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Upper Cretaceous bivalves from Tercis, Landes, SW France.

by Annie V. DHONDT

Abstract

From Upper Campanian and Maastrichtian strata from Tercis (Landes, France) twenty four inoceramid taxa have been recognized. In the lower Upper Campanian they have a strong similarity with faunas from Westphalia and from the area around Aachen, but in younger outcrops the affinities are mainly with faunas from the northern Tethys margin.

Key-words: Mollusca, Bivalvia, inoceramids, Cretaceous, Taxonomy, Biostratigraphy.

Résumé

A Tercis (Landes, France) vingt quatre taxa d'inocérames ont été retrouvés dans des niveaux datés du Campanien supérieur et du Maastrichtien. Pendant la partie inférieur du Campanien supérieur ces faunes présentent de fortes affinités avec celles connues de la Westphalie et des environs d'Aix-la-Chapelle, mais les faunes plus jeunes sont plutôt téthysiennes.

Mots-clefs: Mollusques, Bivalves, inocérames, Crétacé, Taxinomie, Biostratigraphie.

Introduction

The geological setting and stratigraphic interpretation of "La grande Carrière" at Tercis (Landes, SW France) are illustrated in HANCOCK *et al.* (this volume, p. 135, text-figure 2). The ammonites are described therein.

This paper is concerned with the bivalves (mainly inoceramids) from the same quarry (location: Text-figure 1).

Though their existence was known definitely since the middle of the last century, Cretaceous bivalves from Tercis have only rarely been reported in palaeontological literature and almost never been described. d'ORBIGNY did not mention them in the Paléontologie Française (1843-1847), but in his Prodrome (1850) *Inoceramus regularis* and *I. lamarcki* are mentioned from Tercis (misspelt as Teras in the case of *I. regularis*) and *I. planus* from "Rivières (Landes)" - which probably represents Rivière, commune Rivière- Saas-et-Gourby, 3 km. NW of Tercis, across the Adour.

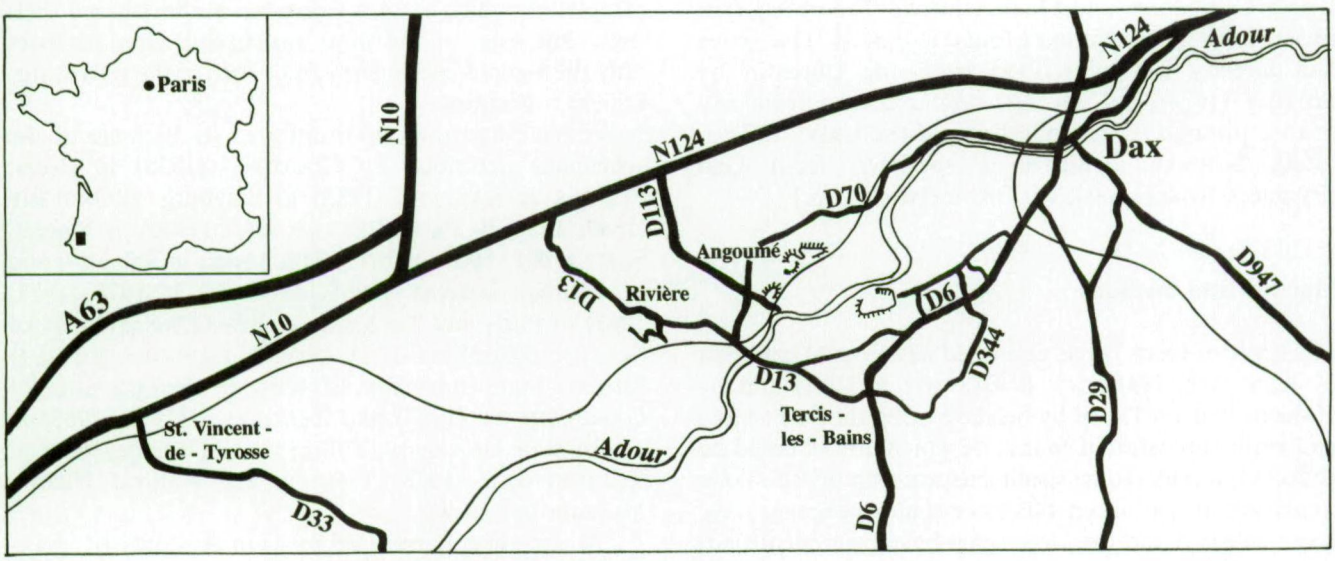


Fig. 1 — Location of "La Grande Carrière", Tercis, Landes.

SORNAY (1976) in a paper on the inoceramids from near Royan (Charente-Maritime) also described and figured *I. regularis* from Tercis, from the d'ORBIGNY collection and from a boring at St-Vincent-de-Tyrosse (Landes) some 15 km. W of Tercis; from the latter locality also he mentioned the possible presence of *I. goldfussi*.

SEITZ (1967) discussed and figured (pl. 16, fig. 3) a cast of a specimen from Tercis, named *I. regularis* in the d'ORBIGNY collection, but identified as *I.* (*Selenoceramus*) cf *gladbeckensis* by SEITZ, thus indicating the possible presence of Santonian (? Lower Campanian) strata in Tercis. In the 1:50,000 "Carte géologique de la France" 975-976 (XII-XIII-43) (Saint-Vincent-de-Tyrosse) the following inoceramids are listed from "la cimenterie Angoumé" near Tercis-les-Bains: *Inoceramus* gr. *goldfussi, I. alaeformis, I. sarumensis*, and in stratigraphically somewhat younger beds *I.* gr. *regularis* (in: SORNAY in KIEKEN, 1975, p. 9), and all are said to represent Campanian-Maastrichtian strata.

In the Laboratoire de Géologie sédimentaire et Paléontologie of the Université Paul Sabatier, Toulouse III, a series of specimens from the same quarry at Angoumé are preserved. They have been also identified by SORNAY who tentatively recognized the following taxa: *Inoceramus pteroides* GIERS, 1964; *I. decipiens* ZITTEL, 1866; *Cordiceramus pseudoregularis* (SORNAY, 1962); *Platyceramus cycloides ahnesensis* (SEITZ, 1961); *Platyceramus* sp.; from Rivière, he identified *Pl.* ex gr. *alaeformis* (ZEKELI, 1852). The results presented herein for inoceramids (Table I, p. 213) are basically not contradictory with those of older authors. The sample we have had was somewhat more extensive than those available to them and almost inevitably we have been able to recognize more taxa.

Inoceramids were collected from units F to V but mainly in F to K (Tercis Marly Member and lowermost part of Tercis Pale Flint Member, all Upper Campanian), and sporadically only above that (Tercis Pale Flint Member and Tercis Dark Flint Member, upper Upper Campanian and Maastrichtian). The oldest *Trochoceramus* specimens were found in unit M. This genus had already been described from the Cotentin by SORNAY (1973), but had not been recorded from SW France [though in the collections of the Univ. of Toulouse, SORNAY identified a specimen from Gan (Pyrénées-Atlantiques), as *Trochoceramus* sp.].

Material and methods

The bivalves from Tercis described herein were collected by KENNEDY, HANCOCK & DHONDT in 1981, and by HANCOCK in 1983. Bed by bed collecting showed a large and varied inoceramid fauna, of which not all could be collected because some specimens were simply too large to extract. In all, about 140 inoceramid specimens have been collected and the larger part have been identified, and are discussed below. They are housed in the collections of the IRScNB (Brussels).

For the study of inoceramids we have tried to follow the method mainly introduced by SEITZ (1934, 1961) and generally also followed by SORNAY (1966, 1973, 1976; in SORNAY & BILOTTE, 1978), TRÖGER & RÖHLICH (1980, 1981) for faunas of similar stratigraphic age. One of the problems has been that of terminology: we have left some descriptive terms in German, have used some of the terms introduced by SORNAY (1966) and have translated some into English: thus we have consistently used "commarginal plications" for the German "Undulationen".

We have tried to measure the specimens whenever possible, but the generally poor preservation has made it especially difficult to measure the angles between the hinge margin and the commarginal plications. For angles, we have followed the definitions of SORNAY (1976) rather than those of SEITZ. In the interpretation of the relation between H and L we have often indicated both H/L and L/H values because the former is a value used by SORNAY and the latter is generally used by SEITZ. We have made "ontogenetic" graphs and have in a few instances been able to demonstrate that the growth of the valves is clearly regularly allometric.

The results obtained are restricted by a typical inoceramid literature problem: the method of the German school, mainly developed by SEITZ, has, except for SORNAY, only rarely been followed in other countries. The vast eastern European inoceramid literature only exceptionally gives full data for the taxa: no precise measurements of plications, of angles, no ontogenetic graphs. Furthermore, when erecting new species, many eastern European authors have a very typological species concept, almost never present differential diagnoses and often do not indicate any kind of differences between closely related taxa. Since the quality of their photographic illustrations often leaves a lot to be desired it is very difficult to use such literature effectively. We are confronted with data which are not really comparable. It would be necessary to see the total samples on which eastern European authors based their taxa, but even in the most favourable circumstances only the figured specimens can be seen in the palaeontological collections.

We have had the opportunity to study some of the specimens described by GOLDFUSS (1835) in Bonn, FUGGER & KASTNER (1885) in Salzburg, d'ORBIGNY (1847, 1850) in Paris, PETRASCHECK (1906) in Vienna, SEITZ (1961, 1967, 1970) in Hannover, in Salzburg and in Vienna, SORNAY (1962, 1968, 1973, 1976, 1978, 1983) in Paris and Toulouse; in Russia we saw part of the type collections of DOBROV & PAVLOVA (1959) at Moscow State University, Moscow; in Georgia, those of GAMBASHIDZE (1963) and TSAGARELI (1949, 1963) at Tbilisi State University, Tbilisi; in the Ukraine, those of KOCIUBYNSKIJ (1958, 1968) at the Natural History Museum in Lwow.

The generic concept used by us in the study of inoceramids is based on the assumption that genera are a biological reality, whereas subgenera are difficult to

quantify. Earlier (DHONDT, 1983) I have explained this. Here the subgenera defined or redefined (if they were based on nomina nuda introduced by HEINZ) previously by SEITZ (1961, 1967, 1970) or by COX (1969) are systematically given generic rank.

Faunal Composition (Table I)

Unit F (Tercis Marly Member, mid-Campanian)
"Inoceramus" borilensis JOLKICEV, 1962
"I". aff. *lapparenti* SORNAY & BILOTTE, 1978
"I". aff. *planus* MÜNSTER in GOLDFUSS, 1835
Pycnodonte vesicularis (LAMARCK, 1806) (very numerous)
Mimachlamys cretosa (DEFRANCE, 1822) (coarse type), brachiopods

Unit G (Tercis Marly Member, Upper Campanian)
"Inoceramus" borilensis JOLKICEV, 1962
Cordiceramus sp.
Endocostea baltica baltica (BOEHM, 1907)
Endocostea baltica elliptica (GIERS, 1964) (only in upper part of unit)
Platyceramus adversus (RIEDEL, 1931) (only in lower half of unit)
Pl. aff. *cycloides* (sensu SEITZ, 1970) (only in upper part of unit)
Selenoceramus sornayi nom. nov.
Pycnodonte vesicularis (LAMARCK, 1806) (especially numerous in lower part of G)

Unit H (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian)
"Inoceramus" borilensis JOLKICEV, 1962

Table I — Distribution of bivalves in the samples from Tercis.

units	F	G	H	J	K	L	M	N	O	P-U	V
species											
"I." borilensis	+	+	+	+			+				
"I." cf. borilensis									+		
"I." aff. lapparenti	+										
"I." aff. planus	+										
Cataceramus goldfussianus			+	+							
Cordiceramus sp.		+									
Cremnoceramus ex gr. sarumensis			+								
Endocostea b. baltica		+									
b. beckumensis			+	+							
b. elliptica		+	+								
baltica subsp. ind.								+	+		
E. flexibaltica				+							
Platyceramus sp.			+	+							
Pl. adversus		+									
Pl. aff. adversus			+	+							
Pl. alaeformis				+	+						
Pl. aff. alaeformis					+						
Pl. artigesi			+	+	+						
Pl. aff. cycloides		+									
Selenoceramus sp.			+								
Se. cf. inflexus			+								
Se. sornayi		+	+								
Trochoceramus nahorianensis									+		+
Tr. radiosus							+				
Pycnodonte vesicularis	+	+	+		+			+	+	+	
Mimachlamys cretosa	+				+						

Cataceramus goldfussianus (d'ORBIGNY, 1847)
Cremnoceramus sp. ex gr. *Cr. sarumensis* (WOODS, 1912)
Endocostea baltica beckumensis (GIERS, 1964)
E. baltica elliptica (GIERS, 1964)
Platyceramus aff. *adversus* (RIEDEL, 1931)
Pl. artigesi (SORNAY, 1976)
Selenoceramus sp.
Se. cf. *inflexus* (BEYENBURG, 1936)
Se. sornayi nom. nov.
fragments of large very thick-shelled (8 mm) inoceramid (no hinge parts!) without visible ornamentation [? *Platyceramus* aff. *salisburgensis* (FUGGER & KASTNER, 1885)]
Pycnodonte vesicularis (LAMARCK, 1806)

Unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian)
"*Inoceramus*" *borilensis* JOLKICEV, 1962
Cataceramus goldfussianus (d'ORBIGNY, 1847)
Endocostea baltica beckumensis (GIERS, 1964)
E. cf. *flexibaltica* (SEITZ, 1967)
Platyceramus sp.
Pl. aff. *adversus* (RIEDEL, 1931)
Pl. alaeformis (ZEKELI, 1852)
Pl. artigesi (SORNAY, 1976)

Unit K (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian)
Platyceramus alaeformis (ZEKELI, 1852)
Pl. cf. *alaeformis* (ZEKELI, 1852)
Pl. artigesi (SORNAY, 1976)
Pycnodonte vesicularis (LAMARCK, 1806)
Mimachlamys cretosa (DEFRANCE, 1822)

Unit L (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian)
no bivalves collected

Unit M (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian)
"*Inoceramus*" *borilensis* JOLKICEV, 1962
Trochoceramus radiosus (QUAAS, 1902)

Unit N (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, uppermost Campanian)
Endocostea baltica (BOEHM, 1907)
Pycnodonte vesicularis (LAMARCK, 1806)

Unit O (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Maastrichtian)
"*I.*" cf. *borilensis* JOLKICEV, 1962
Endocostea baltica (BOEHM, 1907)
Trochoceramus nahorianensis (KOCIUBYNSKIJ, 1968)
Pycnodonte vesicularis (LAMARCK, 1806)

Unit P-U (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Maastrichtian)
Pycnodonte vesicularis (LAMARCK, 1806)

Unit V (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Upper Maastrichtian)
Trochoceramus nahorianensis (KOCIUBYNSKIJ, 1968)

Faunal, stratigraphic and palaeobiogeographic results

The bivalves collected from Tercis (listed above) include long lived taxa such as *Pycnodonte vesicularis* (LAMARCK, 1805) and *Mimachlamys cretosa* (DEFRANCE, 1822) on one hand, and inoceramids on the other. Most of the inoceramids collected by us are concentrated in the Upper Campanian part of the section (Tables I & II). This is partly because that part of the section was better exposed at the time of our visit, but also because the inoceramids occurred more frequently and were more diverse in the Upper Campanian interval than they were in the Maastrichtian interval.

Units G, H, J together yielded 88% of the identified sample, distributed over 18 taxa (70% of the total bivalve fauna). In the Maastrichtian very few inoceramids have been collected; they belong to the genera *Endocostea* and *Trochoceramus*.

— The **lower Upper Campanian** (lower Tercis Marly Member) (units F and G) contains ten taxa (Table I), of which seven were previously known from Germany (Westphalia) and/or from the Aachen area (Lower Campanian probably), with some known over wider areas ("*I*" *borilensis* from Bulgaria; *Selenoceramus sornayi* also from SW France).

— The bivalve fauna in the **lower *Nostoceras hyatti* Zone, Upper Campanian** (upper Tercis Marly Member) contains fourteen taxa of which only four have also been found in the lower strata (Table I); eight of these taxa have previously been described from Westphalia and/or from the Aachen area. *Cataceramus goldfussianus* is so far only known from SW France.

— The bivalve faunas collected from Tercis (Table I) in the **upper *Nostoceras hyatti* Zone, Upper Campanian** (Tercis Pale Flint Member) comprise eight taxa of which four have also been found in the lower strata at Tercis; four of the taxa have previously been described from Westphalia and /or from the Aachen area (Campanian- Lower Maastrichtian) *Platyceramus alaeformis* was originally described from near Vienna (Maastrichtian beds), *Trochoceramus radiosus* from the Libyan desert, Egypt (Maastrichtian) and *Platyceramus artigesi* is so far known only from SW France.

— Of the three inoceramid taxa recognised from Tercis (Table I) in the ***Pachydiscus epiplectus* Zone, Maastrichtian** (Tercis Dark Flint Member) the two *Endocostea* species were originally described from northern Germany but are known from many areas; *Trochoceramus nahorianensis* was originally described from near Vienna, but is widely distributed in Maastrichtian beds on the Russian platform, in Crimea in the Caucasus, in northern Africa, and in SW France.

Table II — Qualitative distribution of inoceramids in the samples from Tercis.

units	F	G	H	J	K	L	M	N	O	P-U	V	
inoceramids												
"I." borilensis	1	2	1	2				1				7
"I." cf. borilensis									1			1
"I." aff. lapparenti	1											1
"I." aff. planus	1											1
Ca. goldfussianus			2	2								4
Co. sp.		1										1
Cr. ex gr sarumensis			2									2
En. b. baltica		2										2
En. b. beckumensis			2	1								3
En. b. elliptica		3	3									6
En. baltica subsp. ind.								1	1			2
En. flexibaltica				1								1
Platyceramus sp.				12								12
Pl. adversus		5										5
Pl. aff. adversus				6								6
Pl. alaeformis				5	7							12
Pl. artigesi			2	1	3							6
Pl. aff. cycloides		4										4
Selenoceramus sp.			9									9
Se. inflexus			8									8
Se. sornayi		1	7									8
Tr. nahorianensis									2		1	3
Tr. radiosus								1				1
	3	18	36	30	10			3	4		1	105

Palaeontology

Phylum **Mollusca**
Classis **Bivalvia**
Superordo **Pteriomorphia**
Ordo **Pterioida**
Subordo **Pteriina**
Superfam. **Pteriacea**

Fam. **INOCERAMIDAE** ZITTEL, 1881 (ICZN 473)

"Inoceramus" borilensis JOLKICEV, 1962 (Pl. 1, Fig. 1; Pl. 3, Fig. 2a, b, Text-fig. 3 a, b)

* 1962 *Inoceramus borilensis* nov. sp. - JOLKICEV, p. 145, pl. 27, figs. 1, 1a.
v? 1976 *Inoceramus borilensis dauensis* n. ssp. - SORNAY, p. 5, pl. 1, fig. 3; pl. 2, figs. 1, 2.
v. 1978 *Inoceramus* aff. *borilensis* Jolkicev - SORNAY, p. 33, text-fig. 4.
. 1981 *Inoceramus* (*Inoceramus*) *borilensis* Jolkicev - TZANKOV in TZANKOV *et al.*, p. 91, pl. 40, fig. 1.
v. 1982 *Inoceramus borilensis* Jolkicev - SORNAY, p. 7, pl. 2, fig. 1; pl. 3, fig. 3.

MATERIAL FROM TERCIS: specimen F2 (steinkern of right valve, somewhat worn and incomplete) from unit F, lowermost Tercis Marly Member, probably mid-Campanian; specimen G2 from unit G (Tercis Marly Member - Upper Campanian); specimen G3 (bivalved, somewhat deformed, with partial shell preservation) from unit G (top) (Tercis Marly Member - Upper Campanian); specimen H14 (deformed with partial shell preservation) from unit H (Tercis Marly Member lowermost *Nostoceras hyatti* Zone, Upper Campanian); specimen J7 (large bivalved specimen) from unit J (upper Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian); specimen J17 (left valve with partial shell preservation) from unit J (uppermost Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian); specimen M2 (right valve with deformed umbonal part) from unit M (Tercis Pale Flint Member, upper *Nostoceras hyatti* Zone, upper Upper Campanian.

DESCRIPTION: medium to large size, subequivalve, very inflated inoceramid, with small and terminal umbo: it reaches above the hinge margin. Two different growth stages:
— a feebly convex early part of the shell is covered with fairly clearly developed, somewhat irregular oval

plications, at a distance of 0-20 mm from the umbo along WA: about 4 mm from each other; at a distance of 20-40 mm from the umbo: about 5 mm; the larger plications form almost "steps";
— at 55 mm from the umbo a sudden fold (angle: 120° to 140°) delimits the earlier part of the shell from the older very much flattened stage, with a few irregular folds, but otherwise largely devoid of ornamentation except for a few very strong and probably irregular plications; distance between the first two of these: 20 mm.

SORNAY (1982) gave a very detailed description of *Inoceramus borilensis*. The specimens from Tercis which are somewhat deformed confirm this description.

DIMENSIONS (in mm):

specimen J7: H>260 mm, G3 H>250 mm.

F2 (umbonal part):

H	L	H/L	L/H
31.5	39.5	79.7%	125.3%
34.5	45.5	75.8%	131.9%
38.0	50.5	75.2%	132.9%
43.5	60.5	71.7%	139.1%

DISCUSSION: as already stated by SORNAY (1982) previous authors illustrated forms under several names which could belong to *Inoceramus borilensis*, but for which the available data are not sufficient to draw definite conclusions on. One of those I saw in the Museum of Moscow State University: the specimen figured by DOBROV & PAVLOVA (1959) under the name *I. brancoi* (pl. 15, fig. 4). SORNAY (1982) considered it as a possible *I. borilensis*. I think this specimen is too deformed to allow any identification, and further the strong and very elevated ribs on a less convex young stage make it unlikely that it belongs in *I. borilensis* as understood here.

The differences between *I. borilensis* and taxa of the *Endocostea baltica* (BÖHM) group is not totally clear. The initial ontogenetic stages are very similar, but *I. borilensis* is possibly somewhat more convex. The later growth stages are different, but the origin of the fold which delimits the two stages might be environmentally induced.

GENERIC ATTRIBUTION: none of the subgenera/ genera described in Cretaceous palaeontological literature totally applies to *Inoceramus borilensis*, though the taxon undoubtedly has characteristics of some more extreme *Endocostea baltica* group species. We have preferred not to take a stand here and have left it under "*Inoceramus*" until a later date.

STRATIGRAPHIC DISTRIBUTION: previously described from the Lower Campanian of NW Belgium, from the Upper Campanian of Royan (SW France), and from the Maastrichtian of Bulgaria.

GEOGRAPHICAL DISTRIBUTION: Bulgaria, Belgium, SW France (Royan - Tercis)

"Inoceramus"* cf. *borilensis JOLKICEV, 1962 (Pl. 4, Fig. 1; Text-fig. 2a, b, c)

MATERIAL FROM TERCIS: specimen O2 (left valve, with partial shell preservation, only the umbo is slightly deformed) from lower third of unit O (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone,, Lower Maastrichtian).

DESCRIPTION: Medium-sized, subequivalve, moderately inflated inoceramid; its anterior margin makes an angle of about 120° with the long hinge margin, forming a small auricle. Ornament consists of well developed

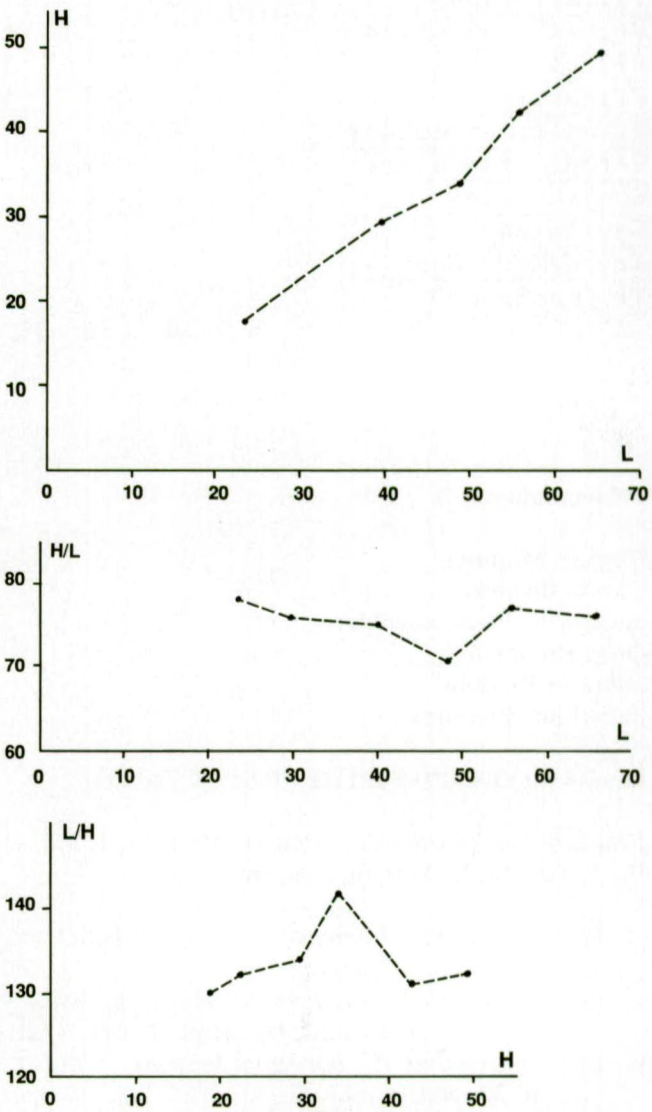


Fig. 2 — *"Inoceramus"* cf. *borilensis:* ontogenetic graphs; 2 a: H versus L (in mm); 2 b: H/L (in %) versus L (in mm); 2 c: L/H (in %) versus H (in mm).

elongate plications; in the older growth stages two to three less developed lamellae (circulae) alternate with plications; the ontogenetic development is shown on Fig. 2; the distance between plications varies from about 7 mm near the umbo to about 12 mm towards the end of the regular ornamentation.
No hinge visible on this specimen.

DIMENSIONS: (in mm) O2

H	L	H/L	L/H
18.2	23.6	78 %	130 %
22.5	29.6	76 %	131.5 %
29.5	39.5	75 %	134 %
34.0	48.2	70.5 %	142 %
42.5	55.5	77 %	131 %
49.5	65.2	76 %	132 %

DISCUSSION: This specimen is tentatively assigned to *I.* cf. *borilensis*. Its stratigraphic age agrees with that of the taxon in Bulgaria.

Inoceramus* aff. *lapparenti SORNAY & BILOTTE, 1978 (Pl. 3, Fig. 4)

Compare:
v = 1978 *Inoceramus lapparenti* n. sp. - SORNAY & BILOTTE, p. 36, pl. 3, fig. 2, pl. 6, figs. 1, 2.

MATERIAL FROM TERCIS: specimen F3 (half left valve, with shell preserved) from unit F, lowermost Tercis Marly Member, mid-Campanian.

DISCUSSION: As far as this incomplete specimen can be tentatively identified, we consider that by its wide plications covered with lineae, sometimes parallel to the plications, and sometimes crossing them, it is similar to *I. lapparenti* SORNAY & BILOTTE. The three specimens from Maastrichtian strata at Orcau and Montesquiu (Pre-Pyrenees of Lerida, Spain) described by SORNAY & BILOTTE (1978) were more complete. Not all the characteristics seen on those specimens can be seen on the half specimen from Tercis, but the unusual rib-ornamentation makes the identification plausible, even though some of the ribs are possibly somewhat more angular on our specimen than on those from the Pre-Pyrenees.

STRATIGRAPHIC DISTRIBUTION: *Inoceramus lapparenti* is Maastrichtian according to SORNAY & BILOTTE (1978); in Tercis possibly lower Upper Campanian

GEOGRAPHIC DISTRIBUTION: NW Spain,? Landes (SW France).

Inoceramus* aff. *planus MÜNSTER in GOLDFUSS, 1835 (Pl. 3, Fig. 1 a, 1 b; Text-fig. 3a, b)

Compare:
p.p. v * 1835 *Inoceramus planus* Münster - GOLDFUSS, p. 117, pl. 113, figs. 1a, 1b.
. 1964 *Inoceramus planus* Münst. - GIERS, p. 246, pl. 3, fig. 2.
v . 1978 *Inoceramus* (*Platyceramus*) cf. *planus* Goldf. Münster) - SORNAY & BILOTTE, p. 31, pl. 3, fig. 1.
? 1979 *Inoceramus planus* Münster - IVANNIKOV, p. 71, pl. 22, fig. 1.

MATERIAL FROM TERCIS: specimen F1 [steinkern of right valve (F1A), umbo missing, and counterpart (F1B)], from unit F, lowermost Tercis Marly Member, probably of mid-Campanian age.

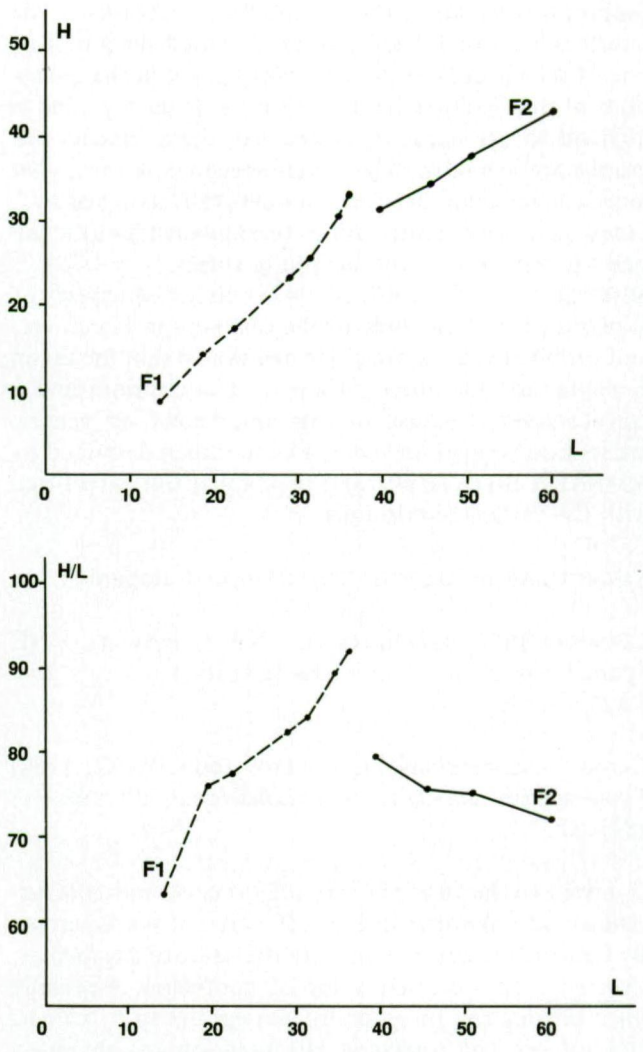


Fig. 3 — *"Inoceramus"* aff. *planus* (F1) and *"I." borilensis* (F2); ontogenetic graphs; 3 a: H versus L (in mm); 3b: H/L (in %) versus L (in mm).

DIMENSIONS (in mm, specimen F1A)

H	L	H/L	L/H
8.5	13.5	62.9%	158.8%
14.4	19.0	76.3%	131.9%
17.5	22.5	77.7%	128.6%
23.5	28.5	82.4%	121.3%
26.5	31.5	84.5%	118.9%
30.5	34.5	88.4%	113.1%
33.5	36.5	91.8%	108.9%

DISCUSSION: description of specimen from Tercis: medium-sized, almost flat, subcircular inoceramid; only the younger part is present; its ontogenetic development is shown on Text-fig. 3; the distance between the fine but strongly developed plications is 2.5 mm near the umbo (0-15 mm from the umbo), around 3 mm on most of the valve, and about 5 - 6 mm near the pallial margin of this relatively small specimen.

The strongly developed, elongated to subcircular plications and small, not very prominent umbo have led us to identify this specimen tentatively as being close to *Inoceramus planus* as understood by GIERS (1964). The interpretation of GIERS is partially based on a cast of one of the GOLDFUSS type specimens kept in the collections of the Geologische Bundesamt at Hannover, but is difficult to use because no detailed measurements nor graphs are available. The Tercis specimen is somewhat more convex than the specimens generally assigned to *I. planus*, but we consider this to be explained by its small size - it represents only the young stages.
SEITZ (1961, p. 52, 1967, p. 76-78) discussed aspects of *I. planus*, based on study of the cast kept in Hannover, and included some graphs. He mentioned that the taxon *I. planus* is somewhere between a platyceramid and a cordiceramid. Because of this uncertainty no generic attribution is suggested here. The specimen described by SORNAY & BILOTTE (1978) is incomplete but agrees well with the earlier descriptions.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian

GEOGRAPHIC DISTRIBUTION: NW Germany, NE Spain,? SW France,? Donbass (Ukraine).

Genus ***"Cataceramus"*** COX, 1969 (non HEINZ, 1932)
Type species *Inoceramus goldfussianus* d'ORBIGNY, 1847 (O.D.)

Contrary to the view of COX, 1969 *Inoceramus goldfussianus* and *I. balticus* BÖHM, 1907 are not synonymous. By figuring the latter taxon with the name of the former, COX (op. cit.) created a lot of confusion, especially since the description given by him applies to *I. balticus* and not to *I. goldfussianus*. His intention was obviously to use the *I. balticus* concept, but he misidentified it [ICZN art. 70 (b)]. To confuse matters even further *Cataceramus* HEINZ, 1932 is not a *nomen nudum* as stated by COX, 1969. Already SEITZ, 1967 (p. 49) did not doubt the validity of *Cataceramus* HEINZ with its clearly indicated "Subgenotyp" or type species (*I. balticus* BÖHM) (HEINZ, 1932, p. 15), which was and is a valid species [ICZN art. 68 (b)]. SEITZ furthermore synonymised *Cataceramus* HEINZ, 1932 with *Endocostea* WHITFIELD, 1880.

So probably the problem of *Cataceramus* should be submitted to the Commission of Zoological Nomenclature [ICZN 68(b)]. Possibly a new genus should be erected with *I. goldfussianus* s.s. as type species.

"Cataceramus" goldfussianus (d'ORBIGNY, 1847) (Pl. 1, Fig. 2; Pl. 2, Figs. 1-3; Text-fig. 4a, b)

v *	1847	*Inoceramus Goldfussianus*, d'Orbigny - d'ORBIGNY, p. 517, pl. 411, figs. 1, 2.
v	(1850)	*Inoceramus Goldfussianus*, d'Orb. - d'ORBIGNY, p. 250.
v.	1957	*Inoceramus goldfussi* d'Orbigny - SORNAY, n° 57.
?	1968	*Inoceramus balticus* Boehm - KOCIUBYNSKIJ, p. 142, pl. 27, figs. 1, 2 (non *I. balticus* BOEHM, 1909 s.s.).
non	1969	*Inoceramus goldfussianus* d'Orbigny - COX in MOORE, p. N315, fig. C46,4 (= *Endocostea baltica* BÖHM, 1907).
v.	1976	*Inoceramus goldfussi* d'Orbigny - SORNAY, p. 9, text-figs. 4 - 5, pl. 4, figs. 1, 2, pl. 5.

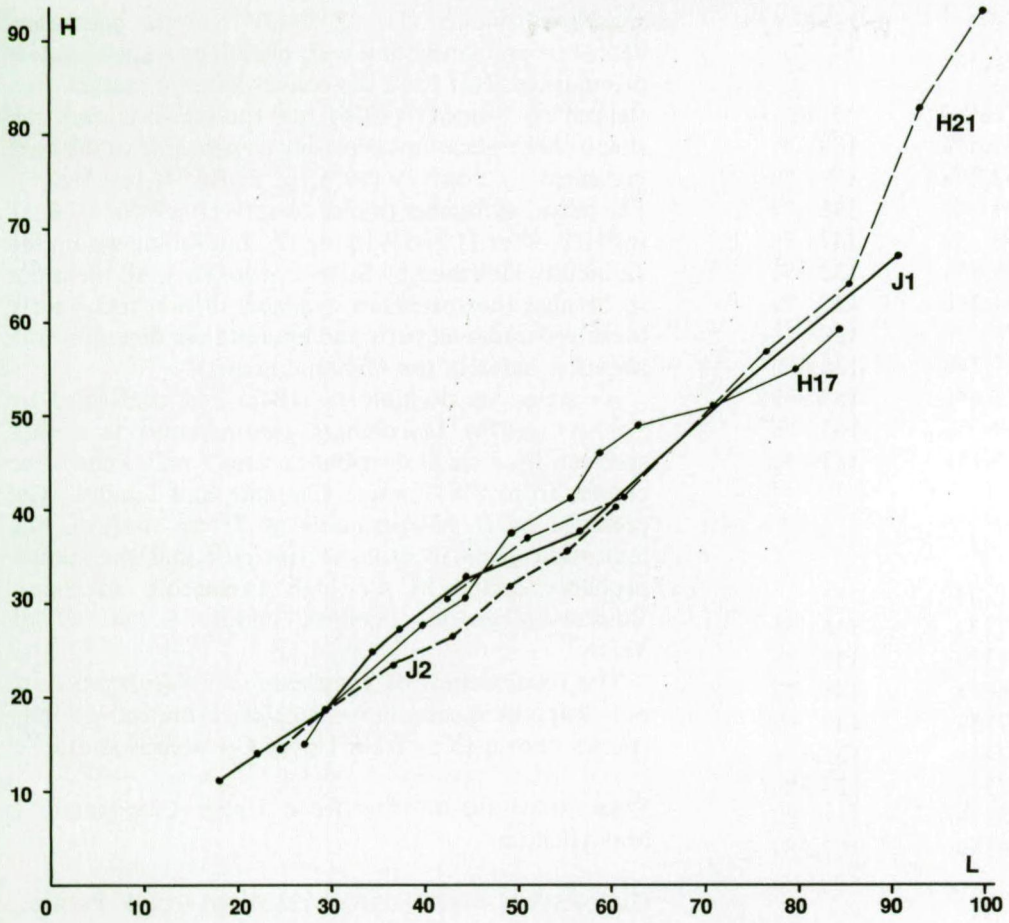
LOCUS TYPICUS: Royan (Charente-Maritime).

STRATUM TYPICUM:? "Maastrichtien" sensu SORNAY

NOMENCLATIVE NOTE: SORNAY (1957) has changed the name of the d'ORBIGNY species to *Inoceramus goldfussi*, but there seems to be no real reason for this alteration since the original Latin adjectivation used by d'ORBIGNY accorded with the Rules of Zoological Nomenclature.

MATERIAL FROM TERCIS: specimens H17 (right valve) and H21 (left valve), from top of unit H, Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian; bivalved specimens J1 and J2, from unit J, upper Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian, somewhat worn and not complete.

DESCRIPTION: Medium to large sized, subequivalve, moderately inflated inoceramid; its anterior hinge margin makes an angle of about 100° with the hinge line, not forming any auricle. Angle γ: 75°. Ornamentation consists of well developed oval plications; the ontogenetic development is shown on Text-fig. 4. The distance between plications varies from about 3.5 mm near the umbo to about 12 mm towards the marginal parts of the shell. No hinge visible on these specimens.



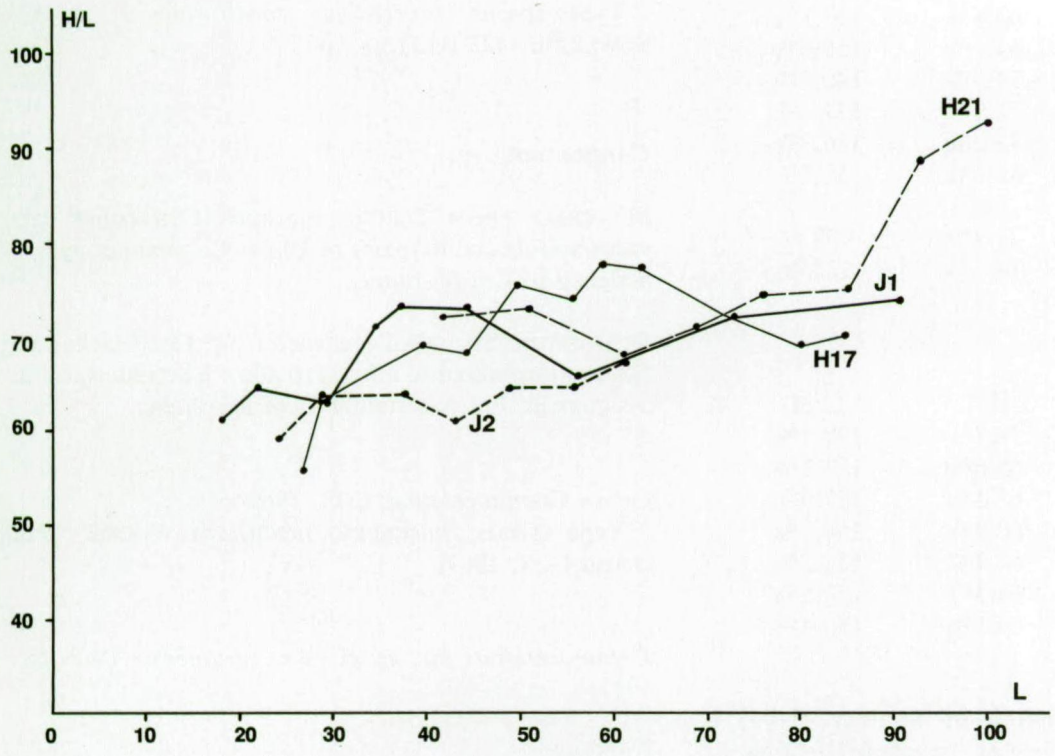


Fig. 4 — *"Inoceramus" goldfussianus:* ontogenetic graphs; 4 a: H versus L (in mm); 4 b: H/L (in %) versus L (in mm).

DIMENSIONS (in mm)

H17

H	L	H/L	L/H
15	27	55.6%	180 %
18.2	29.0	62.7%	159 %
27.2	39.5	69 %	145 %
30.3	44.5	68 %	147 %
37.2	49.2	75.6%	132 %
41.2	55.5	74.2%	135 %
45.8	58.7	78 %	128 %
48.8	62.8	77.7%	128.6%
51.4	70.8	72.6%	138 %
55	79.8	69 %	145 %
59	84.1	70.1%	142.5%

D = 11 to 12.

H21

H	L	H/L	L/H
30.2	41.7	72%	138 %
37.0	50.8	73%	137 %
41.5	61.3	68%	148 %
49.4	69.1	71%	140 %
56.3	76.5	74%	135.8%
64	85.3	75%	133.3%
83.2	93.2	89%	112 %
93	100	93%	107.5%

D = 8, $\beta = 130°$

J1

H	L	H/L	L/H
11	18	61 %	163.6%
14	22	63.6%	157.1%
18.6	29.5	63 %	158.6%
24.5	34.5	71 %	140.8%
27.0	37.0	72.9%	137 %
32.5	44.5	73 %	136.9%
37.5	56.5	66 %	150.7%
50.5	(60.5)	—	—
52.5	73.0	71.9%	139%
67	90.5	74 %	135%

D = 9, $\alpha = \beta = 100°$, $\gamma = 75°$

J2

H	L	H/L	L/H
14.4	24.5	58.7%	170.1%
18	28.3	63.6%	157.2%
23.8	37.5	63.5%	157.6%
26.2	43.0	60.9%	164.1%
31.7	49.2	64.4%	155.2%
35.5	55.2	64.3%	155.5%
40.1	60.3	66.5%	150.4%

D = 9 to 10; $\gamma = 55°$.

DISCUSSION: The description of SORNAY (1976) is satisfactory and as complete as the material allows.

Specimens J1, J2, H17, H21 are identified as *I. goldfussianus* but they are worn (J1 lacks the umbo), somewhat smaller (J1, J2, H17) than the specimens described previously and with plications somewhat less pronounced. H21 has a less convex anterior margin than figured by SORNAY (1976) but for all specimens the shape of the plications is closely comparable to the data presented by SORNAY (1976, p. 8, fig. 4, text-fig. 5). The plication number (indice costal = D) is 8 for H21, 11 for H17, 9 for J1 and 9-10 for J2, thus falling within the variability indicated by SORNAY (*op. cit.*), all the more so because the specimens available to him had poorly preserved umbonal parts and he could not determine the plication index in the umbonal areas.

As stated by d'ORBIGNY (1847) and confirmed by SORNAY (1976) *Inoceramus goldfussianus* is a rare species with a small distribution area - only known for certain from SW France: Charente and Landes. The presence of *I. goldfussianus* at Tercis confirms the indication given in SORNAY (*op cit.*) that the species probably occurs in the high Cretaceous of Saint-Vincent-de-Tyrosse (Landes), about 15 km. W of Tercis.

The relationships of *Cataceramus goldfussianus* are not clear: the species shows no clear affinities with any species known to us from Upper Cretaceous strata.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian -? Maastrichtian.

GEOGRAPHIC DISTRIBUTION: restricted to SW France.

Genus ***Cordiceramus*** HEINZ, 1932

Type species *Inoceramus cordiformis* J. de C. SOWERBY, 1823 (O.D.).

Cordiceramus sp.

MATERIAL FROM TERCIS: specimen G19 (small left valve and its counterpart) of Upper Campanian age, is assigned to *Cordiceramus*.

DISCUSSION: The small specimen from Tercis lacks sufficient morphological criteria to allow a definite specific assignment, but is certainly a cordiceramid.

Genus ***Cremnoceramus*** COX, 1969

Type species *Inoceramus inconstans* WOODS, 1912 (sensu COX, 1969)

Cremnoceramus* sp. ex gr. *Cr. sarumensis (WOODS, 1912)

Compare:

* 1912 *Inoceramus inconstans* var. *sarumensis*, var. nov. - WOODS, p. 293, pl. 52, figs. 2, 3.

? 1959 *Inoceramus convexus* Hall & Meek - DOBROV & PAVLOVA, p. 155, pl. 21, fig. 1 (non 1854 *Inoceramus convexus* n.sp.- HALL & MEEK, p. 386, pl. 2, figs. 2a, 2b)
v. 1982 *Inoceramus sarumensis* Woods - SORNAY, p. 5, pl. 1, fig. 3; pl. 2, figs. 2, 3.

MATERIAL FROM TERCIS: H32 (left valve, with partial shell preservation) from unit H (Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian); H33 (right valve, with fragmentary shell preservation) from unit H (4m above base, Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian).

DIMENSIONS:

	L (mm)	H (mm)	conv. (mm)
H32	(62)	45	(22)
H33	(80)	55	(25)

DISCUSSION: SORNAY (1982) gave a detailed description of *Inoceramus sarumensis* based mainly on specimens from the Belgian Campanian. The specimens from Tercis are less well preserved than this material, and furthermore their umbo seems to be closer to the anterior end of the hinge margin than is the case in the Belgian specimens. Therefore the Tercis specimens are only tentatively interpreted as being ex gr. *I. sarumensis*. They can be described as follows: medium-sized fairly convex inoceramid, sub-equivalve, with generally smooth appearance and few, only poorly indicated and slightly elevated, commarginal plications; very thin shell; umbo near the anterior end of the hinge margin, wide and rounded, not overhanging the hinge margin; auricles not preserved.

STRATIGRAPHIC AND GEOGRAPHIC DISTRIBUTION: mid-Campanian in England, Belgium; Upper Campanian in several regions of Russia;? Upper Campanian of the Landes, SW France.

Genus ***Endocostea*** WHITFIELD, 1877

Type species *Endocostea typica* WHITFIELD, 1877 (O.D.)

Endocostea baltica baltica (J. BOEHM, 1907) (Pl. 4, Fig. 3)

v. 1835 *Inoceramus Cripsii* Mant. - GOLDFUSS, p. 116, pl. 112, fig. 4b.
* 1907 "*balticus*" - J. BÖHM, p. 114.
p.p. 1909 *Inoceramus balticus* nov. sp. - J. BOEHM, p. 47, pl. 11, figs. 2, 2a (non pl. 12, fig. 1 = *E. baltica marcki* GIERS).
. 1964 *Inoceramus balticus balticus* J. Böhm - GIERS, p. 238, pl. 1, figs. 2 - 4.
. 1967 *Inoceramus (Endocostea) balticus* J. Böhm - SEITZ, p. 67, pl. 6, figs. 1, 2; pl. 7, figs. 1, 2; pl. 8, figs. 1, 2; pl. 10, fig. 1; pl. 12, figs. 1, 2.
? 1986 *Inoceramus (Endocostea) balticus* cf. *balticus* - LOPEZ, p. 237, pl. 1, fig. 19.

MATERIAL FROM TERCIS: specimen G9 (bivalved, deformed, particularly the right valve, with fragmentary shell preservation), from unit G (lower half, Tercis Marly Member, Upper Campanian), specimen G18 (left valve, deformed, with fragmentary shell preservation), from unit G (upper quarter part, Tercis Marly Member, Upper Campanian).

DESCRIPTION: small to medium-sized, sub-equivalve, fairly convex inoceramid; length much greater than height (about X 1.5); hinge margin long and straight, umbo almost anterior; shell covered with strong, subcircular plicae in the young stages, elongated, regularly placed commarginal plicae in the older ontogenetic stages.

DISCUSSION: *Inoceramus balticus* BOEHM has been fundamentally redefined by GIERS (1964), who at the same time subdivided the species into no less than 7 subspecies. The specimens from Tercis, though deformed, are close to the illustration in GIERS (1964) of *I. balticus balticus*, but the plications are less pronounced and wider. This might of course be due simply to a different preservation. *I. balticus marcki* GIERS, 1964 differs from *I. balticus balticus* mainly in having more elongated plicae. Since the new definition of *I. balticus* by GIERS, many previous interpretations no longer apply. We have not tried to give a complete synonymy list because it would require the study all the specimens identified as *I. balticus*.

STRATIGRAPHIC DISTRIBUTION: GIERS (*op. cit.*) mentioned *Inoceramus balticus balticus* from Upper Santonian and Campanian beds; TRÖGER (1989) extended it into the lower Upper Campanian, Zones 29, 30, 31, 32.

GEOGRAPHIC DISTRIBUTION: considered as world wide, but this statement needs checking.

Endocostea baltica beckumensis (GIERS, 1964) (Pl. 3, Fig. 3; Text-fig. 5 a, b, c)

* 1964 *Inoceramus balticus beckumensis* n. subsp. - GIERS, p. 241, pl. 2, fig. 1.

MATERIAL FROM TERCIS: specimens H22 and H23 (left valves, composite moulds, somewhat deformed) from unit H (Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian); specimen J9 (right valve) from unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian).

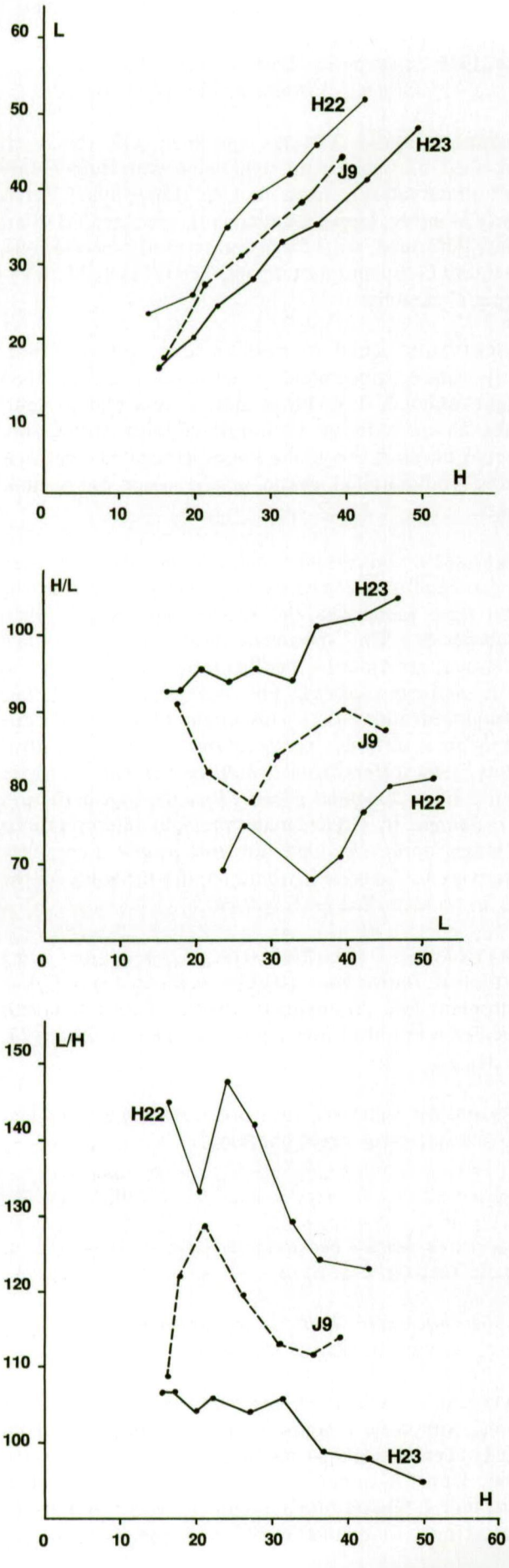


Fig. 5 — *Endocostea baltica beckumensis:* ontogenetic graphs; 5 a: L versus H (in mm); 5 b: H/L (in %) versus L (in mm); 5 c: L/H (in %) versus H (in mm).

DESCRIPTION: small to medium-sized endocosteid, moderately inflated shells, with strongly developed, not very closely set, elongate to sub-circular plications, with sharp summits.

DIMENSIONS: (mm and %)

H22

H	L	H/L	L/H
16.2	23.5	69	145
19.8	26.4	75	133
23.8	35.2	68	148
27.7	39.2	71	142
32.6	42.1	77	129
36.6	45.5	80	124
42.5	52.2	81	123
42.5	41.7	102	98

H23

H	L	H/L	L/H
15.1	16.2	93	107
17.0	18.3	93	107
19.6	20.4	96	104
23.2	24.7	94	106
27.2	28.2	96	104
31.3	33.2	94	106
36.2	36.0	101	99
49.3	46.8	105	95

J9

H	L	H/L	L/H
15.8	17.3	91	109
17.5	21.4	82	122
21.2	27.3	78	129
26.2	31.2	84	119
31.2	35.2	87	113
35.2	39.3	90	112
39.2	44.8	88	114

Plication distance:

	0-20 mm	20-40 mm
H22	5 mm	7 mm
H23	3.5 mm	6.5 mm
J9	3 mm	7 mm

DISCUSSION: The specimens from Tercis are somewhat smaller than those described by GIERS (1964) from northern Germany. The ontogeny is not illustrated by GIERS (op. cit.) but his measurements are not contradictory to those which can be made on the Tercis specimens.

Among the other *Endocostea baltica* "subspecies" described by GIERS (*op. cit.*) also *E. baltica baltica* seems close, but its plications are more elongate. *I. (Cordiceramus) paraheberti* SORNAY, 1968 (p. 38, pl. G, figs. 1-5, pl. H, figs. 1,2; text-figs. 7 -10) from the Campanian of Madagascar is also comparable, but the specimens from Madagascar have a less pointed umbo and are larger. The older parts of the valves are missing in Tercis and a detailed comparison cannot be made.

STRATIGRAPHIC DISTRIBUTION: *Endocostea baltica beckumensis* is considered lower Upper Campanian by GIERS (1964): Beckumer Schichten.

At Tercis the species also occurs in the Upper Campanian.

Endocostea baltica elliptica (GIERS, 1964) (Pl. 6, Fig. 1; Text-fig. 6)

* 1964 *Inoceramus balticus ellipticus* n. subsp. - GIERS, p. 244, pl. 2, figs. 3, 4.

MATERIAL FROM TERCIS: specimen G6 (right valve, composite mould with partial shell preservation) from unit G, (Tercis Marly Member, Upper Campanian; specimen G8 (right valve, steinkern, deformed) from upper quarter of unit G (Tercis Marly Member, Upper Campanian); specimen G13 (left valve, steinkern, deformed, incomplete) from upper quarter of unit G (Tercis Marly Member, Upper Campanian); specimen H16 (composite mould of left valve, anterior margin slightly broken off) from unit H (Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian); H29 (bivalved, somewhat deformed specimen) and H30 (right valve, incomplete) from unit H, Tercis Marly Member, lower *Nostoceras hyatti* Zone, Upper Campanian).

DESCRIPTION: medium-sized to large subequivalve inoceramid with small, pronounced, anteriorly placed umbo, with long hinge margin, and posterior poorly differentiated auricle; sub-elliptical plications, with smaller inter-rugal commarginal ornament on youngest stage of the valve; older stages covered with somewhat irregular sharp plications much further apart than on the ornamentation of the young stage; a weak fold separates the young from the older growth stage of the valve.

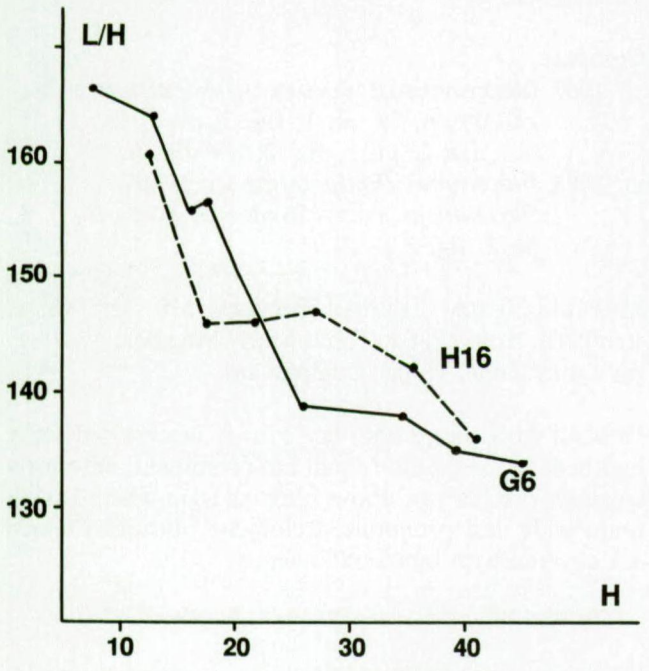


Fig. 5 — *Endocostea baltica elliptica:* ontogenetic graph: L/H (in %) versus H (in mm).

DIMENSIONS:

— G6

H	L	L/H
7.5	12.5	166%
12.5	20.5	164%
15.5	24.2	156%
17.5	27.5	157%
20	30.2	151%
25.5	35.5	139%
35	48	137%
39	52.5	135%
44.5	60	134%

angle β: 35° to 40°; distance between plications: 2.5 mm at 15 mm, 3.5 mm at 20 mm, 4 mm at 30 mm, 5.5 mm at 40 mm, 7 mm at 45 mm.

— H16

H	L	L/H
12.5	20.2	161%
18.2	26.5	146%
21.3	31.2	146%
27.2	40.0	147%
35.5	50.5	142%
40.8	55.5	136%

distance between plications: 2.3 mm at 15 mm, 2.8 mm at 20 mm, 4.1 mm at 30 mm, 5.5 mm at 40 mm.

DISCUSSION: The rib ornamentation illustrated by GIERS (1964, pl. 2, fig. 4) is very similar to that found on the specimens from Tercis. The ellipse-shaped plications vary somewhat in elongation depending on the deformation of the valve. Surprising are the older stages of the valves where commarginal plications are much further apart. Such plications are nearer those found on *Endocostea pteroides* (GIERS, 1964) than on those on *Endocostea baltica* s.s..

The change in ornamentation in different growth stages seen in these Campanian *Endocostea* specimens has also been described for Santonian taxa such as *I. (Selenoceramus) inaequabilis* (SEITZ, 1967, p. 110) from northern Germany.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian

GEOGRAPHIC DISTRIBUTION: described from Germany and from Tercis (Landes, SW France).

***Endocostea baltica* subsp. indet.** (J. BOEHM, 1907) (Pl. 4, Fig. 2; Text-fig. 7 a, b, c)

MATERIAL FROM TERCIS: specimen N3 (small right valve, with endocostean scar, almost complete

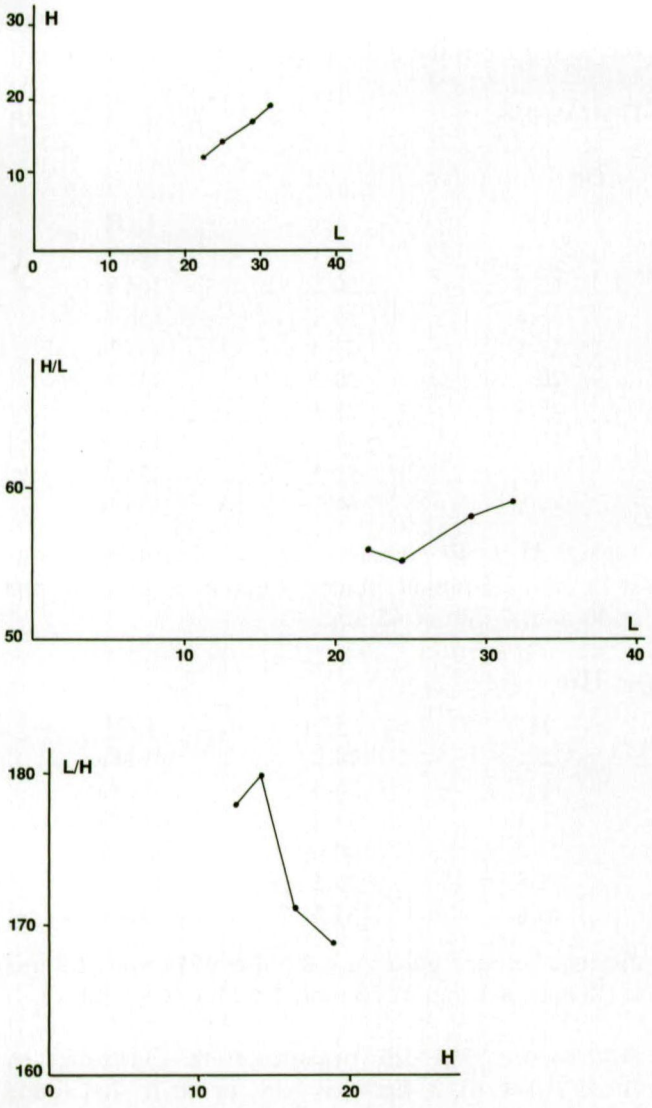


Fig. 7 — *Endocostea baltica* subsp. ind.: ontogenetic graphs; 7 a: H versus L (in mm); 7 b: H/L (in %) versus L (in mm); 7 c: L/H (in %) versus H (in mm).

composite mould) from unit N (loose) (Tercis Pale Flint Member, top of *Nostoceras hyatti* Zone, uppermost Campanian); specimen O4 (small right valve, not totally uncovered, steinkern) from lower third of unit O (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Lower Maastrichtian).

DISCUSSION: The two small valves are considered to be young specimens of *Endocostea baltica*. They are characterised by very elongated (see dimensions below), regular, well developed commarginal plications, a long hinge margin, an anterior umbo, not very prominent, but reaching above the hinge margin. Specimen N3 does not seem to be deformed. The commarginal plications reach the hinge margin under an angle of about 90°-100°.

DIMENSIONS N3 (mm):

H	L	L/H
12.5	22.3	1.78
13.8	24.8	1.80
16.7	28.6	1.71
18.7	31.7	1.69

DISCUSSION: At first glance these small specimens are reminiscent of the lectotype of *Endocostea typica* WHITFIELD, 1880 designated and illustrated by SEITZ, 1967 (p. 54, pl. 2, fig. 3), especially as one shows a well developed endocostean scar, but on the Tercis specimens the commarginal plications form a much wider oval.

The specimens described and figured as *Inoceramus barabini* by DOBROV & PAVLOVA (1959, p. 140, pl. 22, fig. 2), KOCIUBYNSKIJ *in* PASTERNAK *et al.* (1968, p. 145, pl. 29, fig. 3), KOCIUBYNSKIJ & SAVCZINSKAJA *in* BLANK *et al.* (1974, p. 83, pl. 20, figs. 1a, b; pl. 23, fig. 2) have some similarity with the Tercis specimens, but seem to have more rounded plications. Whether these eastern European specimens belong to *I. barabini* MORTON, 1834 is difficult to judge: the original specimen of MORTON kept in the Academy of Natural Sciences in Philadelphia (n° 15469) is very incomplete. The Tercis specimens do not belong to the taxon named *I. balticus ellipticus* by GIERS (1964): their plications do not form an ellipse. As far as can be ascertained they are nearest to the form named *I. balticus marcki* GIERS, 1964 in the same paper, but with even more elongate commarginal plications.

Endocostea* cf. *flexibaltica (SEITZ, 1967) (Pl. 4, Fig. 4; Text-fig. 8a, b)

Compare:

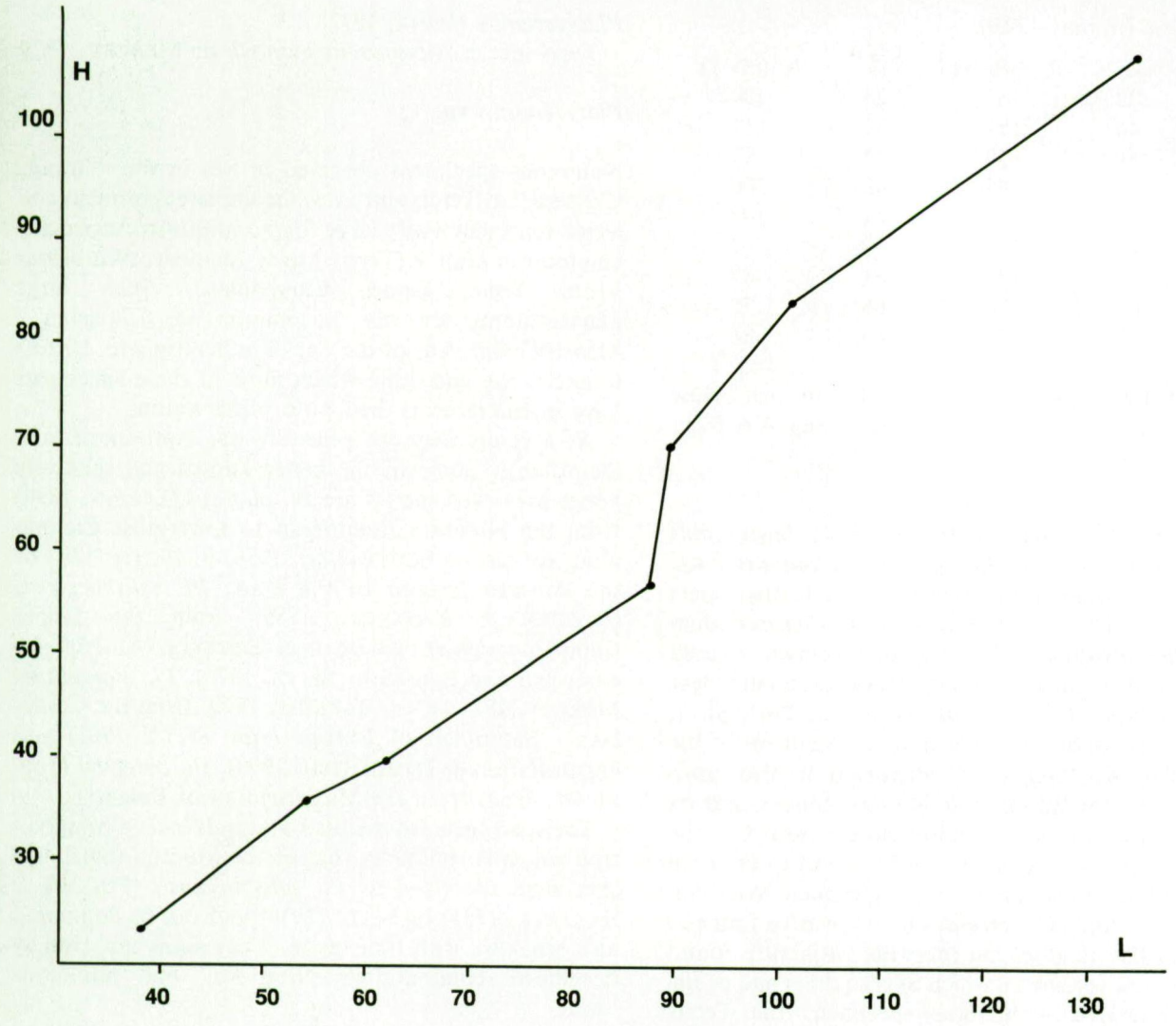
* 1967 *Inoceramus (Endocostea) flexibalticus* n. sp. - SEITZ, p. 59, pl. 1, fig. 5; pl. 3, fig. 1; pl. , fig; 2; pl. 5, fig. 2; text-fig. 6.

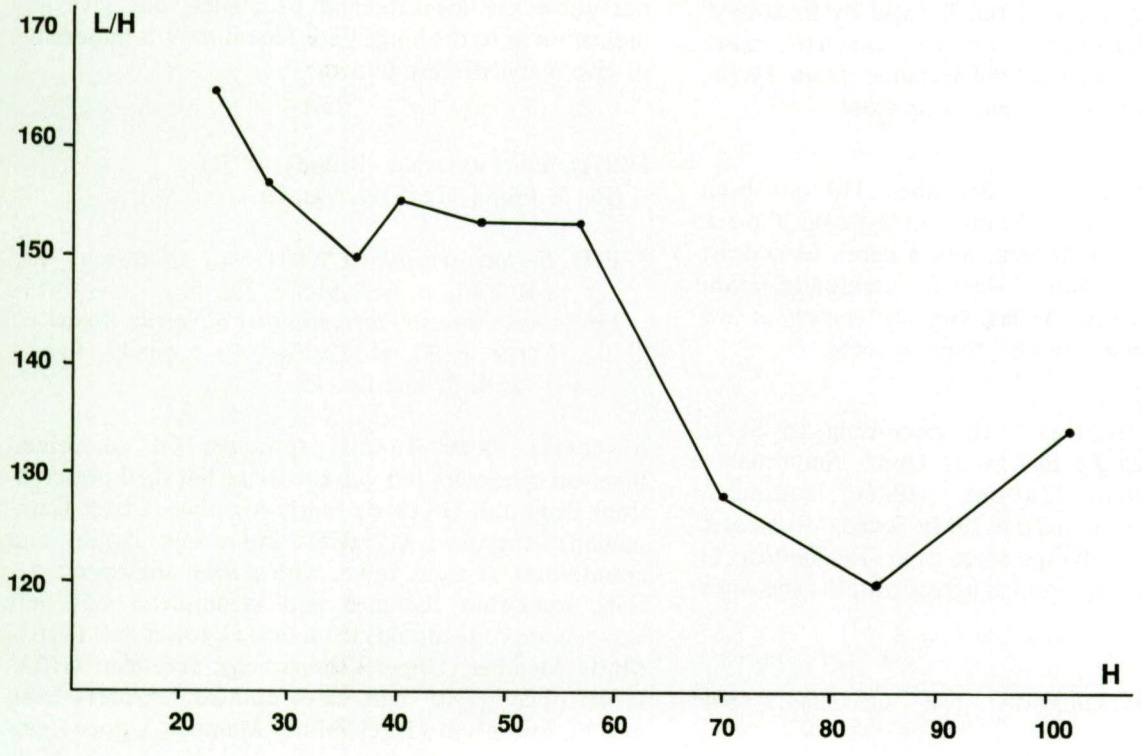
v. 1983 *Inoceramus (Endocostea)* sp. ex gr. *flexibalticus* Seitz - ROMAN & SORNAY, p. 8, pl. 2, fig. 2.

MATERIAL FROM TERCIS: specimen J10, left valve, steinkern, from Unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian).

DESCRIPTION: large not very convex inoceramid, only lightly deformed; umbo small but prominent, anteriorly situated, reaches just above hinge margin which is very long; wide and pronounced elongate plications which are covered with numerous lineae.

Fig. 8 — *Endocostea flexibaltica:* ontogenetic graphs; 8 a: H versus L (in mm); 8 b: L/H (in %) versus H (in mm). →


H
100
90
80
70
60
50
40
30
L
40
50
60
70
80
90
100
110
120
130


L/H
170
160
150
140
130
120
H
20
30
40
50
60
70
80
90
100

DIMENSIONS (in mm - J10):

H	L	L in% H	S	S in% H
23	38	165	24	104
28	44	157	31	111
36	54	150	35	97
40	62	155	40	100
47	72	153	51	109
57	87	153	59	104
70	89	127	61	87
84	101	120	66	79
102	137	134	83	81

Distance between plications is wide: 11 mm just below the umbo, to about 15 mm at 50 mm along WA from the umbo.

DISCUSSION: As stated by SEITZ (1967) *Inoceramus flexibalticus* is similar to *Endocostea pteroides* (GIERS, 1964) but the commarginal plications are further apart [and they are already further apart in *E. pteroides* than in *E. baltica* (BOEHM, 1909)]. On the specimens figured and described by SEITZ (*op. cit.*) this is especially clear on the holotype of *I. flexibalticus* (SEITZ, 1967, pl. 3, fig. 1) but less so on the other figured specimens of the same taxon. *E. "impressa"* auctorum is also comparable to *E. flexibaltica* but is more convex and its plications are somewhat more closely set. On the photograph (Pl. 4, Fig. 4) the umbo seems to be more prominent than it actually is on the specimen. We think that it differs from *E. pteroides* by its relative flatness, and would like to insist on the wide variability found among the few specimens which SEITZ (1967) had of the taxon. Compared with these specimens the Tercis specimen probably has a more abrupt anterior margin.

The specimen described from Senegal by ROMAN & SORNAY (1983) has ribs which are somewhat more strongly developed than on the specimen from Tercis, but otherwise both forms seem to be close.

PALAEOECOLOGICAL NOTE: Specimen J10 has been bitten by a largish animal: the more or less conical mark has a width of about 21 mm, and a depth of at least 10 mm. Possible predators were an ammonite, crab, fish or mosasaur, but the last two are somewhat less likely since only one "tooth" mark is seen.

STRATIGRAPHIC DISTRIBUTION: According to SEITZ (1967) *Endocostea flexibaltica* is Upper Santonian - Lower Campanian, TRÖGER (1989) Santonian-Campanian transition in Zone 29. In Senegal ROMAN & SORNAY (1983) date the specimen ex gr. *flexibalticus* as of Late Campanian age, which agrees with the specimen from Tercis.

GEOGRAPHIC DISTRIBUTION: NW Germany,? SW France,? Senegal.

Platyceramus HEINZ, 1932

Type species *Inoceramus mantelli* de MERCEY, 1879

***Platyceramus* sp.**

Numerous specimens observed *in situ* in the "Grande Carrière" at Tercis and a few incomplete specimens collected represent a very large *Platyceramus* sp., especially common in Unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian). Such large platyceramids are not uncommon in Coniacian - Maastrichtian beds of the northern hemisphere. Unfortunately, the one thing which most of these specimens have in common, is their poor preservation.

As a result they are generally not even specifically identifiable. Some of the better known and relatively better preserved species are *Pl. platinus* (LOGAN, 1898) from the Niobrara (Santonian to lowermost Campanian, see also in SCOTT *et al.*, 1986, p. 18, fig. 12i) of the Western Interior of the USA, *Pl. salisburgensis* (FUGGER & KASTNER, 1885) from the Upper Campanian-Maastrichtian near Salzburg, Austria (redescribed and figured by SEITZ, 1970), *Pl. mantelli* de MERCEY, 1874 (*sensu* BARROIS, 1879) from the Coniacian - Santonian of Europe (*vide* SEITZ, 1961) and Japan (NODA & TOSHIMITSU, 1990), *Pl. beregovi* (JOLKICEV, 1962) from the Maastrichtian of Bulgaria.

The specimens from Unit J at Tercis have a preservation which is similar to that of the Muntigl (Salzburg) specimens described as *Pl. salisburgensis* (FUGGER & KASTNER, 1885) by SEITZ (1970) and can be compared also size-wise with that taxon. They show no strongly developed commarginal plications, but numerous lineae.

The incompleteness of the specimens from Tercis does not allow the measurement of angles, nor give any indication as to the hinge line. Therefore it is impossible to give a specific assignment.

Platyceramus adversus (RIEDEL, 1931)
(Pl. 5, Fig. 1; Text-fig. 9 a, b)

* 1931 *Endocostea typica* Whitf. var. *adversa* n. var. - RIEDEL, p. 665, pl. 75, fig. 5.
. 1967 *Inoceramus (Platyceramus) adversus* Riedel - SEITZ, p. 87, pl. 12, figs. 4 - 6; pl. 13, figs. 1, 2, 4, 5; text-fig. 15.

MATERIAL FROM TERCIS: specimen G1 (deformed bivalved specimen, left valve with partial shell preservation) from unit G (Tercis Marly Member, Upper Campanian); specimen G5 (G5A composite mould and counterpart of right valve, with partial shell preservation, somewhat flattened and incomplete, G5B left valve, composite mould) from unit G, lower half (Tercis Marly Member, Upper Campanian); specimen G10A-G10B (incomplete right valve and counterpart) from unit G, lower half (Tercis Marly Member, Upper Cam-

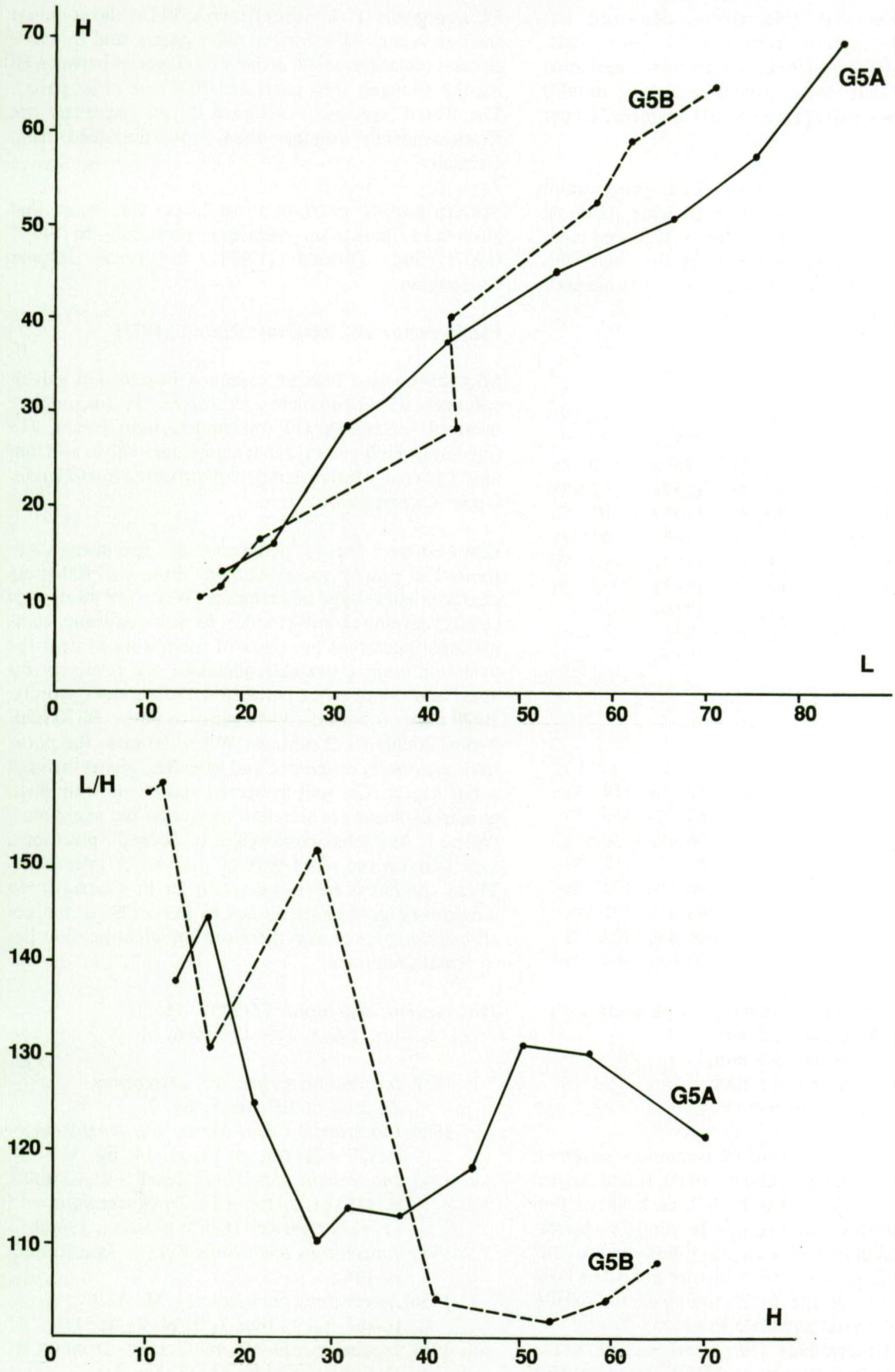


Fig. 9 — *Platyceramus adversus:* ontogenetic graphs; 9 a: H versus L (in mm); 9 b: L/H (in %) versus H (in mm).

panian); specimen G11 (incomplete, deformed left valve, composite mould) from unit G, lower half, (Tercis Marly Member, Upper Campanian); specimen G12 (deformed, left valve, partial composite mould) from unit G, lower half, (Tercis Marly Member, Upper Campanian).

DESCRIPTION: medium to large-sized inoceramid, equivalve, very slightly inflated, with wide umbonal angle (120° to 130°) with subcircular, well spaced commarginal plications; ornamentation of the shell with clearly visible "Anwachs-Schnittreifen". Ontogenetic development shown on Text-figure 9.

DIMENSIONS:

G5A:

L	H	HA	NA	H/L	L/H	HA/NA
18	13	15.5	19.5	72 %	138%	80 %
23.5	16.2	24.5	30.5	69 %	145%	80 %
26.8	21.4	28.5	34.5	80 %	125%	82.6%
31.5	28.5	34.5	41.5	90 %	110%	83 %
36	31.5	41.5	43.5	87.5%	114%	95 %
42.2	37.2	47.5	51.5	88 %	113%	92 %
52.8	44.8	63.5	76.5	84 %	118%	83 %
66	50.5	—	—	76.5%	131%	—
75	57.5	—	—	76 %	130%	—
84.5	69.5	—	—	82 %	121%	—

AA 130°

G5B:

L	H	—	—	H/L	L/H
15.5	9.8	—	—	62 %	158 %
17.8	11.2	—	—	63 %	159 %
22.2	17.0	—	—	76.6%	130.6%
43.0	28.2	—	—	66 %	152 %
41.8	40.2	—	—	96 %	104 %
53.8	53	—	—	98.5%	101.5%
61.2	59	—	—	96.4%	103.7%
70.2	65	—	—	92.6%	108 %

average distance between commarginal plications:
at 20 mm from the umbo: 2.5 mm;
at 40 mm from the umbo: 5.5 mm;
at 60 mm from the umbo: 6.5 mm;
near the pallial margin: 10 mm.

DISCUSSION: When comparing *Platyceramus adversus* with *Pl.* aff. *cycloides* (WEGNER, 1905) found in the same unit, it is obvious that both taxa have similar characteristics in their adult stages. In young stages we have the impression that *Pl. adversus* is less convex, and that its plications are somewhat further apart. In how far this suffices for specific distinction we cannot decide on the limited material available to us.

The other platyceramids [*Pl. alaeformis* (ZEKELI, 1852) and *Pl. artigesi* (SORNAY, 1976)] also described herein from Tercis, are characterised by generally flatter shells and by more elongate commarginal plications in *Pl. alaeformis* (H/L varies between 50 for the youngest shell parts and 72% for the older parts), and by more circular plications in *Pl. artigesi* (H/L varies between 80 for the youngest shell parts and 100% on older parts). The Tercis specimens assigned to *Pl. adversus* are stratigraphically younger than those described from Germany.

STRATIGRAPHIC DISTRIBUTION: Upper Santonian and Santonian-Campanian transition according to SEITZ (1967) and TRÖGER (1989). In Tercis, Upper Campanian.

Platyceramus* aff. *adversus (RIEDEL, 1931)

MATERIAL FROM TERCIS: specimen J4 (half left valve), specimen J5 (incomplete left valve), J8 (incomplete bivalved specimen), J13 (incomplete right valve), J15 (incomplete left valve), J16 (fragmentary valve) all from unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian)

DISCUSSION: these platyceramid specimens are somewhat poorly preserved but show the following characteristics: large inoceramids (WA > 150 mm), with clearly developed sub-circular to sub-quadratic commarginal plications but parts of the plications near the posterior margin straight; plications are relatively far apart and the distance between them increases rapidly: 20-30 mm: 3.5 mm; 30-50 mm: 6 mm; 50-70 mm: 9 mm; 70-90: 10-12 mm. At WA > 100 mm, the plications are poorly developed and irregular, giving the shell a flat aspect. On well preserved specimens with shell, numerous lineae are seen and they cross the plications - typical 'Anwachs-Schnittreifen'. Several plications, especially on the older part of the valves, intercalate. These specimens have characteristics of *Platyceramus adversus* (RIEDEL) as described by SEITZ (1967), but not all can be checked and therefore the identification has to remain tentative.

Platyceramus alaeformis (ZEKELI, 1852)
(Pl. 5, Figs. 2 & 4, Text-fig. 10 a, b)

* . 1852 *Inoceramus Cripsi* var. *alaeformis* - ZEKELI, p. 102, pl. 1, fig. 3.
. 1866 *Inoceramus Cripsi* Mant. var. *alaeformis* Zekeli - ZITTEL, p. 97, pl. 14, fig. 5.
non 1942 *Inoceramus alaeformis* Zekeli - TSAGARELI, p. 118, pl. 2, fig. 4 [= *Trochoceramus* ex gr. *nahorianensis* (KOCIUBYNSKIJ, 1968)].
? 1949 *Inoceramus alaeformis* Zekeli- TSAGARELI, p. 194.
? 1956 *Inoceramus gandjaensis* - M. ALIEV, p. 463, pl. 1, figs. 1, 2; pl. 2, fig. 1.
non 1959 *Inoceramus alaeformis* Zekeli - DOBROV & PAVLOVA, p. 154, pl. 18, fig. 1 [= *Trochoceramus* ex. gr. *nahorianensis* (KOCIUBYNSKIJ, 1968)].

? 1963 *Inoceramus* cf. *alaeformis* Zek. - GAMBASHIDZE, p. 169, pl. 2, fig. 2.

v . 1978 *Inoceramus (Platyceramus)* aff. *alaeformis* Zek. - SORNAY & BILOTTE, p. 30, pl. 1, figs. 1, 3.

? 1986 *Inoceramus (Platyceramus)* aff. *alaeformis* - LOPEZ, p. 237, pl. 1, fig. 12.

? 1988 *Inoceramus gandjaensis* M. Aliev - ALIEV & KHARITONOV in ALI-ZADE *et al.*, p. 265, pl. 18, fig. 2; pl. 19, fig. 2;

non 1988 *Inoceramus alaeformis* Zekeli - ALIEV & KHARITONOV in ALI-ZADE *et al.*, p. 262, pl. 16, figs. 1-3 [= *Trochoceramus* ex. gr. *nahorianensis* (KOCIUBYNSKIJ, 1968)]

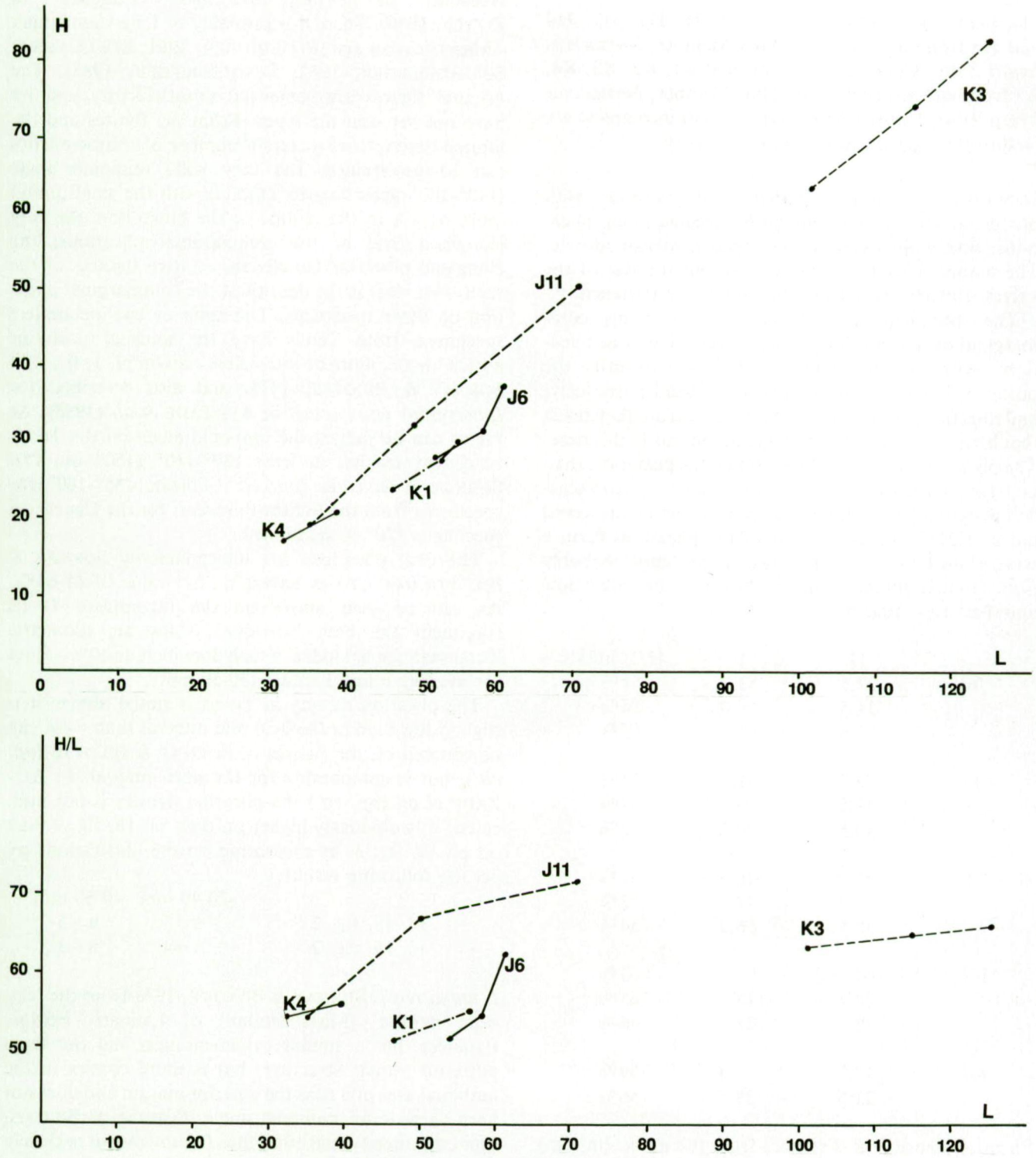


Fig. 10 — *Platyceramus alaeformis:* ontogenetic graphs; 10 a: H versus L (in mm); 10 b: H/L (in %) versus L (in mm).

LECTOTYPE: specimen figured by ZEKELI (pl. 1, fig. 3) (designated herein).

LOCUS TYPICUS: "Gegend von Wiener Neustadt", Austria.

STRATUM TYPICUM: Upper Campanian-Lower Maastrichtian.

MATERIAL FROM TERCIS: specimens J6, J11, J12, J14 and J18 from unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian) and K1, K2, K3, K4, K5 from unit K (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian) though incomplete are tentatively assigned to the Austrian species.

DESCRIPTION: large, flattened inoceramid with numerous closely set, elongated commarginal plications, and with a clearly developed posterior auricle. The umbonal area is feebly convex but the rest of the valves, further away from the umbo, are flattened.

The specimens from Tercis show a strong commarginal ornamentation of closely set, numerous plications separated by wider interspaces; towards the posterior hinge margin the plications bend posteriorly, and thus there seem to be straight; just before they reach that hinge margin, they bend again, anteriorly this time. The plications are more closely set on the posterior, than on the anterior side of the valve. "Anwachs-Schnittreifen" can clearly be seen on better preserved parts of J11. The major part of the plications form a wide elongated half-ellipse, which becomes probably more circular allometrically as shown by the data below and Text-figs. 10a, b:

	H	L	H/L in %
J6	27.5	53.2	51 %
	31.5	58.0	54 %
	37.8	60.8	62 %
J11	19.2	35.0	54 %
	33.5	50.0	67 %
	50.5	70.5	72 %
K1	23.9	46.5	51 %
	27.3	52	53 %
	30.5	56.2	54 %
K3	64	101	63 %
	74.5	115	65 %
	83	125	66 %
K4	17.2	31.8	54 %
	21.5	38.5	56 %

Plication density: at distances from the umbo (in mm) distances between ribs (also in mm) and number of plications in the intervals (n):

0-20	n	20-40	n	40-60	n	60-80	n	80-100	n	
2.5	>8	4	5	5.5	4	6	3-4	6	3	J6
2	9	3	6	4.5	5	—	—	—	—	J11
2	9	3	6	4	5	—	—	—	—	K1

AA = 135° (K4), 150° (K5)

DISCUSSION: *Platyceramus alaeformis* was originally described from eastern Austria ("Gegend von Wiener Neustadt" in ZEKELI, 1852 and "Grünbach" in ZITTEL, 1866). There it is probably of Late Campanian - Maastrichtian age (PLÖCHINGER, 1961; KOLLMANN & SUMMESBERGER, 1982; SUMMESBERGER, 1985). The original figures are somewhat unsatisfactory and we have not yet seen the types. From the figures and the limited descriptions a certain number of characteristics can be ascertained: the very wide umbonal angle (140°-160° according to ZEKELI) with the small umbo more or less in the middle of the hinge line; the very elongated oval of the commarginal plications; the elongated posterior auricle; the relative flatness of the shell. Not clear is the density of the commarginal plication on those specimens. The more or less incomplete specimens from Tercis have the unusual posterior auricle shape, more or less visible also on pl. 1, fig. 1 in SORNAY & BILOTTE, 1978, and also described for *Inoceramus gandjaensis* in ALI-ZADE *et al.* (1988). As far as can be judged the umbonal angle on the Tercis specimens reaches at least 130°-140° (150° on K5); SORNAY & BILOTTE (*op. cit.*) indicate 155°-160° for specimens from the Petites-Pyrénées; for the Caucasian specimens 120° is mentioned.

The oval plications are interpreted by SORNAY & BILOTTE (*op. cit.*) as having an h/l value of 61-63 %. As can be seen above on the incomplete Tercis specimens the best individuals show an allometric increase in the h/l index, which does include 60 % values for average h and l values (30-50 mm).

The plication density in Tercis is stated above; it is slightly less high in the 0-20 mm interval than what can be counted on the figures of SORNAY & BILOTTE (*op. cit.*), but is comparable for the next interval. In ALI-ZADE *et al.* (*op. cit.*) the plication density is not indicated; it is obviously higher on their pl. 18, fig. 2 than on pl. 19, fig. 2; by measuring on the illustrations we get the following results:

	20-40 mm	40-60 mm
pl. 18, fig. 2	n = 5	n = 5
pl. 19, fig. 2	n = 4	n = 3

I. launartensis SORNAY & BILOTTE, 1978 from the 'calcaire nankin' (Maastrichtian) of Launart, Petites-Pyrénées, has a similar ornamentation ànd the same posterior auricle structure, but is more convex in the umbonal area and near the anterior margin and does not have as wide an umbonal angle. SORNAY & BILOTTE (*op. cit.*) already suggested that *I. launartensis* is closely related to *I. gandjaensis* M. ALIEV, 1956. To know the exact relationship between *Platyceramus alaeformis* and

the taxon *Inoceramus gandjaensis* it would be necessary to study a wider series of specimens from both taxa. We have at this moment no idea of the precise variability of the umbonal angles of inoceramid species.

In Eastern European palaeontological literature *I. alaeformis* is always interpreted (also in PERGAMENT, 1978, p. 170, text-fig. 39) as being what we herein interpret as a *Trochoceramus*, and probably better placed in *T. nahorianensis* KOCIUBYNSKIJ (see below). The origin of this erroneous interpretation I think goes back to TSAGARELI (1942), but I cannot be certain because the text is in Georgian.

STRATIGRAPHIC DISTRIBUTION: uppermost Campanian-Lower Maastrichtian in the Vienna Basin (Austria), Lower Maastrichtian in the Petites-Pyrénées (S. France), Upper Campanian in Tercis (Landes, S. France),? Upper Campanian in the Spanish Pre-Pyrenees,? Lower Maastrichtian in the Caucasus.

Platyceramus cf. *alaeformis* (ZEKELI, 1852)

Two incomplete large specimens (K8 and K9, unit K Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian), showing well-preserved interior plications but no umbones, are tentatively assigned to *Platyceramus* cf. *alaeformis*. The commarginal plications are elongate in the parts nearest to the umbo but become more circular towards the ventral margin. They are covered with "Anwachs-Schnittreifen". The plication density clearly decreases towards the pallial margin and the oldest shell parts (near the ventral margin) are seemingly smooth, but still covered with numerous lineae. Though there is no definite proof that these specimens belong to *Pl. alaeformis*, there is a reasonable chance that they do. What we describe is a later shell-stage than that normally encountered which is comparable to that known for other *Platyceramus* species, f.i. in SEITZ (1961, 1967).

Platyceramus cf. *artigesi* (SORNAY, 1976)
(Pl. 5, fig. 5; Text-fig. 11 a, b)

v * 1976 *Inoceramus (Platyceramus) artigesi* nov. sp. - SORNAY, p. 3, pl. 1, figs. 1, 2; text-fig. 3.

HOLOTYPE: Institut de Paléontologie, Muséum national d'Histoire naturelle, Paris (Figured SORNAY, 1976, pl. 1, fig. 1).

LOCUS TYPICUS: Dau (Charente-Maritime, France).

STRATUM TYPICUM: Upper Campanian.

MATERIAL FROM TERCIS: specimens H19 and H20 (bivalved) from unit H (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian), specimen J3 (somewhat deformed left valve, steinkern-composite mould preservation) from unit J (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian), specimens K6 (left valve), K7 (right valve) and K10 (right valve) from unit K (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian).

DESCRIPTION: medium to large-sized inoceramid, with flattened valves with clearly developed oval commarginal plications; plications are sometimes irregular and with intercalations; plications and interplications are covered with very many lineae (where the shell is preserved).

H19: D = 13, angle $\alpha = 120°$, angle $\beta = 120°$, angle $\gamma = 60°$;
J3: D = 13; angle $\alpha = 110°$; angle $\beta = 130°$; angle $\gamma = 50°$;
K10: D = 12; angle $\alpha = 145°$; angle $\beta = 110°$; angle $\gamma = 60°$.

DIMENSIONS (in mm):

H19

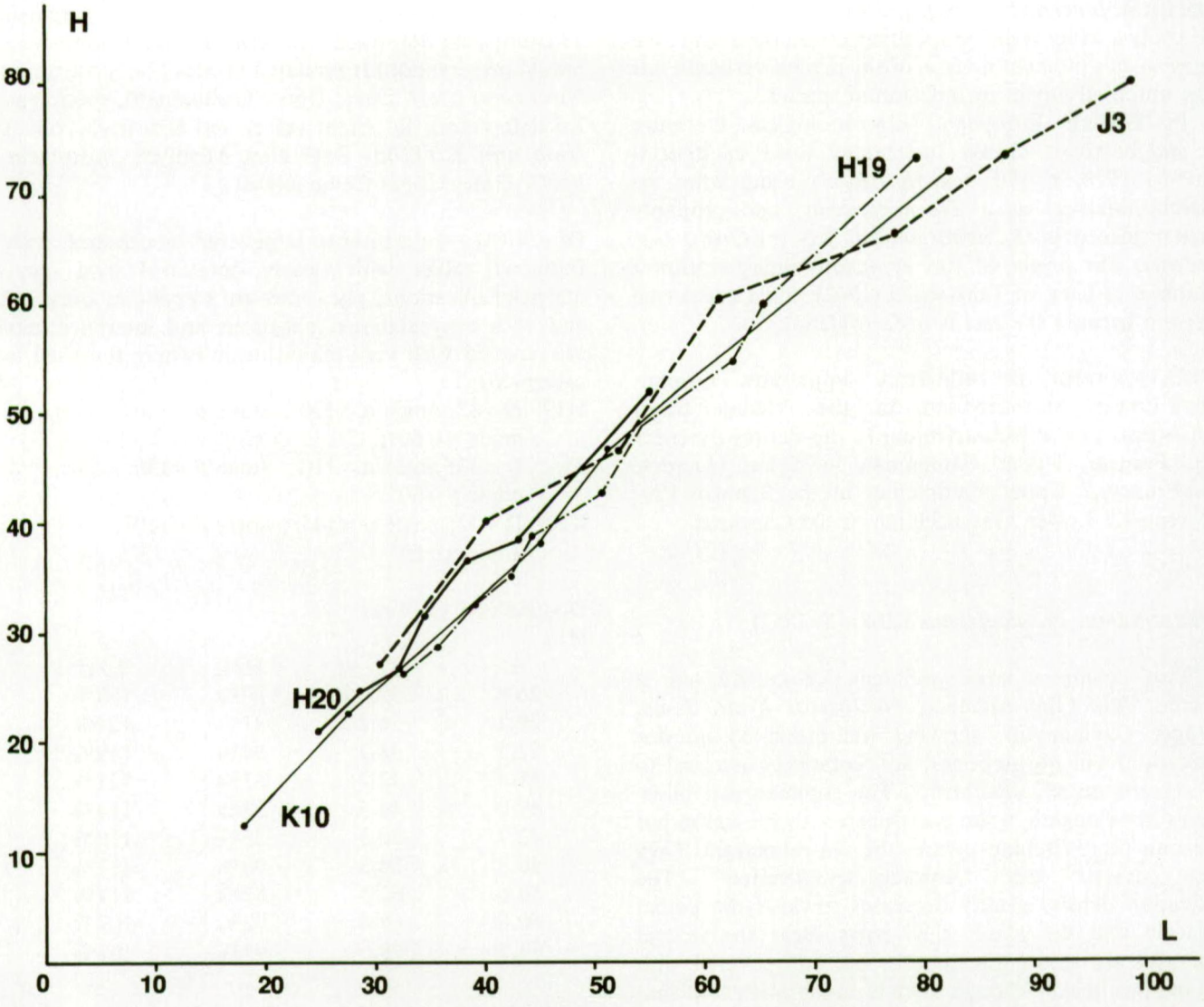
H	L	H/L	L/H
26.0	32.6	80%	125%
29.2	36.2	81%	124%
32.5	38.7	84%	119%
35.4	42.7	83%	121%
39.0	44.5	88%	114%
42.7	50.3	85%	118%
48.8	54.5	90%	117%
54.6	62.5	87%	114%
60.0	65.4	92%	109%
73.5	79.0	93%	107%

H20

H	L	H/L	L/H
20.8	24.8	84 %	119%
23.8	28.5	83.5%	120%
26.5	31.9	83.5%	120%
31.3	34.4	91 %	110%
36.3	37.8	96 %	104%
38.5	43.2	89 %	112%
51.8	55.2	94 %	107%

J3

H	L	H/L	L/H
22	>25	-	-
27	30.4	89%	113%
31.2	33.5	93%	107%
40	40	100%	100%
46.5	52.5	89%	113%
55	57.5	96%	105%
60.5	66.5	91%	110%
63.5	70.5	90%	110%
66.5	77.5	86%	117%
73.5	87.5	84%	119%
76.5	(96.5)	—	—
85	98.5	86%	116%



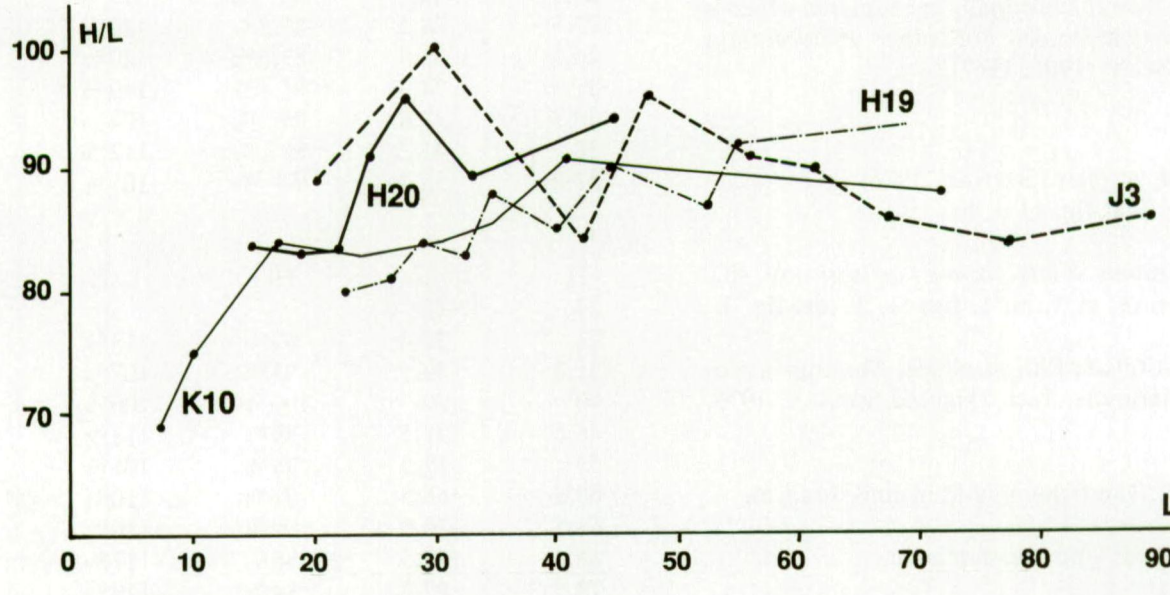


Fig. 11 — *Platyceramus artigesi:* ontogenetic graphs; 11 a: H versus L (in mm); 11 b: H/L (in %) versus L (in mm).

K10

H	L	H/L	L/H
12.3	17.8	69%	144%
15.2	20.2	75%	133%
22.8	27.2	84%	119%
28.3	34.0	83%	120%
34.1	40.5	84%	119%
38.8	44.8	86%	115%
46.6	50.9	91%	109%
53.0	58.7	90%	111%
72.2	82.0	88%	114%

DISCUSSION: The specimens from Tercis are not very well preserved: J3 is flattened and also otherwise somewhat deformed; K6 and K7 are fairly worn, and as a result not all the ribs are visible; K10 is a good steinkern which is very close to the specimens figured by SORNAY (1976, pl. 1, fig. 2: i.e. specimen JS2) for the angles and general shape.

Inoceramus artigesi was originally described by SORNAY (1976) from Dau (Charente-Maritime) in what is stated as "Campanien supérieur terminal" and from other somewhat older Upper Campanian outcrops, and from the "Maestrichtien de la falaise de Royan"; it is also present in Haldem, Westphalia (*fide* SORNAY, 1976).

In the same description SORNAY (*op. cit.*) stated that *I. artigesi* has obvious characteristics in common with *I. planus* GOLDFUSS (1835, p. 117, pl. 60. 113, figs. 1a, b, from Haldem, Upper Campanian, and also from southern France!), re-described and figured in GIERS (1964, p. 246, pl. 3, fig. 2). Both taxa are certainly very close, but very few certain *I. planus* specimens have been recognised, and relatively few data have been published on them (see also p. 217). Since specimens of *I. artigesi* from southern France are, as stated by SORNAY (*op. cit.*), slightly larger (at least the holotype is) than those known so far of *I. planus*, I have herein preferred to use the name introduced by SORNAY for the large and relatively flat specimens from Tercis - not showing the fold visible on the holotype. A smaller specimen from Tercis, with strongly developed commarginal plications has been assigned to *I.* aff. *planus* (see p. 217).

It is not impossible that the poorly known taxon *I. gandjaensis* M. ALIEV, 1956 described originally from the uppermost Lower Campanian of the Caucasus, represents the same taxon, but not having seen the types it is difficult to understand its exact significance.

Selenoceramus sornayi n. nov. (=*I. regularis* d'ORBIGNY, non *regularis* MÜNSTER, 1840; see below, p. 236) though at first glance similar, has a more convex young stage, plications which are more subcircular, and an older stage which forms a clear angle with the closely plicated initial stage.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian. (Lower Maastrichtian *sensu* ABRARD, 1924, SÉRONIE-VIVIEN, 1972)

GEOGRAPHIC DISTRIBUTION: SW France,? Westphalia (Germany),? Caucasus (Azerbaidzhan).

Platyceramus* aff. *cycloides (WEGNER, 1905) sensu SEITZ, 1970
(Pl. 5, fig. 3; Text-fig. 12 a, b)

v. 1970 *I.* (*Platyceramus*) aff. *cycloides* Wegner - SEITZ, p. 129, pl. 23, fig. 2, pl. 28, fig. 1.
v? 1978 *Inoceramus* (*Platyceramus*) aff. *cycloides* Wegner - SORNAY & BILOTTE, p. 31, pl. 1, fig. 2; pl. 2, fig. 2.

MATERIAL FROM TERCIS: specimen G14 (right valve, incomplete in the umbonal area, worn) from unit G, (top 1/4, Tercis Marly Member, Upper Campanian); specimen G15 (left valve, steinkern) from unit G, (Tercis Marly Member, Upper Campanian). Tentatively also G16 and G17 (incomplete bivalved specimens showing the two stages), from unit G, top 1/4, Tercis Marly Member, Upper Campanian).

DIAGNOSIS: medium to large-sized platyceramid, with fairly convex umbonal region.

DIMENSIONS (in mm):

G14

H (mm)	L (mm)	L/H (%)	H/L (%)
28.6	41.2	144	69
40.5	57.0	141	71
53.0	70.0	132	76
55.0	75.0	136	73
72.0	93.5	130	77
80.0	97.5	122	82

30-50 mm: 6 mm; 50 - mm: 7.5 mm; AA = 150°.

G15

H (mm)	L (mm)	L/H (%)	H/L (%)
20.2	27.2	135	74
24.2	30.0	125	81
28.2	35.2	125	80
34.7	41.5	120	84
37.8	48.2	128	78
40.7	54.2	133	75
48.2	62.3	129	77
57.2	68.2	119	84

0-30 mm: 2.5 mm; 30-50 mm: 4.25 mm; 50-60 mm: 6.25 mm; AA = 130°.

DISCUSSION: The specimens from Tercis seem to be very close to *Platyceramus* aff. *cycloides* as understood by SEITZ (1970), which represents specimens which are close but not totally conspecific with *Pl. cycloides* (WEGNER, 1905) as explained in SEITZ, 1970. The commarginal plications on the Tercis specimens assigned to

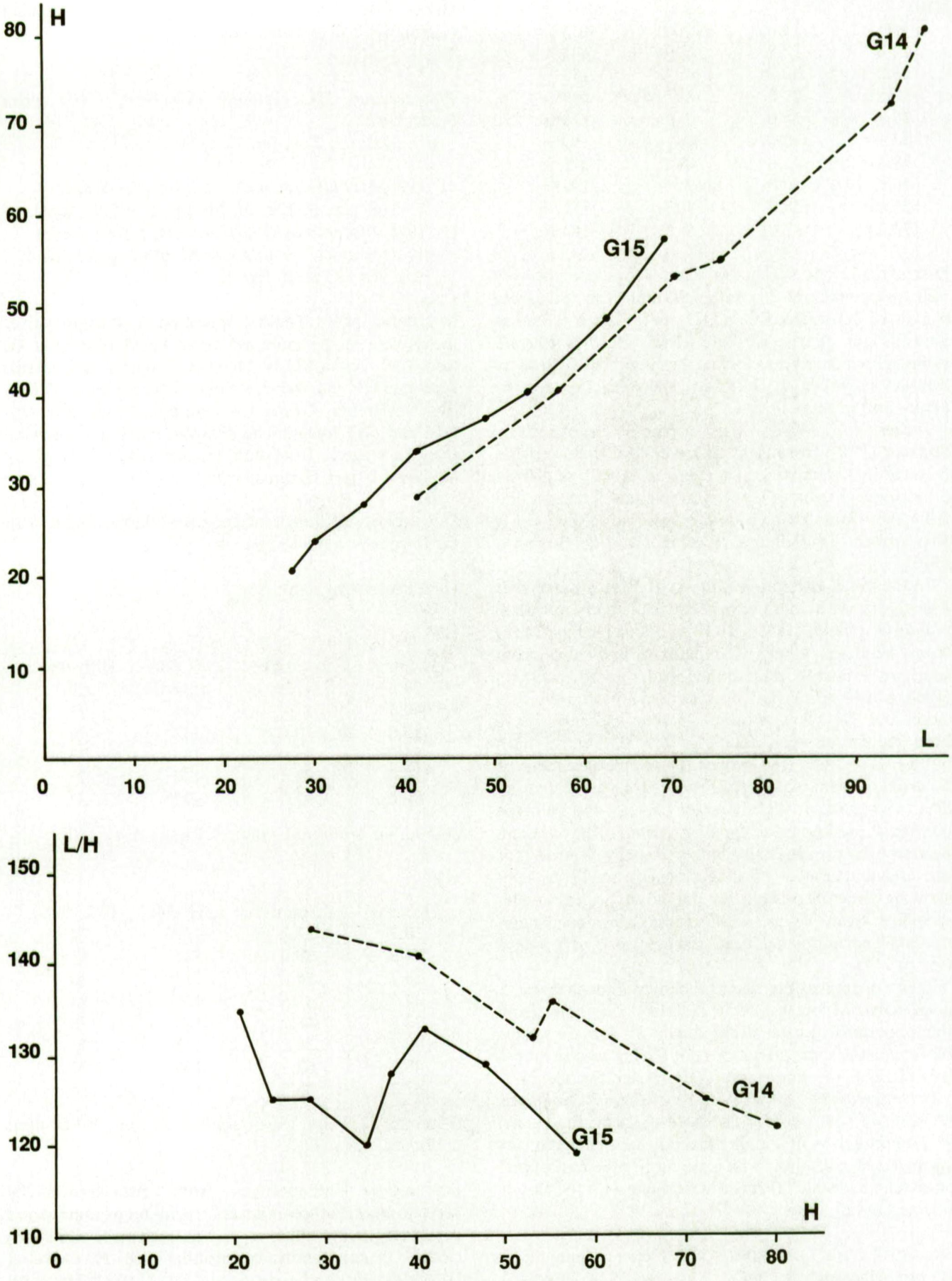


Fig. 12 — *Platyceramus* aff. *cycloides:* ontogenetic graphs; 12 a: H versus L (in mm); 12 b: L/H (in %) versus H (in mm).

Pl. aff. *cycloides* have a shape which is elongate in young stages and subcircular in older stages. The change in angle γ described by SEITZ (*op. cit.*) illustrates the same aspect.

The specimens described by SORNAY & BILOTTE (1978) from the Spanish Pre-Pyrenees are similar with those from Austria and from Tercis.

Compared with other *Platyceramus* taxa described from Tercis *Pl.* aff. *cycloides* is a little more convex in the umbonal region.

As stated by SEITZ (1967, 1970) and by TRÖGER (1989) *Platyceramus cycloides* is generally considered as Santonian - Lower Campanian. Nevertheless *Pl.* aff. *cycloides* is recorded as being in Upper Campanian - Maastrichtian (SEITZ, 1970, p. 136). In strata of eastern Europe [described as *Inoceramus regularis* auctorum (non d'ORBIGNY), see below p. 236] and in North Africa (unpublished personal research) a closely related taxon exists.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian - Maastrichtian.

GEOGRAPHIC DISTRIBUTION: Austria, NE Spain, SW France.

Genus ***Selenoceramus*** HEINZ, 1932, sensu SEITZ, 1967
Type species *Inoceramus selenae* SEITZ, 1967

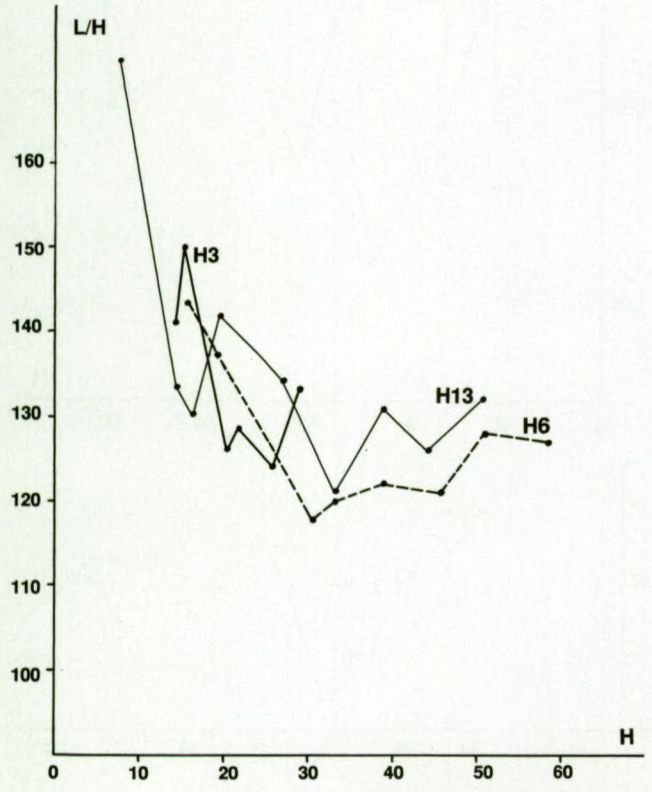


Fig. 13 — *Selenoceramus* cf. *inflexus:* ontogenetic graph, L/H (in %) versus H (in mm).

Selenoceramus* cf. *inflexus (BEYENBURG, 1936)
(Pl. 6, fig. 2 a-c; Text-fig. 13)

* 1936 *Endocostea inflexa* n. sp. - BEYENBURG, p. 295, pl. 11, figs. 1 - 3; pl. 12, figs. 1, 3.
. 1967 *Inoceramus* (*Selenoceramus*) *inflexus* Beyenburg - SEITZ, p. 98, pl. 12, fig. 5; pl. 19, figs. 3, 4; pl. 20, figs. 1, 3; text-figs. 4; 18.

MATERIAL FROM TERCIS: specimens H3 (right valve, partial shell preservation), H6 (left valve, with partially preserved hinge), H13 (right valve), H18 (left valve, deformed and right valve, incomplete), H24, H25 (incomplete right valves), H26 (incomplete right valve, with "Hohlkehle"),? H27 (incomplete left valve) from unit H (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian).

DESCRIPTION: small to medium-sized subequivalve inoceramid with small almost anteriorly placed umbo, long hinge margin, elongated to subquadrate sharp plications, somewhat irregular, especially on older shell stages; fold between young and old stages is important but not sudden; some valves with "Hohlkehle".

DIMENSIONS:

H13

H (mm)	L (mm)	L/H (%)
7.5	12.5	167
13.5	17.9	133
16.8	21.5	130
19.2	27.2	142
23.5	32.6	138
27	36.2	134
33.1	40.0	121
39.2	51.3	131
44.2	55.5	126
50.5	66.8	132

Density of plications: distance between individual plications at different distances from umbo (in mm)

	0-20	20-40	40-60	>60
H3	2.5-3	4.5	—	—
H6	2.5	4.5-5	—	8.5
H13	2-2.5	3.5-4.5	7.5	9
H18	2.5-3	3.5-5	5-6.5	—
H24	2.2	3.5	6.5	—
H25	—	3.5-4.5	6.5-7.5	—
H26	—	3.5-4.5	4.5	5.5

DISCUSSION: The best preserved specimens have strong and sharp plications, which seem to be fairly frequent also on older shell parts, in contradiction to what can be seen on *Selenoceramus inaequabilis* (SEITZ, 1967, p. 111) from the Santonian of Westphalia and on *S. sornayi* nom. nov. (see p. 236). The plications of *S. inflexus* are less elliptical than on *S. inaequabilis*, and

less rounded than on *S. sornayi*. It must be stressed however that a comparative statistical analysis of these taxa has never been undertaken, nor do we know to what extent the different plication shapes have been influenced by deformation. The distance between the plications (plication density) is comparable in the Tercis specimens of *S.* cf. *inflexus* with that of the specimens described by SEITZ from Westphalia. The coeval and co-occurring taxon *S. selenae* (SEITZ, 1967) differs by its somewhat more widely spaced plications. However it seems plausible that detailed statistical analysis might prove *S. inflexus* and *S. selenae* to be conspecific. *S. ghadamesensis* (TRÖGER & RÖHLICH, 1981) from the Lower Maastrichtian of W. Libya has a more protruding and more anteriorly situated umbo. The young stages of the Libyan taxon are smaller, but this is probably due to environmental factors according to TRÖGER & RÖHLICH, 1981.

STRATIGRAPHIC DISTRIBUTION: SEITZ: "*patootensiformis*-Schichten", Lower Campanian; TRÖGER (1989): uppermost Santonian - lowermost Campanian; in Tercis: Upper Campanian.

GEOGRAPHIC DISTRIBUTION: NW Germany,? SW France.

***Selenoceramus sornayi* nomen novum**
(Pl. 6, Fig. 3, Pl. 7, Figs. 2 & 5; Text-fig. 14 a, b)

v. 1847 *Inoceramus regularis,* d'Orbigny - d'ORBIGNY, p. 516, pl. 410, figs. 1, 2. (non 1840 *Inoceramus regularis* MÜNSTER, Beiträge zur Petrefactenkunde 3, p. 48, *fide* SHERBORN, 1930).
v (1850) *Inoceramus regularis,* d'Orb. - d'ORBIGNY, p. 250.
1931 *Inoceramus regularis* d'Orb. - RIEDEL, p. 663.
v. 1962 *Inoceramus regularis* d'Orbigny - SORNAY, p. 120, text-fig. 1C, pl. 7 (sic), fig. 3.
? 1964 *Inoceramus* cf. *regularis* d'Orbigny - GIERS, p. 247, pl. 3, figs. 3, 4.
? 1967 *Inoceramus* (*Selenoceramus*) *gladbeckensis* n. sp. - SEITZ, p. 102, pl. 14, figs. 1 - 4; pl. 15, figs. 1 - 7; text-fig. 19 - 22.
v. 1976 *Inoceramus regularis* d'Orbigny - SORNAY, p. 7, text-fig. 4, pl. 2, fig. 3, 4, pl. 3, figs. 3, 4.
? 1979 *Inoceramus regularis* Orbigny - IVANNIKOV, p. 71, pl. 22, figs. 2, 3.

NOMENCLATIVE NOTE: *Inoceramus regularis* d'ORBIGNY was a homonym at the time of its introduction, since MÜNSTER had already used the name in 1840 (according to SHERBORN, 1930). If it could be demonstrated that *I.* (*Selenoceramus*) *gladbeckensis* SEITZ, 1967 is conspecific with *I. regularis* d'ORBIGNY non MÜNSTER (which I think possible, but cannot prove at present), then the species name *gladbeckensis* SEITZ could be used. Until then it seems better to rename the d'ORBIGNY taxon.

DERIVATIO NOMINIS: in honour of Jacques SORNAY who has devoted so much energy and good sense to Cretaceous inoceramids, particularly from France and Africa.

LECTOTYPE: d'ORBIGNY 7594 (R 6788) in the Institut de Paléontologie, Muséum national d'Histoire naturelle in Paris (designated by SORNAY, 1962).

LOCUS TYPICUS, STRATUM TYPICUM: Royan (Charente Maritime, France); "Sénonien supérieur" (there is no precise indication as to where the specimen of d'ORBIGNY was found; its age in the area around

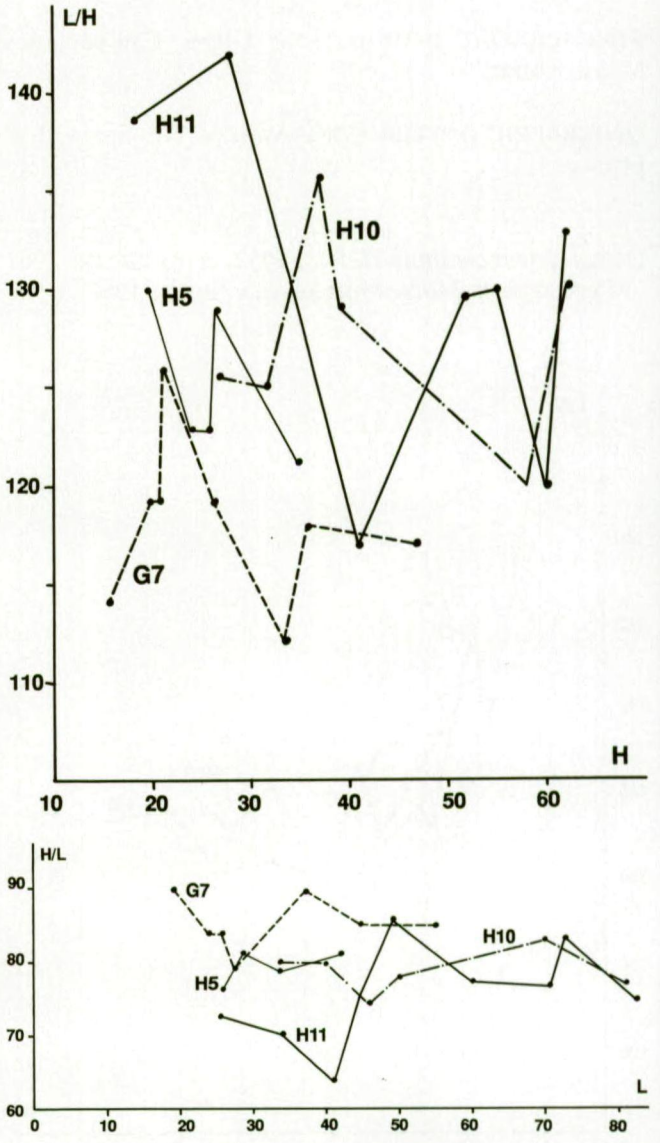


Fig. 14 — *Selenoceramus sornayi:* ontogenetic graphs; 14 a: L/H (in %) versus H (in mm); 14 b: H/L (in %) versus L (in mm).

Royan could be as low as mid-Campanian or as high as?lowermost Maastrichtian, and could only be checked with a micropalaeontological analysis of the matrix of the specimen).

MATERIAL FROM TERCIS: specimen G7 (left valve) from unit G (quarter top) (Tercis Marly Member, Upper Campanian); specimen H31 (left valve), specimen H4 (interior mould of right valve), specimen H5 (incomplete left valve, composite mould), specimen H10 (right valve, composite mould with very partial shell preservation), specimen H11 (incomplete 69. bivalved specimen), specimen H31 (right valve), specimen H34 (right valve) from unit H (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian), and specimen R6818 (=d'ORBIGNY collection 7594D-1) from the collections of the Paris Muséum.

DIAGNOSIS: Medium-sized *Selenoceramus* species with almost circular commarginal plications on the young stages.

DESCRIPTION: Medium to large-sized inoceramid with lightly convex young stages, covered with regular, narrow, more or less equidistant, subcircular commarginal plications. Hinge margin long. The umbo is not totally anteriorly placed because the anterior margin is strongly recurved.

The young stage is relatively extensive, compared to those of other *Selenoceramus species*.

The older stage begins with a typical selenoceramid fold - which is not abrupt in *S. sornayi*, and is also covered with subcircular ribs, however further apart than on the young shell stages.

DIMENSIONS:

R6788 (d'ORBIGNY 7594), lectotype

H (mm)	L (mm)	L/H (%)	H/L (%)
20.5	23.5	115	87
22.3	25.5	114	87
26.2	30.0	115	87
29.8	36.2	121	82
34.8	42.3	122	82
36.7	44.2	120	83
47.1	55.5	118	85
48.8	58.7	120	83

R6810 (d'ORBIGNY 7594D-1) from Tercis

12.8	16.2	126	79
18.3	21	115	87
22.3	26.4	118	84
25.5	29.5	116	86
28.2	31.5	112	89
31.3	34.8	111	90
35.4	42.5	120	83
39.4	45.0	114	87.5
42.5	53.9	127	79
44.1	55.5	126	79.5

G7

H (mm)	L (mm)	L/H (%)	H/L
13.2	(13)	—	—
17.3	19.7	114	90
20.3	24.2	119	84
21.5	25.6	119	84
21.8	27.5	126	79
25.1	30.3	121	84
26.7	31.9	119	84
33.3	37.2	112	89.5
36.2	42.8	118	85
46.8	54.7	117	85

plication density [average distance between two plications at different distances (in mm) from the umbo]: O-30 mm: 2.5 mm; 30-40 mm: 3.5 mm; 43 mm -pallial margin: 8.5 - 10.5 mm.

DISCUSSION: I mainly follow the interpretation of SORNAY (1962, 1976) for the understanding of *Inoceramus regularis* d'ORBIGNY non MÜNSTER. I would like to add that the strong angle between the young and older stage, which has been described by SORNAY (1962), has never been illustrated, neither by d'ORBIGNY nor by him. This and the extensive young stage with its subcircular commarginal plications are probably the origin for the usage in literature of a concept "*Inoceramus regularis*" auctorum which represents undoubtedly a *Platyceramus* species, of the *Pl. cycloides* (WEGNER, 1905) group (see also p. 235).

The identity of *I. regularis* d'ORBIGNY with *Selenoceramus gladbeckensis* (SEITZ, 1967) has not been recognized definitely previously, but implicitly SEITZ (1967, p. 108, pl. 16, fig. 3) indicated it: he discussed a cast of a specimen 7594D Coll. d'ORBIGNY, from Tercis and assigned it to *I.* (*Selenoceramus*) cf. *gladbeckensis*. In the same publication SEITZ (*op. cit.*) stated that the lectotype of *I. regularis* figured by SORNAY (1962) had a different "Kurvenverlauf", and is closer to *Endocostea baltica*. After seeing the lectotype and measuring it I cannot agree with this interpretation of SEITZ. As can be seen clearly in SORNAY (1962, pl. 7, fig. 3) the lectotype of *I. regularis* d'ORBIGNY (=*Selenoceramus sornayi* nom. nov.) has subcircular commarginal plications (see also Text-figure 15a); on *E. baltica* the plications are elongate by definition [among the subspecies of GIERS, 1964 only *I. balticus beckumensis* (p. 241, pl. 2, fig. 1) has subcircular plications and GIERS stated he was not certain of the origin of that taxon]. Therefore the only argument which seems to remain valid for differentiating the two taxa is the different size of their initial stage. According to SEITZ (*op. cit.*) the initial stage of *I. gladbeckensis* is smaller than that of *I. regularis* d'ORBIGNY. However, the specimens G7, H2, H31, H34 from Tercis also have a small initial stage, as is illustrated for *I. gladbeckensis* in SEITZ (1967, pl. 14, pl. 15). The possibility that *I. gladbeckensis* and *I. sornayi* (= *I. regularis* d'ORBIGNY

non MÜNSTER) are synonymous, is real, but until I have been able to study the specimens of SEITZ I cannot draw definite conclusions.

The lectotype of *Selenoceramus sornayi* nom. nov. could come from strata of mid-Campanian - latest Campanian (? Maastrichtian) age. In Tercis *S. sornayi* probably is very high Upper Campanian. According to SEITZ (1967) *S. gladbeckensis* is limited to the mid-Santonian. However in the lowermost Campanian (Hervian at Croix Polinard, Liège, Belgium) the taxon is also present (identification J. SORNAY, 1981).

Also *I. agraphanicus* IVANNIKOV, 1979 from the Upper Campanian of the Donbass (The Ukraine) might refer to poorly preserved specimens of the same taxon.

GEOGRAPHIC DISTRIBUTION: SW France, Germany (Westphalia), Belgium, ? Crimea, ? Donbass (The Ukraine).

***Selenoceramus* sp.**

Specimens from Tercis: among the material from unit H (Tercis Marly Member, *Nostoceras hyatti* Zone, Upper Campanian) several specimens are too deformed or relatively incomplete to be assigned even tentatively to a species, yet represent probably the same taxon and are placed in the genus *Selenoceramus:*

— specimen H1 (right valve; L: 83.5 mm; H: 60.8 mm; unit H: 4 m above base);
— specimen H7 [right valve; L: 95.5 mm; H: (83 mm)];
— specimen H8 [right valve; L (62 mm)];
— specimen H9 [right valve; H (115 mm); L (130 mm)];
— specimen H15 [right valve; H (120 mm)];
— specimen H28 [bivalved specimen, L (58.5 mm)];
— specimen H35 [right valve; L (95 mm)];
— specimen H36 (right valve);
— specimen H37 [right valve; L (65 mm)].

All these specimens show the following characteristics: large initial stage with oval elongated plications; steep fold with older stage with commarginal plications which are fewer and further apart; old and initial stage make an angle of about 110°.

Genus ***Trochoceramus*** HEINZ, 1932

Type species *Trochoceramus helveticus* HEINZ, 1932 (O.D.)

Trochoceramus is a genus with an interesting distribution: species belonging to the genus are known to occur commonly from Upper Campanian - Maastrichtian Tethyan strata in Africa (Algeria, Tunisia, Libya, Egypt, Nigeria, Senegal, ? Angola, Somalia, Madagascar, S. Africa) and S. Europe (Spain, Bulgaria, Crimea, Caucasus) (DHONDT *et al*, 1985; DHONDT, 1992). It has also been recorded from S. America (ETAYO-SERNA, 1985) and from Texas (STEPHENSON, 1941, pl. 13, fig. 3, sub *Inoceramus vanuxemi* Meek and Hayden?, from the Nacatoch Sands at Corsicana, Navarro County). Further it is known from several localities in western and central Europe in strata of Maastrichtian age which represent shallow water environments [Cotentin (France, Calcaire à baculites), near Aachen (Germany) and Nagoryani near Lwow (W. Ukraine)].

Trochoceramus nahorianensis (KOCIUBYNSKIJ, 1968)
pl. 7, Fig. 4; Text-fig. 15 a, b)

v. 1866 *Inoceramus latus* Mant. - ZITTEL, p. 100, pl. 13, fig. 7.
v. 1958 *Inoceramus zitteli* n. sp. - KOCIUBYNSKIJ, p. 21, pl. 8, figs. 31, 32 (non *zitteli* PETRASCHECK, 1906).
. 1959 *Inoceramus alaeformis* Zekeli - DOBROV & PAVLOVA, p. 154, pl. 18, fig. 1 (non *alaeformis* ZEKELI, 1852)
p.p. 1959 *Inoceramus salisburgensis* Fugger et Kastner - DOBROV & PAVLOVA, p. 155, pl. 19, fig. 1 (non fig. 2).
? 1963 *Inoceramus latus* Mant. var. *zitteli* n. var. - TSAGARELI, p. 98, pl. 3, fig. 1.
v* 1968 *Inoceramus nahorianensis* Kociubynskij, sp. nov. - KOCIUBYNSKIJ *in* PASTERNAK *et al.*, p. 145, pl. 28, fig. 4.
? 1969 *Inoceramus zitteli* Kocjubinskij non Petr. - ANTUNES & SORNAY, p. 89, pl. 7, fig. 1.
v. 1970 *I.* (*Trochoceramus*) aff. *helveticus* Heinz - SEITZ, p. 114, pl. 15, fig. 1a, 1b.
v. 1970 *I.* (*Trochoceramus*) *zitteli* Kocj. (non Petr.) - SEITZ, p. 116, pl. 18, fig. 1.
. 1974 *Inoceramus nahorianensis* Kociubynskij - KOCIUBYNSKIJ & SAVCZINSKAJA *in* BLANK *et al.*, p. 85, pl. 23, figs. 3a, 3b.
? 1981 *Inoceramus nachorianensis* Kociubynskij - TZANKOV *in* TZANKOV *et al.*, p. 90, pl. 39, figs. 7, 8.
. 1988 *Inoceramus alaeformis* Zekeli - ALIEV & KHARITONOV *in* ALI-ZADE *et al.*, p. 262, pl. 16, figs. 1 - 3

LECTOTYPE: specimen NHMW 1965/640 figured by ZITTEL, 1866, pl. 13, fig. 7 (designated formally herein) (this specimen is mentioned by KOCIUBYNSKIJ, 1958, together with two specimens from near Lwow - but no type was chosen explicitly).

LOCUS TYPICUS: Maiersdorf, Hohe Wand, Niederösterreich, Austria.

STRATUM TYPICUM:? Maastrichtian.

MATERIAL FROM TERCIS: specimen O1 (fragment, with clear ornamentation) and specimen O3 (small left valve)

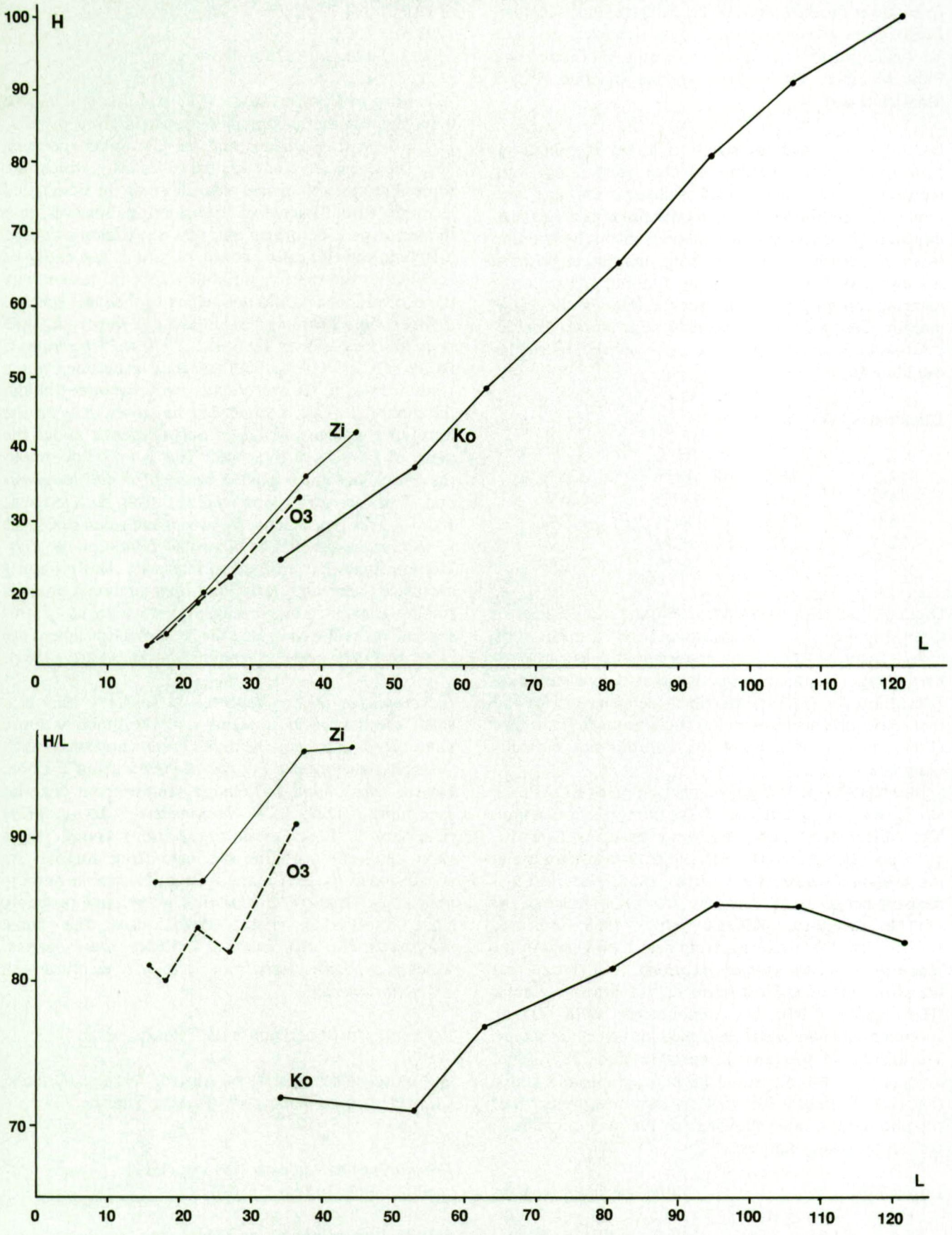


Fig. 15 — *Trochoceramus nahorianensis:* ontogenetic graphs; O3: specimen from Tercis, Ko: specimen from KOCIUBYNSKIJ (1958 & 1968); Zi: *Inoceramus latus* as described by ZITTEL (1866), lectotype of *T. nahorianensis*. 15 a: H versus L (in mm); 15 b: H/L (in %) versus L (in mm).

from lower third of unit O (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Maastrichtian); specimen V1 (incomplete? left valve) from unit V (Tercis Dark Flint Member, *Pachydiscus epiplectus* Zone, Upper Maastrichtian).

DESCRIPTION: medium sized to large, inequilateral, equivalve, flat inoceramid covered with a not very regular, narrow commarginal ornamentation, and with numerous radial riblets, which on steinkerns are as prominent as the commarginal plications themselves. Umbo small, just reaching above the hinge-margin, its position somewhat variable but generally at about 1/3 from the anterior margin, to about the middle of the hinge margin: this results in an unusually wide umbonal angle. "Anwachs-Schnittreifen" not seen on the specimens available to us.

DIMENSIONS O3 (in mm):

H	L	H/L	L/H
12.5	15.5	81%	124%
14.5	18.2	80%	126%
18.9	22.5	84%	119%
22.2	27.2	82%	123%
33.2	36.5	91%	110%

DISCUSSION: - KOCIUBYNSKIJ (1958) did not designate a type specimen for "*Inoceramus zitteli*" sp. n. (non *zitteli* PETRASCHECK; = *I. nahorianensis* KOCIUBYNSKIJ, 1968). He stated in his text that " in his opinion ZITTEL (under *I. latus*) described the same species and that therefore he gives it ZITTEL's name". TZANKOV (1981) mentioned a holotype, but did not formally designate it.

SEITZ (1970, p. 117) gave a translation of KOCIUBYNSKIJ's description but not of the complete discussion. The "differences" between *I. latus* sensu ZITTEL and *I. zitteli in* KOCIUBYNSKIJ, 1958 as SEITZ saw them are in the ***umbonal angle*** (140° versus 145°, *fide* SEITZ; I measure between 145° and 150° for the left valve of the ZITTEL specimen, KOCIUBYNSKIJ, 1968 indicated 150-155° for the specimens from near Lwow) and in the ***shape of the commarginal plications***. It is certain that the plications of *I. latus* sensu ZITTEL are sub-circular (H/L about 0.90), but undoubtedly both ZITTEL specimens are somewhat deformed in their older stages. The Ukrainian specimen (Lwow Museum 7337) is not deformed. SEITZ measured its photograph and stated that H/L is about 0.80; from my own measurements of the photograph, and allowing for the magnification, I get the following figures:

Lwow 7337			Zittel specimen (L.V.)		
H	L	H/L	H	L	H/L
24.5	34.2	72%	13.5	15.5	87%
37.6	53.0	71%	20	23	87%
48.2	62.6	77%	36.2	37.5	96%
66.2	82.1	81%	42.2	44	96%
81.5	94.7	86%			
91.5	106.2	86%			
100.3	120.9	83%			

According to KOCIUBYNSKIJ, 1968 H/L is about 0.75 to 0.80, but for the maximum dimensions given by him, H/L = 0.83. It is obvious that the Ukrainian specimen has, on average, commarginal plications which are somewhat more elongated than those of the designated lectotype from Maiersdorf. Considering, however, that the lectotype is deformed and that a variation of about 5-10% in the elongation of the plications can easily be accepted in the specific variability I see no reason why the two specimens could not belong to the same species.

Inoceramus salisburgensis FUGGER & KASTNER, 1885 is as has been shown by SEITZ, 1970 a *Platyceramus*. DOBROV & PAVLOVA (1959) associate a specimen which I consider as a *Trochoceramus nahorianensis* (though the umbonal angle is somewhat narrower than on the lectotype) with a possible *pl. salisburgensis* under the name of FUGGER & KASTNER. This is probably due to the confusion which existed between *pl. salisburgensis* and *Trochoceramus monticuli* (FUGGER & KASTNER, 1885). The specimens figured and described as *I. nachorianensis* (sic) by TZANKOV (1981, pl. 39, figs. 7-8) are somewhat difficult to interpret: their umbones are placed very anteriorly, and their umbonal angle is smaller than in most specimens known to us of this species. It could well be that the Bulgarian specimens are closer to *Trochoceramus tenuiplicatus* (TZANKOV, 1981).

Inoceramus zitteli in ANTUNES & SORNAY, 1969 is a small specimen, but it seems that the umbo is more anteriorly situated and the radial ornamentation is much stronger than on any *Tr. nahorianensis* from Europe. On the other hand on a large sample from Nigeria, specimens assigned to *Tr. ianjonensis* (SORNAY, 1973) (DHONDT & TRÖGER, in preparation) young stages show similarity with the specimen from Angola. As stated above (p. 231) many Eastern European authors have since DOBROV & PAVLOVA [1959, and probably since TSAGARELI (1942, 1949)] used the name *alaeformis* for an obvious *Trochoceramus* species, which is probably close if not necessarily identical with *Tr. nahorianensis*.

STRATIGRAPHIC DISTRIBUTION: Maastrichtian

GEOGRAPHIC DISTRIBUTION: Austria, Ukraine, Crimea, Georgia, Azerbaidzhan, SW France, Tunisia.

Trochoceramus radiosus (QUAAS, 1902)
(Pl. 7, Fig. 3; Text-fig. 16)

* 1902 *Inoceramus Cripsi,* Mant. var. *radiosa* n. var. - QUAAS, p. 170, pl. 20, figs. 9, 10

. 1970 *Inoceramus* (*Trochoceramus*) *radiosus* Quaas - SEITZ, p. 123, pl. 23, fig. 1a, b.

1970 *Inoceramus* (*Trochoceramus*) aff. *radiosus* Quaas - SEITZ, pl. 124, pl. 24, fig. 2.

MATERIAL FROM TERCIS: M1 (right valve, well preserved steinkern; somewhat deformed near the umbo) probably from unit M (found loose) (Tercis Pale Flint Member, *Nostoceras hyatti* Zone, Upper Campanian.

DESCRIPTION: medium sized, inequilateral, equivalve, almost flat inoceramid covered with a regular, strongly developed commarginal ornamentation, and with numerous radial riblets, which are most clearly visible near the anterior margin. Umbo small, not prominent, situated near the anterior margin. "Anwachs-Schnittreifen" are present but only rarely do they cross the commarginal plications.

DIMENSIONS (in mm):

H	L	L/H (%)	H/L (%)
6.0	10.5	175	57
7.5	11.5	153	65
8.5	13.5	159	63
9.0	15.0	167	60
10.0	17.8	178	56
13.5	20.5	152	66
15.5	23.5	152	66
19.2	(28)	(146)	69
23.0	32.0	139	72
27.5	36.5	133	75
32.0	42.8	134	74
36.5	48.5	133	75
41.0	51.0	124	80

DISCUSSION: The specimen M1 from Tercis is comparable to the holotype of *Inoceramus radiosus* QUAAS, 1902 as figured by SEITZ (1970), but it seems to be somewhat more flattened, the proportions L/H are on average higher because the commarginal plications are less circular in Tercis. This might be due to deformation. M1 has plication curves which are closer to those given by SEITZ (1970, p. 120 for *I.* (*Tr.*) aff. *monticuli* F. & K.), i.e. for the PETRASCHECK (1906, text-fig. 3) specimen which is also the holotype of *I. tenuiplicatus* TZANKOV, 1981. We have also placed the data for this specimen on the ontogenetic graph.

Very little is known about the variability of *Trochoceramus* species generally [except for *Tr. ianjonaensis* (SORNAY, 1973) from the Maastrichtian of Madagascar, studied in great detail in TRÖGER & RÖHLICH, 1980 on the basis of a very large sample from the Maastrichtian of Libya; a series from Nigeria of the same taxon under study by us shows an even wider variability than that illustrated by the previous authors on specimens from Libya]. From the rigid point of view, traditionally followed by inoceramid workers, *Tr. tenuiplicatus* (TZANKOV) is a different species from *Tr. radiosus* (QUAAS) because it has more elongated plications than those illustrated by SEITZ (1970) for *Tr. radiosus*. A larger sample of the different taxa re-described and discussed in the same paper by SEITZ such as *Tr. helveticus, Tr. monticuli, Tr. somaliensis*, might show these to be synonymous with *Tr. radiosus*. *Tr. ianjonaensis* and the apparently closely related *Tr. morgani* (SORNAY, 1973) from the Cotentin, France are characterised by a folding between young and old stages

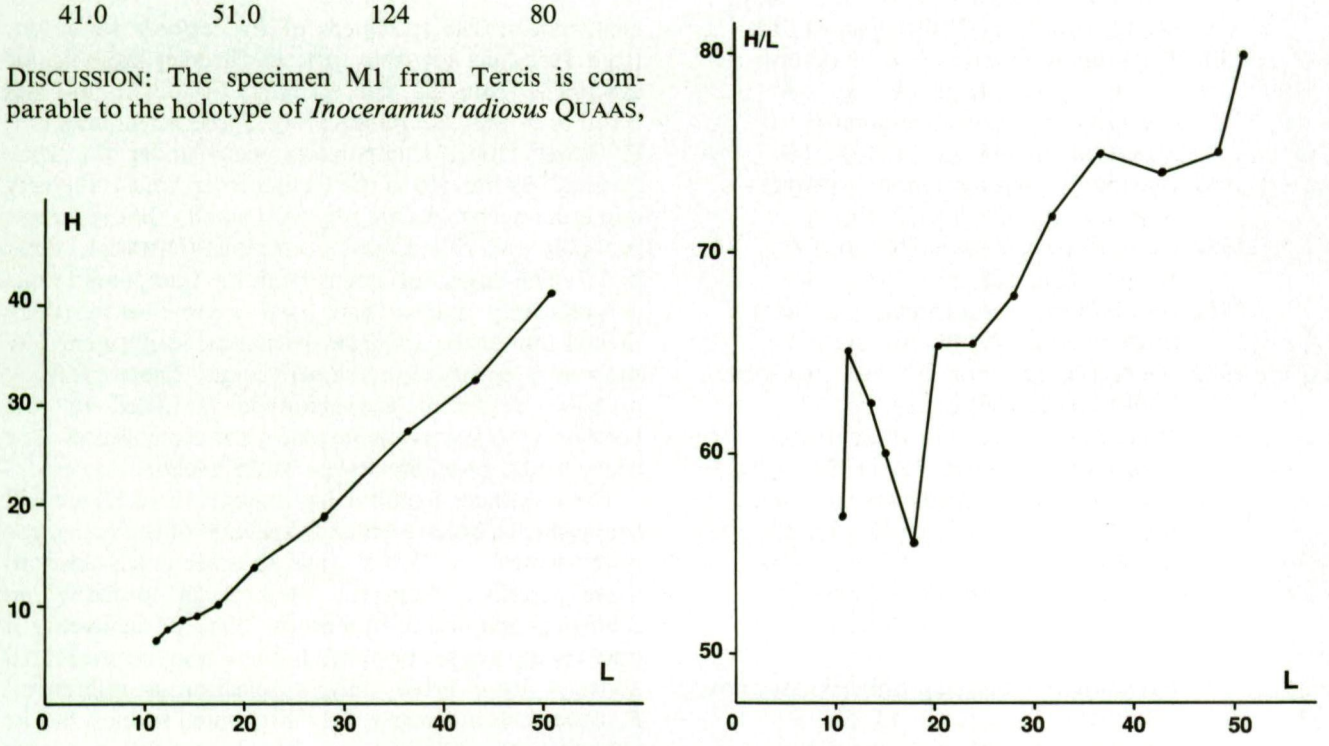


Fig. 16 — *Trochoceramus radiosus:* ontogenetic graphs on specimen M1 from Tercis. 16 a: H versus L (in mm); 16 b: H/L (in %) versus L (in mm).

which is more pronounced than is seen on the taxa mentioned above.

STRATIGRAPHIC DISTRIBUTION: Upper Campanian - Lower Maastrichtian (as far as we know).

GEOGRAPHIC DISTRIBUTION: Egypt, SW France.

Ordo **Ostreoida**
Subordo **Ostreina**
Superfam. **OSTREACEA**
Fam. **GRYPHAEIDAE** VYALOV, 1936
Genus ***Pycnodonte*** FISCHER de WALDHEIM, 1835
Type species *Pycnodonte radiata* FISCHER de WALDHEIM, 1835 (O.D.)
Subgenus ***Phygraea*** VYALOV, 1936
Type species *Phygraea frauscheri* VYALOV, 1936 O.D.

Pycnodonte (Phygraea) vesicularis (LAMARCK, 1806)

* 1806 *Ostrea (vesicularis)* - LAMARCK, p. 160.
. 1809 *Ostrea vesicularis* - LAMARCK, p. 375, pl. 22 (27), fig. 3.
v . 1847 Ostrea vesicularis Lamarck - d'ORBIGNY, p. 742, pl. 487, figs. 1, 2.
. 1878 *Pycnodonte vesicularis* Lamarck sp. - BAYLE, pl. 135, figs. 1 - 7.
pp v. 1913 *Ostrea vesicularis* Lamarck - WOODS, p. 360, pl. 55, figs. 1-7, text-figs. 143 - 182 (*cum syn.*)
. 1972 *Pycnodonte* (*Pycnodonte*) *vesicularis vesicularis* (Lam.) - FRENEIX, p. 105, pl. 10, figs. 5, 6, 7; text-figs. 11, 12.
v . 1977 *Pycnodonte hippopodium* (Nilsson) - SOBETSKI, p. 144, pl. 11, figs. 4-6.
v . 1977 *Pycnodonte vesiculare* (Lamarck) - SOBETSKI, p. 145, pl. 11, figs. 7-9.
v . 1982 *Pycnodonte hippopodium* (Nilsson) - SOBETSKI, p. 128, pl. 12, fig. 15.
v . 1982 *Pycnodonte clavatum* (Nilsson) - SOBETSKI, p. 128, pl. 12, fig. 16.
v . 1982 *Pycnodonte proboscideum* (Archiac) - SOBETSKI, p. 129, pl. 12, fig. 17.
v . 1982 *Pycnodonte frejdlini* Sobetski, sp. nov. - SOBETSKI, p. 129, pl. 12, fig. 18.
v . 1982 *Pycnodonte vesiculare* (Lamarck) - SOBETSKI, p. 12, fig. 19, pl. 32, fig. 6.
v . 1982 *Pycnodonte transcaspicum* Sobetski, sp. nov. - SOBETSKI, p. 131, pl. 13, fig. 2.
v . 1982 *Pycnodonte intermedium* Sobetski, sp. nov. - SOBETSKI, p. 132, pl. 13, fig. 4.
v . 1982 *Pycnodonte adhaesum* Sobetski, sp. nov. - SOBETSKI, p. 132, pl. 13, fig. 5 (number not marked on the plate!).
v. 1982 *Pycnodonte consimile* Sobetski, sp. nov. - SOBETSKI, p. 133, pl. 13, fig. 6.
v . 1982 *Pycnodonte singulare* Sobetski, sp. nov. - SOBETSKI, p. 133, pl. 13, fig. 7.
. 1985 *Pycnodonte* (*Phygraea*) *vesiculare* (Lamarck) (+ subsp.) - DHONDT, p. 54, figs. 3b, 4c, 4e, 4g.
. 1986 *Pycnodonte* (*Phygraea*) *vesicularis vesicularis* (Lam.) - FRENEIX & VIAUD, p. 33, pl. 2, figs. 11-14.
. 1986 *Pycnodonte* (*Phygraea*) *vesiculare* (Lamarck) - ABDEL-GAWAD, p. 162, pl. 38, fig. 5, pl. 86. 39, figs. 5-7.
. 1990 *Pycnodonte* (*Phygraea*) *vesiculare* (Lam.) - MALCHUS, p. 146, pl. 2, figs. 8-10; pl. 3, figs. 1-3, 5 (*cum syn.*)

NOMENCLATIVE NOTE: The gender of *Pycnodonte* has been treated in a random way by palaeontologists. FISCHER de WALDHEIM (1835) when erecting the genus considered it as feminine. STENZEL (1970) in the Treatise used it as feminine (*radiata, gigantica, vesicularis*), but since BOTTJER *et al.* (1979) described *P. kansasense* most authors have regarded it as neuter. Grammatically, *-odonte* stands for the Greek *odontos* genitive of *odous* (tooth); *odous* is a feminine word (contrary to the statement in the I.C.Z.N.) - therefore the correct form is *Pycnodonte* (*Phygraea*) *vesicularis*.

MATERIAL FROM TERCIS: from unit F (numerous specimens - almost a *Pycnodonte* lumachelle), from unit G (especially numerous in lower half), from unit H (rare), from unit K (rare), from unit N (rare), from unit O (rare), from unit U (rare).

DISCUSSION: The specimens of *Pycnodonte vesicularis* from Tercis do not seem to reach the very large size of specimens from the White Chalks of the Anglo-Paris Basin or in the "Schreibkreide". Those from units F to H (lower Upper Campanian) occur under the same "forms" as they do in the Charente: in Unit F the very numerous specimens are relatively small - they represent probably a so-called mass occurrence (DHONDT, 1985, p. 57). The larger specimens from the Campanian units are relatively narrow and have a very heavy, thick shelled umbonal part. The specimens do not generally show very extensive attachment areas. These "forms" probably represent ecophenotypes adjusted to soft bottoms with few available places for cementation. The heavy umbo probably served as an anchor.

The specimens from the higher units (K to U) are still heavy-shelled but are wider and several of the specimens have "wings" or "lobes", and thus are much closer to those described from the Paris Basin: probably an ecological adaptation to a more "chalky" sediment - a possibly quieter sea bottom? In the synonymy presented above I have listed only a selection a references. *P. vesicularis* is a very widely distributed species, but its sedentary life, adapted to substrate, results in a wide variety of shapes, often in the same environment. The numerous names introduced by SOBETSKI (1982) for

oysters found in "chalks" of the Precaspian Depression illustrate the diverse shapes found in *P. vesicularis*.

STRATIGRAPHIC AND GEOGRAPHIC DISTRIBUTION: from (? Albian) Cenomanian to highest Maastrichtian (possibly Danian); world wide, but more common in fine-grained, outer-shelf sediments.

Subordo **Pectinina**
Superfam. **PECTINACEA**
Fam. **PECTINIDAE** RAFINESQUE, 1815
Genus ***Mimachlamys*** IREDALE, 1929
Type-species *Pecten asperrimus* LAMARCK, 1819.

Mimachlamys cretosa (DEFRANCE *in* BRONGNIART, 1822)

* 1822 *Pecten cretosus* Defr. - DEFRANCE in BRONGNIART, p. 251, 598, pl. 3, fig. 7.
v . 1902 *Pecten* (*Chlamys*) *cretosus* Defrance - WOODS, p. 174, pl. 32, figs. 4 - 6, pl. 33, figs. 1 - 12 (*cum syn.*).
v . 1973 *Mimachlamys cretosa* (M. Defrance in A. Brongniart) - DHONDT, p. 77, pl. 6, fig. 2; pl. 7, fig. 1 (*cum syn.*).
v . 1982 *Chlamys* (*Chlamys*) *nitida* (Mantell) - SOBETSKI, p. 103, pl. 6, fig. 28.
v . 1982 *Chlamys* (*Chlamys*) *cretosa* (Defrance) - SOBETSKI, p. 104, pl. 11, figs. 1, 2; pl. 31, fig. 6.
v . 1982 *Chlamys* (*Chlamys*) *undulata* (Nilsson) - SOBETSKI, p. 104, pl. 11, fig. 3 (non *undulata* NILSSON, 1827).
v . 1985 *Mimachlamys cretosa* (Defrance) - DHONDT, p. 39.
. 1986 *Mimachlamys cretosa cretosa* (Defrance in A. Brongniart) - ABDEL-GAWAD, p. 154, pl. 34, figs. 1, 2 (*cum syn.*).
v . 1987 *Mimachlamys cretosa* (Defrance) - CLEEVELY & MORRIS, p. 80, pl. 17, figs. 7, 8; text- figs. 5.1e, 5.2a.

MATERIAL FROM TERCIS: one incomplete valve from bottom part of unit F (lowermost Santonian), one incomplete left valve from unit K (or L?, loose), mid-Campanian.

DISCUSSION: *Mimachlamys cretosa* has been re-described and discussed frequently in recent publications. I would only like to add a short comment on the ornamentation. In 1973, I discussed the variability of *Mimachlamys cretosa*. The specimen from unit F in Tercis is of the "coarse-ribbed" variety, whereas the mid-Campanian specimen is of the very fine-ribbed variety. As suggested previously (DHONDT, 1973, 1985) the specimen with the coarser ornamentation comes from coarser grained sediments.

DISTRIBUTION: known from Turonian to Maastrichtian of Eurasia, and also from the Upper Campanian Demopolis Chalk of Alabama-Mississippi, and from the Campanian of Queen Charlotte Island (W. Canada).

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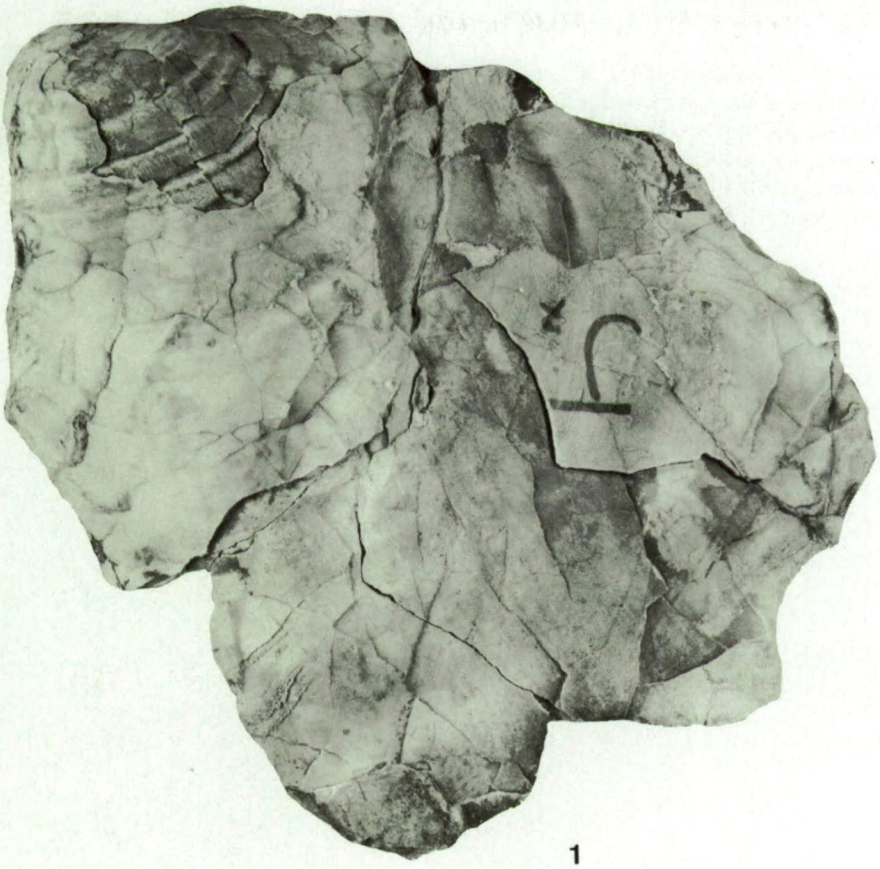
PLATE 1

Fig. 1 — ***"Inoceramus" borilensis*** JOLKICEV, 1962, X 0.7; left valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (J7 = KBIN TCM 10515).

Fig. 2 — ***"Cataceramus" goldfussianus*** (d'ORBIGNY, 1847), X 1; left valve from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H21 = KBIN TCM 10516).



1

2

PLATE 2

Fig. 1 — ***"Cataceramus" goldfussianus*** (d'ORBIGNY, 1847), X 1, right valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (J2 = KBIN TCM 10517).

Fig. 2 — ***"Cataceramus" goldfussianus*** (d'ORBIGNY, 1847), X 1, right valve from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H17 = KBIN TCM 10518). 109.

Fig. 3 — ***"Cataceramus" goldfussianus*** (d'ORBIGNY, 1847), X 1.2, right valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (J1 = KBIN TCM 10519).

1

2

3

PLATE 3

Fig. 1 — ***"I."* aff. *planus*** MÜNSTER in GOLDFUSS, 1835, steinkern of right valve from Unit F (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (F1A = KBIN TCM 10520)
Fig. 1a: X 1.2, right valve
Fig. 1b: X 1, right valve, side view.

Fig. 2 — ***"I." borilensis*** JOLKICEV, 1962, steinkern of right valve from Unit F (Upper Campanian, Tercis Marly Member) Grande Carrière, Tercis, Landes, France (F2 = KBIN TCM 10521)
Fig. 1a: X 1.2, right valve, initial stages.
Fig. 1b: X 1, right valve, side view.

Fig. 3 — ***Endocostea baltica beckumensis*** (GIERS, 1964), X 1.2, composite mould of left valve from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H23 = KBIN TCM 10522)

Fig. 4 — ***"I." aff. lapparenti*** SORNAY & BILOTTE, 1978, X 1, half left valve with shell preserved from Unit F (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (F3 = KBIN TCM 10523)

1A

1B

2A

2B

3

4

PLATE 4

Fig. 1 — ***"Inoceramus" cf. borilensis*** JOLKICEV, 1962, X 1.2, left valve with partial shell preserved from Unit O, (Maastrichtian, *Pachydiscus epiplectus* Zone, Tercis Dark Flint Member), Grande Carrière, Tercis, Landes, France (O2 = KBIN TCM 10624)

Fig. 2 — ***Endocostea baltica*** subsp. ind. (J. BOEHM, 1907), X 2.5, composite mould of right valve, from Unit N (Maastrichtian, *Pachydiscus epiplectus* Zone, Tercis Dark Flint Member), Grande Carrière, Tercis, Landes, France (N3 = KBIN TCM 10525)

Fig. 3 — ***Endocostea baltica baltica*** (J. BOEHM, 1907), X 1, deformed left valve with partial shell preservation, from Unit G (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (G18 = KBIN TCM 10526)

Fig. 4: — ***Endocostea flexibaltica*** (SEITZ, 1967), X 0.8, composite mould of left valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, 111. France (J10 = KBIN TCM 10527)

1

2

3

4

PLATE 5

Fig. 1 — ***Platyceramus*** aff. ***cycloides*** (WEGNER, 1905), X 1, composite mould of right valve from Unit G (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (G5A = KBIN TCM 10528)

Fig. 2 — ***Platyceramus alaeformis*** (ZEKELI, 1852), X 1, incomplete left valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (J11 = KBIN TCM 10529)

Fig. 3 — ***Platyceramus aff. adversus*** (RIEDEL, 1931), X 1.1, steinkern of left valve from Unit G (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (G15 = KBIN TCM 10530)

Fig. 4 — ***Platyceramus alaeformis*** (ZEKELI, 1852), X 1.1, steinkern of ? right valve from Unit K (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Pale Flint Member), Campanian, Grande Carrière, Tercis, Landes, France (K5 = KBIN TCM 10531)

Fig. 5 — ***Platyceramus adversus*** (RIEDEL, 1931), X 1.1, incomplete left valve from Unit J (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (J3 = KBIN TCM 10532)

1

2

3

4

5

PLATE 6

Fig. 1 — ***Endocostea baltica elliptica*** (GIERS, 1964), X 1.2, composite mould of right valve from Unit G (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (G6 = KBIN TCM 10533)

Fig. 2a, b, c — ***Selenoceramys* cf. *inflexus*** (BEYENBURG, 1936), X 1, incomplete right valve from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H26 = KBIN TCM 10534)
Fig. 2a: partial initial stages
Fig. 2b: central ventral part of valve
Fig. 2c: lateral ventral part of valve.

Fig. 3 — ***Selenoceramus sornayi*** nom. nov. X 1.2, steinkern of bivalved specimen from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H11 = KBIN TCM 10535)

1

2A

2B

2C

3

PLATE 7

Fig. 1 — ***Cremnoceramus* sp. ex gr. *sarumensis*** (WOODS, 1912), X 1.1, left valve with partial shell preservation from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H32 = KBIN TCM 10536)

Fig. 2 — ***Selenoceramus* cf. *sornayi*** nom. nov. X 0.8, incomplete left valve from Unit G (Upper Campanian, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (G7 = KBIN TCM 10537)

Fig. 3 — ***Trochoceramus radiosus*** (QUAAS, 1902), X 1.2, right valve with partial shell preservation from Unit M (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Pale Flint Member), Grande Carrière, Tercis, Landes, France (M1 = KBIN TCM 10538)

Fig. 4 — ***Trochoceramus nahorianensis*** (KOCIUBYNSKIJ, 1968), X 2, incomplete left valve from Unit O, (Maastrichtian, *Pachydiscus epiplectus* Zone, Tercis Dark Flint Member), Grande Carrière, Tercis, Landes, France (O3 = KBIN TCM 10539) (the slight radial ribs are not visible on the photograph).

Fig. 5 — ***Selenoceramus sornayi*** nom. nov. X 1, steinkern of bivalved specimen view on hinge region from Unit H (Upper Campanian, *Nostoceras hyatti* Zone, Tercis Marly Member), Grande Carrière, Tercis, Landes, France (H11 = KBIN TCM 10535)

1

2

3

4

5