

Early Devonian Ostracodes of Thuringian Ecotype from NW Anatolia (Turkey)

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With 6 figures

DOJEN, C., ÖZGÜL, N., GÖNCÜOĞLU, Y. & GÖNCÜOĞLU, M. C. (2004): Early Devonian Ostracodes of Thuringian Ecotype from NW Anatolia (Turkey). – N. Jb. Geol. Paläont., Mh., 2004: 733–748; Stuttgart.

Abstract: The first report of silicified ostracodes of Thuringian Ecotype (sensu BECKER) from Early Devonian (Emsian) limestones of the Pelitli and Kartal formations in NW Anatolia (Yacik area, Istanbul, Turkey) is presented. The poorly preserved faunas of only nine taxa indicate faunal relations of the Istanbul Terrane especially to Thuringia (Germany) and Morocco during the Emsian.

Zusammenfassung: Aus Pelitli Formation und Kartal Fomation (Unterdevon, Emsium) von NW Anatolien (Yacik-Gebiet, Istanbul, Türkei) werden erstmals verkieselte Ostrakoden des Thüringischen Ökotyps sensu BECKER beschrieben. Die mäßig erhaltenen Faunen mit insgesamt neun Taxa weisen auf Beziehungen des Istanbul-Terrane insbesondere mit Thüringen (Deutschland) und Marokko während des Emsium hin.

1. Introduction

The Paleozoic rocks in the Istanbul area, NW Anatolia, are characterized by a continuous and well-developed sedimentary succession, extending from Ordovician to Carboniferous (see ABDÜSSELAMOĞLU 1963, 1977). The stratigraphy and paleontology of these rock-units have been studied since the 1860's. PAECKELMANN (1938) performed the first detailed stratigraphic work in Istanbul, followed by a series of comprehensive studies (see HAAS 1968 and KAYA 1973 for a brief review of the previous studies).

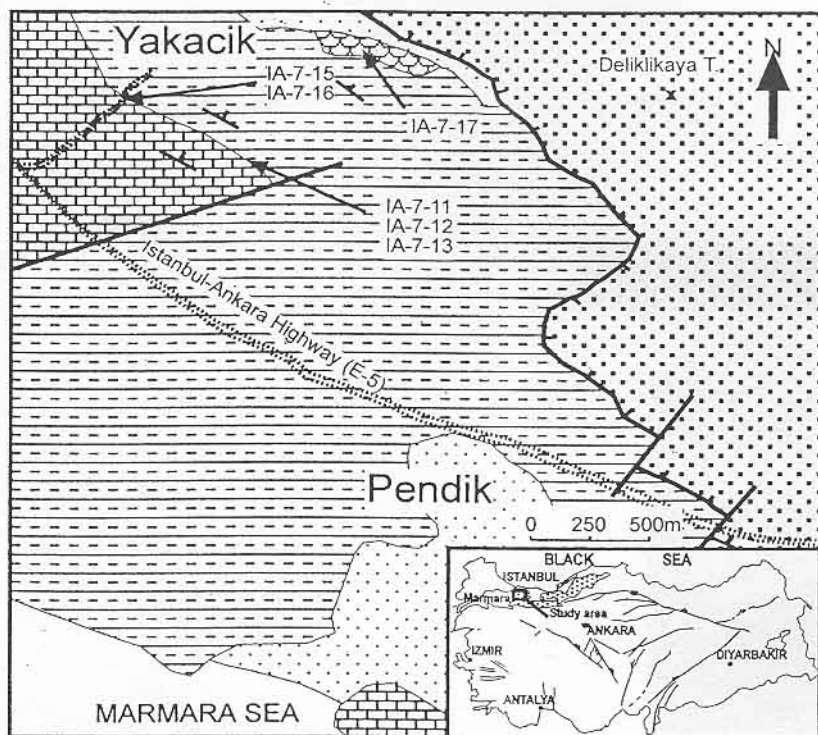
The Late Silurian to Late Devonian part of the succession is mainly characterized by a variety of carbonate and clastic rocks, which were dated by means of brachiopods, corals, conodonts and trilobites (see HAAS 1968; ÖNALAN 1988). SENGÖR et al. (1984) suggested that the Istanbul Unit was located at the southern part of Laurussia throughout its early geological history and that the Late Silurian to Late Devonian interval is characterized in this unit by Atlantic-type continental margin sediments. GÖNCÜOĞLU (1997, 2001) recently proposed that the Paleozoic rocks of the Istanbul area represent a distinct terrane and display similarities to the Gondwana-derived terranes such as Iberia and Bohemia.

This study presents the first record of ostracodes from the Early Devonian carbonates in the Yakacık area on the east of Bosphorus.

2. Geology of the sample locations

The Devonian succession in the Istanbul area includes the Pelitli, Kartal and Büyükada formations. The Pelitli Formation, introduced by HAAS (1968), is almost 450 m thick, comprising a variety of carbonate rocks, ranging from boundstone to mudstone. The lower part of the unit consists of massive reefal limestones (Dolayoba Limestone) rich in late Silurian corals. They gradually pass upwards through dark-colored, thinly laminated carbonate mudstones of Lochkovian age, followed by well-bedded wackestones and mudstones of Pragian age, as dated by means of conodonts, Bohemiantype brachiopods and trilobites (HAAS 1968). The upper part of the Pelitli Formation is built up of nodular limestones, called the "Knollenkalke von Yakacık" by PAECKELMANN (1938). According to conodonts and trilobites, this unit is of Early Emsian age (HAAS 1968). The conformably overlying Kartal Formation comprises mainly mica-rich fossiliferous shales with a few nodular limestone intercalations in its lower part. Brachiopods and trilobites demonstrate that this formation is Late Emsian (PAECKELMANN 1938; HAAS 1968). A change from Bohemian to Rhenish brachiopod and trilobite faunas occurs in this formation (HAAS 1968). The overlying Büyükada Formation is a condensed succession with nodular limestones and cherts; its age is Late Devonian (HAAS 1968). To the east of the studied area, the quartz-arenites of the Aydos Formation with Ordovician ostracodes (SAYAR & SCHALLREUTER 1989) are thrust over the Devonian successions. The ostracodes studied herein have been found within the transition zone between the nodular limestones of the Pelitli Formation and the overlying Kartal Formation.

In the south of Yakacık (Fig. 1), the second author collected samples along three measured sections from the nodular limestone bands in the upper part of the Pelitli Limestone and in the lower part of the Kartal Formation (Fig. 2). The samples IA-7-11, IA-7-12 and IA-7-15 are from the upper part of



Explanation







-  alluvium and colluvium - **QUATERNARY**
 -  Büyükada Formation (nodular limestone)
 -  Kartal Formatio (sandy and silty shales)
 -  Pelitli Formation (various limestones)
 -  Aydos Formation (mainly quartzarenite) - **ORDOVICIAN**
 -  thrust fault
- DEVONIAN**

Fig. 1. Geological map of Istanbul-Yakacik area with the locations of the samples and studied sections shown on Fig. 3.

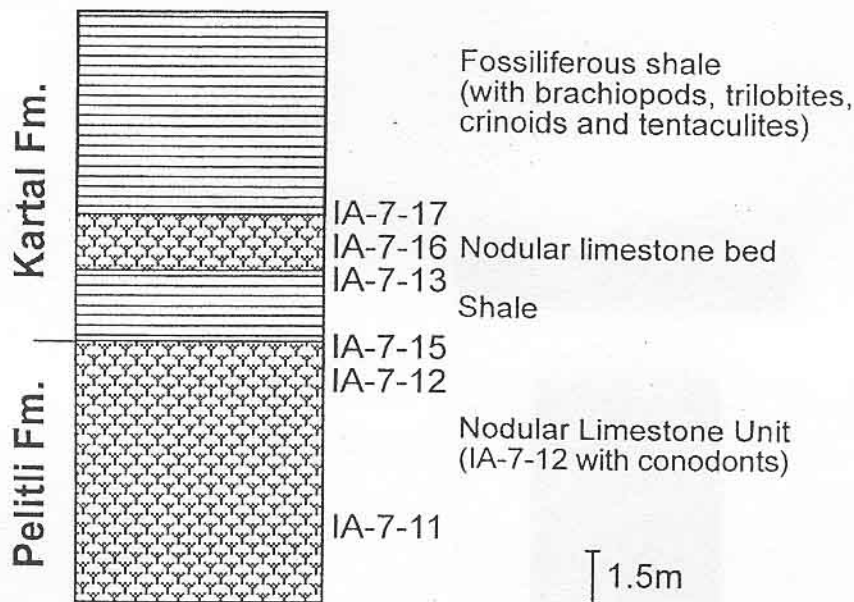


Fig. 2. Generalized columnar section of the Pelitli Formation and lower part of the Kartal Formation with the locations of the ostracod-bearing samples.

Pelitli Limestone, and the samples IA-7-13, IA-7-16 and IA-7-17 are from the nodular limestone intercalations within Kartal Formation (Fig. 3). All samples yielded ostracodes in variable preservation.

Sample IA-7-12 yielded, among other conodont elements *Icriodus beckmanni sinuatus* KLAPPER, ZIEGLER & MASHKOVA, 1978, indicative of Early to early Late Emsian.

3. Systematics

Remarks: All ostracodes are silicified, and were obtained from limestones etched for conodonts. The preservation is poor and the bulk of the ostracodes is identified in open nomenclature. The studied specimens are deposited in the Natural History

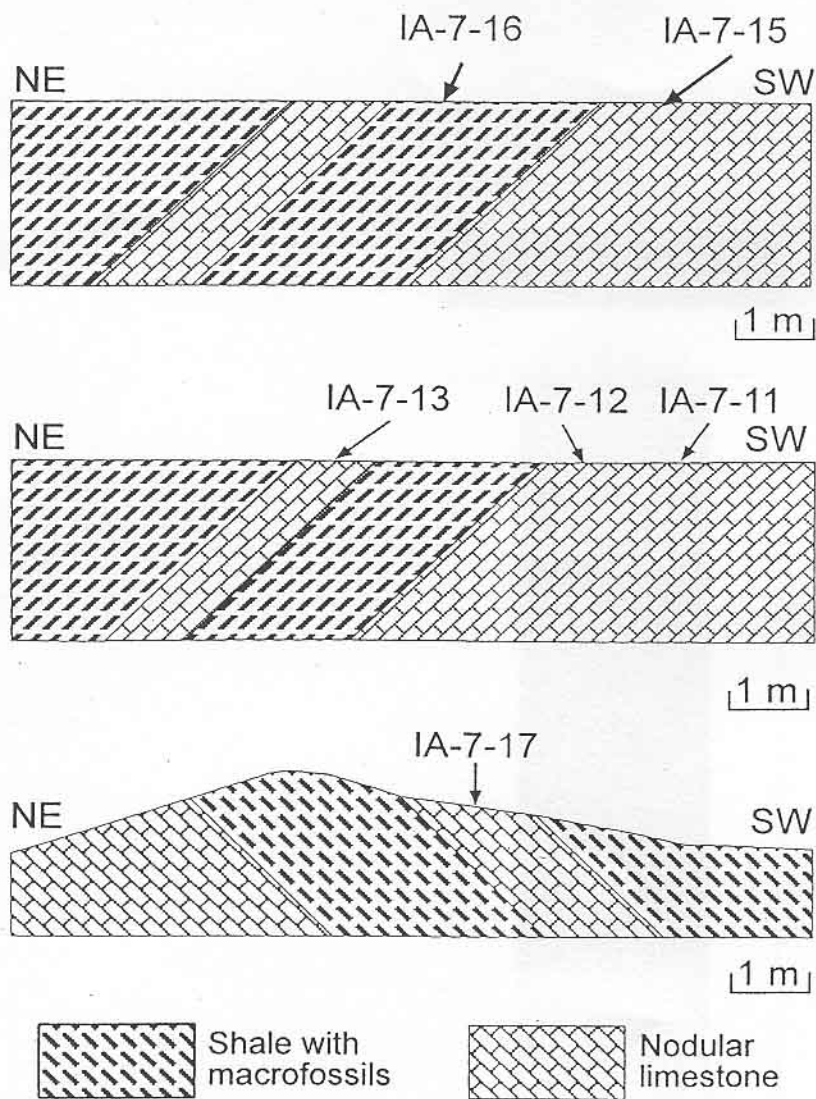


Fig. 3. Geological cross-sections of the studied successions. The localities of the cross-sections are shown on Fig. 1.

Taxa	Formation	Pelitli Formation					
		IA7-11	IA7-12	IA7-13	IA7-15	IA7-16	IA7-17
<i>Aechima</i> sp					4 frag.		1 frag.
<i>Sulcella</i> ? sp.						1	
<i>Marginohealdia costata</i>	7	1		7		5	
Thlipsuridae ? sp.	1						
<i>Bythocyproidea</i> sp.	2						
" <i>Cytherellina</i> " <i>inconstans</i>	6	1		1		1	1
<i>Praepilatina</i> sp., gr. <i>P. praepilatina</i>	1			1		1	
<i>Tricornina (Bohemina)</i> sp. A		1					
<i>Tricomina (Bohemina)</i> sp. B	2						
Podocopida indet.	8			8		9	8

Fig. 4. Distribution chart of the ostracods from the Pelitli and Kartal Formations.

Museum, General Directorate of Mineral Research and Exploration of Turkey (MTA), Ankara under the inventory numbers IA-7-11, IA-7-12, IA-7-13, IA-7-15, IA-7-16 and IA-7-17.

Abbreviations: C: Carapace; LV: Left valve; RV: Right valve; l_{\max} : maximum length; h_{\max} : maximum height; l/h: length to height ratio; IA-7-XX: sample numbers.

Fig. 5. 1-3 – *Marginohealdia costata* (K. ZAGORA, 1968), 1: right valve, sample IA-7-15, a) external lateral view, b) oblique ventral view; 2. left valve, external lateral view, sample IA-7-15; 3. right valve, internal lateral view, sample IA-7-11. 4 – *Sulcella?* sp., left valve, external lateral view, sample IA-7-16. 5-6 – "*Cytherellina*" *inconstans* K. ZAGORA, 1967, 5: right valve, external lateral view, sample IA-7-16, 6: right valve, external lateral view, sample IA-7-15. (all 60 x; scale bar: 1.0 mm).

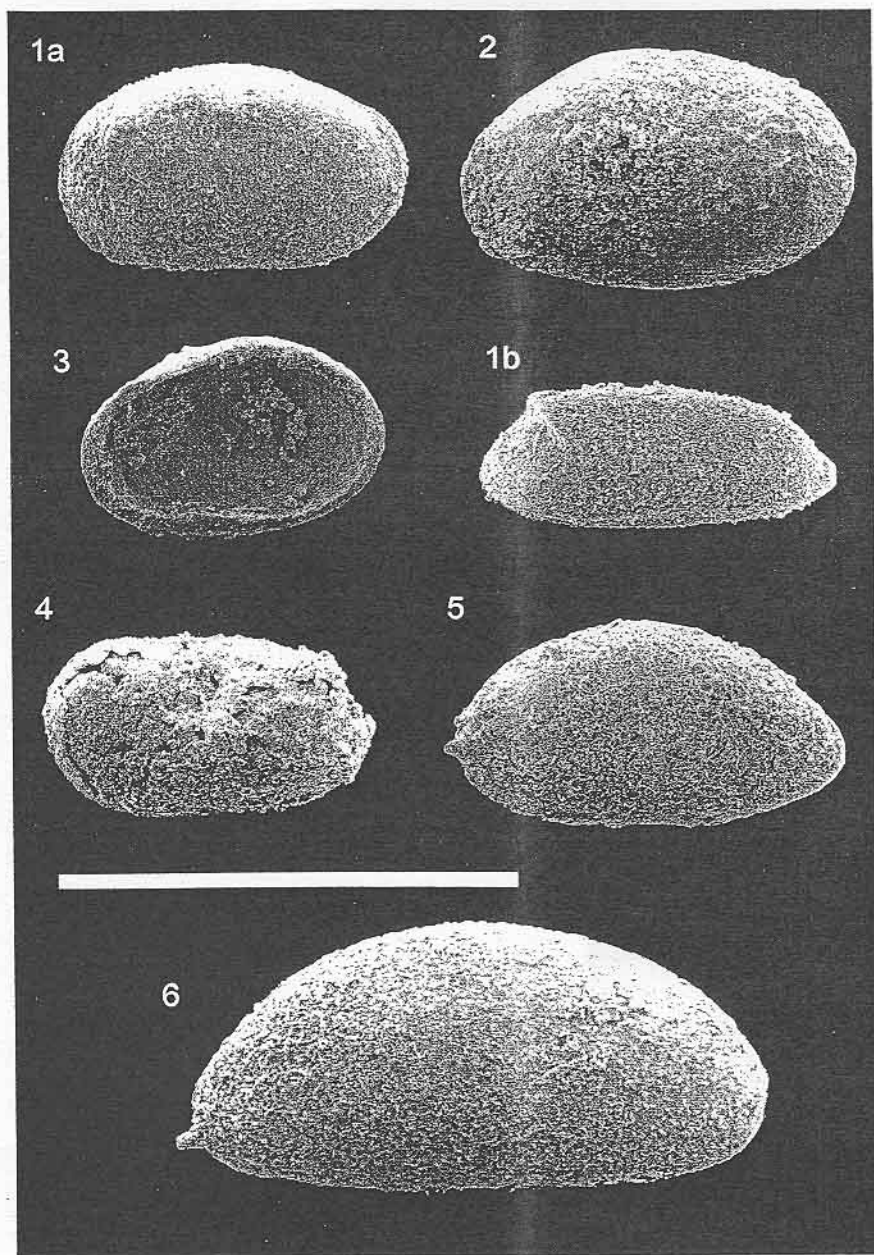


Fig. 5 (Legend see p. 738)

Class	Ostracoda LATREILLE, 1802
Order	Palaeocopida HENNINGSMOEN, 1953
Suborder	Palaeocopina HENNINGSMOEN, 1953
Superfamily	Drepanellacea ULRICH & BASSLER, 1923
Family	Aechminidae BOUČEK, 1936
Genus	<i>Aechmina</i> JONES & HOLL, 1869

Type species: *Aechmina cuspidata* JONES & HOLL, 1869.

Aechmina sp.

Material: 4 fragmentary valves from sample IA-7-15; 1 fragmentary valve from sample IA-7-17.

Remarks: All fragments have a rather long mid-dorsal spine with a narrow base. *Aechmina gracilis* BLUMENSTENGEL, 1965 from the Ordovician in Thuringia ("Lederschiefer") is similar in these features. The poor preservation of the present material does not allow a closer identification.

Occurrence: Pelitli and Kartal Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Suborder	Platycopina SARS, 1866
Family	<i>Cavellenidae</i> EGOROV, 1950
Genus	<i>Sulcella</i> CORYELL & SAMPLE, 1932

Type species: *Sulcella sulcata* CORYELL & SAMPLE, 1932.

Sulcella? sp.

Figs. 5-4

Material: 1 LV from sample IA-7-16.

Remarks: The poorly preserved subrectangular valve with a distinct adductorial pit and an inflated posterior part is assumed to be a *Sulcella*. As the stragulum and the hinge system are not observable, the affiliation to the genus is tentative.

Occurrence: Kartal Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Order	Podocopida SARS, 1866
Suborder	Metacopina SYLVESTER-BRADLEY, 1961
Superfamily	Healdioidea HARLTON, 1933
Family	Healdiidae HARTON, 1933
Genus	<i>Bythocyproidea</i> STEWARD & HENDRIX, 1945

Type species: *Bythocyproidea sanduskyensis* STEWARD & HENDRIX, 1945.

Bythocyproidea sp.

Material: 2 RVs from sample IA-7-11.

Remarks: Both valves are subreniform in outline and h_{max} is situated in the posterior part of the valve. One specimen shows a holosolenic contact list. The surface seems to be smooth. Due to the poor state of preservation, a closer identification is not possible.

Occurrence: Pelitli Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Superfamily Thlipsuracea ULRICH, 1894
Family Thlipsuridae ULRICH, 1894
Genus *Marginohealdia* BLUMENSTENGEL, 1965

Type species: *Marginohealdia marginata* BLUMENSTENGEL, 1965.

Marginohealdia costata (K. ZAGORA, 1968)

Figs. 5-1 a, 5-1 b, 5-2, 5-3

*1968 *Healdia costata*. – K. ZAGORA: 41, pl. 8, figs. 10-11, 13.
1977 *Marginohealdia costata*. – BLUMENSTENGEL: 15.

Material: 4 LVs and 3 RVs from sample IA-7-11; 1 RV from sample IA-7-12; 1 C and 6 RVs from sample IA-7-15; 2 LVs and 3 RVs from sample IA-7-16.

Dimensions (of 2 selected specimens): LV: l_{max} : 0,93 mm, h_{max} : 0,61 mm; RV: l_{max} : 0,87 mm, h_{max} : 0,60 mm.

Important diagnostic features: Outline suboval in lateral view, distinct posterior ridge in both valves; marginal flange present; smooth lateral surface.

Description: See ZAGORA (1968: 41).

Occurrence: Pelitli Fm. and Kartal Fm. (Early to early Late Emsian), NW Anatolia, Turkey; "Tentakuliten-Schiefer" (Early to early Late Emsian), Thuringian Slate Mountains, Germany; Khebchia Fm. (Late Emsian) of SW Anti-Atlas, Morocco (BECKER, oral comm.).

Thlipsuridae? sp.

Material: 1 RV from sample IA-7-11.

Remarks: The single specimen is elongate, ellipsoidal in lateral outline. It has a distinct posterior ridge and a marginal ridge. As the hinge structure is not preserved, its assignment to the family is uncertain.

Occurrence: Pelitli Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Suborder	Podocopina SARS, 1866
Superfamily	Bairdiocypridacea SHAVER, 1961
Family	Bairdiocyprididae SHAVER, 1961
Genus	<i>Praepilatina</i> POLENOVA, 1970

Type species: *Bairdiocypris praepilata* POLENOVA, 1960.

Praepilatina sp., ex. gr. *P. praepilata* (POLENOVA, 1960)
sensu BECKER, 2001 Figs. 6-1, 6-2

*1960 *Bairdiocypris praepilatus*. – POLENOVA: 64, pl. 8, fig. 5.

2001 *Praepilatina* sp., Gr. *P. praepilata*. – BECKER: 79-80, pl. 7, fig. 16; pl. 11, figs. 1-3; pl. 15, fig. 8. [with detailed synonymy]

Material: 1 RV from sample IA-7-11; 1 LV from sample IA-7-15; 1 RV from IA-7-16.

Important diagnostic features (according to BECKER 2001: 80): Valves in lateral outline irregularly semicircular; dorsal margin highly arched; "apical region" distinct; RV with marginal structure, which is anteroventrally and posteroventrally flange-like and grades posteroventrally into a small spine or a corner.

Occurrence: Early Devonian of Russia, Europe and N-Africa: Pelitli Fm. and Kartal Fm. (Early to early Late Emsian), NW Anatolia, Turkey; Verchnekrekov-, Remnevo- and Yakuschin-Horizon (Early Devonian), Altai; Emsian of Ougarta Hills, Algeria; Moniello-Fm. and Santa Lucia Fm. (Emsian), Cantabrian Mts.; Montagne Noire (Emsian); Eastern margin of the Rhenish Slate Mts. (Lochkovian to Pragian); Carnic Alps (Siegenian to Emsian); Khebchia Fm. (Late Emsian) of SW Anti-Atlas, Morocco (BECKER, oral comm.).

"Cytherellina" inconstans K. ZAGORA, 1967 Figs. 5-5, 5-6

*1967 *Cytherellina inconstans*. – K. ZAGORA: 705f, pl. 3, figs. 22-28.

2001 *"Cytherellina" inconstans*. – BECKER: 80-81, pl. 15, fig. 1. [with detailed synonymy]

Material: Six RVs from sample IA-7-11; one RV from sample IA-7-12, one RV from sample IA-7-15; one RV from sample IA-7-16; one RV from sample IA-7-17.

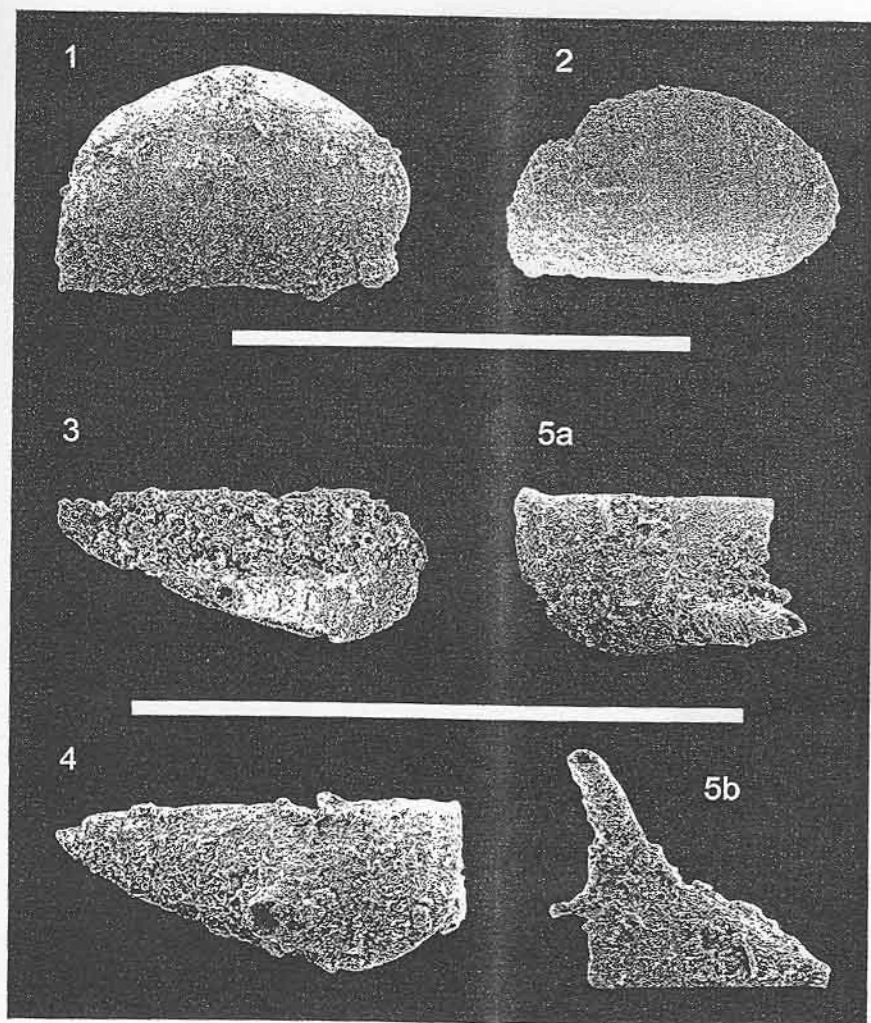


Fig. 6. 1-2 - *Praepilatina* sp., ex. gr. *P. praepilatina* (POLENOVA, 1960) sensu BECKER, 2001; 1: right valve, external lateral view, sample IA-7-11; 2 - right valve, external lateral view, sample IA-7-16; 3 - *Tricornina (Bohemina)* sp. A, right valve, external lateral view, sample IA-7-12; 4-5 - *Tricornina (Bohemina)* sp. B; 4: right valve, external lateral view, sample IA-7-11; 5: left valve, sample IA-7-11, a) external lateral view b) oblique dorsal view. (all 60 x; scale bar: 1.0 mm).

Important diagnostic features (after BECKER 2001: 80): Valves in lateral outline suboval to subtriangular; h_{\max} about mid-length; anterior margin slightly higher than posterior margin; posteroventrally a small spine on each valve.

Description: The lateral outline of the right valves is elongate, suboval to roundly triangular; h_{\max} is situated near mid-length. The dorsal margin is long and evenly rounded; the posterior margin is more narrowly curved than the anterior margin. The ventral margin is straight to slightly convex. The l/h is about 1.6. The right valves have a small posteroventral spine. The contact list and the marginal ridge are preserved in some specimens. The surfaces of the valves are smooth.

Remarks: Following ADAMCZAK (1976: 391), the genus *Cytherellina* JONES & HOLL, 1896 is now included within the family Healdiidae HARLTON, 1933 (Metacopina without duplicature). This cannot be applied to "*Cytherellina*" *inconstans* K. ZAGORA, 1967, which has a calcified inner lamella (BECKER, oral comm.) and is preliminarily assigned to the Bairdiocyprididae.

"*Cytherellina*" *inconstans* was originally described as having a posteroventral spine on each valve (ZAGORA 1967: 705). In the present material only right valves with a posteroventral spine were found, whereas left valves with such a spine could not be identified. Also in other articles (BECKER & SANCHEZ DE POSADA 1977; GROOS-UFFENORDE et al. 1972; GROOS-UFFENORDE & LEFÈVRE 1979) only right valves were reported and/or figured. Only Becker (2001: 80) reported a left valve without a spine. In Moroccan material (including articulated carapaces; BECKER, oral comm.), all left valves lack spines. The question arises whether all these specimens are conspecific and whether the presence versus absence of a spine on the left valve is a matter of variability.

Occurrence: Pelitli Fm. and Kartal Fm. (Early to early Late Emsian), NW Anatolia, Turkey; Schwärzschiefer (Early Eifelian, *Nowakia sulcata* Zone), Thuringia, Germany; Moniello- and Santa Lucía Fm. (Emsian), Cantabrian Mts., Spain; Vilaller Fm. (Late Emsian to Eifelian), Spanish Pyrenees; Khebia Fm. (Late Emsian) of SW Anti-Atlas, Morocco (BECKER, oral comm.).

? Superfamily	Cytheracea BAIRD, 1850
Family	Tricorninidae BLUMENSTENGEL, 1965
Genus	<i>Tricornina</i> BOUČEK, 1936

Type species: *Tricornina navicula* BOUČEK, 1936.

Subgenus *Tricornina* (*Bohemina*) ŠNAJDR, 1951

Type species: *Tricornina* (*Bohemina*) *prantli* ŠNAJDR, 1951.

Tricornina (Bohemina) sp. A

Fig. 6-3

Material: 1 RV from sample IA-7-12.

Description: The outline of the valve is subtriangular, the straight dorsal margin is about 85 % of l_{max} . The anterior corner is rounded, the anterior cardinal angle about 135°. The anterior margin is broadly rounded and merges evenly with the ventral margin. h_{max} situated near the first quarter of the length. The posterior margin is very short. The posterior cardinal angle is about 95°. An indistinct and small marginal rim extends parallel to the free margin. The midventral spine has its base just behind h_{max} . The spine, although broken, is slim and long, and its preserved length is about 50 % of l_{max} . It is slightly curved and directed backwards and upwards. The base of spine is moderately widened.

Remarks and comparisons: The present specimen is well distinguished by its broadly rounded anterior margin. It is similar to *T. (B.) sp. A* sensu BECKER, 1987 from the Devonian-Carboniferous boundary in NW Africa; in the latter the anterior cardinal angle less obtuse (about 120°).

Occurrence: Pelitli Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Tricornina (Bohemina) sp. B

Figs. 6-4, 6-5a, 6-5b

Material: 1 RV and 1 fragmentary LV from sample IA-7-11.

Description: The outline of valves is subtriangular with a long and straight dorsal margin (= l_{max}). The anterior cardinal angle is about 90°. The anteroventral margin curves steadily into the ventral margin. h_{max} is situated in the anterior third of the valve; from there the ventral margin rises evenly to the narrowly rounded posterior margin. The posterior corner is pointed and its cardinal angle is about 45°. An indistinct rim runs parallel to the free margin. The midventral spine inserts just behind h_{max} . The spine is slim, straight and at least (broken in both specimens) about 50 % of l_{max} . It is directed slightly back- and downwards. The left valve has a very small anterodorsal spine or protuberance.

Comparisons: The subrectangular anterior cardinal angle of *Tricornina (Bohemina) sp. B* is easily distinguishable from the obtuse angle of *T. (B.) sp. A* and *T. (B.) sp. A* BECKER 1987. *T. (B.) gracilis* RABIEN, 1954 and *T. (B.) bilamellosa* (GRÜNDEL, 1963) have similar outlines, but they have longer anterodorsal spines.

Occurrence: Pelitli Fm. (Early to early Late Emsian), NW Anatolia, Turkey.

Podocopida indet.

Remarks: Various rounded to elongated smooth valves were obtained, which could not be identified.

3. Conclusions

For the first time, silicified ostracode faunas are described from Early Emsian and early Late Emsian limestones in the Istanbul area. The poorly preserved faunas are of low diversity and have few individuals. The assemblage is of Thuringian Ecotype sensu Becker (in BANDEL & BECKER 1975), as it is dominated by thin and smooth shells, some with spines. They characterize an environment of low hydro-energy below the wave base, "independent of palaeo-depth and -shoreline" (BECKER et al. 2003: 42). The lack of *Bairdia* s.l. seems to plead against an open marine environment, but it can also be due to the scarcity of material.

The ostracode assemblage shares taxa especially with Thuringia (K. ZAGORA 1967, 1968, Schwärzschiefer and Tentakulitenschiefer) and Morocco (BECKER, oral comm., Torkoz section) and indicates open marine connections between the Istanbul Terrane and the cited areas during the Emsian.

Acknowledgments

We thank Prof. T. NORMAN and Prof. R. LUNDIN, who have kindly improved the English text and Prof. G. BECKER, who provided information on the ostracode faunas of Morocco and who helped with the classification of the ostracodes. Our sincere thanks go to the reviewers Dr. H. GROOS-UFFENORDE and Prof. G. BECKER for the improvement of the manuscript. This study is a contribution to the TUBITAK-BAS Project No: 102Y 157.

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Manuscript received: April 13th, 2004.

Revised version accepted by the Stuttgart editor: June 15th, 2004.

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