

MIDDLE TRIASSIC BRACHIOPODS FROM VAL PARINA, BERGAMASC ALPS, ITALY

VALENTINA TORTI & LUCIA ANGIOLINI

Key-words: Brachiopods, Palaeoecology, Biostratigraphy, Anisian, Ladinian.

Riassunto. La Formazione di Esino affiorante in Val Parina, contiene una ricca fauna a brachiopodi, bivalvi, gasteropodi, coralli e ammoniti di età Triassico medio. La fauna a brachiopodi della Val Parina comprende forme ubiquitarie (*P. fragilis*, *A. aff. posterior*, *M. mentzeli*, *D. cf. dinarica*, *L. praepunctata* and *A. angustaeformis*), specie che si ritrovano solo nel retro-scogliera (*T. cf. intervallata*, *A. aff. ladina* and *A. aff. raxana*) e forme esclusive del margine della piattaforma (*C. aff. altapecta*, *V. vivida*, *A. aff. dilatata*, *H. aff. ambitiosa*, *T. trigonella*, *M. ampla*, *A. aff. canaliculata*).

L'età dei brachiopodi della Val Parina è compresa tra l'Anisico sommitale ed il Ladinico superiore.

Abstract. The Middle Triassic Esino Limestone of Val Parina yields a rich brachiopod fauna associated with bivalves, gastropods, corals, and ammonoids. The brachiopod fauna of the Esino Limestone includes ubiquitous species (*P. fragilis*, *A. aff. posterior*, *M. mentzeli*, *D. cf. dinarica*, *L. praepunctata* and *A. angustaeformis*), species exclusive to the back reef (*T. cf. intervallata*, *A. aff. ladina* and *A. aff. raxana*) and species exclusive to the shelf margin (*C. aff. altapecta*, *V. vivida*, *A. aff. dilatata*, *H. aff. ambitiosa*, *T. trigonella*, *M. ampla*, *A. aff. canaliculata*).

The age of the Val Parina brachiopods spans from latest Anisian to Late Ladinian.

Introduction.

The present paper considers the taxonomy, biostratigraphy and palaeoecological significance of the brachiopod fauna of the Esino Limestone of Val Parina (Val Brembana, Bergamo), in the Southern Alps of North-west Italy (Fig. 1).

The Esino Lmst. of Val Parina contains a very rich fauna of brachiopods, gastropods, bivalves, corals, ammonoids, nautiloids, echinoderms, algae and vertebrates (Jadoul et al., 1992; Fantini Sestini, 1994, 1996). For a detailed study of the ladinian ammonoids, see Fantini Sestini (1994, 1996). Casati & Gnaccolini (1967), in the only previous study of the brachiopods of the Esino Lmst. by reported the occurrence of *Spiriferina fragilis* and *Aulacothyris* sp. from M. Pegherolo (Val Brembana, Bergamo).

The brachiopods examined in this study were collected and prepared by M. Gervasutti and donated to the Museo Civico di Scienze Naturali "E. Caffi" of Bergamo (Paganoni, 1985), where all the specimens are stored.

Geological setting.

Val Parina, a lateral valley of Val Brembana is located about 30 km north of Bergamo (northern Italy) and is largely cut in the Middle Triassic Esino Lmst., which represents a complex carbonate platform 750 to 900 m thick (Jadoul et al., 1992).

The brachiopods described in this paper were collected from bioclastic lenses 10-100 cm thick, at the transition between lithozones 3 and 4 (Fig. 2) which partially interfinger in the lower-middle part of the Esino Lmst., from 200-350 m above the base to 500 m be-

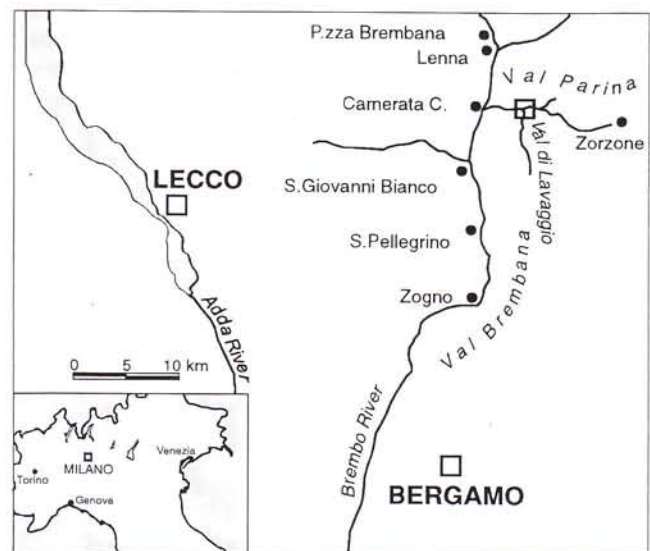


Fig. 1 - Geographic sketch map of Val Parina (Val Brembana, Bergamo, Italy).

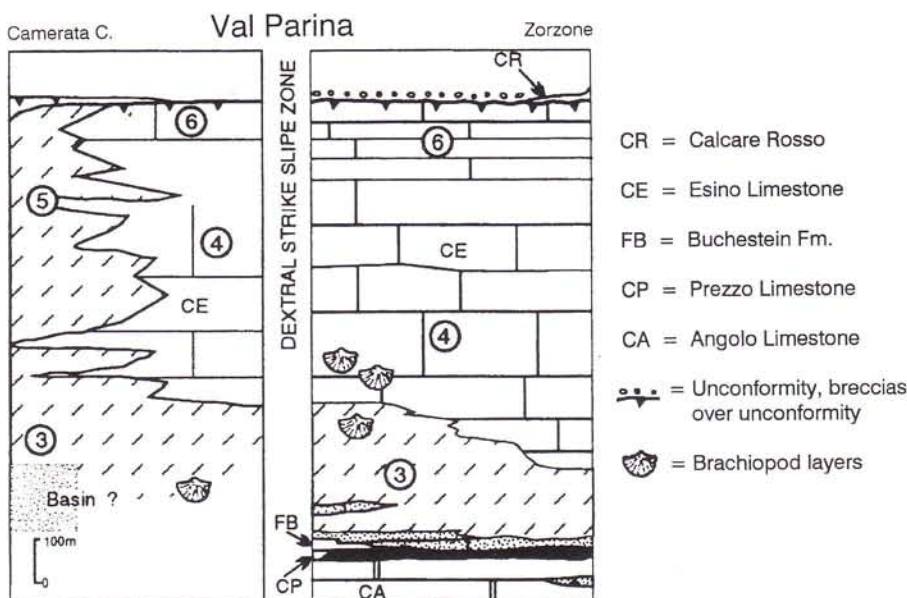


Fig. 2 - Stratigraphic scheme of Middle Triassic formations cropping out in Val Parina, showing the location of the brachiopod-bearing levels. The numbers indicate lithozone 3 to 6 of the Esino Lmst. (see also Jadoul et al., 1992).

low the top of the formation, as described by Jadoul et al. (1992). Lithozone 3 consists of bindstones, bafflestones and bio-intraclastic packstones and wackestones, whereas lithozone 4 consists of peloidal and bio-intraclastic packstones, wackestones, mudstones and rarely grainstones. For descriptions of the other four lithozones of the Esino Lmst. see Jadoul et al. (1992).

Brachiopod occurrence.

The brachiopods listed below were collected along the right hydrographic side of Val Parina ($45^{\circ}50'30''N-9^{\circ}40'00''E$), just opposite Val di Lavaggio (Fig. 3, 6). The fossiliferous horizons of "sections" 1 and 2 were collected in stratigraphic order, whereas those of localities 3-10 are separate fossiliferous levels, whose stratigraphic relationships cannot be ascertained. The quotation marks in "sections" 1 and 2 indicate that we have no control on the exact thickness separating each fossiliferous level.

Sections

"Section" 1 (from the base to the top):

S754 - at the edge of the gully located eastward of the end of the old railroad at 555/565 m altitude;

S759 and S749 - debris of S754;

S992(B-C-G) - between S944 (600 m altitude) and S754 (565 m altitude);

S993(A-B-E) - on the ridge westward of S992, between 695 m (993-A) and 715 m (993-E) altitude;

S747(A-B) - debris of S746 (the latter is a sample lacking brachiopods, but with ammonoids, located be-

tween the two upper branches of the gully, at 840/845 m altitude).

"Section" 2 (from the base to the top):

S1011(H-L-M-P-Q) - scattered outcrops along the bottom of a gully and on its eastern ridge, between 550 m (S1011-H) and 700 m (S1011-Q) altitude;

S1010(B-D) - scattered blocks in the S1011 gully (S1010-D is located near S1011-P).

Isolated localities.

Locality 3

S944 (F-H) - in the lower part of the gully opposite Val di Lavaggio, at 600-650 m altitude (944H is located 50 m above S944F).

Locality 4

S1117 - ridge between the second and third gullies located eastward of S1010.

Locality 5

S904 - debris at the bottom of the valley, at 500 m altitude.

Locality 6

S954 - lenses at 650 m altitude, between the second and third gullies eastward of S993.

S1060-B - outcrop located at 780 m altitude on the ridge eastward of the gully of S747.

Locality 7

S1137 - small outcrop between S754 and S1032.

Locality 8

S1032 - located at 650 m altitude westward of S754.

Locality 9

S1136 - outcrop located on the ridge westward of S944.

Locality 10

S939 - blocks in the gully located eastward of "section" 1.

Age and correlation.

Due to the poor superpositional control on the Val Parina fossiliferous horizons, a detailed biostratigraphical analysis is not possible.

The age of the Val Parina brachiopods spans from latest Anisian to Late Ladinian.

In particular, the only brachiopod species of locality 6 (Fig. 3), *S. cf. kittli*, was collected in association with ammonoids of the Nevadites Zone (Fantini Sestini, 1996). The age of the Nevadites Zone is still debated (see discussion in Fantini Sestini, 1996, p. 214) being latest Anisian according to Brack & Rieber (1993) or earliest Ladinian according to Krystyn (1983). In fact, *S. kittli* has been found so far only in the Anisian.

The brachiopod association of "section" 1 (except for sample S747), "section" 2 and localities 3, 4, 5, 7, 8, 9, 10 (Fig. 3) was collected together with ammonoids of the Curionii Zone and is thus Early Ladinian (Fantini Sestini, 1994). In fact, this brachiopod association consists of long-ranging (Anisian-Ladinian) species (such as *T. trigonella*, *P. fragilis*, *M. mentzeli*, *M. ampla* and *A. angustaeformis*), of Ladinian species (*L. praepunctata*) and of specimens similar to species exclusive to the Ladinian or even younger (such as *A. aff. dilatata*, *A. aff. canaliculata*, *T. cf. intervallata*, *A. aff. ladina* and *A. aff. raxana*).

In "section" 1, *P. fragilis* shows a higher range (sample S747), up to the Archelaus Zone (Fantini Sestini, 1994) in the Late Ladinian, defined on the basis of the associated ammonoids.

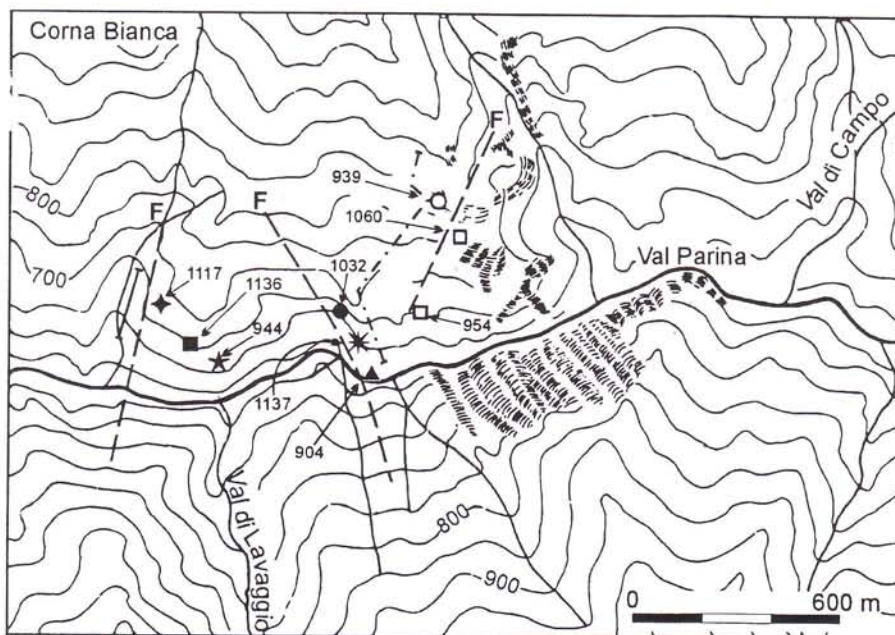
The Val Parina brachiopod fauna can be partially compared to the Ladinian faunas of the Wettersteinkalk of Raxalpe (Bittner, 1892; Lobitzer et al., 1990; Siblik, 1994) and of Ostry vrch (Malé Karpaty Mts.) (Kochano-

va & Pevny, 1982). The Val Parina fauna shares 2 species (*M. ampla*, *L. praepunctata*) and 3 genera with the former, and 3 species (*A. angustaeformis*, *P. fragilis* and *T. trigonella*) with the latter. Finally the Val Parina fauna shares 4 species with the Ladinian fauna of Latemar and Viezzana described by Wilckens (1909).

Palaeoecology of the Brachiopod fauna.

For the palaeoecological analysis, only the brachiopods of "section" 1, "section" 2, and localities 3, 4, 5, 7, 8, 9 and 10 were considered. In fact, locality 6 is characterised by the only occurrence of *S. cf. kittli* together with a peculiarly homogeneous ammonoid assemblage (Balini, pers. comm.) and is located east of a fault (Fig. 3) which displaces the Esino Lmst.

The brachiopods under study were collected in the transitional facies between lithozones 3 and 4 of the Esino Lmst. (Fig. 2). Lithozone 3 consists of massive bioclastic limestones and patch reefs and represents the margin of the Esino platform facing an intraplatform trough or an open basin to the south (Jadoul et al., 1992, p. 309). Lithozone 4 consists of subtidal limestones deposited in back reef lagoons and tidal channels locally affected by storm action (Jadoul et al., 1992, p. 309). The two lithozones are partially interfingering, with the westward progradation of the backreef (lithozone 4) over the margin (lithozone 3) in the middle part of the Esino platform (Fig. 2; see also Jadoul et al., 1992, p. 310, fig. 5).



"Section" 1 / S 754-759-992-993-747

"Section" 2 / S 1011-S 1010

★ Loc. 3 * Loc. 7
 ◆ Loc. 4 ● Loc. 8
 ▲ Loc. 5 ■ Loc. 9
 □ Loc. 6 ○ Loc. 10

Fig. 3 - Topographic map of Val Parina showing the location of the brachiopod-bearing samples collected by M. Gervasutti.

Two brachiopod assemblages were distinguished: assemblage A, collected in the lower part of "section" 1, "section" 2, and localities 3, 4 and 8, and assemblage B, collected in the upper part of "section" 1 and locality 5. The two assemblages differ significantly, suggesting an ecological control on the distribution of the brachiopods.

Assemblage A is characterized by *P. fragilis*, *A. aff. posterior*, *M. mentzeli*, *D. cf. dinarica*, *L. praepunctata*, *A. aff. raxana*, *A. angustaeformis*, *C. aff. altaplecta*, *V. vivida*, *A. aff. dilatata*, *H. aff. ambitiosa*, *T. trigonella*, *M. ampla*, and *A. aff. canaliculata*.

Assemblage B is characterized by *P. fragilis*, *A. aff. posterior*, *M. mentzeli*, *D. cf. dinarica*, *L. praepunctata*, *A. aff. raxana*, *A. angustaeformis*, *T. cf. intervallata*, and *A. aff. ladina*.

The brachiopods of Val Parina can thus be subdivided into: 1) species exclusive to assemblage A, such as *C. aff. altaplecta*, *V. vivida*, *A. aff. dilatata*, *H. aff. ambitiosa*, *T. trigonella*, *M. ampla*, *A. aff. canaliculata*; 2) species exclusive to assemblage B, such as *T. cf. intervallata*, and *A. aff. ladina*; and 3) ubiquitous species, such as *P. fragilis*, *A. aff. posterior*, *M. mentzeli*, *D. cf. dinarica*, *L. praepunctata*, *A. aff. raxana* and *A. angustaeformis*.

M. mentzeli was considered an "opportunistic" species by Palfy (1991) together with *T. tetractinella* which, however, occurs only in assemblage A. In localities 7, 9 and 10 only ubiquitous species were detected.

A larger diversity index for assemblage A (MI = 1.7-2.2; Margalef index, 1957) indicates greater diversity than assemblage B (MI = 0.6), except for the upper part of "section" 1 where the diversity index for assemblage B is moderately high (MI = 1.9).

Within assemblage B, all specimens from locality 5 are articulated, whereas in the upper part of "section" 1 the articulation/disarticulation ratio is 0.8 (Fig. 4). The articulation/disarticulation ratio of assemblage A varies from 0 to 0.6, except for the lower part of "section" 1 where a high articulation/disarticulation ratio (3.5) was observed, due to the abundance of *A. angustaeformis* (81% of the complete specimens) which is characterized by cyrtomatodont articulation and high hydrodynamic stability (Alexander & Gibson, 1993) (Fig. 5).

Assemblage A, characterised by high diversity, a generally low articulation/disarticulation ratio and dominance of ornamented species (rhynchonellids and spiriferids) belongs to the shelf margin, whereas assemblage B, which is poorly diversified and dominated by smooth shells (terebratulids), indicates a backreef setting, occasionally disturbed by storm events.

In "section" 1, the evolution from assemblage A to assemblage B indicates the progradation of the back

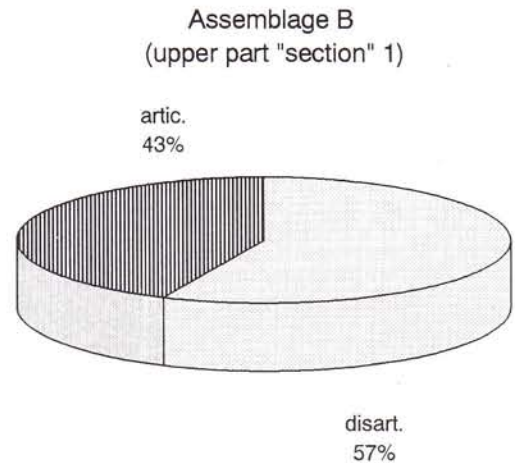


Fig. 4 - Percentage of articulated versus disarticulated valves of assemblage B in the upper part of "section" 1.

reef over the margin during the early Ladinian, in accordance with observations based on lithofacies analysis (Jadoul et al., 1992) (Fig. 2).

Systematic descriptions

Classification is according to the Treatise on Invertebrate Paleontology Part H (Williams et al., 1965) for the Rhynchonellids, to Dagys (1974) for the Athyrids and Terebratulids, and to Carter et al. (1994) and Dagys (1996) for the Spiriferids.

The original date of publication of some older papers is uncertain, since they were published in several editions: i.e. Bittner (Jahrb. K. K. geol. Reichsanst., 52) is referred to as 1902, but was published in 1903 (Siblik, pers. comm.). The same holds true for the species of Boeckh (*A. angustaeformis* and *C. altaplecta*) which were published in 1872 in the Hungarian version (Siblik, 1988; Palfy, 1988).

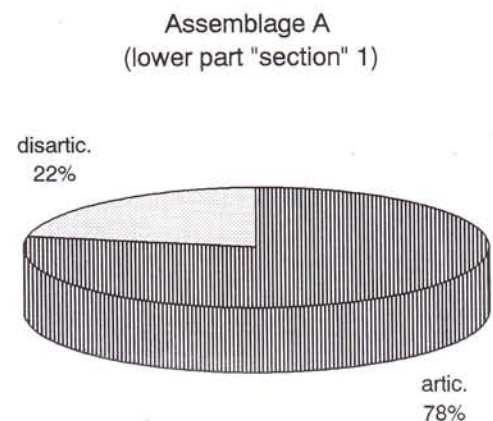


Fig. 5 - Percentage of articulated versus disarticulated valves of assemblage A in the lower part of "section" 1.

SPECIES	"SECTION" 2					loc 4	loc 9	loc 3	loc 5	loc 8	loc 7	"SECTION" 1					loc 10	loc 6	
	1 0 1 1 - H	1 0 1 1 - L	1 0 1 1 - M	1 0 1 1 - P	1 0 1 1 - Q	1 1 1 1 7	1 1 1 3 6	9 4 4	9 0 4	1 0 3 2	1 1 3 7	7 5 4 7 7 5 9	9 9 3 - A	9 9 3 - B	9 9 3 - E	7 - 7	9 3 9	9 5 4	1 0 6 0 - B
<i>V. cf. vivida</i>								1				5							
<i>C. aff. altaplecta</i>						1						2							
<i>A. aff. dilatata</i>												1							
<i>H. ambitiosa</i>												1							
<i>T. trigonella</i>				4								12	11						
<i>A. aff. posterior</i>					1	2	1	6				5	1			5			
<i>M. mentzeli</i>	1					2		6		1		4				3			
<i>M. ampla</i>		1		3		1		2											
<i>D. cf. dinarica</i>					5			4		2		4	2	3					
<i>P. fragilis</i>	1		1		1		2	1	36			5	3	2	2	3	9		
<i>A. aff. canaliculata</i>				2		2		1				1							
<i>L. praepunctata</i>								10				2		1					
" <i>T.</i> " cf. <i>intervallata</i>														1					
<i>A. angustiformis</i>	1				1			18	1		1	102	2	3	4	1		1	
<i>A. aff. raxana</i>												1							
<i>A. aff. ladina</i>									4							1			
<i>S. cf. kittli</i>																		3	2

Fig. 6 - Distribution of the brachiopod species in each sample, with indication of the number of studied specimens. The number of each sample is vertically written below the "section"/locality numbers.

Order *Rhynchonellida* Kuhn, 1949
 Superfamily *Rhynchonelloidea* Gray, 1848
 Family *Praeacyclothyrididae* Makridin, 1964
 Subfamily *Tetrarhynchinae* Ager, 1965
 Genus *Volirhynchia* Dagys, 1974

Type-species: *Rhynchonella volitans* Bittner, 1890.

***Volirhynchia* cf. *vivida* (Bittner, 1890)**

Pl. 1, fig. 1-6

Material. 3 complete specimens (754/55-56-58), 1 dorsal valve (754/185) and 2 ventral valves (754/169, 944-F/83).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); lower part of "section" 1 and locality 3; Early Ladinian (Curionii Zone).

Description. Small to medium sized, biconvex to plano-convex shell, subtriangular to flabellate in outline. Maximum width at 2/3 of the length. Hinge narrow and curved, anterior commissure uniplicate.

Ventral valve moderately convex or relatively flat, with umbo pointed and erect. A median sulcus, wide and rather deep, occurs only in the anterior part of the ventral valve.

Dorsal valve convex, with a wide and rather high median fold.

Ornamentation consisting of costae, faint near the umbo, but becoming stronger near the anterior margin. At the anterior margin costae number 2-4 in the sulcus, 3-5 on the fold and 2 for each flank, and they are not in

corresponding positions on the two valves. The inner costae of the lateral flanks are stronger and sharper, forming two lateral wings on each side of the ventral sulcus.

Dimensions. In mm. Abbreviations as in legend.

specimen	L	W	Th	h	Ws-f
754/55	>10,3	12	5,1	3	8,3
754/56	8,4	10,2	5,7	3,1	6,8
754/58	10,6	11,3	6,7	2,5	8,5
754/169	9,3	12,6			8,2
754/185	9,2	9,8			

LEGEND:

L=length; W=width; Th=thickness; h=hinge length; Ws=sulcus width; Wf=fold width.

Discussion. The specimens studied are very similar to the one originally described by Böckh (1872, p. 177, pl. 11, fig. 29) as *Rhynchonella altaplecta* and subsequently revised as *R. decurtata* var. *vivida* by Bittner (1890, p. 10, pl. 32, fig. 11-12). Gaetani (1966) provisionally placed *R. vivida* Bittner in the genus *Decurtella* Gaetani, 1966 and this was accepted also by Siblik (1971a). Dagys (1974) assigned *R. vivida* to his new genus *Volirhynchia*, followed by Siblik (1983). Palfy (1988) discussed the generic attribution of the species *vivida* enhancing the similarity of its internal characters with those of *Volirhynchia volitans* (Bittner, 1890), type-species of *Volirhynchia*.

We follow Palfy (1988) in assigning the species *vivida* to the genus *Volirhynchia* even though we do not have information on the internal characters.

V. vivida differs from the true *Caucasorhynchia altaplecta* by the flabellate outline, more erect umbo, more numerous costae and the occurrence of lateral wings on the ventral side.

Other occurrences. According to Bittner (1890) *V. vivida* occurs in the Anisian-Ladinian of Southern (M. Croce di Rid near Wengen, San Cassiano) Alps and Northern Alps (Hochalm in Karwendel); it is also present in the Anisian of Mt. Cucco (Friuli) (Bittner, 1903), in the Anisian of Slovak Kars region (Siblik, 1971a) and of the Balaton Highland, Hungary (Palfy, 1986, 1988).

Subfamily *Praecyclothyridinae* Makridin, 1964

Genus *Caucasorhynchia* Dagys, 1963

Type-species: *Caucasorhynchia kunensis* Dagys, 1963.

***Caucasorhynchia* aff. *altaplecta* (Böckh, 1872)**

Pl. 1, fig. 7-8

Material. 2 complete specimens (754/53-57), 1 dorsal valve (1117/1).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); lower part of "section" 1 and locality 4; Early Ladinian (Curionii Zone).

Description. Small sized, biconvex shell, subtriangular in outline. Maximum width at 2/3 of the length. Hinge narrow and curved, anterior commissure multiplicate.

Ventral valve moderately convex, with pointed, erect or gently curved umbo. A shallow median sulcus occurs in the anterior part of the ventral valve.

Dorsal valve moderately convex, with a wide and low median fold.

Ornamentation of costae, faint near the umbo, but becoming stronger near the anterior margin. In one specimen the costae bifurcate at 1/3-1/2 of the valve length. At the anterior margin costae number 6-8, they are about 1 mm wide and not in corresponding positions on the two valves.

Dimensions.

specimen	L	W	Th	h
754/53	8	8,3		
754/57	10,8	9,7	5,9	2,7

Discussion. The attribution of the species *altaplecta* to the genus *Caucasorhynchia* is based on the affinity of internal characters as shown by Siblik (1971b, 1994) and Palfy (1988).

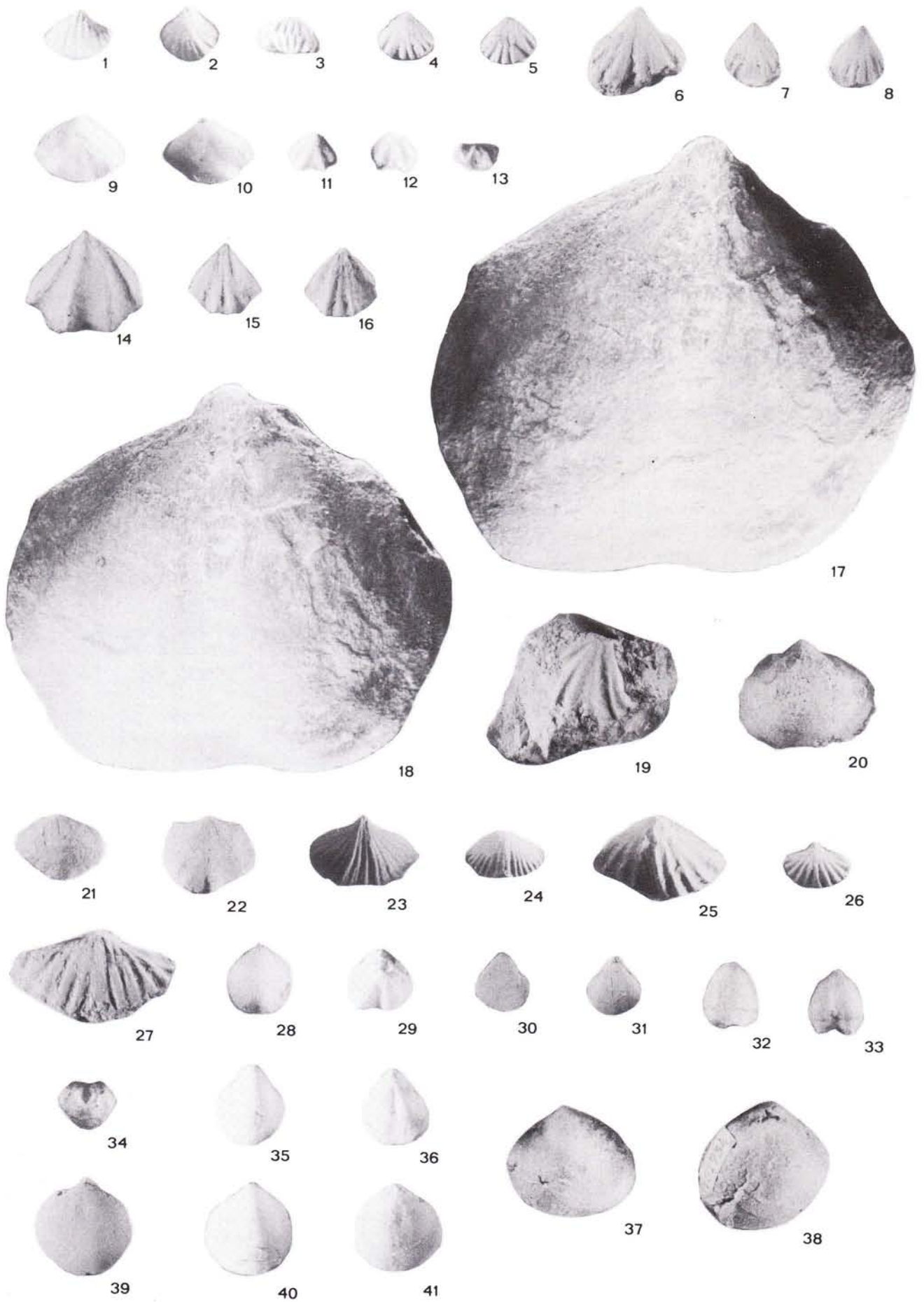
The species *Caucasorhynchia altaplecta* (Böckh, 1872), originally described by Böckh (1872, p. 177, pl. 11, fig. 28), is characterised by high intraspecific variability according to Siblik (1971a), who recognised two subspecies, and to Palfy (1988).

In fact the specimens studied differ from that of Böckh (1872, pl. 11, fig. 28) by their less rounded outline and greater number of costae. The specimens studied are more similar to *C. altaplecta* as illustrated and described by Bittner (1890, p. 11, pl. 37, fig. 9-15), more specifically to the specimen represented in pl. 37, fig. 9-10.

PLATE 1

All x 1, except when specified.

Fig. 1 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Ventral valve. Specimen 754/58. Fig. 2 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Dorsal valve. Specimen 754/58. Fig. 3 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Anterior commissure. Specimen 754/58. Fig. 4 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Ventral valve. Specimen 754/56. Fig. 5 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Dorsal valve. Specimen 754/56. Fig. 6 - *Volirhynchia* cf. *vivida* (Bittner, 1890). Ventral valve. Specimen 944-F/83. Fig. 7 - *Caucasorhynchia* aff. *altaplecta* (Boeckh, 1872). Ventral valve. Specimen 754/57. Fig. 8 - *Caucasorhynchia* aff. *altaplecta* (Boeckh, 1872). Dorsal valve. Specimen 754/57. Fig. 9 - *Austriellula* aff. *dilatata* (Suess, 1855). Ventral valve. Specimen 754/63. Fig. 10 - *Austriellula* aff. *dilatata* (Suess, 1855). Dorsal valve. Specimen 754/63. Fig. 11 - *Holcorhynchella ambitiosa* (Bittner, 1903). Ventral valve. Specimen 754/62. Fig. 12 - *Holcorhynchella ambitiosa* (Bittner, 1903). Dorsal valve. Specimen 754/62. Fig. 13 - *Holcorhynchella ambitiosa* (Bittner, 1903). Anterior commissure. Specimen 754/62. Fig. 14 - *Tetractinella trigonella* (Schlotheim, 1820). Ventral valve. Specimen 992-B/11. Fig. 15 - *Anisactinella* aff. *posterior* Wilckens, 1909. Ventral valve. Specimen 1074/1. Fig. 16 - *Anisactinella* aff. *posterior* Wilckens, 1909. Dorsal valve. Specimen 1074/1. Fig. 17 - *Spirigerellina* cf. *kittli* (Bittner, 1903). Ventral valve. Specimen 1060-B, 20 x. Fig. 18 - *Spirigerellina* cf. *kittli* (Bittner, 1903). Dorsal valve. Specimen 1060-B, 20 x. Fig. 19 - *Anisactinella* aff. *posterior* Wilckens, 1909. Dorsal valve. Specimen 944-F/44. Fig. 20 - *Mentzelia mentzeli* (Dunker, 1851). Ventral valve. Specimen 1117-B/3. Fig. 21 - *Mentzelia mentzeli* (Dunker, 1851). Dorsal valve. Specimen 944-F/49. Fig. 22 - *Mentzelia ampla* Bittner, 1890. Ventral valve. Specimen 1011-L/1. Fig. 23 - *Dinarispira* cf. *dinarica* (Bittner, 1890). Ventral valve. Specimen 1011-Q/4. Fig. 24 - *Dinarispira* cf. *dinarica* (Bittner, 1890). Dorsal valve. Specimen 754/71. Fig. 25 - *Punctospirella fragilis* (Schlotheim, 1814). Ventral valve. Specimen 747-A/2. Fig. 26 - *Punctospirella fragilis* (Schlotheim, 1814). Dorsal valve. Specimen 993-E/8. Fig. 27 - *Punctospirella fragilis* (Schlotheim, 1814). Dorsal valve. Specimen 747-A/3. Fig. 28 - *Aulacothyris* aff. *canaliculata* Bittner, 1892. Ventral valve. Specimen 1011-P/2. Fig. 29 - *Aulacothyris* aff. *canaliculata* Bittner, 1892. Dorsal valve. Specimen 1011-P/6. Fig. 30 - *Lobothyris praepunctata* (Bittner, 1890). Ventral valve. Specimen 944-F/10. Fig. 31 - *Lobothyris praepunctata* (Bittner, 1890). Dorsal valve. Specimen 944-F/10. Fig. 32 - "*Terebratula*" cf. *intervallata* Bittner, 1892. Ventral valve. Specimen 993-A/1. Fig. 33 - "*Terebratula*" cf. *intervallata* Bittner, 1892. Dorsal valve. Specimen 993-A/1. Fig. 34 - "*Terebratula*" cf. *intervallata* Bittner, 1892. Anterior commissure. Specimen 993-A/1. Fig. 35 - *Angustothyris angustaeformis* (Boeckh, 1872). Ventral valve. Specimen 754/3. Fig. 36 - *Angustothyris angustaeformis* (Boeckh, 1872). Dorsal valve. Specimen 754/3. Fig. 37 - *Angustothyris* aff. *raxana* (Bittner, 1892). Ventral valve. Specimen 754/72. Fig. 38 - *Angustothyris* aff. *raxana* (Bittner, 1892). Dorsal valve. Specimen 754/72. Fig. 39 - *Angustothyris* aff. *ladina* (Bittner, 1890). Dorsal valve. Specimen 904-M/2. Fig. 40 - *Angustothyris* aff. *ladina* (Bittner, 1890). Ventral valve. Specimen 904-M/6. Fig. 41 - *Angustothyris* aff. *ladina* (Bittner, 1890). Dorsal valve. Specimen 904-M/6.



Other occurrences. *C. altaplecta* occurs in the Anisian of the Recoarokalk (Balaton Highland, Hungary) (Böckh, 1872; Bittner, 1890; Palfy, 1988) and of Slovak Kars region (Slovakia, Siblik, 1971a, b). *C. aff. altaplecta* described by Siblik (1994) occurs also in the Ladinian of Spielkogel (Mürztaler Alpen, Styria) and of Wettersteinkalk (Raxalpe, Austria).

Family *Dimerellidae* Buckman, 1918

Subfamily *Norellinae* Ager, 1959

Genus *Austriellula* Strand, 1928

(pro *Austriella* Bittner, 1890

= *Jacobella* Patte, 1926

= *Austriellina* Schuchert & Le Vene, 1929)

Type-species: *Rhynchonella dilatata* Suess, 1855.

Austriellula aff. *dilatata* (Suess, 1855)

Pl. 1, fig. 9-10; Pl. 3, fig. 1

Material. 1 complete specimen (754/63).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); lower part of "section" 1; Early Ladinian (Curionii Zone).

Description. Moderately biconvex shell with width exceeding length, triangular-subpentagonal in outline. The maximum width is 16 mm, the length 12,5 mm. Hinge narrow and straight, anterior commissure unipli- cate. Shell substance very thick.

Ventral valve with strong, suberect and pointed umbo; low interarea. A wide median sulcus (12,2 mm wide) starts at the umbo.

Dorsal valve not very convex, with a large fold occurring only in the anterior part of the shell.

Ornamentation of growth lines and strong growth lamellae.

Interior of ventral valve with teeth supported by reduced dental flanges. Interior of dorsal valve with sockets with well developed inner socket-ridges and poorly developed outer socket-ridges. Horizontal cardinal-plates.

Ultrastructure. The primary layer has not been observed. The secondary layer is very thick and consists of rather short and flattened fibres, subparallel to the external surface of the shell. Fibres show an irregular profile in transverse section.

Discussion. The specimen studied is characterised by a flatter shell and more triangular outline in comparison with those illustrated by Bittner (1890, p. 212, pl. 8, figs. 1-18) and Siblik (1982, p. 44, pl. 8, figs. 1-2, 4). More specifically the specimen studied is very similar to the mature specimens represented by Bittner (1890, pl. 8, figs. 8-9) by its triangular outline and unipli- cate anterior commissure.

Other occurrences. *A. dilatata* occurs in the Carnian-Norian of Northern Alps (Subbullatusschichten and Bierenatusschichten, Austria) (Bittner, 1890; Siblik, 1982). *Austriella* cf. *dilatata* occurs also in the Ladinian of Dobrugea (Kittl, 1908).

Subfamily *Holcorhynchellinae* Dagys, 1974

Genus *Holcorhynchella* Dagys, 1974

Type-species: *Rhynchonella delicatula* Bittner, 1890.

Holcorhynchella ambitiosa (Bittner, 1903)

Pl. 1, fig. 11-13

1903 *Rhynchonella ambitiosa* Bittner, p. 566, pl. 21, fig. 22.

Material. 1 complete specimen (754/62).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); lower part of "section" 1; Early Ladinian (Curionii Zone).

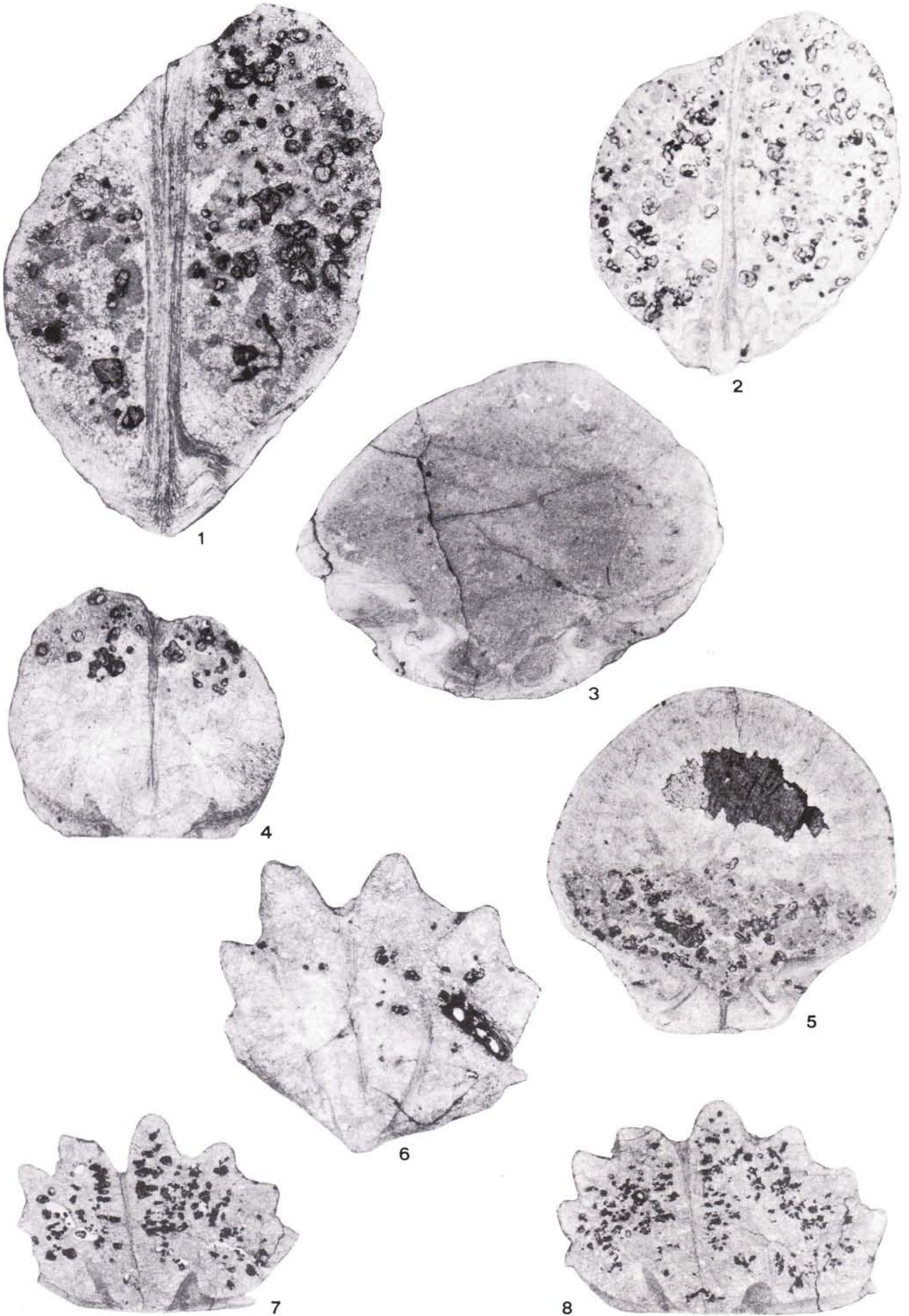
Description. Small, biconvex shell, triangular-subpentagonal in outline. Hinge narrow and curved, anterior commissure episulcate. The maximum width is 7,8 mm, the length 7,6 mm.

Ventral valve with small and erect umbo; low interarea with wide delthyrium. The valve is plicate by 4 folds: two median broad and massive folds, beginning in the umbonal region, and two lateral faint folds, occurring only in the anterior half of the valve. Between the two median folds a sulcus occurs, broadening and flattening anteriorly. Inside the sulcus a small fold is present near the anterior margin.

Dorsal valve with small umbo, incurved under the ventral one. In the umbonal region three large folds arise, the median one bifurcating near the anterior margin.

PLATE 2

- Fig. 1 - *Mentzelia ampla* Bittner, 1890. Specimen 1010-D/3, section at 0.45 mm from the umbo (27X).
 Fig. 2 - *Mentzelia ampla* Bittner, 1890. Specimen 1010-D/3, section at 1.15 mm from the umbo (12X).
 Fig. 3 - *Angustothyris* aff. *raxana* (Bittner, 1892). Specimen 904-M/20, section at 3.25 mm from the umbo (9X).
 Fig. 4 - *Dinarispira* cf. *dinarica* (Bittner, 1890). Specimen 1011-Q/8, section at 1.45 mm from the umbo (14.5X).
 Fig. 5 - *Angustothyris angustaeformis* (Boeckh, 1872). Specimen 944-F/4, section at 2.55 mm from the umbo (9X).
 Fig. 6 - *Punctospirella fragilis* (Schlotheim, 1814). Specimen 754/75, section at 0.75 mm from the umbo (17X).
 Fig. 7 - *Punctospirella fragilis* (Schlotheim, 1814). Specimen 754/75, section at 1.30 mm from the umbo (12X).
 Fig. 8 - *Punctospirella fragilis* (Schlotheim, 1814). Specimen 754/75, section at 1.55 mm from the umbo (12X).



Ornamentation of 5 costae on the ventral valve, one for each fold, and 4 on the dorsal one (two on the lateral folds, while the median one bears two costellae in its anterior part).

Discussion. The external characters of the specimen studied suggest a similarity with *Rhynchonella ambitiosa* Bittner, 1903 (p. 566, pl. 21, fig. 22), which differs only by its more rounded outline.

The internal characters of *R. ambitiosa* are unknown. Furthermore our specimen is strongly recrystallized and no internal structure has been detected.

We provisionally assign the species *ambitiosa* to the genus *Holcorhynchella* Dagys, 1974 because of its similarity with *Holcorhynchella delicatula* (Bittner, 1890), *H. perpusilla* (Bittner, 1903) and *H. atomaria* (Bittner, 1903).

Other occurrences. *H. ambitiosa* occurs in the Anisian of the Dinarides (Bittner, 1903).

Order Athyridida Boucot, Johnson & Staton, 1964

Suborder Athyrididina Boucot, Johnson & Staton, 1964

Superfamily *Athyridoidea* M'Coy, 1844

Family *Spirigerellidae* Grunt, 1965

Subfamily *Spirigerellinae* Grunt, 1965

Genus *Spirigerellina* Dagys, 1974

Type-species: *Spirigerellina pygmaea* Dagys, 1974.

***Spirigerellina* cf. *kittli* (Bittner, 1903)**

Pl. 1, fig. 17-18

Material. 5 complete specimens (1060-B, 954-A).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); locality 6; latest Anisian (Nevadites Zone).

Description. Equibiconvex, small, globose with subcircular outline. Maximum width (5,1 mm on avera-

ge) at mid-length, average length 5,0 mm. Anterior commissure emarginate, rectimarginate or slightly uniplicate.

Ventral valve with small umbo. A wide median sulcus occurs on both valves, deeper on the ventral valve. Two low costae flank the sulcus.

Discussion. The specimens studied resemble *S. kittli* (Bittner, 1903) in their small size, small umbo, ornamentation and occurrence of a sulcus on both valves. They differ slightly in the more rounded outline, which however seems to be a variable character according to Bittner (1903). *S. kittli* differs from *S. canaliculata* (Bittner, 1903) by its larger umbo.

Other occurrences. *S. kittli* occurs in the Anisian of Brachiopodenkalke of Trebevic (Bosnia) (Bittner, 1903) and of M. Rite (De Toni, 1912).

Genus *Tetractinella* Bittner, 1890

Type-species: *Terebratulites trigonellus* Schlotheim, 1820.

***Tetractinella trigonella* (Schlotheim, 1820)**

Pl. 1, fig. 14

1820 *Terebratulites trigonellus* Schlotheim, p. 271.

1890 *Spirigera trigonella* - Bittner, p. 17, pl. 36, fig. 8-31.

1903 *Spirigera (Tetractinella) trigonella* - Bittner, pp. 507, 532, 567, pl. 23, fig. 23-26

1920 *Tetractinella trigonella* - Diener, p. 63.

1958 *Tetractinella trigonella* - Sacchi Vialli & Vai, p. 49.

1967 *Tetractinella trigonella* - Casati & Gnaccolini, p. 123, pl. 9, fig. 10.

1967 *Tetractinella trigonella* - Speciale, p. 1087, pl. 79, fig. 4.

1972 *Tetractinella trigonella* - Siblik, p. 189, pl. 61, fig. 1, 6-8.

1974 *Tetractinella trigonella* - Dagys, p. 159, pl. 45, fig. 3.

1982 *Tetractinella trigonella* - Kochanova & Pevny, p. 34, pl. 7, fig. 2.

1991 *Tetractinella trigonella* - Siblik, p. 168, pl. 1, fig. 6.

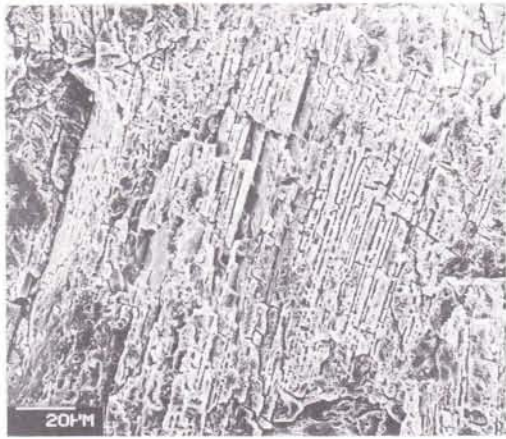
1992 *Tetractinella trigonella* - Urosevic, Radulovic & Pesic, p. 475, pl. 1, fig. 8.

1993 *Tetractinella trigonella* - Angiolini, p. 297, pl. 1, fig. 3-4.

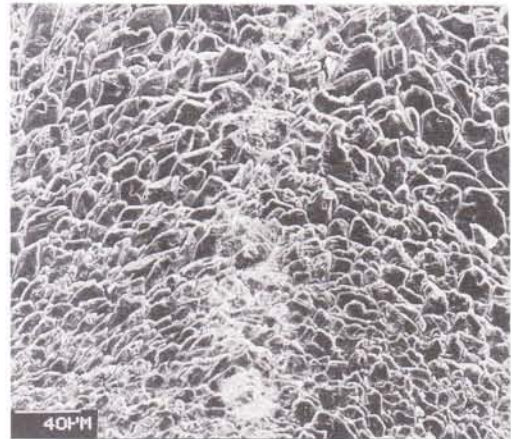
Material. 14 complete specimens (759/1-2-3-4-5-8-9, 1011-P/1-9, 754/59, 992-B/5-8-11-12), 2 ventral valves (1011-P/7, 759/10), 1 dorsal valve (992-B/4) and 10 fragments (754/60-181, 992-B/2-3-6-7-9-10, 1011-P/8, 759/11).

PLATE 3

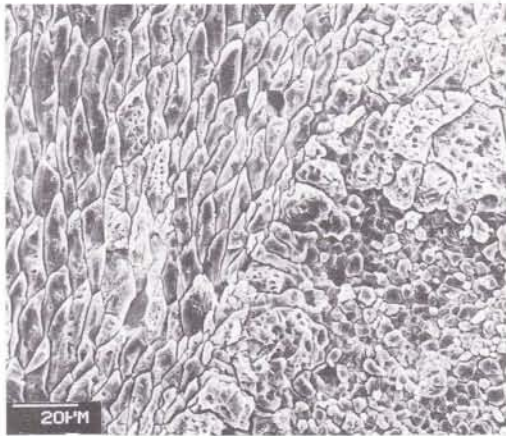
- Fig. 1 - *Austriellula* aff. *dilatata* (Suess, 1855). Longitudinal section of specimen 754/63.
 Fig. 2 - *Anisactinella* aff. *posterior* Wilckens, 1909. Transverse section of specimen 944-F/91, showing a detail of the arrangement of the fibres of the secondary layer along the sulci.
 Fig. 3 - *Anisactinella* aff. *posterior* Wilckens, 1909. Transverse section of specimen 944-F/91 at the transition between primary and secondary layer.
 Fig. 4 - *Anisactinella* aff. *posterior* Wilckens, 1909. Longitudinal section of specimen 754/119 (ventral valve), showing the fibres of the secondary layer.
 Fig. 5 - *Anisactinella* aff. *posterior* Wilckens, 1909. Transverse section of specimen 944-F/91, showing the arrangement of the fibres of the secondary layer along the sulci.
 Fig. 6 - *Anisactinella* aff. *posterior* Wilckens, 1909. Longitudinal section of specimen 754/119 (ventral valve), showing the regular stacking of fibres in the secondary layer near the umbo.
 Fig. 7 - *Mentzelia mentzeli* (Dunker, 1851). Longitudinal section of specimen 944-F/69 (ventral valve).
 Fig. 8 - *Mentzelia mentzeli* (Dunker, 1851). Longitudinal section of specimen 944-F/69 (ventral valve), showing the irregular profile of fibres in the secondary layer.



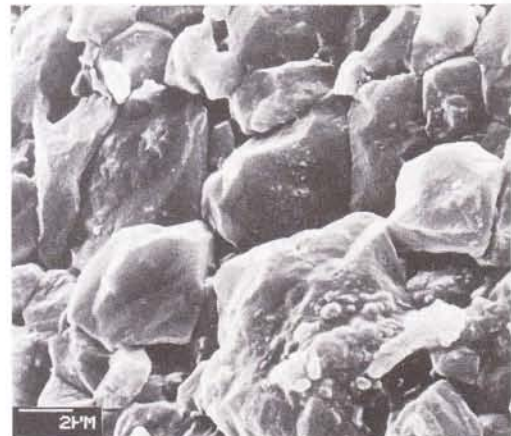
1



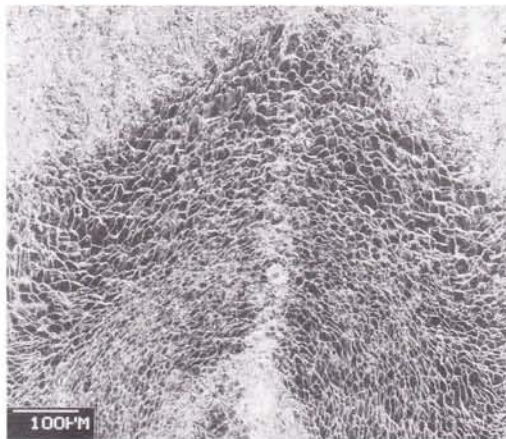
2



3



4



5



6



7



8

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); lower part of "section" 1, "section" 2; Early Ladinian (Curionii Zone).

Description. Biconvex shell, triangular to pentagonal in outline. Maximum width at 2/3 of the length. Hinge narrow and curved; anterior and lateral commissures rectimarginate. Shell substance impunctate.

Ventral valve convex near the umbo, flattening anteriorly; umbo rather strong, curved and pointed; low interarea.

Dorsal valve with umbo incurved under the ventral one.

Both valves with four faint folds bearing thin and sharp costae, with very wide interspaces and in corresponding position on the two valves.

Interior of ventral valve with strong teeth supported by well developed dental plates. Interior of dorsal valve with a flat cardinal plate bearing sockets at its side; low median septum, about 1/4 of the length of the valve.

Ultrastructure. The sectioned specimen (754/60) was completely recrystallized. Irregular fibres of the secondary layer, with a keel and saddle profile have been detected along longitudinal section. The same pattern of fibres is also present in the specimen studied by Angiolini (1993).

Intraspecific variability. There is some variability in the length/width ratio: some specimens are longer than wide, others wider than long.

Dimensions.

specimen	L	W	Th	h
759/1	18,1	17,3	10,6	6,1
1011-P/1	>22,1	21,5	11,5	8,3
754/4	11,6	11,5	6,9	3,2
759/8	>17,5	14,2	8,9	5
759/3	11,1	10,3	5,8	
759/2	14,5	16,8	8,3	6,2
759/5	15,4	15	6,4	
754/59	17,4		11,9	
992-B/11	18,2	21,5	10,9	6,4
992-B/12	16	15,5	7,5	4
992-B/4	13,2	17,1		
1011-P/9	>17,3	22,8	10,1	
992-B/7	19,5			
992-B/3	>16	>14,8		

Discussion. The specimens studied clearly belong to *T. trigonella* (Schlotheim, 1820) as illustrated by Bittner (1890, 1903) and Dagens (1974). All the specimens studied can be included in the morphotype with 4-6 costae and pentagonal outline described by Urosevic et al. (1992).

Other occurrences. *T. trigonella* occurs in the Anisian of Southern Alps ("Banco a brachiopodi" of Calcare di Angolo in Valsassina, Grigna, Val Brembana, Calcare di Prezzo of Western Orobian Alps and of Giudicarie, Calcare di Recoaro of Vicenza); in Middle Triassic of Northern Alps (Wendelstein), of Germany and Austria; in the Anisian of Balkanides, Hungary (Balaton Highland), Dinarides and Iran (Diener, 1920); in the Ladinian of Carpathians (Kochanova & Pevny, 1982).

Subfamily *Diplospirellinae* Schuchert, 1894

Genus *Anisactinella* Bittner, 1890

Type-species: *Terebratula quadripecta* Muenster, 1841.

Anisactinella aff. *posterior* Wilckens, 1909

Pl. 1, fig. 15-16, 19; Pl. 3, fig. 2-6

Material. 7 complete specimens (993-E/1-2-7-11, 754/162, 944-F/91, 1074/1), 10 ventral valves (944-F/39-40, 1011-Q/9, 993-E/12, 754/61-119-164-188, 944-H/2, 1117-B/4) and 3 dorsal valves (992-G/4, 944-F/44-85).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); "section" 1-2, loc. 3-4; Early Ladinian (Curionii Zone).

Description. Small to medium sized, biconvex shell, subpentagonal in outline. Hinge narrow and curved; lateral commissure wavy; anterior commissure from sulcinate to crenulate. Shell substance impunctate.

Ventral valve with umbo pointed and slightly incurved, low interarea and delthyrium partially closed.

Dorsal valve with smaller umbo, incurved under the ventral one.

Ornamentation consisting of sharp costae not in corresponding position on the two valves. On the ventral valve four costae occur, the two lateral costae stronger than the two median ones; the latter are fused for 1/2-2/3 of their length. On the dorsal valve five costae occur, the median one finer and fainter. Some specimens show secondary bifurcations of the costae.

Interior of ventral valve with strong and elongated teeth. Interior of dorsal valve with sockets with poorly developed inner and outer socket ridges; cardinal plate flat and sub-horizontal.

Dimensions.

specimen	L	W	Th
993-E/7	10,2	10,3	5,6
993-E/12	12,2	12,1	
754/61	12,7	13,1	
993-E/2	10,4	10,2	6,8
993-E/1	12,9	11,3	7,8
944-F/40	9	9,4	
754/188	10,9	10,2	
754/162	10,3		8,2

Ultrastructure. Two specimens were analysed, along longitudinal (754/119) and transverse sections (944-F/91), and in both specimens the primary layer is present. It consists of crystallites oriented normal to the shell layers. The secondary layer consists of long and thin, orthodoxy stacked fibres, aligned subparallel to the external surface of the valve. In transverse section the fibres of the secondary layer show a sub-rhomboidal profile; the width of fibres is 21-26 μm and their thickness is 4,5-7,5 μm . The thickness of the secondary layer is greater along the ribs, where the fibres diverge, than along the sulci, where the fibres converge.

Discussion. The specimens studied are very similar to *A. matutina* var. *posterior* Wilckens, 1909 (p. 103, pl. 4, fig. 11-12), which differs from the original *A. matutina* Bittner, 1903 in the triangular outline, the coarser central costa on the dorsal valve and the sharper and narrower costae.

The specimens studied are rather similar to *Anisactinella matutina* illustrated by Bittner (1903, p. 521, pl. 24, fig. 21-22) in the arrangement of the costae, but differ in their more triangular outline, narrower and curved hinge and sharper costae.

Other occurrences. *A. matutina* occurs in the Anisian of Dinarides, while *A. matutina* var. *posterior* occurs in the Ladinian of Southern Alps (Viezzana).

Order Spiriferinida Ivanova, 1972

Suborder Spiriferinidina Ivanova, 1972

Superfamily *Mentzelioidae* Dagys, 1974

Remarks. Dagys (1996) revised the classification proposed by Carter et al. (1994), suggesting the re-assignment of some Mesozoic punctate spiriferids. We agree with Dagys (1996) in excluding the Mentzeliinae and Tethyspirinae from the superfamily Spiriferinoidea and including them in the superfamily Mentzelioidae. In fact the internal characters of the Mentzeliinae and Tethyspirinae differ from those of the spiriferinoids in the occurrence of low dental flanges fused to the median septum, instead of discrete dental flanges and adminicula. However we do not follow Dagys (1996, p. 92), in considering "the median septum not continuing in the spondylial cavity" as a character common to the subfamilies Mentzeliinae and Tethyspirinae; in fact this appears to be a variable character, even at intraspecific level (see serial section in Gaetani, 1969; Siblik, 1991, 1994; present paper).

Finally we follow Dagys (1996) in including the family Balatonspiridae in the superfamily Mentzelioidae, due to the similarity of internal characters.

Family *Mentzeliidae* Dagys, 1974

Subfamily *Mentzeliinae* Dagys, 1974

Genus *Mentzelia* Quenstedt, 1871

Type-species: *Spirifer medianus* Quenstedt, 1852 = *Spirifer mentzeli* Dunker, 1851.

Remarks: *Mentzelia* differs from *Koebesallina* Dagys, 1965 by its smooth shell and absence of spinose microramentation; from *Hirsutella* Cooper & Muir-Wood, 1951 by the absence of dense ribs and the shape of the shell.

Mentzelia mentzeli (Dunker, 1851)

Pl. 1, fig. 20-21; Pl. 3, fig. 7-8

1851 *Spirifer mentzeli* Dunker, p. 287, pl. 34, fig. 17-19.

1890 *Spiriferina* (*Mentzelia*) *mentzelii* - Bittner, p. 22, pl. 34, fig. 1-28.

1912 *Spiriferina mentzeli* - De Toni, p. 328, pl. 1, fig. 5.

1920 *Spiriferina* (*Mentzelia*) *mentzelii* - Diener, p. 54.

1958 *Mentzelia mentzelii* - Sacchi Vialli & Vai, p. 48, pl. 4, fig. 16.

1967 *Mentzelia mentzelii* - Casati & Gnaccolini, p. 24, pl. 9, fig. 4 a-c, fig. 9 a-b

1969 *Mentzelia mentzeli mentzeli* - Gaetani, p. 506, pl. 34, fig. 8-10.

1972 *Mentzelia mentzelii mentzelii* - Siblik, p. 183, pl. 62, fig. 1.

1974 *Mentzelia mentzelii* - Dagys, p. 138, pl. 40, fig. 1-2.

1992 *Mentzelia mentzeli* - Urošević et al., p. 475, pl. 1, fig. 7.

Material. 12 ventral valves (944-F/51-53-69-70, 1011-H/1, 754/81-128-172, 1117-B/3, 993-E/4-13, 1032) and 4 dorsal valves (944-F/49-71, 1117/2, 754/73).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo), "section" 1-2, loc. 3-4, Early Ladinian (Curionii Zone).

Description. Medium to large sized, biconvex shell, with sub-triangular outline. Width generally exceeding length, maximum width at 1/3 of length from the beak. Hinge wide and straight; anterior commissure uniplicate.

Ventral valve with strong umbo and well developed interarea. Wide median sulcus, variable in thickness, beginning at 1/3-1/2 of length from the umbo.

Dorsal valve with small and curved beak; low interarea. Median fold wide but not very high, beginning under the umbo.

Shell ornamented by growth lamellae.

Interior of ventral valve with very high median septum, extending to 1/3 the valve length and fused to low and very long dental flanges.

Dimensions.

specimen	L	W	h	Ws	Wf
1011-H/1	>21,1	27,1			
993-E/4	18,7	18,3		7,1	
944-F/71	16,1	17,5	9,3		6,2
944-F/51	13,4	17,5	10	6,4	
944-F/53	15,9	16			5,4
944-F/49	12,5	16,3	8,1	7,9	
944-F/69	17,1	17,8			
754/172	16,1	16,4	7,5		
1117/2	20,5	26,3			8,7
754/73	29,3				9,5
1117-B/3	>19	>23,6	12,7		
993-E/13	19,2	>19		7,6	
754/81	14,5	>16,1	9,4		

Ultrastructure. Three specimens were analysed (944-F/51 and 754/128 along transverse sections, 944-F/69 along longitudinal section). All of them are strongly recrystallized.

The secondary layer is thick and the fibres show an irregular profile, due to dissolution.

Intraspecific variability. There is some variability in the length/width ratio. Some specimens present the same width and length and consequently have a different profile from specimens with width exceeding length.

Discussion. *Mentzelia mentzeli* (Dunker, 1851) is a very variable species. Bittner (1890) distinguished up to 7 subspecies mainly differing in the shape of the outline. The specimens studied can be included in the subspecies *M. mentzeli mentzeli*, except for two specimens (1011-H/1 and 993-E/4) which are very similar to *M. mentzeli baconica* Bittner, 1890, due to the occurrence of two narrow fold flanking the sulcus.

M. mentzeli differs from *M. ampla* Bittner, 1890 in its shallower and narrower ventral sulcus.

Other occurrences. *M. mentzeli* occurs in the Anisian of Southern Alps (Giudicarie, M. Rite, Val Trompia, Calcare di Prezzo and Banco a Brachiopodi of Western Orobic Alps) and Northern Alps. It is also present in the Anisian and Ladinian of Germany, Slovakia, ex-Yugoslavia, ex-USSR, Bulgaria, Romania, Albania, Spain, Hungary (Balaton Highland), Turkey.

Mentzelia ampla Bittner, 1890

Pl. 1, fig. 22; Pl. 2, fig. 1-2

- 1890 *Spiriferina* (*Mentzelia*) *ampla* Bittner, p. 165, pl. 41, fig. 10-11.
 1895 *Spiriferina ampla* - Salomon, p. 86, pl. 1, fig. 61-62.
 1989 *Mentzelia* sp., aff. *ampla* - Vörös & Palfy, p. 21, pl. 4, fig. 7.
 1994 *Mentzelia ampla* - Siblik, p. 369.

Material. 7 ventral valves (1010-D/3, 1011-P/3-4-5, 1011-L/1, 944-F/52, 944-E/3).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); "section" 2, loc.3; Early Ladinian (Curionii Zone).

Description. Medium sized, biconvex shell, with semicircular outline. Width exceeding length; maximum width at 2/3 of the length. Hinge wide and straight. Shell substance strongly recrystallized.

Ventral valve with pointed and slightly incurved umbo. Surface of the valve with two low folds, separated by a rather narrow central sulcus. Sulcal tongue long.

Smooth shell with growth lines and lamellae.

Interior of ventral valve (Fig. 7) with strong median septum, extending to about 1/4 the valve length and joining to dental flanges at a distance of 1 mm from the umbo. The median septum continues into the spondylial cavity. The dental flanges are low and long, extending anteriorly to 1/3 the valve length.

Dimensions.

specimen	L	W	h	Ws
1010-D/3	>9,8	14	9	6,3
1011-L/1	14,5	17,7	>11,2	7,4
1011-P/3	14	15,7	11,9	7
1011-P/4	13,5	18,5		6,7
1011-P/5	>8,7	14,1		
944-E/3	10,3			
944-F/52	12,4	17,4	10,3	8,9

Discussion. The specimens studied are very similar to *Mentzelia ampla* illustrated by Bittner (1890, p. 165, pl. 41, fig. 10-11), differing only in a less transverse outline. More specifically two specimens, 1011-L/1 and 1010-D/3, belong to the variety *radiata* Salomon, 1895, due to the occurrence of radial gentle plicae at the anterior margin of the ventral valve. The variety *bathycolpos* Salomon 1895, characterized by a wider and deeper sulcus, was not detected in our material.

Siblik (1991) included *M. ampla* and its varieties *radiata* and *bathycolpos* in his new genus *Tethyspira*, due to their external affinity to the type species *T. persis* Siblik, 1991, even if the internal structures of *M. ampla* were unknown. However in 1994 Siblik re-included the species *ampla* in the genus *Mentzelia*.

The serial sections of *M. ampla* (Fig. 7) exclude the inclusion of the species in the genus *Tethyspira*, due to the lower but longer dental flanges and higher median septum. In fact the serial sections of *T. persis* illustrated in Siblik (1991, p. 169, fig. 2) show the occur-

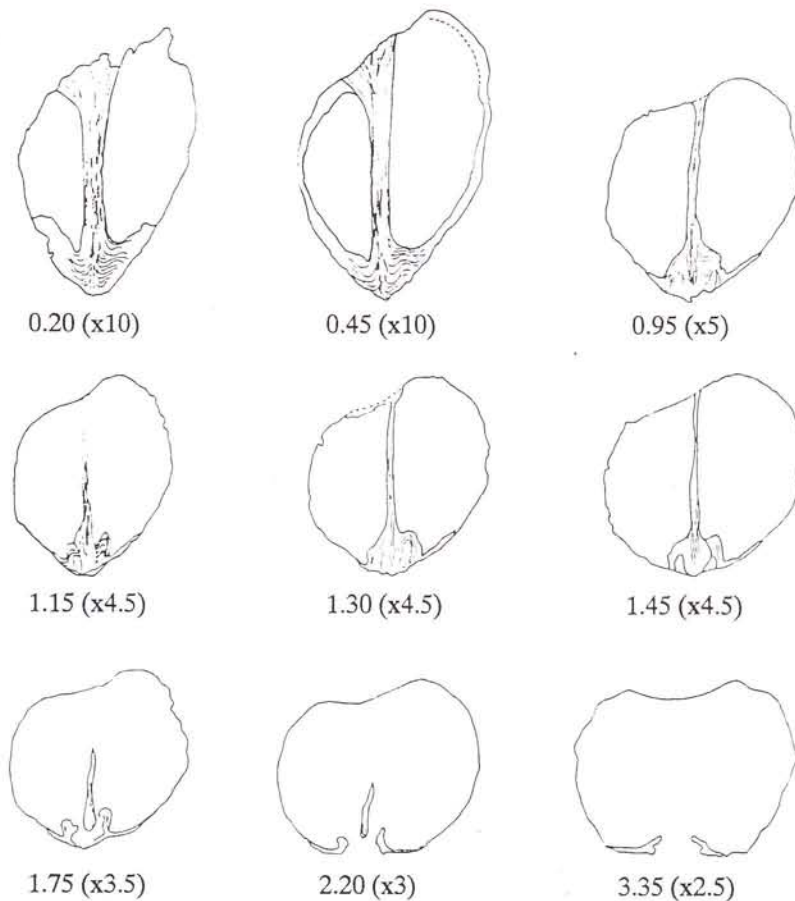


Fig. 7 - Serial sections of *M. ampla* (specimen 1010-D/3), showing internal characters of ventral valve. Distance from the umbo in mm.

ce of a deep "V" shaped spondylium on a low median septum.

M. ampla differs from *Mentzelia fraasi* Bittner, 1890 in its more transverse outline, wider and deeper ventral sulcus, higher ventral interarea.

Other occurrences. *M. ampla* occurs in the "Cassianer Schichten" of the Wendelstein, Bavaria (Bittner, 1890, in the Middle Triassic of Marmolada Lmst. (Dolomites) (Salomon, 1895), in the Ladinian Wettersteinkalk of Raxalpe (Siblik, 1994) and in the Carnian of Cardita-Schichten (Bittner, 1890). *M. aff. ampla* occurs in the Upper Anisian of Dorgicse Fm. (=Buchenstein Beds) in the Balaton Highland (Hungary) (Vörös & Palfy, 1989).

Family *Balatonospiridae* Dagys, 1974

Subfamily *Dinarispirinae* Dagys, 1996

Genus *Dinarispira* Dagys, 1974

Type-species: *Spiriferina pia* var. *dinarica* Bittner, 1890.

***Dinarispira* cf. *dinarica* (Bittner, 1890)**

Pl. 1, fig. 23-24; Pl. 2, fig. 4

Material. 6 dorsal valves (993-A/10, 944-F/78-81-86, 754/71-179) and 15 ventral valves (1011-Q/4-5-6-7-8, 993-A/11-12, 992-C/1 (a+b), 944-F/77, 1175/4, 754/180-187, 1032).

Occurrence and age. Esino Lmst., Val Parina (Val Brembana, Bergamo); "section" 1, loc. 3; Early Ladinian (Curionii Zone).

Description. Medium sized, biconvex shell, triangular in outline. Hinge straight and wide. Maximum width at 1/2 the length. Anterior commissure uniplicate.

Ventral valve with strong, curved and pointed umbo and wide interarea; median sulcus wide, beginning near the umbo, faint in some specimens, almost deep in others.

Dorsal valve more sub-rectangular in outline and flatter than the ventral one, with small umbo and wide fastigium, beginning near the umbo but high only in the anterior half of the shell.

Ornamentation of thin costae beginning near the umbo. At 10 mm from the umbo their width is 0,8-1,2 mm. In the ventral valve 3 costae occur inside the median sulcus, 2 stronger costae border the sulcus and 6-7 occur on each lateral flank. In the largest specimens the costae of the sulcus bifurcate near the anterior margin. In the dorsal valve 3 costae occur on the fastigium, the central one stronger, and 7-9 costae occur on each lateral flank. In one specimen (944-F/78) one of the two lateral costae bifurcates.

Growth lamellae are also present.

Interior of the ventral valve with high and strong median septum and dental flanges (Fig. 8). The septum extends anteriorly to a distance of 5 mm from the umbo. A delthyrial plate is probably present.

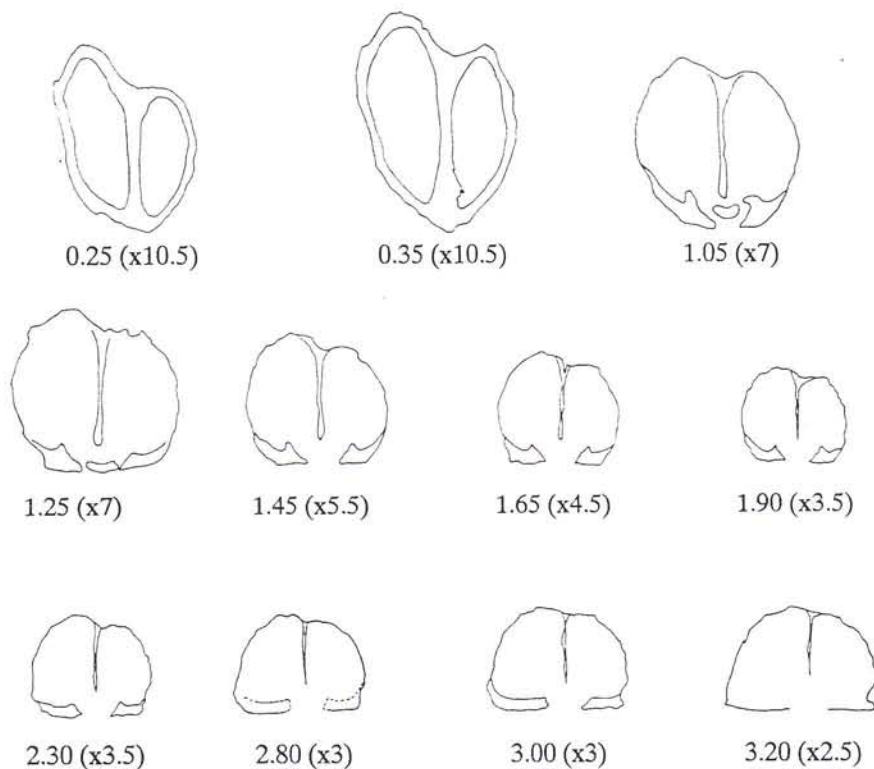


Fig. 8 - Serial sections of *D. cf. dinarica* (specimen 1011-Q/8), showing internal characters of ventral valve. Distance from the umbo in mm.

Dimensions.

specimen	L	W	Ws	Wf
1011-Q/5	9,5		5,5	
1011-Q/4	15	23,4	7,5	
1011-Q/7	>13,7	>17,4		
993-A/10	9,2	13,4		3,8
1011-Q/8	13,8	16,1	6,2	
1011-Q/6	15,7	21,3	7	
754/179	12	>15,1		4,3
944-F/77	12,6	>13,9	5,4	
754/180	>15,9	19	7	
992-C/1B	17,2			
754/71	8,5	14,5		3,5
944-F/78	>11,8	>17,4		6
944-F/81	9,9			3,8
992-C/1A	>11,6	>13,5	7	
1175/4	12,9	>16	5,5	

Ultrastructure. Three specimens were analysed (1011-Q/5 and 1011-Q/8 along transverse sections, 944-F/81 along longitudinal section). The primary layer was not observed. The longitudinal section shows a secondary layer formed by short fibres, subparallel to the external surface of the valve. Partial fusion of adjacent fibres is due to recrystallization. The fibres show an irregular profile in transverse section, roughly keel & saddle profile.

Intraspecific variability. Variable characters are the number of costae on the lateral flanks of the ventral val-

ve (up to 8 in few specimens) and the depth of the ventral sulcus which can vary from shallow to rather deep.

Discussion. The specimens studied were included in the genus *Dinarispira* based on the internal characters. The assignment to the species *D. dinarica* (Bittner, 1890) is supported by the occurrence of up to 6 costae on each flank of the dorsal fold and by the bifurcation of the two costae ornamenting the fold. *Dinarispira pia* (Bittner, 1890) differs by less numerous costae (maximum 5) and absence of bifurcation of the costae ornamenting the dorsal fold.

The specimens studied are very similar to those of *Spiriferina pectinata* Bittner, 1890 illustrated by Wilckens (1909, pl. 4, fig. 9-10), that show 7-10 costae on each flank of the dorsal fold, whereas the original *S. pectinata* illustrated by Bittner (1890, pl. 35, fig. 24-25) bears 13 costae.

D. dinarica differs from *Hirsutella canavarica* (Tommasi, 1885) in its wider dorsal fold and generic internal characters.

Other occurrences. *D. dinarica* occurs in the Anisian and Ladinian of Southern Alps (M.te Rite, Latemar, Viezzana, Marmolada Lmst.), Dinarides, Montenegro, Balaton Highland (Recoarokalk, Hungary).

Superfamily *Pennospiriferinoidea* Dagys, 1972

Family *Punctospirellidae* Dagys, 1974

Subfamily *Punctospirellinae* Dagys, 1974

Genus *Punctospirella* Dagys, 1974

Type-species: *Terebratula fragilis* Schlotheim, 1814.

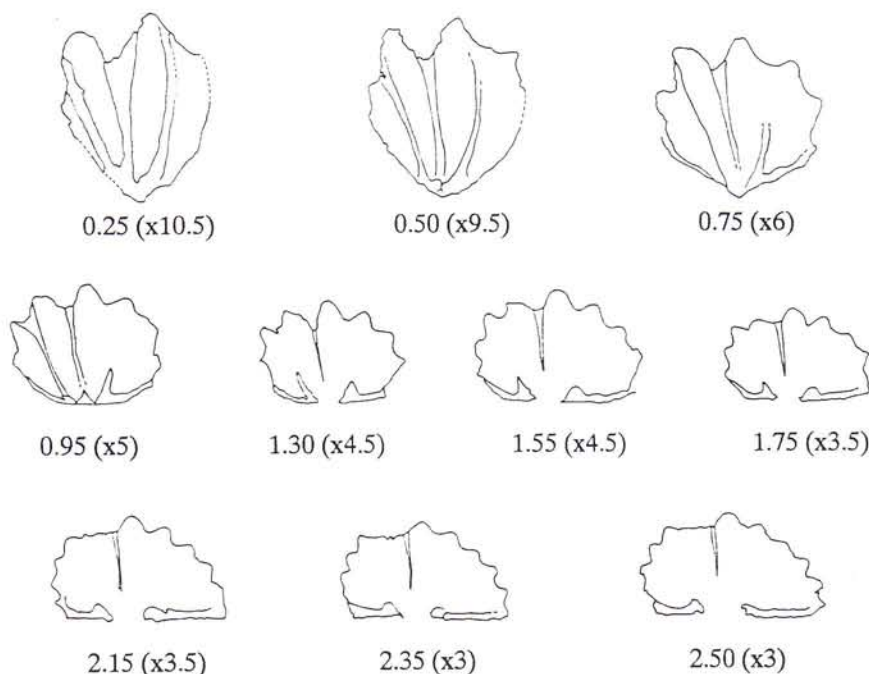


Fig. 9 - Serial sections of *P. fragilis* (specimen 754/75), showing internal characters of ventral valve. Distance from the umbo in mm.

Punctospirella fragilis (Schlotheim, 1814)

Pl. 1, fig. 25-27; Pl. 2, fig. 6-8

- 1814 *Terebratula fragilis* Schlotheim, pl. 2, fig. 4.
 1890 *Spiriferina fragilis* - Bittner, p. 29, pl. 35, fig. 2-4.
 1895 *Spiriferina fragilis* - Salomon, p. 82, pl. 2, fig. 18-19.
 1909 *Spiriferina fragilis* - Wilckens, p. 98, pl. 4, fig. 6-8.
 1912 *Spiriferina fragilis* - De Toni, p. 330.
 1920 *Spiriferina fragilis* - Diener, p. 46.
 1958 *Spiriferina fragilis* - Sacchi Vialli & Vai, p. 46, pl. 4, fig. 1-5.
 1967 *Spiriferina fragilis* - Casati & Gnaccolini, p. 138, pl. 11, fig. 9-10.
 1967 *Spiriferina fragilis* - Speciale, p. 1088, pl. 79, fig. 5.
 1968 *Spiriferina fragilis* - Taddei Ruggiero, p. 363, pl. 5, fig. 1-8, pl. 6, fig. 1-3.
 1972 *Spiriferina fragilis* - Siblik, p. 181, pl. 61, fig. 2.
 1974 *Punctospirella fragilis* - Dagys, p. 136, pl. 39, fig. 2-3.
 1981 "*Spiriferina*" *fragilis* - Taddei Ruggiero, p. 188, pl. 4, fig. 1-6.
 1982 *Punctospirella fragilis* - Kochanova & Pevny, p. 32, pl. 6, fig. 4, 7, pl. 7, fig. 3-4.
 1992 *Punctospirella fragilis* - Urosevic et al., p. 473, pl. 1, fig. 4-6.

Material. 4 complete specimens (944-F/26-94, 993-E/8, 993-B/6), 43 ventral valves (747-A/2-4-5, 747-B/1-2-4, 944-F/21-22-23-24-27-28-30-31-32-33-35-36-37-38-41-42-75-76-92, 993-A/8-9, 993-E/9-10, 1011-Q/3, 992-G/1, 1011-M/1, 1117-B/1-2, 992-B/1, 754/75-123-131-174, 1175/1-3, 944-H/3, 1136), 17 dorsal valves (747-A/1-3, 747-B/3, 944-F/25-29-34-43-46-80-82-84-88-89, 754/54, 1011-H/3, 992-C/2, 993-B/5) and 4 unidentified fragments (944-F/47-79-87-90).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); "section" 1 and 2, loc. 3 and 4; Ladinian (Curionii Zone to Archelaus Zone).

Description. Biconvex shell of small to medium size, semicircular (fan-shaped) in outline. Width exceeding length. Hinge wide and straight, corresponding to the maximum width or somewhat narrower. Anterior commissure multiplicate, with wider and higher median fold.

Ventral valve with massive beak, curved and pointed, high interarea. Rather narrow median sulcus beginning near the umbo.

Dorsal valve moderately convex, with small and curved umbo, fastigium narrow near the umbo but widening towards the anterior margin.

Ornamentation of strong and rounded costae. The costae (numbering generally 10 on the ventral valve and 11 on the dorsal one) are not in corresponding position on the two valves. At 10 mm from the umbo their width is 1,4-2,5 mm.

Interior of ventral valve showing dental flanges, adminicula and high median septum, extending to 1/3 of the length of the valve (Fig. 9).

Dimensions (Fig. 10).

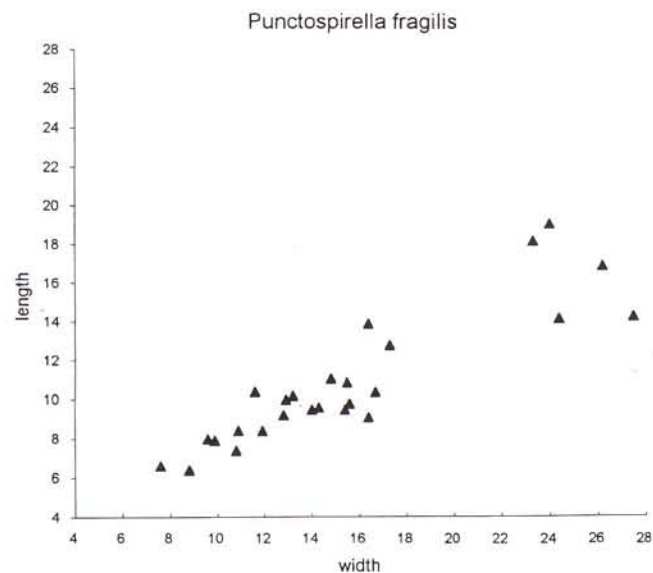


Fig. 10 - Length vs. width diagram of *P. fragilis* showing a constant relationship between length and width.

Ultrastructure. Three specimen were analysed (944-F/22 along longitudinal section, 944-F/27 and 754/75 along transverse sections).

The specimens 944-F/22 and 944-F/27 were almost completely recrystallized. In the first only perpendicular crystallites have been detected, that may represent the primary layer.

The shell is very thick and consists of thin fibres. In specimen 754/75 fibres of the secondary layer occur, with an irregular profile, generally sub-rhomboidal in transverse section. Locally the fibres show an aureole of wider crystallites formed by dissolution and recrystallization of fibres. Punctae were not clearly detected, due to the strong recrystallization.

Discussion. Diagnostic characters of *Punctospirella fragilis* (Schlotheim, 1814) are the transverse outline, the wide median sulcus and fold and the ornamentation of 10-12 costae. The specimens studied were assigned to *Punctospirella fragilis* despite the higher ventral septum (see for comparison serial sections in Dagys, 1974, p. 136). In fact also the serial section of Urosevic et al. (1992, p. 474) shows a high ventral septum.

The specimens illustrated by Casati & Gnaccolini (1967) as *P. fragilis* from the Esino Lmst. of M. Pegherolo differ slightly in a less transverse outline.

Other occurrences. *P. fragilis* occurs in the Anisian of Germany, Northern Alps, Dinarides, Balkanides, Carpathians, Balaton Highland (Hungary); it occurs also in the Anisian and Ladinian of Southern Alps (Giudicarie, Predazzo, M.te Rite, Angolo Lmst. in Lombardy, Esino Lmst. of M.te Pegherolo, Marmolada Lmst. of Dolomites) and in the Ladinian of Montenegro, Dalmatia and Carpathians. It is present also in the M.te Facito Fm. (Lucania) in the Anisian (Taddei Ruggiero, 1968).

Order Terebratulida Waagen, 1883

Suborder Terebratellidina Muir-Wood, 1955

Superfamily Zeilleriacea Allan, 1940

Family Zeilleridae Allan, 1940

Genus *Aulacothyris* Douvillè, 1879

Type-species: *Terebratula resupinata* J. Sowerby, 1816.

Remarks. The internal characters of genus *Aulacothyris* as described and illustrated in the Treatise (Williams et al., 1965) show the absence of ventral adminicula. However, these are clearly represented in the sections of *A. sandlingensis* Bittner, 1890 illustrated by Siblik (1990) and they have been also detected in *A. aff. canaliculata* Bittner 1892 in the present work (Fig. 11).

In 1977 Siblik introduced the new genus *Gemerithyris* to describe specimens similar to *Aulacothyris* but differing in external characters, i.e. intraplicate anterior commissure and occurrence of ventral sulcus and dorsal fold. Furthermore *Gemerithyris* shows the occurrence of ventral adminicula. Siblik (1990) included in the genus *Gemerithyris* also specimens with sulcate anterior commissure (*G. copiosa* Siblik, 1990), but he retained very similar species in the genus *Aulacothyris* (for example *A. canaliculata*). Which are thus the differences between *Aulacothyris* and *Gemerithyris*?

The problem of *Gemerithyris* cannot be satisfactorily solved until better preserved specimens are collected (Siblik, pers. comm.).

Aulacothyris aff. *canaliculata* Bittner, 1892

Pl. 1, fig. 28-29

Material. 6 complete specimens (944-F/1, 1010-D/1-2, 759/6, 1011-P/2-6).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); lower part of "section" 1, "section" 2, loc. 3; Early Ladinian (Curionii Zone).

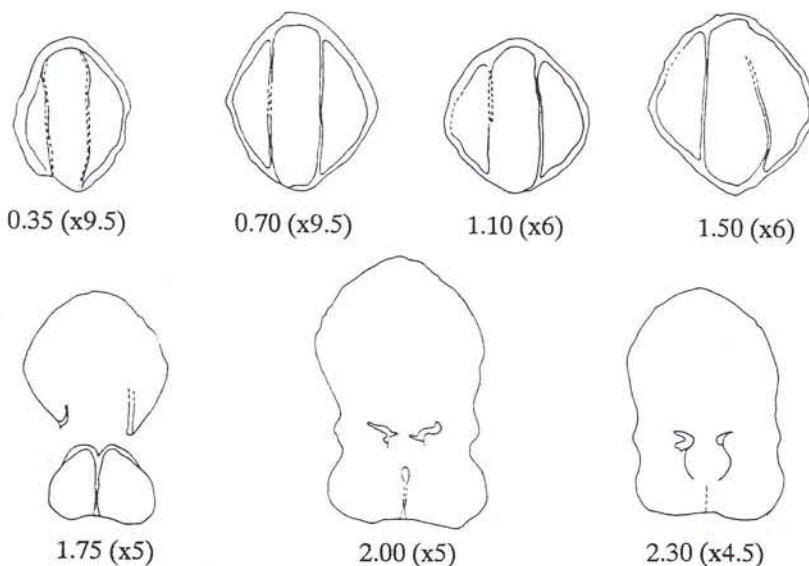


Fig. 11 - Serial sections of *A. aff. canaliculata* (specimen 1010-D/2), showing internal characters. Distance from the umbo in mm.

Description. Small to medium sized, biconvex shell, rather globose. Hinge narrow and curved; anterior commissure sulcate.

Ventral valve strongly convex and swollen, with strong, curved and pointed umbo. High interarea; deltidium closed by deltidium leaving a permesothyridd foramen. Wide median fold, strong in the umbonal region but faint near the anterior margin.

Dorsal valve not very convex, with flattened umbonal region and a small beak, incurved under the ventral one. Median sulcus delimited by two wide lateral folds.

Smooth shell; some specimens with growth lamellae.

Interior of ventral valve (Fig. 11) with well developed dental plates and adminicula. Interior of dorsal valve with short median septum (1/5 of the valve length) and a V-shaped septalium.

Dimensions.

specimen	L	W	Th	h
944-F/1	>13,9	11,1	11,7	4,7
1010-D/1	12,9	10,1	10,3	9,1
1010-D/2	11,7	9,2	9	7,4
759/6	9,2	6,6	6,3	3,8
1011-P/2	14	11,6		6,3
1011-P/6	13,7	12,1	10,9	

Discussion. The specimens studied were assigned to *Aulacothyris* aff. *canaliculata* Bittner, 1892 on the basis of the occurrence of the diagnostic deep sulcus extending for the whole length of the dorsal valve. However our specimens differ from the true *A. canaliculata* Bittner, 1892 in the more swollen dorsal valve and the shorter median septum.

According to Siblik (1990) *A. canaliculata* differs from *Gemerithyris copiosa copiosa* in the different outline, narrower dorsal sulcus and shorter septum.

The specimens studied differ from *A. dualis globularis* Bittner, 1890 in the occurrence of a deep sulcus extending for the whole length of the dorsal valve and from *A. angusta* (Schlotheim, 1820) in the not carinate and anteriorly flatter ventral valve.

Other occurrences. *A. canaliculata* occurs in the Wettersteinkalk of Raxalpe (Bittner, 1892; Siblik, 1994).

Genus UNCERTAIN

"*Terebratula*" cf. *intervallata* Bittner, 1892

Pl. 1, fig. 32-34

Material. 1 complete specimen (993-A/1).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); upper part of "section" 1; Early Ladinian (Curionii Zone).

Description. Small biconvex shell, sub-triangular in outline. Hinge narrow and curved, anterior commissure paraplicate, with well developed sinus. The width is 6.8 mm, the length 8.2 mm and the thickness 5,5 mm.

Ventral valve with small, suberect and pointed umbo; low interarea. Three low folds occur in the anterior half of the valve: the two lateral are narrower, whereas the medium fold is low and wide. On the two lateral folds two thin costae are present.

Dorsal valve more convex than the ventral one. Two wide and high folds begin at the umbo and are interspaced by a large sulcus. In the anterior half of the valve each fold bears a sharp costa.

Ornamentation of two costae on each valve, only in the anterior half of the valves.

Interior of the ventral valve with dental plates (Fig. 12). Interior of dorsal valve with median septum, extending to 1/4 the valve length and fused to the cardinal plates to form a septalium.

Discussion. The specimen studied resembles *Terebratula intervallata* Bittner, 1892 in its external characters and more specifically in its anterior commissure, but differs for the absence of strong growth lamellae.

The specimen studied differs from *Triadithyris gervariaeformis* (Zugmayer, 1882) in the occurrence of two folds for the whole length of the dorsal valve. The assignment to the genus *Triadithyris* can be excluded by the presence of dental plates in the Val Parina species.

The internal structures of *T. intervallata* are characteristic of the family Zeilleriidae, but the external characters are unusual for the genera of the family. The internal characters of the specimen studied are also similar to those of the Aulacothyropsidae (Dagys, 1974, p. 204), but differ in the shape of the dental plates and cardinal plates and in external features.

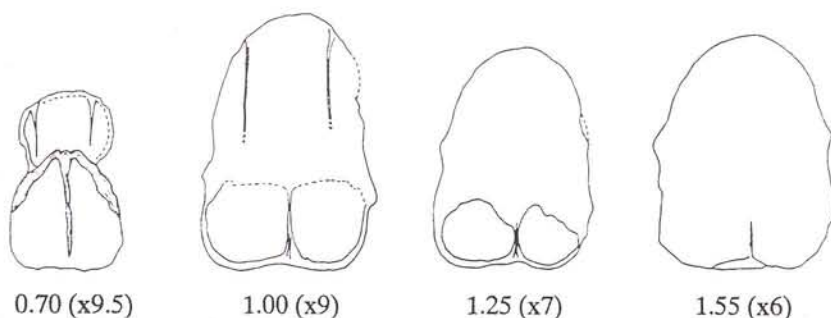


Fig. 12 - Serial sections of *T. cf. intervallata* (specimen 993-A/1), showing internal characters. Distance from the umbo in mm.

Other occurrences. Bittner (1892) dubitatively reports *T. intervallata* from the Upper Triassic of Northern Alps.

Suborder Terebratulidina Waagen, 1883
 Superfamily Terebratulacea Gray, 1840
 Family Terebratulidae Gray, 1840
 Subfamily Terebratulinae Gray, 1840

Genus *Lobothyris* Buckman, 1918

Type-species: *Terebratula punctata* J. Sowerby, 1813.

***Lobothyris praepunctata* (Bittner, 1890)**

Pl. 1, fig. 30-31

1890 *Terebratula praepunctata* Bittner, p. 257, pl. 28, figs. 2-5.
 1892 *Terebratula praepunctata* - Bittner, p. 28, pl. 3, figs. 16-20.
 ?1892 *Terebratula pleurocoela* - Bittner, p. 28, pl. 3, fig. 15.
 1920 *Terebratula praepunctata* - Diener, p. 87.
 1994 *Lobothyris praepunctata* - Siblik, p. 373, pl. 2, figs. 3, 4, 7, 9.

Material. 13 complete specimens (944-F/5-9-10-13-15-18-56-57-58-65, 754/28-92, 993-A/7).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); "section" 1, loc. 3; Early Ladinian (Curionii Zone).

Description. Small sized, biconvex, drop-shaped shell. Hinge narrow and curved, anterior commissure rectimarginate or slightly sulcate. Lateral commissure straight.

Ventral valve less convex than the dorsal one, with strong, slightly curved and pointed umbo, truncated by a foramen; low interarea.

Dorsal valve rather convex, with small umbo, hidden under the ventral one.

Smooth shell; some specimens with growth lines.

Interior of ventral valve with small teeth. Interior of dorsal valve with cardinal plates not clearly observed due to recrystallization and sockets with well developed inner socket-ridges.

Dimensions.

specimen	L	W	Th	h
993-A/7	10,4	9,5	5,3	6,6
944-F/9	14,8	11,7	7	7,7
944-F/10	10,5	10	6,2	6
944-F/13	9,8	9,1	5,4	3
944-F/15	>10	10,2	6,3	7
944-F/18	11,8	10,9	6,8	3,6
754/28	13	13,2	7,6	
944-F/57	7,5	7	4,1	3,5
944-F/58	7,8	7,5	4,2	3,7
944-F756	8,7	7,3	4,4	3,3
754/92	10,4	10,4	6,2	6,5
944-F/65	13,8		7,5	

Discussion. According to Bittner (1890) and to Siblik (1994) *L. praepunctata* shows a very variable outline. More specifically the latter author include *L. pleurocoela* Bittner, 1892 in synonymy with *L. praepunctata*. The specimens studied are more similar to *L. praepunctata* illustrated by Bittner (1890) in pl. 28, fig. 5. Due to recrystallization, the specimens studied show some differences in the hinge plates with respect to those illustrated by Siblik (1994, p. 373).

Other occurrences. *L. praepunctata* occurs in the Ladinian of Wettersteinkalk from Raxalpe (Bittner, 1892; Siblik, 1994) and in the Norian Dachstein Lmst. of Styria (Bittner, 1890). It is also present in the Norian of Caucasus and Bulgaria (Siblik, 1988).

Superfamily *Dielasmatoidae* Schuchert, 1913

Family *Angustothyrididae* Dagys, 1972

Genus *Angustothyris* Dagys, 1972

Type-species: *Waldheimia angustaeformis* Böckh, 1872.

***Angustothyris angustaeformis* (Böckh, 1872)**

Pl. 1, fig. 35-36; Pl. 2, fig. 5

1872 *Waldheimia angustaeformis* Böckh, p. 172, pl. 11, fig. 20.
 1890 *Waldheimia angustaeformis* - Bittner, p. 8, pl. 36, fig. 37-40.
 1895 *Waldheimia angustaeformis* - Salomon, p. 104, 141, pl. 3, fig. 29-31, 34.
 1912 *Waldheimia angustaeformis* - De Toni, p. 348.
 1920 *Waldheimia angustaeformis* - Diener, p. 97.
 1972 "*Zeilleria*" *angustaeformis* - Siblik, p. 195, pl. 62, fig. 5.
 1974 *Angustothyris angustaeformis* - Dagys, p. 187, pl. 48, fig. 1.
 1982 *Angustothyris angustaeformis* - Kochanova & Pevny, p. 29, pl. 5, fig. 12, pl. 6, fig. 3.

Material. 135 complete specimens (754/1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-17-18-19-20-21-22-23-24-25-26-29-30-31-32-33-34-35-36-37-39-40-41-42-43-44-45-46-47-48-49-51-52-68-70-80-83-84-85-86-87-88-89-90-91-93-94-96-97-98-99-100-101-102-103-105-107-109-110-112-114-116-121-125-126-127-130-132-136-137-139-140-141-142-143-144-145-149-152-153-157-165-167-168-171-177-186, 944-F/2-3-4-6-7-8-11-12-14-16-17-19-20-48-59-73, 993-A/2-5-6, 1011-Q/1, 993-B/1-2-3-4, 759/7, 993-E/2, 944-H/1, 904-D/2, 992-C/3, 1011-H/2, 992-G/2, 944-E/4, 1137, 939).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); "section" 1 and 2, loc. 3 and 5; Early Ladinian (Curionii Zone).

Description. Small to medium sized, biconvex to plano-convex, drop-shaped shell. Maximum width at about 1/2 length. Hinge narrow and straight, anterior commissure rectimarginate to slightly sulcate; lateral commissure rectimarginate.

Ventral valve with strong, curved umbo, truncated by a foramen. In some specimens a pedicle collar occurs. Low interarea.

Dorsal valve convex in the umbonal region but flatter near the anterior margin. Umbo incurved under the ventral valve. Some specimens show a weak sulcus,

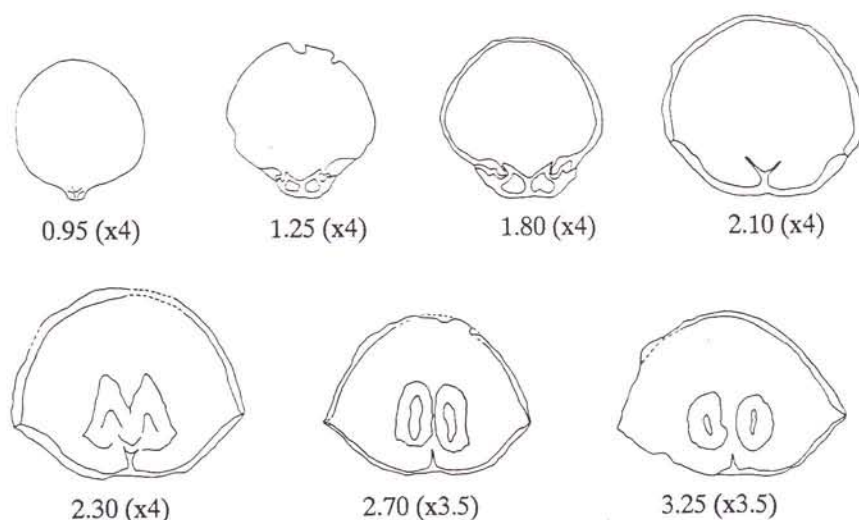


Fig. 13 - Serial sections of *A. angustaeformis* (specimen 944-F/8), showing internal characters. Distance from the umbo in mm.

visible only in the anterior half of the valve. Growth lines rarely occur.

Interior of ventral valve (Fig. 13) with long teeth, without dental plates. Interior of dorsal valve with median septum, rather low and long (extending to half the length of the valve); dental sockets with well developed inner and outer socket-ridges; septalium V-shaped.

Dimensions (Fig. 14).

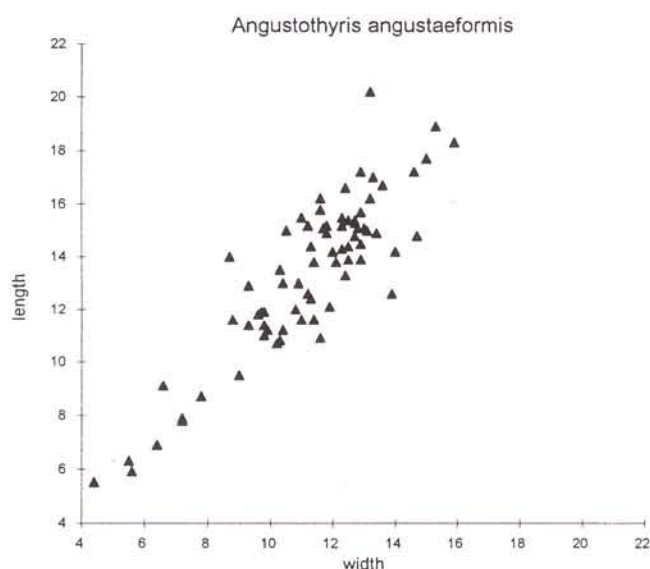


Fig. 14 - Length vs. width diagram of *A. angustaeformis* showing the regular increase in width during growth.

Intraspecific variability. The dorsal valve convexity varies inside the population.

Some variability affects the outline: some specimens are rather rounded, others are more elongated, but generally length exceeds width. Thickness is also variable, due to the major or minor convexity of the dorsal valve.

Discussion. The specimens studied are more similar to *Angustothyris angustaeformis* as illustrated by

Bittner (1890, pl. 36, fig. 37-40) and Dagys (1974, pl. 48, fig. 1) which shows a dorsal sulcus shallower than the original illustrated by Boeckh (1872, pl. 11, fig. 20).

Siblik (1972) provisionally assigned the species *angustaeformis* to the genus *Zeilleria* Bayle and stressed its similarity to *Aulacothyris angusta* (Schlotheim, 1820). Later Siblik (1983) and Urosevic et al. (1992) placed the species *angusta* in the genus *Silesiathyris* Brugge, 1977 which differs from *Angustothyris* in the occurrence of dental plates.

However, the internal characters of the specimens studied resemble those of *A. angustaeformis* illustrated by Dagys (1974, p. 188), differing only by a "V" shaped septalium and higher dorsal septum.

Other occurrences. *A. angustaeformis* occurs in the Anisian of Recoarokalk of the Balaton Highland (Hungary) (Böckh, 1872; Palfy, 1986), of M.te Rite (Cadore) in Italy and of Slovakia, Ex-USSR, Poland, Romania, Turkey, Caucasus. It occurs also in the Middle Triassic of Northern Alps (Bittner, 1890) and of Predazzo (Marmolada Lmst., Dolomites) (Salomon, 1895). It is present in the Ladinian of Wetterstein Lmst. from Karpaty Mts. (Kochanova & Pevny, 1982).

Angustothyris aff. *raxana* (Bittner, 1892)

Pl. 1, fig. 37-38; Pl. 2, fig. 3

Material. 20 complete specimens (754/72, 904-M/1-3-5-7-8-9-10-11-12-13-14-15-16-17-18-19-20-22-23).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); lower part of "section" 1, loc. 5; Early Ladinian (Curionii Zone).

Description. Medium sized, biconvex shell, with oval to sub-quadrangular outline. Maximum width at 1/2 the length. Hinge rather narrow and slightly curved; anterior commissure rectimarginate; all commissures sharp and laying in the same plane.

Ventral valve rather convex, with strong, slightly incurved and pointed umbo; low interarea.

Dorsal valve generally not very convex, rather flat in some specimens.

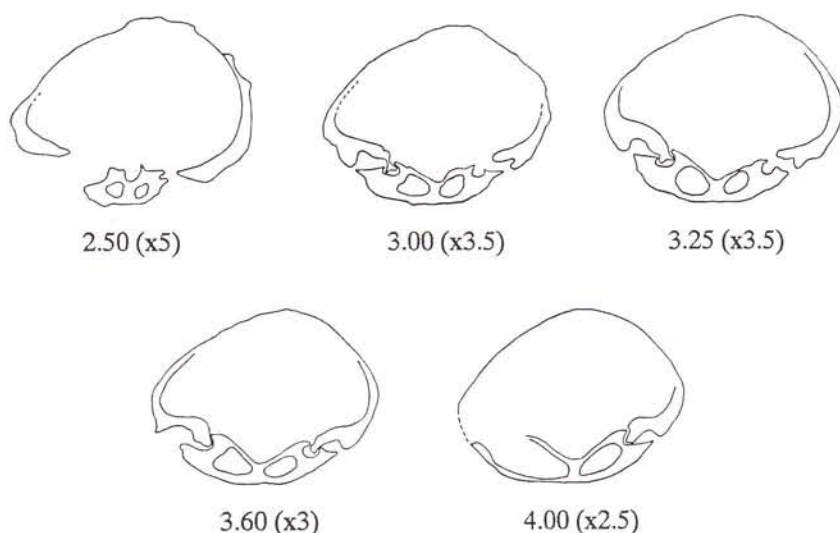


Fig. 15 - Serial sections of *A. aff. raxana* (specimen 904-M/20), showing internal characters. Distance from the umbo in mm.

Smooth shell with few growth lamellae.

Interior of ventral valve with elongated teeth (Fig. 15). Interior of dorsal valve with low and thick median septum, extending to 1/5 the valve length; dental sockets with well developed inner and outer socket ridges; wide V-shaped septalium.

Dimensions.

specimen	L	W	Th	h
754/72	24,7	22,5	13,1	11
904-M/22	>18,8	20	11	9,5
904-M/20	24,3	19,9	12	10,4
904-M/13	>19	17,3	9,5	>9,4
904-M/18	26,2	19,3	10,2	10,9
904-M/17	>22	19,9	10,7	9,9
904-M/19	>22,3	>17,1	12,3	
904-M/7	>22,4	19,7	11,2	
904-M/15	19,2	18,1		
904-M/9	16,3	>13,2	8,3	7,5
904-M/5	20,7	17,7	8,7	
904-M/10	>11,1	>9,4	4,6	6,2
904-M/11	>18	15,4	9,2	8,7
904-M/23	24,2	>17,7	10,9	
904-M/1	>13,9	11,7	7	5,5
904-M/16	20,4	18		

Intraspecific variability. Some specimens show a sharp angle between the lateral commissure and the hinge, whereas other specimens show rounded cardinal extremities.

Discussion. The specimens studied are placed in the genus *Angustothyris* because they show the internal characters of the genus as illustrated by Dagens (1974).

The specimens from Val Parina are rather similar to the species *raxana* Bittner (1892, pl. 3, fig. 14), differing slightly in their more rounded outline; more specifically they fit better with the lectotype illustrated by Siblik (1994, pl. 2, fig. 1). However, the internal structure of the species *raxana* were never illustrated, except for a brief remark of Bittner (1892, p. 29) who described the absence of the septum. The Val Parina specimens are thus doubtfully attributed to the species *raxana*.

Other occurrences. *A. aff. raxana* occurs in the Ladinian Wettersteinkalk (Bittner, 1892; Siblik, 1994) from Raxalpe.

Angustothyris aff. *ladina* (Bittner, 1890)

Pl. 1, fig. 39-41

Material. 5 complete specimens (993-E/6, 904-M/2-4-6-21).

Occurrence and age. Esino Lmst.; Val Parina (Val Brembana, Bergamo); upper part of "section" 1, loc. 5; Early Ladinian (Curionii Zone).

Description. Medium to large sized, biconvex to plano-convex shell, with sub-circular outline. Maximum width at 1/2 the length of the valve. Hinge rather wide and slightly curved; anterior commissure faintly unipli-cate.

Ventral valve flattening near the anterior margin, with strong, erect and rather pointed umbo; low interarea.

Dorsal valve flat, with small umbo and weak median fold, occurring near the anterior margin.

Smooth shell, with growth lines and lamellae.

Interior of ventral valve with strong and elongated teeth. Interior of dorsal valve with low and thick median septum, developed for 1/4 the length valve, joining with narrow and long crural plates to form a wide V-shaped septalium. Sockets with long and sharp inner socket-ridges and well developed outer socket-ridges.

Dimensions.

specimen	L	W	Th	h
904-M/4	>13	12,6		
904-M/6	19,9	18,3	8,3	7,3
904-M/21	>19,7	20,4	10,9	8,2
904-M/2	>18	18	8,5	5,6
993-E/6	>23,4	28,9	15,3	13,5

Discussion. The specimens studied are placed in the genus *Angustothyris* due to the similarity of the internal characters with those illustrated by Dags (1974).

The specimens from Val Parina differ from *T. ladina* Bittner, 1890 in their less pear-shaped outline and less angular cardinal extremities.

Other occurrences. *A. ladina* occurs in the Carnian of San Cassiano Fm. (Dolomites) (Bittner, 1890).

Acknowledgements.

This work could not have been accomplished without the extensive field work and specimens preparation done by M. Gervasutti. We are also deeply grateful to M. Balini, A. Dags, M. Gaetani, and M. Siblik for their valuable advices and revisions. A. Paganoni kindly put the Val Parina collections at our disposal. G. Pezzi, G. Chiodi and A. Rizzi are acknowledged for technical assistance.

REFERENCES

- Alexander R. R. & Gibson M. A. (1993) - Paleozoic brachiopod autoecology based on taphonomy: example from the Devonian Ross Formation of Tennessee. *Palaeogeog., Palaeoclimat., Palaeoecol.*, v. 100, pp. 25-35, Amsterdam.
- Angiolini L. (1993) - Ultrastructure of some Permian and Triassic Spiriferida and Athyridida (Brachiopoda). *Riv. It. Paleont. Strat.*, v. 99, pp. 283-306, Milano.
- Bittner A. (1890) - Brachiopoden der Alpenen Trias. *Abh. K. K. Geol. Reichsanst.*, v. 14, pp. 1-325, Wien.
- Bittner A. (1892) - Brachiopoden der alpinen Trias. *Nach. I. Abh. K.K. Geol. Reichsanst.*, v. 17, pp. 1-40, Wien.
- Bittner A. (1903) - Brachiopoden und Lamellibranchiaten aus der Trias von Bosnien, Dalmatien und Venetien. *Sep.-Abd. Jb. K.K. Geol. Reichsanst.*, v. 52, pp. 495-642, Wien.
- Böckh J. (1872) - Geological setting of the Southern part of the Bakony Mts.. *Jb. Ung. Geol. Reichsanst.*, v. 2 (2), pp. 65-173 (Hungarian version), Budapest.
- Brack P. & Rieber H. (1993) - Towards a better definition of the Anisian/Ladinian boundary: New stratigraphic data and correlations of boundary sections from the Southern Alps. *Ecl. Geol. Helv.*, v. 86, pp. 415-527, Basel.
- Carter J. L., Johnson J.G., Gourvenec R., Hou H. (1994) - A revised classification of the spiriferid brachiopods. *Ann. Carn. Mus.*, v. 63, pp. 327-374, Pittsburgh.
- Casati P. & Gnaccolini M. (1967) - Geologia delle Alpi Orobic occidentali. *Riv. It. Paleont. Strat.*, v. 73, pp. 26-162, Milano.
- Dags A. (1974) - Triassic Brachiopods (morphology, classification, phylogeny, stratigraphical significance and biogeography). *Transact. Inst. Geol. Geoph., Acad. Sci.*, v. 214, pp. 1-385, Novosibirsk.
- Dags A. (1996) - On the classification of the order Athyridida. In Copper P. & Jin J. (Eds.) *Brachiopods. Proceedings of the Third International Congress, Sudbury (Canada), 2-5 September 1995*, A. A. Balkema, pp. 89-90, Rotterdam.
- Dags A. (1996) - Remarks on the classification of punctate spiriferids. In Copper P. & Jin J. (Eds.) *Brachiopods. Proceedings of the Third International Congress, Sudbury (Canada), 2-5 September 1995*, A. A. Balkema, pp. 91-94, Rotterdam.
- De Toni A. (1912) - Brachiopodi della Zona a *Ceratites trinodosus* di Monte Rite in Cadore. *Mem. Ist. Geol. R. Univ. di Padova*, v. 1, pp. 317-351, Padova.
- Diener C. (1920) - Brachiopoda Triadica. *Fossilium Catalogus I Animalia*. v. 10, pp. 1-108, Berlin.
- Dunker W. (1851) - Über die im Muschelkalk Oberschlesiens bis jetzt gefundenen Molluschen. *Palaeontographica*. v. I, pp. 1-237, Stuttgart.
- Fantini Sestini N. (1994) - The Ladinian ammonoids from Calcare di Esino of Val Parina (Bergamasc Alps, Northern Italy). Pt. 1. *Riv. It. Paleont. Strat.*, v. 100, pp. 227-284, Milano.
- Fantini Sestini N. (1996) - The Ladinian ammonoids from the Calcare di Esino of Val Parina (Bergamasc Alps, Northern Italy). Pt. 2. *Riv. It. Paleont. Strat.*, v. 102, pp. 211-226, Milano.
- Gaetani M. (1966) - Il Trias in Lombardia. (Studi geologici e paleontologici). XVI. *Decurtella*, nuovo genere triassico di Rhynchonellida. *Riv. It. Paleont. Strat.*, v. 72, pp. 343-356, Milano.
- Gaetani M. (1969) - Osservazioni paleontologiche e stratigrafiche sull'Anisico delle Giudicarie (Trento). *Riv. It. Paleont. Strat.*, v. 75, pp. 469-546, Milano.
- Jadoul F., Fantini Sestini N. & Gervasutti M. (1992) - The Middle Triassic of the Brembana Valley: preliminary study of the Esino platform (Bergamasc Alps). *Riv. It. Paleont. Strat.*, v. 98, pp. 299-324, Milano.
- Kittl E. (1908) - Beitrage zur Kenntnis der Triasbildungen der nordoestlichen Dobrudscha. *Denkschr. Akad. Wiss.*, v. 81, pp. 447-532, Wien.
- Kochanova M. & Pevny J. (1982) - Bivalves and brachiopods from Wetterstein limestones of Ostry vrch (Malé Karpaty Mts.). *Zap. Karpaty Paleont.*, v. 8, pp. 7-40, Bratislava.
- Krystyn L. (1983) - Das Epidaurus-Profil (Griechenland) - Ein Beitrag zur Conodonten-Standardzonierung des tethyalen Ladin und Unterkarn. In Zapfe H. (Ed.) - *Neue Beitrage zur Biostratigraphie des Tethys-Trias*.

- Schriften. Erdwiss. Komm. Oesterr. Akad. Wiss.*, v. 5, pp. 231-258, Wien.
- Lobitzer H., Mandl G.W., Mazzullo S. J. & Mello J. (1990) - Comparative study of Wetterstein carbonate platforms of the easternmost northern Calcareous Alps and West Carpathian mountains: preliminary results. Minarikova D. & Lobitzer H., *Thirty years of geological cooperation between Austria and Czechoslovakia*, pp. 136-158, Vienna-Praga.
- Margalef R. (1957) - La teoria de la informacion en ecologia. *Mem. Real. Acad. Ciencias. Y. Arte*, v. 33, pp. 373-449.
- Muenster G. (1841) - Beitrage zur Geognosie und Petrefaktenkunde des Suedoestlichen Tirols, v. 4, pp. 1-152, Bayreuth.
- Paganoni A. (1985) - Una importante donazione di fossili: la "Collezione Gervasutti". *Riv. Mus. Sc. Nat. Bg.*, v. 9, pp. 147-148, Bergamo.
- Palfy J. (1986) - Investigations on Middle Triassic brachiopod faunas from the Balaton Highland (Transdanubian Central Range, Hungary). *Ösl. Viták*, v. 33, pp. 3-52, Budapest.
- Palfy J. (1988) - Middle Triassic rhynchonellids from the Balaton Highland (Transdanubian Central Range, Hungary). *Ann. His.- Nat. Mus. Nat. Hung.*, v. 80, pp. 25-46, Budapest.
- Palfy J. (1991) - Paleocological significance of Anisian (Middle Triassic) brachiopod assemblages from the Balaton Highland, Hungary. MacKinnon, Lee & Campbell (eds), *Brachiopods through time*: pp. 241-246, Rotterdam.
- Sacchi Vialli G. & Vai A. (1958) - Revisione della fauna triassica bresciana: la fauna dell'Anisico. *Atti Ist. Geol. Univ. di Pavia*, v. 8, pp. 41-91, Pavia.
- Salomon W. (1895) - Geologische und palaeontologische Studien über die Marmolada. *Palaeontographica*, v. 42, pp. 1-210, Stuttgart.
- Schlotheim E. F. (1814) - Beitrage zur Naturgeschichte der Versteinerungen in geognostischer Hinsicht. *Taschenbuch fuer die gesamte Mineralogie von Leonhard, C. C.*, v. 7, pp. 3-134.
- Schlotheim E. F. (1820) - Die Petrefaktenkunde auf ihrem jetzigen Standpunkte. Gotha, pp. 1-430.
- Siblik M. (1971a) - Anisian Rhynchonellids from the Slovak Kars Region. *Geol. práce Spravy*, v. 56, pp. 163-184, Bratislava.
- Siblik M. (1971b) - New Anisian Rhynchonellid from Slovakia. *Geol. Zbornik-Geol. Carpat.*, v. 22, pp. 159-167, Bratislava.
- Siblik M. (1972) - Anisian Spiriferida and Terebratulida from the Slovak Kars Region. *Geol. práce Spravy*, v. 59, pp. 179-202, Bratislava.
- Siblik M. (1975) - Triassic Brachiopods from Nepal. *Riv. It. Paleont. Strat.*, v. 81, pp. 133-160, Milano.
- Siblik M. (1977) - New brachiopod genus *Gemerithyris* gen. n. from the Slovak Triassic. *Zap. Karpaty Paleont.*, v. 2-3, pp. 203-220, Bratislava.
- Siblik M. (1982) - Genus *Austriellula* Strand, 1928 (Brachiopoda) from the Upper Triassic. *Zap. Karpaty Paleont.*, v. 8, pp. 41-70, Bratislava.
- Siblik M. (1983) - Triassic brachiopods of the Northern Alps and their generic attributions. *Schrift. Erdwissensch. Kommis.*, v. 5, pp. 277-286, Wien.
- Siblik M. (1988) - Brachiopoda Triadica. *Catalogus Fossilium Austriae, Vc 2a: Brachiopoda Mesozoica*, pp. 1-131, Wien.
- Siblik M. (1990) - Carnian Terebratulid brachiopods from the Slovak Karst (SE Slovakia). *Zap. Karpaty Paleont.*, v. 11, pp. 7-34, Bratislava.
- Siblik M. (1991) - Triassic Brachiopods from Aghdarband (NE-Iran). *Abh. Geol. B.-A.*, v. 38, pp. 165-174, Wien.
- Siblik M. (1994) - The Brachiopod Fauna of the Wetterstein Limestone of the Raxalpe (Austria). *Jahrb. Geol. Bund.*, v. 137, pp. 365-381, Wien.
- Speciale A. (1967) - Il Trias in Lombardia (studi geologici e paleontologici) XXI. Fossili del Trias medio delle valli Trompia e Sabbia. *Riv. It. Paleont. Strat.*, v. 73, pp. 1055-1140, Milano.
- Taddei Ruggiero E. (1968) - Brachiopodi triassici della Pietra Maura (Lucania). *Studio paleontologico e statistico. Boll. Soc. Natur. Napoli*, v. 77, pp. 349-392, Napoli.
- Taddei Ruggiero E. (1981) - Ultrastruttura del guscio di alcuni Spiriferidi Triassici - *Boll. Soc. Paleont. It.*, v. 20, pp. 185-196, Modena.
- Urosevic D., Radulovic V. & Pesic L. (1992) - Middle Triassic brachiopods from the Yugoslavian Carpatho-Balkanides. *Revue de Paléobiologie*, v. 11, pp. 469-481, Geneve.
- Vörös A. & Palfy J. (1989) - The Anisian/Ladinian boundary in the Vászoly section (Balaton Highland, Hungary). *Frag. Mineral. Palaeont.*, v. 14, pp. 17-27, Budapest.
- Wilckens R. (1909) - Palaontologische Untersuchung triadischer Faunen aus der Umgebung von Predazzo in Sudtirol. *Verhandl. d. Heidelb. Naturhist.-Med. Vereins. N.F.*, v. 10, pp. 81-231, Heidelberg.
- Williams A., Rowell A.J., Muir-Wood H.M., Pitrat C.W., Schmidt H., Stehli F.G., Ager D.W., Wright A.D., Elliott G.F., Amsden T.W., Rudwick M.J.S., Hatai K., Biernat G., McLaren D.J., Boucot A.J., Johnson J.G., Staton R.D., Grant R.E. & Jope H.M. (1965) - *Treatise on Invertebrate Paleontology. Pt. H: Brachiopoda*, pp. H1-H927. Moore R. C. (Ed.), Lawrence, Kansas.

Received April 4, 1997; accepted June 12, 1997