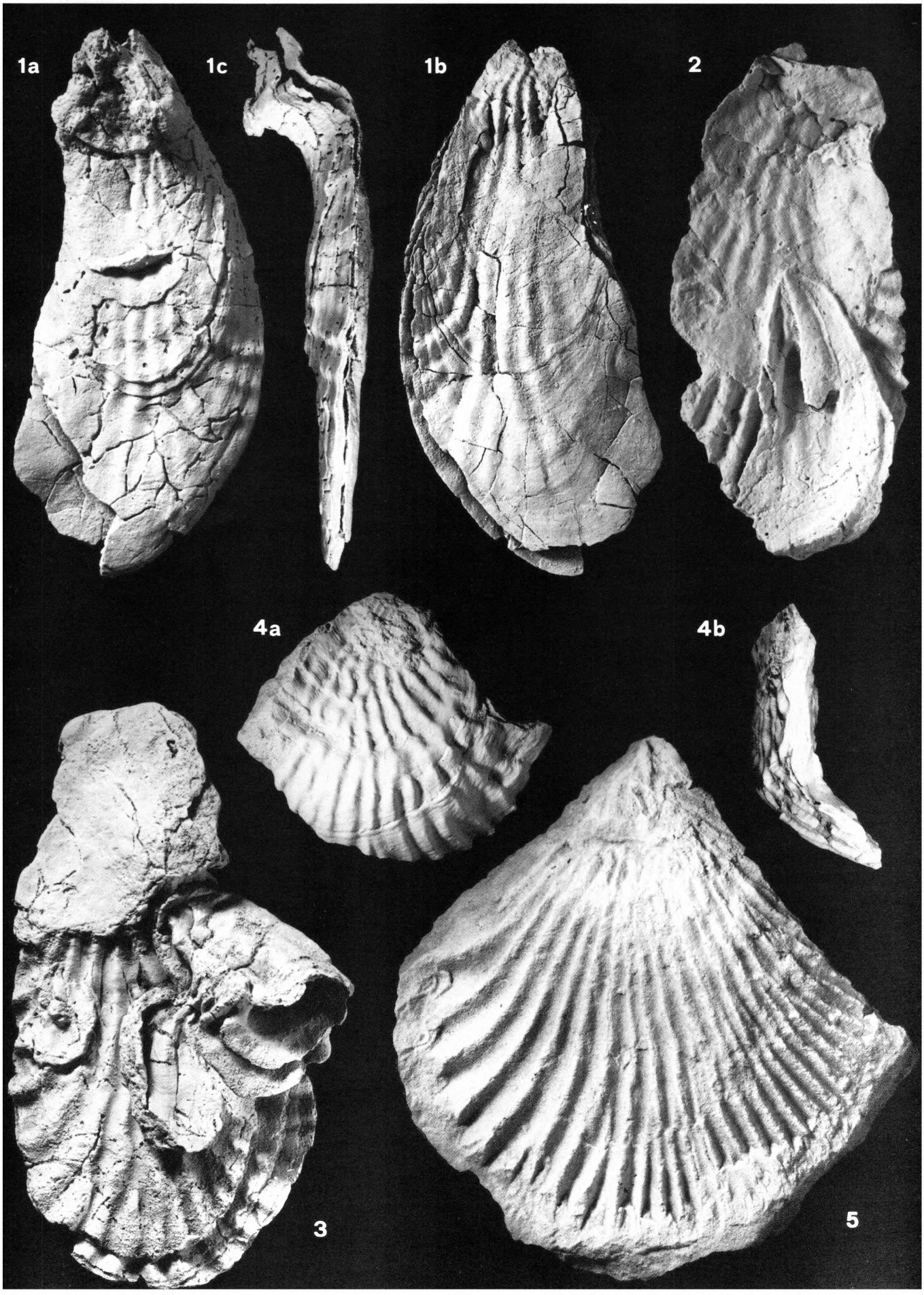
2 - Interior of the right valve of a small specimen cemented to the left valve of a larger specimen. Note the development of the chondrophore.

3 - Right valve of a bivalved specimen on which a right valve of *Praeradiolites fleuriausus* (d'Orbigny, 1842) is laterally cemented.
Upper Cenomanian, Monfalcone (Gorizia); MSNT 11014b, MSNT 11014a, MSP 65.

4a, 4b - Right valve (4a) and anterior view (4b) of an incomplete bivalved specimen. Note the attachment area on the umbonal part of the right valve (4a, 4b) and the geniculation of the shell (4b) indicating a gradually more inclined life position of the bivalve during its ontogeny.
Upper Cenomanian, Pula (= Pola), Istria (Croatia); MB/M555 (coll. Ewald).

5 - Left valve, external mould.
Upper Cenomanian, Istria, precise locality unknown; DGP 26703.

All the specimens are whitened and natural size.


1a
1c
1b
2
4a
4b
3
5

Subcl. PALAEOHETERODONTA Newell, 1965
Ord. TRIGONIOIDA Dall, 1889
Superfam. TRIGONIACEA Lamarck, 1819
Fam. TRIGONIIDAE Lamarck, 1819

Pterotrigonia (*Scabrotrigonia*) *scabra* (Lamarck, 1819)

\+ 1819 *Trigonia scabra*, Lamarck - Lamarck, p. 63.
. 1844 *Trigonia scabra*, Lamarck - d'Orbigny, p. 153, pl. 296, figs 1-4 (*cum syn.*).
. 1844 *Trigonia limbata*, d'Orbigny - d'Orbigny, p. 156, pl. 298, figs 1-4.
v . 1865 *Trigonia limbata* d'Orb. - Zittel, p. 160, pl. 9, figs 1a-c.
1865 *Trigonia scabra* Lam. - Zittel, p. 161, pl. 9, figs 2a-c.
1871 *Trigonia scabra*, Lam. - Stoliczka, p. 314, pl. 15, figs 24 - 26; pl. 16, figs 35-40.
. 1885 *Trigonia Vaelsensis* Joh. Böhm - J. Böhm, p. 99, pl. 2, figs 1a-c (*cum syn.*).
1889 *Trigonia Vaalsiensis* J. Böhm - Holzapfel, p. 198, pl. 21, figs 1-6.
. 1912 *Trigonia scabra* Lamarck - Pervinquière, p. 220, pl. 15, figs 1-3.
. 1912 *Trigonia scabra* Lamk. - Cossmann, p. 75, pl. 2, figs 7-9.
. 1914 *Trigonia scabra* Lm. - Favre, pl. 35, figs 250, 251.
. 1920 *Trigonia scabra* Lamarck - Roman, Mazeran, p. 85, pl. 8, figs 3-8.
1923 *Trigonia scabra* Lmk. - Parona, p. 37.
1948 *Trigonia scabra* Lmk. - Tavani, p. 119.
1957 *Pterotrigonia scabra* (Lamarck) - Dartevelle, Freneix, p. 126.
. 1958 *Scabrotrigonia scabra* (Lamarck) - Saveliev, p. 119, pl. 58, fig. 4 (from d'Orbigny, 1844).
. 1969 *Pterotrigonia* (*Scabrotrigonia*) *scabra* (Lamarck) - Cox in Moore, p. N487, fig. D73,1 (from d'Orbigny, 1844).
? 1972 *Trigonia scabra* Lamk. - Besairie, p. 164.
. 1981 *Trigonia scabra* Lamarck - Tzankov in Tzankov *et al.*, p. 133, pl. 66, figs 6-10.
? 1982 *Pterotrigonia scabra* (Lamarck) - Sobetski, p. 149, pl. 15, fig. 11.
? 1992 *Pterotrigonia* (*Scabrotrigonia*) *scabra* (Lamarck) - Metwally, p. 135, figs 5 j, k.

Material: Internal mould of a left valve and external mould of a right valve, belonging to the same specimen (B186). They were collected along the road from Rifugio Maset to Casera Can de Piera, 1 km SSW of Casere Scios (Col dei Schiosi), where the species is not rare in *Orbitolina* grainstones and is always preserved as external and internal moulds.

Discussion: The external mould clearly shows the characteristics of this species.

Contradictory interpretations exist concerning the specific identity of *Trigonia scabra* Lamarck (from the Turonian in the Drôme, France), *T. limbata* d'Orbigny, 1844 (from the Coniacian of the Aude, France) and *T. crenulata* Lamarck, 1819 (from the Cenomanian of the Sarthe, France). We consider *T. scabra* and *T. limbata* as synonymous for reasons exposed by Dhondt (1987). It seems probable that also *T. crenulata* is identical with the two previous taxa, but detailed research hereon falls outside the purpose of this paper.

The arguments exposed by J. Böhm (1885) for considering *T. scabra* as different from his *T. vaelsensis*, and examined by Holzapfel (1889), failed to convince us. Seemingly the specimens from Vaals have a narrower posterior part of the shell, but this fact might simply be due to better and more complete preservation.

In central European palaeontological literature the name *T. glaciana* Sturm, 1901 has been used for material which is similar to *T. scabra* and has been collected from strata of the same age. The specimens included in *T. glaciana* are generally of such poor preservation that we have been unable to compare them properly with specimens described as belonging to *T. scabra*.

T. eufalensis Gabb, 1860 and *T. thoracica* Morton, 1834, from the Campanian-Maastrichtian of the Gulf Coast of North America (see Wade, 1926), are undoubtedly closely related to *T. scabra* but different preservation makes it difficult to compare them precisely.

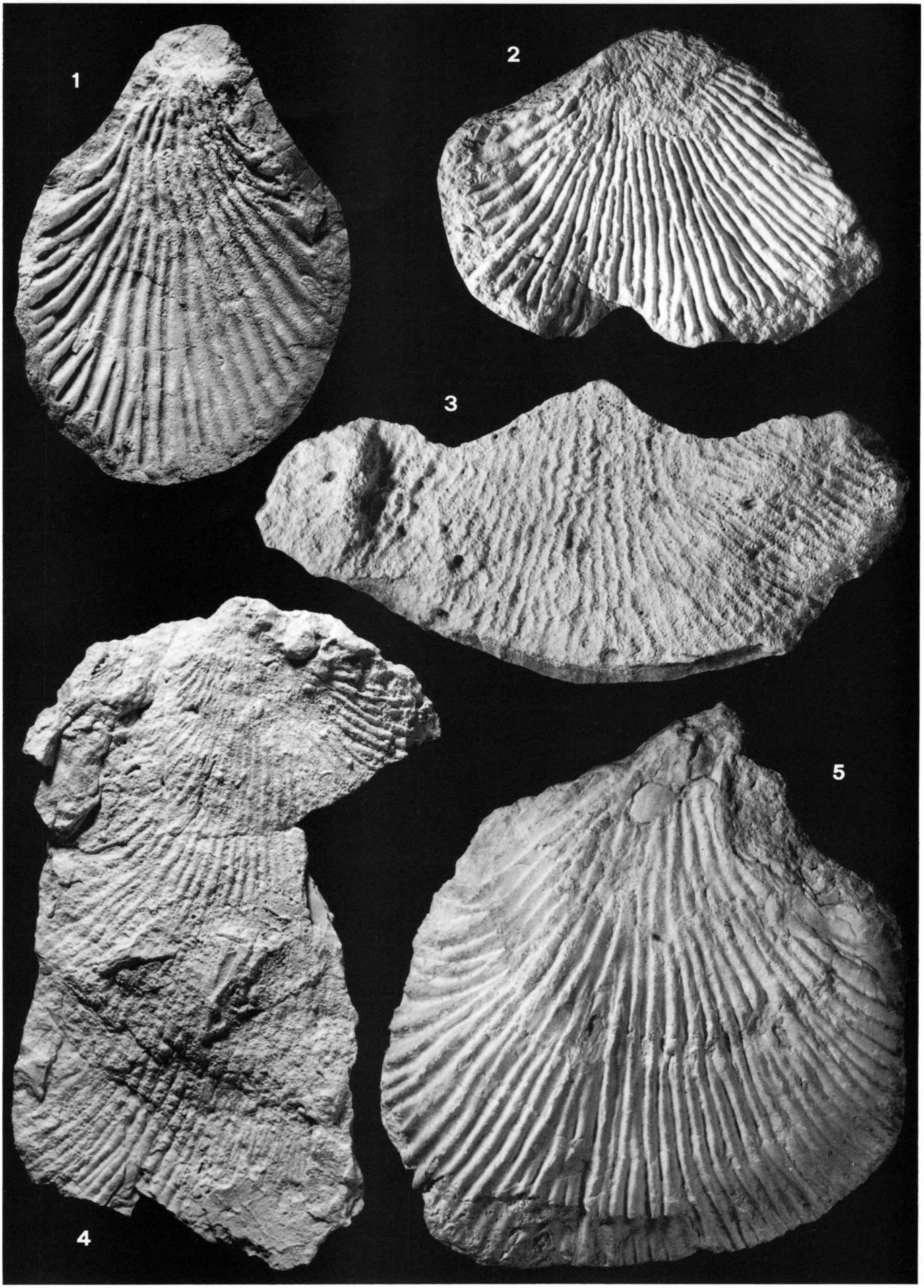
Distribution: Widely distributed in shallow water, generally coarse-grained Cenomanian-Maastrichtian deposits: warm Temperate and marginal Tethyan regions (Le Mans, Uchaux and the Corbières in France, Vaals Aachen and the Harz in Germany, Gosau in Austria, western Carnic Prealps in NE Italy, Pre-caspian depression and Mangyshlak in Kazakhstan, Tunisia and Libya in North Africa, Somalia in East Africa and possibly Oman, southern India and Madagascar.

Subcl. HETERODONTA Neumayr, 1883
Ord. VENEROIDA H. Adams and A. Adams, 1856
Superfam. LUCINACEA Fleming, 1828
Fam. LUCINIDAE Fleming, 1928

EXPLANATION OF PLATE XVII

Figs 1-5 - *Chondrodonta joannae* (Choffat, 1886).
1 - Right valve, external mould; morphotype "*Pinna ostreaeformis* Futterer, 1896".
Upper Cenomanian, Istria, precise locality unknown; DGP 26704.
2 - Left valve; morphotype with numerous ribs.
Upper Cenomanian, Col dei Schiosi (Pordenone); DGP 26700.
3, 4 - Left valves; morphotypes with numerous, narrow ribs [= *Chondrodonta delgadoi* (Choffat) in Tavani, 1948].
Upper Cenomanian, Bur Ghedud, Somalia; IGF 3434E (b, a).
5 - Right valve; morphotype with subcircular shape [= holotype (by monotypy) of *Alectryonia polae* Parona, 1926].
Upper Cenomanian, Pula (=Pola), Istria (Croatia); MSNT 11827; x 0.75.

All the specimens are whitened and, unless otherwise stated, natural size.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"*Lucina*" cf. *tenera* (J. de C. Sowerby, 1836)
Pl. XX, fig. 13.

v . 1897 *Lucina* sp. - G. Boehm, p. 178, fig. 7.

Material: One incomplete left valve (IGF 354E; H = 17 mm) from the Upper Cenomanian at Bocca di Crosis, Tarcento (Udine), figured by G. Boehm (1897). One internal mould (B35) from Col dei Schiosi is tentatively assigned to the same taxon.

Discussion: As far as can be ascertained from the incomplete specimen, somewhat unfaithfully figured by G. Boehm (L>H on the specimen but not on the figure), an undoubted similarity exists with *Lucina tenera* (J. de C. Sowerby, 1836) as described and figured by Woods, 1907, p. 154, pl. 24, figs 10-14. Especially the valve outline, the shape of the umbo and the rib pattern are comparable. *Lucina tenera* is known from the Gault (Albian) of England.

Fam. FIMBRIIDAE Nicol, 1950

Fimbria alpaghina (Catullo, 1827)
Pl. XX, figs 1a-12.

v + 1827 *Venus alpaghina* nob. - Catullo, p. 165.
. 1834 *Venus alpaghina*, Nob. - Catullo, p. 17.
. 1892 *Lucina alpaghina* Catullo sp. - Futterer, p. 106, pl. 3, fig. 8 and fig. 9 (*vidimus*).
? 1908c *Fimbria* (n. f.) - Parona, p. 301.
. 1990 *Arctica* (?) sp. - Galvani, fig. on p. 61.

Lectotype: Among the type series of Catullo the lectotype is designated herein: specimen DGP 7161b, from Pignè (= Pinei); Pl. XX, fig. 4.

Material:
- Thirty four topotypes (some are relatively poorly preserved) among which one bivalved specimen (B164), twelve left valves [B125, B131-136, B145, B151, B152, MB/M 556 (original of Futterer with counterpart), MGB/Ve 809] and twelve right valves [(B126, B141, B148, B157, B158, P41, DGP 7161b (coll. Catullo), DGP 2505 (coll. de Zigno, under the name *Lucina taramellii*, MS), MGB/Ve 805-808], all from Pinei, Lago di S. Croce.
- Six right and four left valves from Zolla, near Trieste (MSNT 11843-11852).

Original diagnosis: *Testa subcordata, obliqua; sulcis transversis elevatis; ano cordato?*

Description: Equivalve, subcircular, not very globose shell with a very thick test, a crenulated margin and only a slightly prosogyrous umbo.

The ornamentation combines commarginal and radial elements forming a reticulate pattern. The commarginal narrow lightly imbricated ridges are distributed somewhat irregularly. Occasionally they divide or are partially covered by the anterior or posterior commarginal ridges (Pl. XX, figs 5, 8, 9). The radial riblets are much more pronounced near the anterior and posterior margins of the valves.

When the shell is worn or decorticated (or both) the radial ornamentation is still clearly visible as lines when worn (Pl. XX, fig. 10) and as riblets when decorticated. This ornamentation also forms the marginal crenulation (Pl. XX, fig. 1b).

The radial ornamentation element is seen even on internal moulds, together with the pallial line and the muscle scars (Pl. XX, fig. 1a).

Hinges are worn on all specimens, but the few elements which are still visible agree with the hinge of a typical *Fimbria* (Pl. XX, fig. 12). Lunula and escutcheon are worn away on all the available specimens.

Dimensions (mm):

	H	L	B'	H/L
B125	(18.3)	(20.3)	(7.0)	(0.91)
B157	(35)	(41)	—	(0.85)
B152	(39)	(44)	—	(0.88)

EXPLANATION OF PLATE XVIII

Figs 1-7 - *Chondrodonta joannae* (Choffat, 1886).

1 - Natural cross section of an exceptionally thick right valve bored by a specimen of *Botuloides intermedius* (d'Orbigny, 1845).
Upper Cenomanian, Col dei Schiosi (Pordenone); DGP 26726; x 0.8.

2a, 2b - Right valve (external mould with part of the shell) with subcircular shape and many fine ribs. Note the presence of chomata-like ridgelets at the anterior umbonal margin (2b; x 2).
Upper Cenomanian, Cori area (Lepini Mts., Latium); MPUR/ns, 23-21.

3 - Interior of the right valve belonging to the specimen described and figured as "*Chondrodonta*? n. f." by Parona, 1926, p. 50, pl. 6, figs 4,5.
Upper Cenomanian, Buzet (= Pinguente), Istria (Croatia); MSNT 11826a, b.

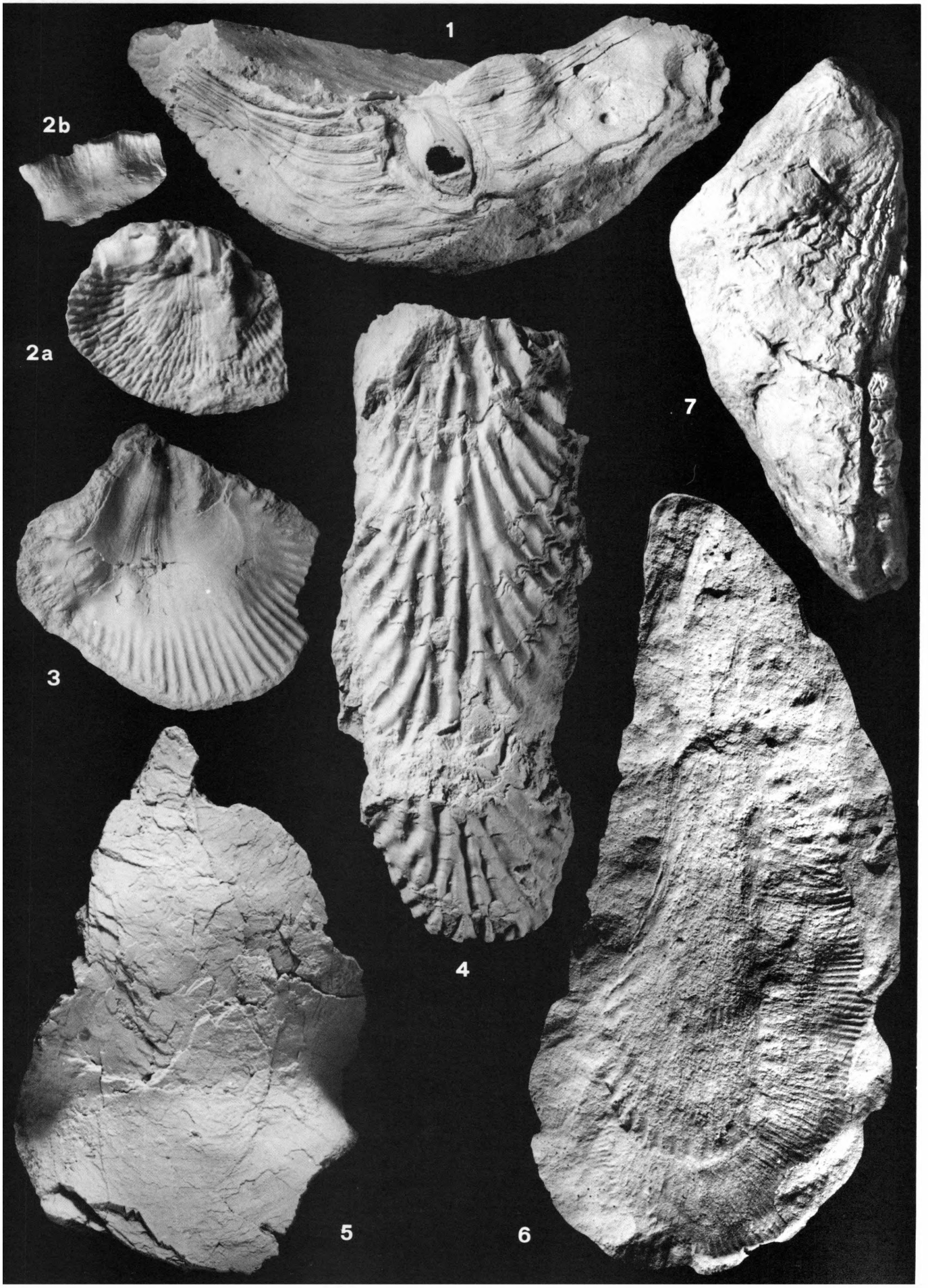
4 - Right valve. Note its commarginal squamae which indicate growth interruptions.
Upper Cenomanian, locality Piemonte, Groznjan (= Grisignana), Istria (Croatia); DGP 26696.

5 - Interior of a very incomplete left valve (= figured syntype of *Chondrodonta sellaeformis* Parona, 1912, text-figs 1, 2).
Upper Cenomanian, Colle Vigli, Trivigliano (Frosinone, Latium); MTO (unreg.).

6 - Right valve. Note the wide rim covered by numerous riblets perpendicular to the shell margin which encloses the central part of the valve bearing a broad radial ornamentation of the " *Pinna ostreaeformis* Futterer, 1886" pattern (silicone cast).
Upper Cenomanian, Pradis (Pordenone); MFU.

7 - Anterior view of a bivalved specimen [= "Holotypus" of *Lamellotis* (*Grypheolamellotis*) *cenomana* Horváth, 1964, MS]. Note the large, flat attachment area of the very thick right valve. A very similar specimen from the same locality was determined as "*Ostrea villei* Coq." by Gheorghiu (1959, pl. 3, fig. 1).
Upper Cenomanian, Cherghes-Deva (Transylvania, Romania); MAFI K.1057.

All the specimens are whitened and, unless otherwise stated, natural size.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MSNT 11843	39.5	44.7	13.1	0.88
MB/M556	(48)	55	—	(0.87)
MSNT 11844	49.2	58.5	(16.7)	0.84
B151	(50)	(55)	—	(0.91)
MSNT 11845	52.4	—	(19.8)	—
MSNT 11846	54.0	(63)	(19.8)	(0.86)
B135	(57)	(64)	—	(0.89)
B132	(59)	(67)	(18.0)	(0.88)
B133	(66)	—	—	—

Discussion: *Fimbria alpaghina* was originally described very briefly as *Venus alpaghina* by Catullo (1827) and dated as Jurassic. Futterer (1892) found two good internal moulds of the species (one is illustrated herein on Pl. XX, figs 1a, 1b) in the type locality (labelled "Calloniche") and on the base of these assigned the taxon to *Lucina*. Until now, a series of reasonably well preserved specimens of Catullo's species had never been collected nor described.

The reticulate ornamentation of *Fimbria alpaghina* contains the same elements, but less strongly developed, than on the recent *F. fimbria* (Linné, 1758), type species of the genus.

Several taxa of species assigned to Fimbriidae have been described from Cenomanian-Santonian strata: for instance *Corbis rotundata* d'Orbigny, 1845 and *Lucina turoniensis* d'Orbigny, 1845 (both from the Cenomanian stratotype), *Corbis franchii* Schnarrenberger, 1901 (from the Monti d'Ocre, Abruzzi) [and possibly also synonymous is *Fimbria* (*Mutiella*) *rotundata* (d'Orb.) in Zuffardi-Comerci, 1930, p. 14, from Cenomanian rudist facies in Apulia], *Fimbria sharpei* Choffat, 1886 (from Upper Cenomanian rudist facies in Portugal) and *Fimbria coarctata* Zittel, 1865 (from the Santonian Gosau beds). All these taxa differ from *Fimbria alpaghina* in being more convex, and in having a more prosogyrous umbo.

Distribution: Until now known only from Italian rudist limestones: in the eastern Venetian Prealps, latest Coniacian-earliest Campanian; in the Gorizia-Trieste Karst, from beds dated by rudists as Turonian (Galvani, 1990); possibly also occurring in the Subiaco area, Latium, from "Senonian" beds.

Superfam. CARDITACEA Fleming, 1820
Fam. PERMOPHORIDAE Van de Poel, 1959

Myoconcha (*Modiolina*) *dilatata* Zittel, 1865
Pl. VI, fig. 5.

+ 1865 *Myoconcha dilatata* Zitt. - Zittel, p. 154, pl. 10, fig. 1.
? 1975 *Myoconcha dilatata* Zittel - Czabalay, p. 442.
? 1982 *Myoconcha dilatata* Zittel - Czabalay, p. 23.

Material: One poorly preserved right valve with partially visible hinge (P20) from Pinei, Lago di S. Croce.

Dimensions (mm): H = (73); L = (127); B' = (30).

Discussion: Several *Myoconcha* taxa, generally based on very poorly preserved specimens, have been described in Upper Cretaceous literature. A few examples:
- *M. cretacea* d'Orbigny, 1844 (p. 260, pl. 335, figs 1-5), mentioned from Cenomanian to Campanian strata, but later divided arbitrarily and without description in the *Prodrome* (d'Orbigny, 1850) in *M. cretacea* (for Cenomanian localities) and in *M. supracretacea* (for Coniacian-Campanian localities);
- *M. angulata* d'Orbigny, 1844 (p. 261, pl. 336, figs 1-4), from the Cenomanian of Le Mans, France;
- *M. subovata*, Stoliczka, 1871 (p. 362, pl. 23, fig. 1), from the "Senonian" of southern India;
- *M. discrepans* (J. Müller, 1847), from the Campanian of Vaals, near Aachen, western Germany (in Holzapfel, 1889, pl. 24, figs 14-16);
- *Myoconcha* n. sp. in G. Müller (1898, p. 48, pl. 7, fig. 3) from the Campanian of the Harz, Germany.

The differences between these taxa are based on the presence/absence of an umbonal-ventral fold, on the shape of the postero-ventral margin (rounded/angular) and on the convexity.

The specimen from Pinei, despite its imperfections, is closest to the Gosau taxon and therefore has been identified as such. However, with better material a revision of the known taxa might simplify the taxonomy of the group.

Distribution: Recorded from Coniacian-Santonian deposits [(Gosau (Austria) and eastern Venetian Prealps (NE Italy)] and possibly from the Campanian of Hungary.

Fam. CARDITIDAE Fleming, 1828

Cyclocardia? cf. *ottonis* (Geinitz, 1843)
Pl. XIII, fig. 3.

+ 1843 *Cardium Ottonis* m. - Geinitz, p. 14, pl. 1, figs 31, 32.
. 1865 *Cardium Ottoi* Gein. - Zittel, p. 144, pl. 6, figs 4a, 4b.
. 1897 *Cardium Ottoi*, Gein. - Frič, p. 51, fig. 53.
. 1901 *Cardium Ottonis* Gein. - Sturm, p. 77, pl. 6, figs 8a-c.
? 1916 *Cardium Ottoi* Gein. - Papp in Lóczy, p. 250.
1934 *Cardium ottoi* Gein. - Andert, p. 259, pl. 12, figs 17, 18.

EXPLANATION OF PLATE XIX

Figs 1-5 - *Chondrodonta joannae* (Choffat, 1886).
Some morphotypes present on a bedding surface of about two square metres.
1-3 - The elongate pyriform to flabelliform outline and the ornamentation of the specimens is nearly identical to that of the figured syntypes of "*Pinna ostreaeformis* Futterer, 1896".
4 - Specimen with subtriangular shell outline and characterised by numerous narrow ribs.
5 - Specimen with triangular-flabelliform outline and characterised by an abrupt change in ornamentation pattern at the transition from the central part (comparable to "*Pinna ostreaeformis* Futterer, 1896") to the marginal part of the valve.
Upper Cenomanian, Pradis (Pordenone); rock slab housed in the Museo Friulano di Storia Naturale, Udine.

All the specimens are natural size.

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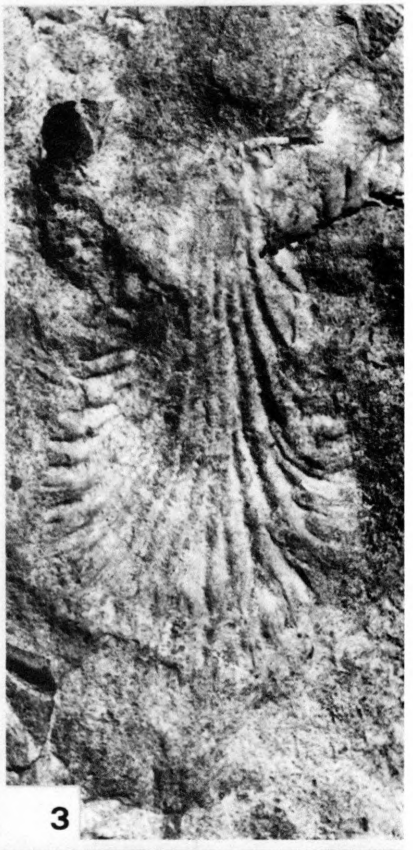

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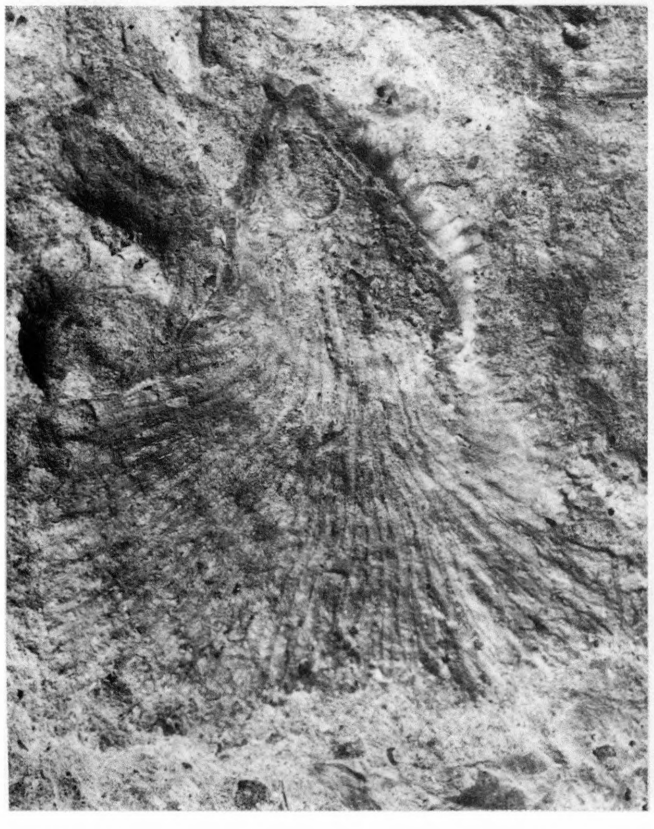

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Material: One almost complete, somewhat worn left valve [B124: H = 17.6 mm; L = (17.3) mm; B = 7.4 mm] from Pinei, Lago di S. Croce.

Description: Suborbicular specimen, covered with about 35 flat-topped ribs, separated by narrower interspaces, in which lie regularly placed commarginally arranged lines. Umbo strongly incurved; margin crenulated; shell thick; growth interruptions present.

Discussion: *Cardium ottonis* Geinitz, 1843, from the Coniacian of Kieslingswalde (Poland), has a shape and rib-number which are similar to those of the specimen from Pinei. The ribs of that taxon are shown by several authors to be sharp and angular. However, Frič (1897) demonstrated that depending on the preservation the ribs can vary strongly in shape:
- when not worn they are wide and have narrow intercostal intervals;
- when the outer shell layer is peeled off the ribs are narrower and the intercostal intervals wider, and from nearly smooth and wide in the first case the ribs change to angular and covered with occasional small knobs.

The best preserved ornamentation figured by Frič (*op. cit.*, fig. 53-A-1) is very close to that seen on the Pinei specimen.

The specimen under discussion is different from the roughly coeval *Cardium turoniense* Woods, 1897 (= "*Beguina*" *turoniensis* in Cleevely and Morris, 1987) by its proportions, by its lesser convexity, and by its ornamentation (in as far as it can be ascertained from the descriptions available in literature of "*Cardium*" *turoniense*).

From *Cardium gosaviense* Zittel, 1865, from the Santonian of the Gosau, our specimen differs by its less postero-ventrally elongate shape, its more incurved umbo, and its smaller rib number.

Cardium reussi Zittel, 1865, from the Maastrichtian near Vienna, has more numerous narrow ribs but is otherwise comparable to *C. gosaviense*.

Cardium becksii J. Müller, 1847, from the Campanian of Vaals (The Netherlands), as shown in Holzapfel (1889) and Frič (1897), is also characterised by narrow and sharp ribs.

Cardium cenomanense d'Orbigny, 1844 (p. 37, pl. 249, figs 5-9), from the Cenomanian stratotype, has a similar ornamentation but its rib number is much higher, judging from the figures in d'Orbigny. Furthermore, *C. cenomanense* is less incurved at the umbo and less prosocline than the specimen from Pinei.

The taxon under discussion is definitely not a cardiid. On the specimen from Pinei the hinge is not visible, but tentatively on arguments related to the shell shape and rib ornamentation we have included it in *Cyclocardia* Conrad, 1867.

Distribution: Recorded from Coniacian of Czechia and western Poland, Santonian and Maastrichtian of Austria, uppermost Coniacian-lowermost Campanian of eastern Venetian Prealps, NE Italy.

Ludbrookia cf. *cottaldina* (d'Orbigny, 1844)
Pl. XIII, fig. 1.

v + 1844 *Cardita Cottaldina*, d'Orbigny - d'Orbigny, p. 91, pl. 269, figs 6-8.
. 1906 *Cardita Cottaldina*, d'Orbigny - Woods, p. 126, pl. 18, figs 15, 16.
1987 ?*Ludbrookia cottaldina* (d'Orbigny) - Cleevely and Morris, p. 117, pl. 15, fig. 10; pl. 20, fig. 15.

Material: One incomplete right valve (MFU 1316) from Col dei Schiosi, in association with *Caprotina hirudo* (Pirona, 1887).

Discussion: Though incomplete, the specimen has retained a cancellate ornamentation which is typical of *Ludbrookia cottaldina* (d'Orbigny, 1844), from the Cenomanian of the Paris Basin, and of "*Cardita*" *cancellata* Woods, 1906, from the Chalk Rock (Turonian) of southern England. More and better material might prove these two taxa to be synonymous, but the data available at present do not allow conclusions to be drawn. This also applies to the taxon "*Cardita*" *geinitzii* d'Orbigny, 1850, erected for material from the Turonian-Coniacian of Central Europe, generally of very poor preservation.

Distribution: Recorded from the Cenomanian of southern England and of the Paris Basin (France); Upper Cenomanian in calcareous rudist facies of western Carnic Prealps (NE Italy).

Superfam. CRASSATELLACEA Férussac, 1822
Fam. CRASSATELLIDAE Férussac, 1822

Crassatella macrodonta (J. de C. Sowerby, 1832)
Pl. XIII, figs 2a, 2b.

v + 1832 *Astarte macrodonta* Sowerby - J. de C. Sowerby in Segdwick, Murchison, p. 417, pl. 38, fig. 8.
v ? 1844 *Crassatella Marrotiana*, d'Orbigny - d'Orbigny, p. 82, pl. 266, figs 8, 9.
v . 1865 *Crassatella macrodonta* Sow. sp. - Zittel, p. 150, pl. 8, fig. 3.
v ? 1865 *Crassatella macrodonta* var. *sulcifera* - Zittel, p. 150, pl. 8, figs 2a-f.
1871 *Crassatella macrodonta*, Sow. sp. - Stoliczka, p. 295, pl. 5, figs 12-14.
1883 *Crassatella* cf. *macrodonta* Sow. sp. - Frič, p. 100, fig. 63.
. 1902 *Crassatella macrodonta*, Sow. - Pálfy, p. 290, pl. 21, fig. 10; pl. 22, fig. 1.
1907 *Crassatella macrodonta*, Sow., var. *obtusa*, Rep. - Repelin, p. 58, pl. 9, figs 5, 6, 10.
? 1953 *Crassatella macrodonta*, Sow. - Petković, p. 17, pl. 14, fig. 12.
? 1975 *Crassatella macrodonta* var. *sulcifera* Zittel - Czabalay, p. 443, pl. 3, fig. 1.
? 1981 *Crassatella* (*Crassatella*) *macrodonta* Sowerby - Tzankov in Tzankov *et al.*, p. 136, pl. 67, fig. 5.
? 1981 *Crassatella* (*Crassatella*) *austriaca* Zittel - Tzankov in Tzankov *et al.*, p. 136, pl. 67, fig. 7.
? 1982 *Crassatella macrodonta* var. *sulcifera* Zittel - Czabalay, p. 23, pl. 5, fig. 4.
? 1985 *Crassatella marrotiana* d'Orbigny - Freneix in Freneix, Viaud, p. 205, pl. 2, fig. 21.
v . 1987 *Crassatella* spec. cf. *Cr. macrodonta* (J. Sowerby) - Dhondt, p. 76.

Material: One incomplete right valve (B91: L = 55 mm; B = 15 mm), missing its umbonal part but showing the pallial margin and the muscle scars; from Pinei, Lago di S. Croce.

Discussion: The incomplete specimen shows sufficient internal and external characteristics to allow to identify

it. On the other hand, as Dhondt (1987) already stated, it would be necessary to check with ontogenetic series whether there is a difference between *Crassatella macrodonta* and *C. arcacea* Roemer, 1841. The problem with both taxa is that many specimens described as belonging to them are either crushed or in steinkern preservation.

North American species, such as for instance *Crassatellites vadosus* (Morton, 1834) in Wade (1926, p. 79, pl. 25, figs 6-8), seem close to, if not necessarily conspecific with, *C. macrodonta*.

Distribution: Recorded from Coniacian to Campanian, in coarse-grained, shallow water deposits: in Gosau (Austria), SW and SE France, Czechia, eastern Venetian Prealps (NE Italy), southern India and possibly Bulgaria. Santonian to Lower Campanian of Romania, ?Campanian of Hungary, ?Maastrichtian of Serbia.

Superfam. CARDIACEA Lamarck, 1809
Fam. CARDIIDAE Lamarck, 1809

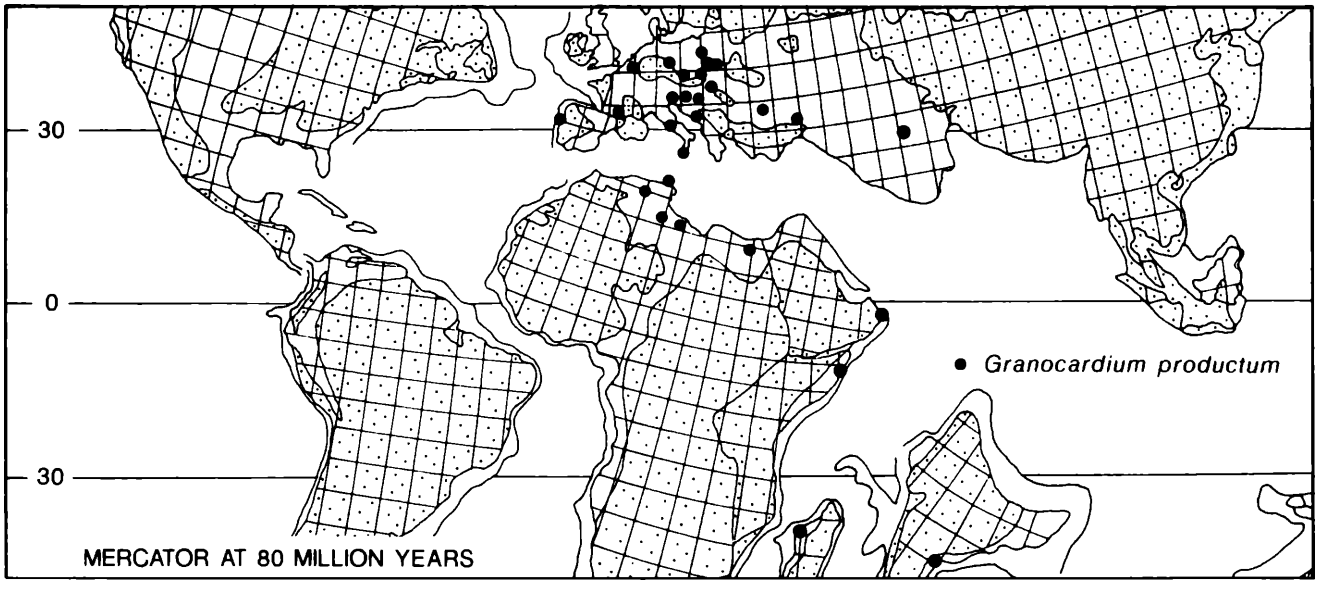
Granocardium productum (J. de C. Sowerby, 1832)
Pl. XIV, figs 4-9b; Text-fig. 18.

v + 1832 *Cardium productum* Sowerby - J. de C. Sowerby in Sedgwick, Murchison, p. 417, pl. 39, fig. 15.
? 1850 *Cardium Olisiponense*, n. s. - Sharpe, p. 181, pl. 14, figs 4a, b.
. 1882 *Cardium ponderosum* n. sp.- Seguenza, p. 84, pl. 10, figs 4-4b.
. 1882 *Cardium giganteum* n. sp. - Seguenza, p. 84, pl. 10, figs 1-1b.
? 1882 *Cardium nebrodense* n. sp.- Seguenza, p. 84, pl. 10, figs 5-5b.
1918 *Cardium Olisiponense* Sharpe - Parona, p. 1.
1919 *Cardium* (*Trachycardium*) *productum* Sow. var. *subproducta* Th. et Peron et var. *Byzacenica* Perv. - Greco, p. 2.
. 1922 *Cardium productum* Sow. mut. *subtriangulare* nov. - Cottreau, p. 153, pl. 5, figs 13, 14.
1928 *Cardium productum* J. de C. Sowerby - Lees, p. 647.
1932 *Cardium productum* Sow. - Parona, p. 104.
1935 *Cardium* (*Trachycardium*) *productum* Sowerby - Furon, p. 53, pl. 2, figs 6a, b.
. 1937 *Cardium* (*Trachycardium*) *productum* Sow. - Trevisan, p. 102.
1949 *Cardium* (*Trachycardium*) *productum* Sow. - Tavani, p. 8.
1949 *Cardium* (*Trachycardium*) *productum* Sow. - Naldini, p. 100.
1961 *Cardium* cf. *productum* Sowerby - Bobkova, p. 137, pl. 13, fig. 3.
1961 *Cardium productum* Sowerby var. *daganakiikensis* Bobkova var. nov. - Bobkova, p. 139, pl. 13, fig. 4.
. 1963 *Cardium productum* Sow. - Gambashidze, p. 136, pl. 2, fig. 5.
? 1963 *Cardium* aff. *productum* Sowerby - Fawzi, p. 70.
1975 *Granocardium* (*Granocardium*) *productum* (Sowerby) - Czabalay, p. 444, pl. 2, fig. 3.
1982 *Granocardium productum* (Sowerby) - Czabalay, p. 23.
? 1986 *Granocardium* (*Granocardium*) *alutacium* (v. Münster) - Abdel-Gawad, p. 169, pl. 40, figs 3, 4.
. 1986 *Granocardium* (*Granocardium*) aff. *pustulosum* (v. Münster) - Abdel-Gawad, p. 169, pl. 40, fig. 8.
? 1986 *Granocardium* (*Criocardium*) *productum* (Sowerby) - Abdel-Gawad, p. 169, pl. 40, figs 6, 7.
v . 1987 *Granocardium productum* (J. Sowerby) - Dhondt, p. 77, pl. 4, figs 5, 6 (*cum syn.*).

Material: Twenty specimens mainly with worn shells, of which eight right valves (B137, B146, B149, B155, P30, P33, P35, P37) and twelve left valves (B138-140, B143, B147, B153, B161, P29, P31, P32, P34, P36), from Pinei, Lago di S. Croce.

Discussion: Though most specimens from Pinei are very worn, small shell portions with the typical rib pattern are present. Generally the posterior part of the shell is less worn than the other parts.

The spines are only present as worn knobs on specimen B138 (Pl. XIV, fig. 9a); otherwise small rounded



Text-fig. 18 - Palaeogeographic distribution of *Granocardium productum* (J. de C. Sowerby, 1832) including occurrences from Cenomanian to Maastrichtian.

holes representing the spine bases can be seen (Pl. XIV, fig. 7).

The ornamentation and the fairly elongate shape are very similar to those of the Gosau material.

The extreme thickness of the shell in the specimens from Pinei (for example, although they are worn specimens, B137 and B139 have near the umbo a thickness of more than 6 mm) has not been observed by us on material from any other locality.

For more details on the variability of *Granocardium productum* we refer to Dhondt (1987).

Dimensions (mm):

	H	L	B'	L/H	B'/H
P29	51	40	24	0.78	0.47
B146	54	39	24	0.72	0.44
B147	54	43	23	0.79	0.43
P37	59	47	24	0.79	0.41
P35	60	41	25	0.68	0.42
P32	60	(45)	28	(0.75)	0.47
B138	62	43	23	0.69	0.37
P34	63	44	23	0.70	0.36
P33	63	46	27	0.73	0.43
B139	(64)	42	27	(0.66)	(0.42)
B143	66	42	31	0.64	0.47
P36	66	46	27	0.70	0.41
P30	66	48	27	0.73	0.41
B137	68	51	29	0.75	0.43

Discussion: No cardiid was mentioned previously from the Lago di S. Croce area, which considering the number of specimens available at present is surprising.

The *Cardium* taxa, represented only by internal moulds, found in Seguenza (1882) undoubtedly partially belong in *Granocardium productum* as was already stated by Trevisan (1937) for *Cardium giganteum* Seguenza.

Cardium olisiponense Sharpe, 1850 is very similar to *Granocardium productum* for shape and configuration, but the ornamentation as described originally seems somewhat different. Without studying the type specimens no further conclusions can be drawn on their possible synonymy.

Abbass (1962) described several new cardiid species from Albian and Cenomanian localities in Egypt. Among those *Granocardium hassani* (*op. cit.*, p. 122, pl. 20, figs 2, 3), of Cenomanian age from the Sinai Peninsula, is, as far as can be judged from the illustrations, very close to *G. productum*. Further study of the Egyptian material would probably show that *G. hassani* is a junior synonym of *G. productum*.

Distribution: Widely distributed from Cenomanian to Maastrichtian. For Italy: recorded from eastern Venetian Prealps, Trieste Karst and Latium in rudist formations of latest Coniacian-earliest Campanian age; from Sicily in the marly "Cenomaniano di facies africana" (Text-fig. 18).

Superfam. TELLINACEA de Blainville, 1814
Fam. ICANOTIIDAE Casey, 1961

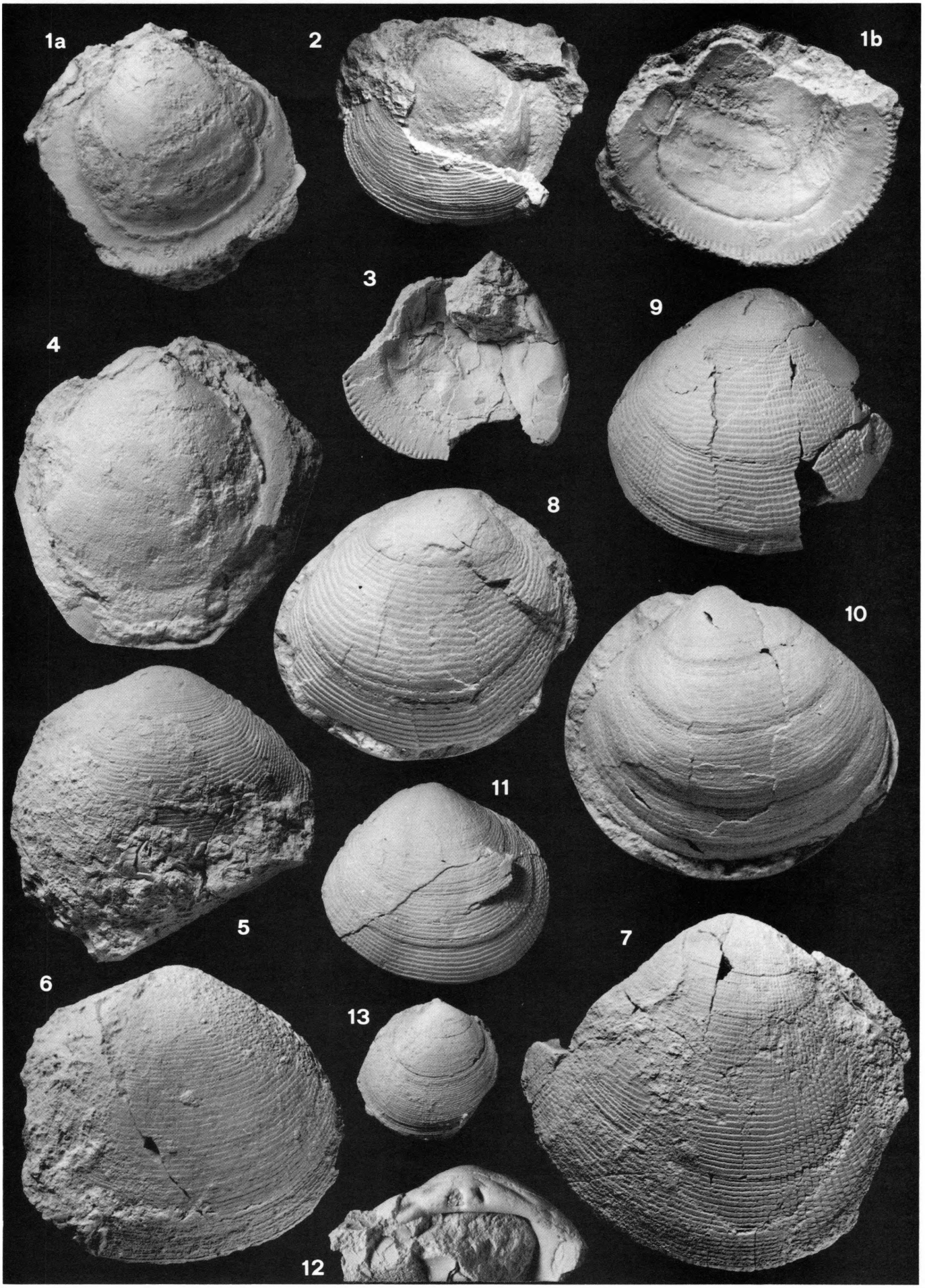
Icanotia impar (Zittel, 1865)
Pl. II, fig. 9.

? 1843 *Solen elegans*, Math. - Matheron, p. 134, pl. 11, fig. 3.
. 1845 *Capsa elegans*, d'Orbigny - d'Orbigny, p. 423, pl. 381, figs 1, 2.
v + 1865 *Psammobia impar* Zitt. - Zittel, p. 16, pl. 2, fig. 4.
. 1871 *Baroda* (*Icanotia*) *impar*, Zitt. - Stoliczka, p. 163, pl. 17, fig. 5.
. 1873 *Psammobia Zitteliana* Gein. - Geinitz, p. 232, pl. 51, figs 9, 10.
? 1907 *Tapes* (*Icanotia*) *elegans*, Math. - Repelin, p. 68, pl. 2, fig. 3.
. 1913 *Tapes* (*Icanotia*) sp. - Woods, p. 431, pl. 62, fig. 14.
? 1937 *Tapes* (*Icanotia*) *zitteli* (Geinitz) - Lehner, p. 144, pl. 20, fig. 16.
. 1961 *Icanotia zitteli* sp. nov. - Casey, p. 582, text-fig. 9f.
. 1961 *Icanotia siliqua* sp. nov. - Casey, p. 583, text-fig. 9e.
. 1969 *Icanotia impar* (Zittel) - Keen in Moore, p. N635, text-fig. E119 (from Zittel, 1881-1885, text-fig. 156).
1975 *Psammobia impar* Zittel - Czabalay, p. 445, pl.

EXPLANATION OF PLATE XX

Figs 1a-12 - *Fimbria alpaghina* (Catullo, 1827).
1a-7 - Topotypes.
1a,1b - Plesiotype figured by Futterer, 1892, pl. 3, fig. 9; internal mould of left valve (1a) and interior of the same valve (1b). Note the muscle scars, the pallial line and the crenulated margin.
2 - Left valve, internal mould with part of the shell.
3 - Right valve, interior.
4 - Lectotype; right valve, internal mould.
5-7 - Left valves.
Uppermost Coniacian-lowermost Campanian, Pinei (Belluno); MB/M556, B152, B158, DGP 7161b (coll. Catullo), B131, B132, B134.
8 - Right valve.
9-11 - Left valves.
12 - Right valve, interior showing the hinge.
Upper Turonian (?), Zolla (Trieste); MSNT 11844, MSNT 11845, MSNT 11846, MSNT 11843, MSNT 11848.
Fig. 13 - "*Lucina*" cf. *tenera* (J. de C. Sowerby, 1836).
Left valve (= *Lucina* sp. in G. Boehm, 1897, p. 178, fig. 7).
Upper Cenomanian, Bocca di Crosis, Tarcento (Udine); IGF 354E; x 1. 5.

All the specimens are whitened and, unless otherwise stated, natural size.


1a
2
1b
3
9
4
8
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11
5
7
6
13
12

1, fig. 5.
. 1976 *Baroda* (*Icanotia*) cf. *impar* (Zittel) - Pojarkowa, p. 117, pl. 77, figs 1a, b.
. 1985 *Icanotia* affin. *zitteli* Casey - Freneix in Freneix, Viaud, p. 202, pl. 2, fig. 22.
v . 1987 *Icanotia impar* (Zittel) - Dhondt, p. 82, pl. 4, figs 3, 4.

Material: One almost complete right valve (B25: H = 19.6 mm) from Col dei Schiosi.

Description: Posterior part of the valve with fairly strong radial ribs with sharp summits. The rest of the valve is covered with less pronounced radial riblets and commarginal lines, especially near the ventral margin.

Discussion: *Icanotia impar* is characterised by an oblong shape and a combination of radial and commarginal ornamental elements. The radial ornamentation is especially strong in the posterior part of the valves. Reasonably preserved specimens of *I. impar* are not especially frequent and not much attention has been given in the past to the variation of the ornamentation in this species.

Several species of *Icanotia* have been described (see lists in Wade, 1926, p. 91 and in Dartevelle and Freneix, 1957, p. 198), but most of these taxa are based on only a few specimens. Because of the variability noticed in the Gosau specimens (Dhondt, 1987), we have tried to use a wider species concept.

The nomenclature of "*Icanotia impar*" is utterly confused, and has given rise to several interpretations.

The first Upper Cretaceous taxon described which could apply to our specimen is *Solen elegans* Matheron, 1843, from the Cenomanian near Marseille. Unfortunately, a precise interpretation of this species is not possible at present because the Matheron type has been lost and good topotypical specimens are not available.

Capsa elegans was erected by d'Orbigny in 1845 (not mentioning Matheron's species) for specimens from the uppermost Cenomanian near Le Mans. The available specimens are few, but *C. elegans* and *Solen elegans* Matheron seem very close.

Capsa discrepans was erected by d'Orbigny, at the same time as *C. elegans*, for specimens of Turonian-Campanian age which have similar but less strongly developed radial ornamentation.

Zittel (1865) when describing the Gosau faunas had some specimens which he considered as belonging to *C. elegans* d'Orbigny. He proposed a new name (*Psammobia impar*) for the d'Orbigny taxon, which as *Ps. elegans* would have been a secondary homonym of *Solen elegans* Matheron, which was also a *Psammobia*. Later authors often considered that the specimens of Cenomanian age belonged to a different species than those of Turonian-Maastrichtian age. The correct nomenclatural interpretation of this situation is to give the name *impar* to the Cenomanian taxon and change the name for the younger taxon. This was done by Casey (1961), who created for the Gosau specimens described by Zittel the name *Icanotia zitteli*.

However, Casey was unaware of earlier work of Geinitz (1873), who also considered that Zittel used one name for two different species. Geinitz named the Cenomanian specimens *Psammobia zitteliana*, and the Gosau specimens *Ps. impar*. Strictly speaking of course, *Ps. zitteliana* Geinitz and *Icanotia zitteli* Casey are not synonymous, but their existence for closely related taxa does not make the situation any easier to understand. Furthermore, a taxon was created in 1907 by Repelin with the name of *Psammobia zitteli*, for again a taxon in the same group.

To complicate matters even further, Stoliczka (1871) selected *Ps. impar* Zittel as the type species of *Icanotia*, using specimens from the Gosau to illustrate the taxon. Zittel himself, when illustrating the species and the genus in his *Handbuch der Paläontologie* (1881-1885, p. 111, text-fig. 156) followed the same interpretation as Stoliczka. Keen (in Moore, 1969) also followed this interpretation which agrees obviously with Zittel's intention.

Casey (1953) used the problem of *Icanotia impar* and his interpretation as an example of a nomenclatural problem, in a letter published in the *Bulletin of Zoological Nomenclature*.

From the strictly nomenclatural point of view we think that the conclusion of Casey (1961) is wrong, since nomenclatural choices had already been made by earlier authors.

However, since from the taxonomical point of view we have come to the conclusion that *I. impar* is a somewhat variable species which originated in the Cenomanian and disappeared in the Campanian, further nomenclatural discussion becomes useless.

Distribution: Recorded from Cenomanian to Campanian: southern England, western and SE France, Franconia (?) and Saxony (Germany), Gosau (Austria), Hungary, Friuli (NE Italy), southern India, Uzbekistan.

Subcl. ANOMALODESMATA Dall, 1889
Ord. PHOLADOMYOIDA Newell, 1965
Superfam. PHOLADOMYACEA Gray, 1847
Fam. PHOLADOMYIDAE Gray, 1847

Pachymya? frequens (Zittel, 1865)
Pl. VI, figs 1a, 1b.

v + 1865 *Panopaea frequens* Zitt. - Zittel, p. 111, pl. 1, figs 5a-g.
. 1907 *Liopistha* (*Panopaea*) *frequens*, Zitt. - Repelin, p. 73, pl. 12, figs 2-4.
1907 *Liopistha* (*Panopaea*) *frequens* Zittel - Fugger, p. 517.
? 1985 *Pachymya* (?) sp. - Freneix in Freneix, Viaud, p. 209, pl. 2, fig. 24.
v . 1987 *Poromya* s. l. *frequens* (Zittel) - Dhondt, p. 92, pl. 6, figs 6, 7.

Material: One bivalved internal mould (B103) from Pinei, Lago di S. Croce.

Dimensions (mm): H = 35; L = 59; B = 31.

Discussion: Though very distinctive, the partially shelled specimens and moulds known of "*Panopaea*" *frequens* Zittel present a taxonomical problem: their generic attribution remains difficult because no specimen seen by us is preserved with a good hinge. We have, on arguments of shape only, tentatively placed the taxon in the genus *Pachymya* Sowerby, 1826.

Distribution: Found in Coniacian-Santonian deposits: Vendée and near Marseille (France), Gosau (Austria), eastern Venetian Prealps (NE Italy).

Fam. LATERNULIDAE Hedley, 1918

Platymyoidea? cf. *royana* (d'Orbigny, 1845)
Pl. II, figs 10a, 10b.

v . 1845 *Anatina royana*, d'Orbigny - d'Orbigny, p. 377, pl. 371, figs 5, 6.
v . 1865 *Anatina Royana* d'Orb. - Zittel, p. 113, pl. 1, figs 7a-c.

Material: One bivalved internal mould [B98: H = (30) mm; L = (49) mm; B = (15) mm] from Pinei, Lago di S. Croce.

Discussion: Though poorly preserved, the undeformed specimen from Pinei has commarginal ribbing visible near the umbo and near the antero-ventral margin of the right valve.

The specimen has a strong similarity with that described by Zittel (1865) from the Gosau (Santonian). The d'Orbigny specimen from Royan (the only specimen recovered from the type series) is so poorly preserved that it cannot be identified as being definitely the specimen figured in the *Paléontologie française*. However, other specimens from the d'Orbigny collection coming from Montrichard (Cher) (probable Turonian: Tuffeau de Bourré) are comparable with the figures in the *Paléontologie française* and with our specimen. Because of the poor preservation of the specimen from Pinei we have used open nomenclature.

Distribution: Turonian of the Loire Valley (western France), Campanian of Royan (SW France), Santonian and (?) Maastrichtian of Austria, uppermost Coniacian-lowermost Campanian of eastern Venetian Prealps (NE Italy).

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