

**Early Jurassic brachiopods from diverse localities of  
northern Anatolia (Turkey)**

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**Abstract** – The Early Jurassic brachiopods collected by Füsün Alkaya from diverse localities of northern Anatolia (Turkey) were examined in detail. The taxonomic and nomenclatural study of the 93 specimens resulted in 32 brachiopod taxa. They represent 18 genera and 31 nominal species; these are shortly described and documented by photographs and partly by serial sections. The species *Cirpa alkayae* is introduced and described as new. The brachiopod localities fall to the Sakarya Zone of northern Anatolia. Presence vs. absence data of the identified species in the major Tethyan palaeogeographic provinces show that the Early Jurassic brachiopod fauna of the Sakarya Zone has a transitional character between the two major faunal provinces (NW-European and Mediterranean). With 115 figures and 1 table.

**Key words** – Brachiopoda, Lower Jurassic, systematic description, Turkey

INTRODUCTION

The present work was initiated by Dr Hayriye Füsün Alkaya (at the Ankara University at that time), who made a short visit at the Department of Palaeontology of the Eötvös Loránd University, Budapest in 1986. Dr Alkaya worked hard on Early Jurassic ammonoids of Turkey (ALKAYA 1981, 1982, 1983, 1984, 1991) and collected many brachiopods besides the ammonoids. During the personal talks and a detailed letter in 1991, she encouraged the present author to work on this brachiopod material and in 1992 she mailed a box of Jurassic brachiopods to the Hungarian Natural History Museum. Afterwards, the fossil collection of the Department of Palaeontology and Geology had to move three times, partly to different buildings of Budapest which resulted some degree of disorder. For a long time, the parcel with brachiopods has been appeared to be lost. But recently, it was found again and the carefully packed and labelled brachiopods reached their safe place in due order.

Previous and recent publications on the Early Jurassic brachiopods from Turkey contained mostly faunal lists with few or no illustrations (VADÁSZ 1913a,

b, 1918; OTKUN 1942; AGER *et al.* 1980; AGER 1991) or described brachiopod faunas from single localities, where the stratigraphic position was uncertain or was based solely on brachiopod evidence (AGER 1959a; VÖRÖS & KANDEMİR 2011; VÖRÖS 2014).

The Early Jurassic brachiopods collected by Füsün Alkaya have particular significance in the knowledge of the Turkish faunas, because: (1) the material came from an extensive area (10 localities) of northern Anatolia and, (2) in most cases, the brachiopods have been collected by Füsün Alkaya together with age-diagnostic ammonoids. These make reasonable to publish the detailed palaeontological description of this well-dated and well-preserved brachiopod fauna.

In those times when Dr Füsün Alkaya sent the brachiopods to the present author, she promised to provide detailed information on the stratigraphy of the localities and the idea was to prepare a joint publication. In the last years the author made multiple attempts (via e-mails and Facebook; correspondence with Turkish colleagues and former co-authors) to contact Dr Füsün Alkaya, but the efforts failed. Due to this regrettable situation, this paper remained as single-authored and the merits of Dr Füsün Alkaya are celebrated only by a new species nominated after her name.

#### MATERIAL AND LOCALITIES

The Early Jurassic brachiopod material (93 specimens) sent by F. Alkaya has been collected from 10 localities of northern Anatolia; in some cases from different stratigraphic levels of the measured sections (Fig. 1). The specimen numbers of the respective brachiopod taxa according to localities are shown in Table 1. Concise information about the brachiopod-bearing stratigraphical successions and the geographical and geological setting of the localities (partly given by F. Alkaya) are listed below.

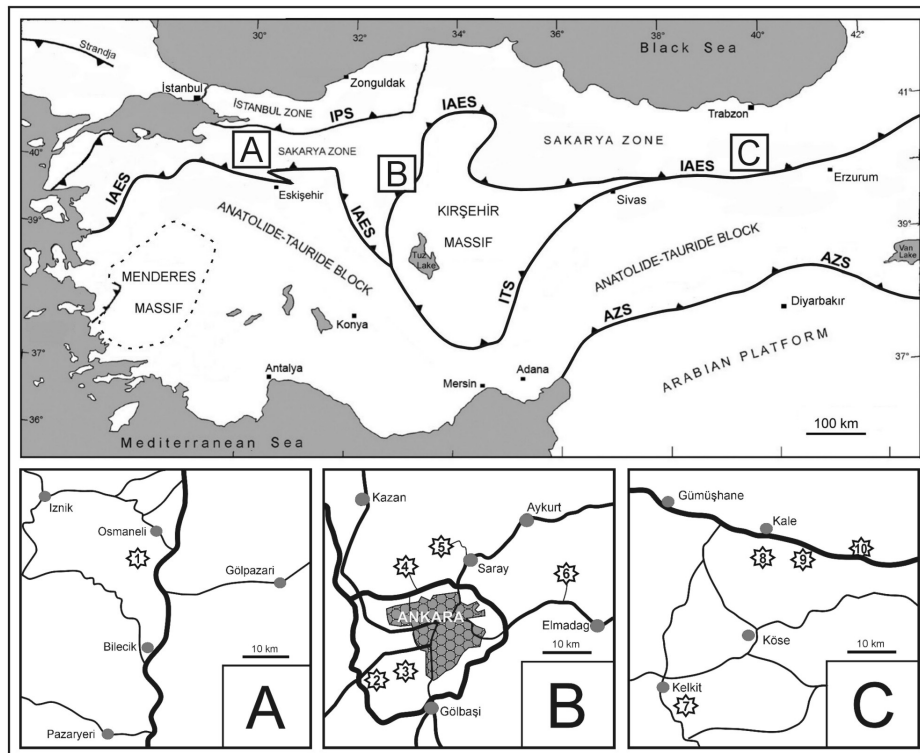
##### Bilecik area, Günüviran

This locality lies about 20 km to the north of the town Bilecik. The lithology and ammonoid stratigraphy of the section was described and illustrated by ALKAYA (1981), who also gave a list of nine brachiopod species from here. The locality Günüviran is probably identical with that mentioned as Günören by ALTINER *et al.* (1991), who published further details on its stratigraphy, and as Gunoren by AGER (1991, p. 240), who listed 15 brachiopod species from the upper Sinemurian to lower Pliensbachian beds. In the presently described material from Günüviran, eight brachiopods, collected by F. Alkaya as loose from the upper Sinemurian to Carixian red limestone and marl, represent *Linguithyris*

*aspasia* (Zittel), *Aulacothyris resupinata* (J. Sowerby) and *Aulacothyris anatolica* (Vadász). Other five loose specimens from the Raricostatum to Ibx Zone interval have been identified as *Gibbirhynchia* cf. *muirwoodae* Ager, *Callospriferina* cf. *tumida* (Buch) and *Liospiriferina alpina* (Oppel).

#### Ankara area, Alacaatlı

It is nearly 20 km to the SW of the centre of Ankara. The locality was shortly mentioned by BREMER (1965, p. 196, fig. 7). Recently, DELI & ORHAN (2007) made comprehensive field work in this area and published a detailed geological map with a measured section and many photographs illustrating the sedimentary features of the Jurassic series. They showed that the Lower to Middle



**Fig. 1.** Geographic situation of the northern Anatolian Early Jurassic brachiopod localities. Tectonic sketch map, simplified after OKAY (2008); IPS = Intra-Pontide Suture; IAES = İzmir–Ankara–Erzincan Suture; ITS = Inner-Tauride Suture; AZS = Assyrian–Zagros Suture. A = Bilecik area; B = Ankara area; C = Gümüşhane area. Numbered localities in star symbols: 1 = Bilecik, Günüviran; 2 = Alacaatlı; 3 = Beytepe (Lodumlu); 4 = Yakacık; 5 = Köşrelik Kızığı; 6 = Hasanoğlan; 7 = Kelkit (Dayısı); 8 = Gökdere; 9 = Çalık; 10 = Elma Tepe

**Table 1.** Distribution and number of identified specimens of the Early Jurassic brachiopod taxa collected from diverse localities of Northern Anatolia

Brachiopod taxa	Localities									
	1. Bilecik, Güneşli	Ankara area					Gümüşhane area			
		2. Alacaatlı	3. Beytepe (Lodumlu)	4. Yakacık	5. Köşrelik Kızıği	6. Hasanođlan	7. Kelkit (Dayısı)	8. Gökdere	9. alıık	10. Elma Tepe
<i>Jakubirhynchia?</i> cf. <i>fascicostata</i> (Uhlig, 1880)	1		1							
<i>Prionorhynchia?</i> <i>flabellum</i> (Gemmellaro, 1874)				1						
<i>Cirpa fronto</i> (Quenstedt, 1871)					1					
<i>Cirpa borissiaki</i> (Moisseev, 1926)	1									
<i>Cirpa kiragliae</i> Ager, 1959					2					
<i>Cirpa alkayae</i> sp. n.			3							
<i>Cirpa?</i> sp.					1					
<i>Salgirella alberti</i> (Oppel, 1861)			3							
<i>Calcirhynchia?</i> <i>hungarica</i> (Böckh, 1874)									2	
<i>Homoeorhynchia</i> cf. <i>maninensis</i> (Siblík, 1967)			1							
<i>Cuneirhynchia?</i> aff. <i>palmata</i> (Oppel, 1861)					3					
<i>Cuneirhynchia</i> cf. <i>retusifrons</i> (Oppel, 1861)					1					
<i>Cuneirhynchia dalmasi</i> (Dumortier, 1869)				8	1	1		1		
<i>Cuneirhynchia</i> cf. <i>persinuata</i> (Rau, 1905)									1	
<i>Holcorhynchia?</i> <i>meneghinii</i> (Zittel, 1869)				1						
<i>Gibbirhynchia</i> cf. <i>curviceps</i> (Quenstedt, 1858)		2	2							
<i>Gibbirhynchia</i> cf. <i>muirwoodae</i> Ager, 1954	1	2		2	1					
<i>Callospiriferina</i> cf. <i>tumida</i> (Buch, 1837)	1	1								
<i>Callospiriferina haueri</i> (Suess, 1854)		1	2							
<i>Liospiriferina alpina</i> (Oppel, 1861)	3	2					1	3		
<i>Liospiriferina obtusa</i> (Oppel, 1861)							1			
<i>Lobothyris</i> cf. <i>punctata</i> (J. Sowerby, 1813)		1						1	3	
<i>Linguithyris aspasia</i> (Zittel, 1869)	3					1				
<i>Zeilleria</i> cf. <i>waterhousi</i> (Davidson, 1851)									1	
<i>Zeilleria</i> cf. <i>lycetti</i> (Davidson, 1851)					2					
<i>Zeilleria</i> cf. <i>subnumismalis</i> (Davidson, 1851)			5							
<i>Zeilleria</i> cf. <i>mutabilis</i> (Oppel, 1861)					5					
<i>Aulacothyris resupinata</i> (J. Sowerby, 1816)	1									
<i>Aulacothyris anatolica</i> (Vadász, 1913)	4				1				2	
<i>Bakonythyris</i> cf. <i>apenninica</i> (Zittel, 1869)		2								
<i>Cincta numismalis</i> (Lamarck, 1819)		1								
<i>Fimbriothyris</i> cf. <i>guerangeri</i> (Desl., 1856)				1						
Number of specimens	13	14	16	14	18	1	1	2	11	3

Jurassic Bayırköy Formation rests unconformably on the basement of the metamorphosed Karakaya Complex. The crinoidal limestone beds of the Sinemurian-Pliensbachian Uzundere Member are especially rich in brachiopods (Arif Delikan, pers. comm.). The presently described brachiopods (14 specimens) have been collected by F. Alkaya as loose specimens probably from the Upper Pliensbachian. They have been identified as follows:

- Gibbirhynchia* cf. *curviceps* (Quenstedt)
- Gibbirhynchia* cf. *muirwoodae* Ager
- Jakubirhynchia?* cf. *fascicostata* (Uhlig)
- Cirpa borissiaki* (Moisseev)
- Callospiriferina haueri* (Suess)
- Callospiriferina* cf. *tumida* (Buch)
- Liospiriferina* cf. *alpina* (Oppel)
- Lobothyris* cf. *punctata* (J. Sowerby)
- Cincta numismalis* (Lamarck)
- Bakonyithyris* cf. *apenninica* (Zittel)

On the basis of the known ranges of the above brachiopod species (AGER 1962; ALMÉRAS 1964; VÖRÖS 2009), the fauna suggests a Pliensbachian age.

#### Ankara area, Beytepe

It is about 15 km to the SW of the centre of Ankara. It was mentioned as Lodumlu by BREMER (1965, p. 196), who described that the Liassic is represented by coarse crinoidal calcarenite with limestone and greywacke clasts; this around one hundred metres thick series is intercalated by brachiopodal layers. Most of the presently described brachiopods (15 specimens) have been collected by F. Alkaya from a 50–70 cm thick layer, younger than the Ibex Zone. These brachiopods are unusually large as compared to any other Turkish Liassic brachiopods; they have been identified as follows:

- Gibbirhynchia* cf. *curviceps* (Quenstedt)
- Homoeorhynchia* cf. *maninensis* (Siblík)
- Cirpa alkayae* sp. n.
- Salgirella alberti* (Oppel)
- Callospiriferina* cf. *haueri* (Suess)
- Zeilleria* cf. *subnumismalis* (Davidson)

One further specimen, identified as *Gibbirhynchia* cf. *curviceps* (Quenstedt) has been collected from a 50 cm thick layer containing redeposited ammonoids of the Raricostatum Zone.

## Ankara area, Yakacik

This is one of the “celebrated localities” of the Liassic of Anatolia (ARKELL 1956, p. 349), about 15 km northwest of the centre of Ankara. The first reports on the local stratigraphy and palaeontology were given by VADÁSZ (1913*a, b*, 1918), who described and illustrated two new brachiopods and listed further 16 brachiopod taxa from the Lower Jurassic brownish red limestones. AGER (1959*a*) described 11 brachiopod species from Yakacik, partly different from those previously known. Recently VÖRÖS (2014) made a revision and complete description of the Vadász collection and gave an overview of the previous research on the geology and palaeontology of the locality. The presently described brachiopods (14 specimens) have been collected by F. Alkaya as loose specimens said to be coming mainly from the Raricostatium Zone. They have been identified as follows:

- Gibbirhynchia* cf. *muirwoodae* Ager
- Prionorhynchia flabellum* (Gemmellaro)
- Jakubirhynchia?* cf. *fascicostata* (Uhlig)
- Cuneirhynchia* cf. *dalmasi* (Dumortier)
- Holcorhynchia?* *meneghinii* (Zittel)
- Fimbriothyris* cf. *guerangeri* (Deslongchamps)

The known ranges of the above brachiopod species (AGER 1962; ALMÉRAS 1964; VÖRÖS 2009) are restricted to the Pliensbachian (mostly to the Late Pliensbachian); therefore, the dating by Alkaya (Raricostatium Zone) seems to be disproved.

## Ankara area, Kösrelik Kızıği

It is about 15 km north of the centre of Ankara. The site was mentioned as KIZIK by BREMER (1965, p. 194, fig. 9), who described the locality as a wider area of folded Jurassic beds with frequently exposed reddish Lower and Middle Jurassic fossiliferous horizons, and gave a detailed lithological profile of a 200 m thick section starting from the Palaeozoic schists overlain by Lower Jurassic conglomerates and sandstones. It is followed by Sinemurian red limestones and marls, and Pliensbachian greyish marls and nodular limestones, then Bajocian red marls and nodular limestones and terminated by sandy and clayey layers of the higher Middle Jurassic. This seemingly regular Jurassic sequence of beds is akin to that was reported previously from Yakacik, and a great degree of tectonic disturbance can reasonably be supposed also at Kösrelik Kızıği. ALKAYA & MEISTER (1995, fig. 3) published a measured section of the Sinemurian part of the sequence with detailed ammonoid stratigraphy. OKAN & HOŞGÖR (2007) gave a detailed geological map of this area with a measured section, and conveyed

the idea that the Ammonitico Rosso type sedimentation in the Pontides might be connected to rapidly subsiding seamounts.

The presently described brachiopods (18 specimens) have been collected by F. Alkaya as loose specimens coming partly from the Raricostatum to Ibex Zone interval, partly perhaps from the upper Pliensbachian. They have been identified as follows:

- Gibbirhynchia* cf. *muirwoodae* Ager
- Cirpa fronto* (Quenstedt)
- Cirpa kiragliae* Ager
- Cirpa?* sp.
- Cuneirhynchia dalmasi* (Dumortier)
- Cuneirhynchia* cf. *retusifrons* (Oppel)
- Cuneirhynchia?* aff. *palmata* (Oppel)
- Zeilleria* cf. *mutabilis* (Oppel)
- Zeilleria* cf. *lycetti* (Davidson)
- Aulacothyris anatolica* (Vadász)

#### Ankara area, Hasanoglan

The locality is about 35 km to the east of Ankara. Its brief geological overview was given by BILGÜTAY (1960), who listed, among many ammonoids, three brachiopod taxa. According to the description by BREMER (1965, p. 198), the Lower Jurassic starts with a basal conglomerate, followed by red crinoidal marls with ammonoids. ALKAYA (1991) published the measured section of the locality with the detailed ammonoid stratigraphy. She collected a single brachiopod, loose from the Sinemurian to Pliensbachian interval, identified here as *Linguithyris aspasia* (Zittel).

#### Gümüşhane area, Kelkit (Dayısı)

This locality lies less than ten kilometres southeast of the town Kelkit, along a valley. ALKAYA & MEISTER (1995, fig. 13) published a measured section with detailed ammonoid stratigraphy and dated the measured part of the sequence as Sinemurian. A single brachiopod specimen has been collected from this locality by F. Alkaya, identified here as *Cuneirhynchia dalmasi* (Dumortier).

#### Gümüşhane area, Gökdere

This group of localities are found about five kilometres to the south of the village Kale, near a small settlement called Aşağı. ALKAYA & MEISTER (1995, fig. 7) published a measured section with detailed ammonoid stratigraphy and

dated the measured part of the sequence as spanning from the lower Sinemurian to the Toarcian. Two brachiopods, collected by F. Alkaya from the Carixian (Ibex Zone), have been identified here as *Liospiriferina alpina* (Oppel) and *L. obtusa* (Oppel).

#### Gümüşhane area, Çalık

This group of localities lie about one kilometre to the south of the settlement Çalık; a few kilometres to the south of the main road Gümüşhane-Bayburt. ALKAYA & MEISTER (1995, fig. 9) published a measured section with detailed ammonoid stratigraphy and dated the measured part of the sequence as Lower Pliensbachian (lower to middle Carixian). F. Alkaya collected brachiopods from two different levels. Four brachiopod specimens from the base of the Ibex Zone have been identified as *Cuneirhynchia* cf. *persinuata* (Rau), *Zeilleria* cf. *waterhousi* (Davidson) and *Aulacothyris anatolica* (Vadász). Further seven specimens have been found as loose from the Jamesoni to Ibex Zone interval; they have been identified as follows:

- Cuneirhynchia* cf. *dalmasi* (Dumortier)
- Calcirhynchia?* cf. *hungarica* (Böckh)
- Liospiriferina alpina* (Oppel)
- Lobothyris* cf. *punctata* (J. Sowerby)

Considering the known ranges of the above brachiopod species, the fauna supports the Pliensbachian age dating.

#### Gümüşhane area, Elma Tepe

The locality is about 20 km to the east of the village Kale, on the northern side of the main road Gümüşhane-Bayburt. No further published data on the local geology are available. Three brachiopod specimens have been collected from this locality by F. Alkaya, loose from the Sinemurian to Pliensbachian (Raricostatum to Ibex Zone) interval. They are identified here as *Lobothyris* cf. *punctata* (J. Sowerby).

### SYSTEMATIC DESCRIPTIONS

The thirty-one brachiopod species, identified from the ten Lower Jurassic localities of northern Anatolia, will be described and illustrated below. Many of the identified species are frequently illustrated taxa, well-known from the palaeontological literature and do not need detailed description, neither the study of their internal morphology is necessary. In these cases only abridged synonym



lists and short remarks will be given. Some other forms, with less clear taxonomy, e.g. poorly known, or described as new species, will be discussed more comprehensively. In some of these cases, the internal morphology was also examined and illustrated.

In the systematic descriptions, the classification of the revised “Treatise” (SAVAGE *et al.* 2002; CARTER & JOHNSON 2006; LEE *et al.* 2006) is followed. The measurements of the figured specimens (L = length, W = width, T = thickness, Ch = height of the deflection in the anterior commissure) are given in millimetres. The brachiopod material is deposited in the collection of the Department of Palaeontology and Geology of the Hungarian Natural History Museum (HNHM), Budapest. The figured specimens are under the inventory numbers prefixed by “INV” and/or “PAL”.

Order Rhynchonellida Kuhn, 1949  
 Superfamily Pugnacoidea Rzhonsnitskaia, 1956  
 Family Basiliolidae Cooper, 1959  
 Subfamily Pamirorhynchiinae Ovcharenko, 1983  
 Genus *Jakubirhynchia* Tomašových, 2006

*Jakubirhynchia?* cf. *fascicostata* (Uhlig, 1880)  
 (Figs 2–4)

v \*1880 *Rhynchonella fascicostata* n. f. – UHLIG, Sospirolo, p. 42, pl. V, figs 1–3.

v 2009 *Jakubirhynchia?* cf. *fascicostata* (Uhlig, 1880) – VÖRÖS, Bakony, p. 63, pl. VIII, figs 12, 13 (cum syn.).

*Material* – Two moderately preserved specimens from Yakacik and Alacaatlı (Ankara area), Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.92.	10.5	11.6	5.4	2.2

*Remarks* – This small and rather flat rhynchonellid species was thoroughly discussed recently by VÖRÖS (2009) and was placed tentatively to the genus *Jakubirhynchia*. The present material did not allow investigation of the internal features; therefore, this tentative generic attribution is accepted here. *J. fascicostata* is very easy to separate from other rhynchonellids because it is entirely and finely ribbed and the bifurcate ribs appear in bundles posteriorly. *J. fascicostata* is widespread in the Sinemurian and Pliensbachian of the Alpine-Mediterranean region and now it is recorded from northern Anatolia.

Superfamily Rhynchotetradoidea Licharew, 1956  
 Family Prionorhynchiidae Manceñido & Owen, 2002  
 Genus *Prionorhynchia* Buckman, 1918

*Prionorhynchia?* *flabellum* (Gemmellaro, 1874)  
 (Figs 11–13)

- v \*1874 *Rhynchonella flabellum*, Menegh. – GEMMELLARO, Zona con Terebratula Aspasia, p. 83 (partim), pl. XI, figs 25–27, (non fig. 14).  
 v 2009 *Prionorhynchia ? flabellum* (Gemmellaro, 1874) – VÖRÖS, Bakony, p. 68, pl. VIII, fig. 5 (cum syn.).

*Material* – One rather well-preserved specimen from Yakacik (Ankara area), Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.95.	13.4	14.0	7.1	–

*Remarks* – This very characteristic rhynchonellid species was thoroughly discussed recently by the present author (VÖRÖS 2009) and was placed tentatively to the genus *Prionorhynchia*. The single specimen was not suitable to investigate the internal features; therefore, this tentative generic attribution is accepted here. *P. flabellum* can be distinguished from other species of *Prionorhynchia* by its laterally expanded subtrigonal, flabelliform outline and straight anterior commissure, with coarse zig-zag deflections. *P. flabellum* is a characteristic Pliensbachian species of the Alpine-Mediterranean region and this is its first record from northern Anatolia.

Superfamily Wellerelloidea Licharew, 1956  
 Family Wellerellidae Licharew, 1956  
 Subfamily Cirpinae Ager, 1965  
 Genus *Cirpa* de Gregorio, 1930

*Cirpa fronto* (Quenstedt, 1871)  
 (Figs 5–7)

- \* 1871 [*Terebratula*] *triplicata fronto* – QUENSTEDT, Petrefactenkunde Deutschlands, p. 71, pl. 37, figs 177–183.  
 1934 *Rhynchonella variabilis* Dav. var. *fronto* Quenst. – MOISSEIEV, Crimea and Caucasus, p. 43, 178, pl. II, figs 30–33.  
 1959b *Cirpa fronto* (Quenstedt). – AGER, British Rhynchonellidae, p. 53, text-figs 29–30, pl. V, figs 1–3.  
 1964 *Cirpa fronto* (Quenstedt, 1871) – SIBLÍK, Belanska Dolina, p. 168, text-fig. 3, pl. VIII, figs 4–6.

- ? 2003 *Cirpa fronto* (Quenstedt, 1871) – DULAI, Hettangian and Early Sinemurian, p. 17, text-fig. 4, pl. II, figs 1–3.  
 ? 2010 *Cirpa fronto* (Quenstedt, 1871) – ALMÉRAS *et al.*, Massif Armoricain, p. 28, text-fig. 18, pl. 2, fig. 2, pl. 5, fig. 4.  
 v 2011 *Cirpa fronto* (Quenstedt, 1871) – VÖRÖS & KANDEMİR, Eastern Pontides, p. 353, fig. 4/1 (cum syn.).  
 2012 *Cirpa fronto* (Quenstedt 1871) – HÖFLINGER, Deutsch. Lias, p. 39 + fig. (unnumbered).

*Material* – One well preserved specimen from Köşrelik Kızıği (Ankara area), loose, from Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.93.	10.3	10.9	7.6	7.2

*Remarks* – This well-known and typical species of the genus *Cirpa* was recently figured and discussed by VÖRÖS & KANDEMİR (2011) from Turkey. The above synonymy contains more items but far from being complete. The specimen figured by DULAI (2003, l.c.) does not show the diagnostic flattened frontal region of *C. fronto*, therefore, that identification is queried. The same holds true for the record by ALMÉRAS *et al.* (2010, l.c.) where the ribbing is too much coarse and the anterior view is missing. This Pliensbachian species is cosmopolitan in distribution, occurring in Northwest Europe, the Alpine-Mediterranean region, in the Atlas Mts, the Crimea and Turkey.

*Cirpa borissiaki* (Moisseiev, 1926)  
(Figs 8–10)

- \*1926 *Rhynchonella Borissiaki* n. sp. – MOISSEIEV, Crimea, p. 971, 991, pl. XXVIII, figs 5–7.  
 1934 *Rhynchonella borissiaki* n. sp. – MOISSEIEV, Crimea and Caucasus, p. 45, 178 (pars), pl. II, figs 46–48, (non pl. III, figs 1–4).  
 1989 *Cirpa borissiaki* (Moisseiev, 1934) – TCHOUMATCHENCO, Kotel I, p. 6, text-figs 2, 3, pl. VI, figs 1–5.  
 v 2011 *Cirpa cf. borissiaki* (Moisseiev, 1934) – VÖRÖS & KANDEMİR, Eastern Pontides, p. 354, fig. 4/2.

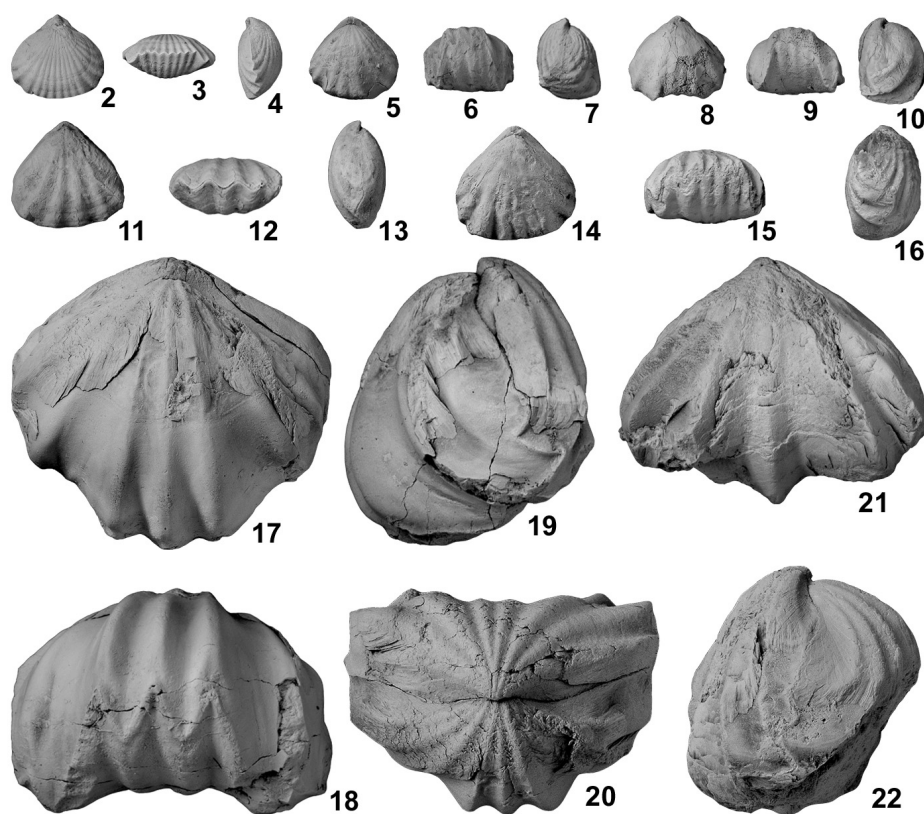
*Material* – One moderately preserved specimen from Alacaatlı (Ankara area), Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.94.	10.8	12.6	8.6	6.2

*Remarks* – This is a small *Cirpa* with high oval outline and somewhat “cyncephalous” lateral view. The uniplicate anterior commissure shows four narrowly spaced, sharp zig-zag deflections. The ornamentation consists of 8 to 9 regular ribs, which are weak on the posterior part and became very sharp anteriorly. *C. borissia-*

*ki* differs from *C. fronto* by its very narrow uniplication and that it has no anterior flattening. VÖRÖS & KANDEMİR (2011, l.c.) described this species and cited Moisseiev, 1934 as author. However, the correct date is 1926, since MOISSEIEV (1926, l.c.) properly described and figured the species *borissiaki*. So far, *C. borissiaki* was reported only from the Pliensbachian of the Pontian region (Crimea, Bulgaria, Turkey).



**Figs 2–4.** *Jakubirhynchia?* cf. *fascicostata* (Uhlig, 1880), INV 2014.92., Yakacik, Pliensbachian, 2 = dorsal view, 3 = anterior view, 4 = lateral view. – **Figs 5–7.** *Cirpa fronto* (Quenstedt, 1871), INV 2014.93., Köşrelik Kızıği, loose, from Sinemurian to Pliensbachian interval, 5 = dorsal view, 6 = anterior view, 7 = lateral view. – **Figs 8–10.** *Cirpa borissiaki* (Moisseiev, 1926), INV 2014.94., Alacaatlı, Pliensbachian, 8 = dorsal view, 9 = anterior view, 10 = lateral view. – **Figs 11–13.** *Prionorhynchia?* *flabellum* (Gemmellaro, 1874), INV 2014.95., Yakacik, Pliensbachian, 11 = dorsal view, 12 = anterior view, 13 = lateral view. – **Figs 14–16.** *Cirpa kiragliae* Ager, 1959, INV 2014.96., Köşrelik Kızıği, loose, from Sinemurian to Pliensbachian interval, 14 = dorsal view, 15 = anterior view, 16 = lateral view. – **Figs 17–20.** *Cirpa alkayae* sp. n., holotype: PAL 2014.137., Beytepe, Pliensbachian, 17 = dorsal view, 18 = anterior view, 19 = lateral view, 20 = posterior view. – **Figs 21–22.** *Cirpa alkayae* sp. n., INV 2014.97., Beytepe, Pliensbachian, incomplete specimen with two folds in the uniplication, 21 = ventral view, 22 = lateral view. (All figures are in natural size. Specimens have been coated with ammonium chloride before photography.)

*Cirpa kiragliae* Ager, 1959  
(Figs 14–16)

\* 1959a *Cirpa kiragliae* Ager, n. sp. – AGER, Turkey, p. 1019, text-fig. 2, pl. 128, fig. 2.  
v 2014 *Cirpa* cf. *kiragliae* Ager, 1959 – VÖRÖS, Yakacik, p. 236, pl. I, fig. 6.

*Material* – Two moderately preserved specimens from Kösrelik Kızıği (Ankara area), loose, from Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.96.	14.4	15.3	9.4	6.4

*Remarks* – This is a rather coarsely costate species of the genus *Cirpa*, which differs from the typical species by its less convex valves and the absence or weak development of the anterior flattening. It has 11 ribs, five of which are in the uniplication. *C. kiragliae* was described by AGER (1959a) from Yakacik (Turkey) and was recorded recently from the same locality by the present author (VÖRÖS 2014). Both authors discussed the relationships of *C. kiragliae* to other species of *Cirpa*. *C. kiragliae* seems to be endemic for Turkey (northern Anatolia).

*Cirpa alkayae* sp. n.  
(Figs 17–20, 21–22, 23)

*Holotypus* – Hungarian Natural History Museum (Budapest), inventory number: PAL 2014.137.

*Locus typicus* – Beytepe (Lodumlu), Ankara area, Turkey.

*Stratum typicum* – Pink crinoidal limestone, Pliensbachian.

*Paratypus* – Hungarian Natural History Museum (Budapest), inventory number: PAL 2014.138.

*Derivatio nominis* – After the name of Füsün Alkaya, who collected the brachiopod specimens.

*Diagnosis* – Very large, strongly costate *Cirpa* with highly uniplicate anterior commissure and depressed beak. Double deltidial plates; strongly crenulated hinge teeth. Long, ventrally arched crura of hamiform type.

*Material* – Three specimens, one well-preserved (holotype) and two partly fragmentary articulated valves from Beytepe (Lodumlu), Ankara area, Pliensbachian.

*Measurements* –

	L	W	T	Ch
PAL 2014.137. (holotype)	37.0	40.8	30.2	24.2
PAL 2014.138. (paratype)	>32.0	39.1	26.8	–

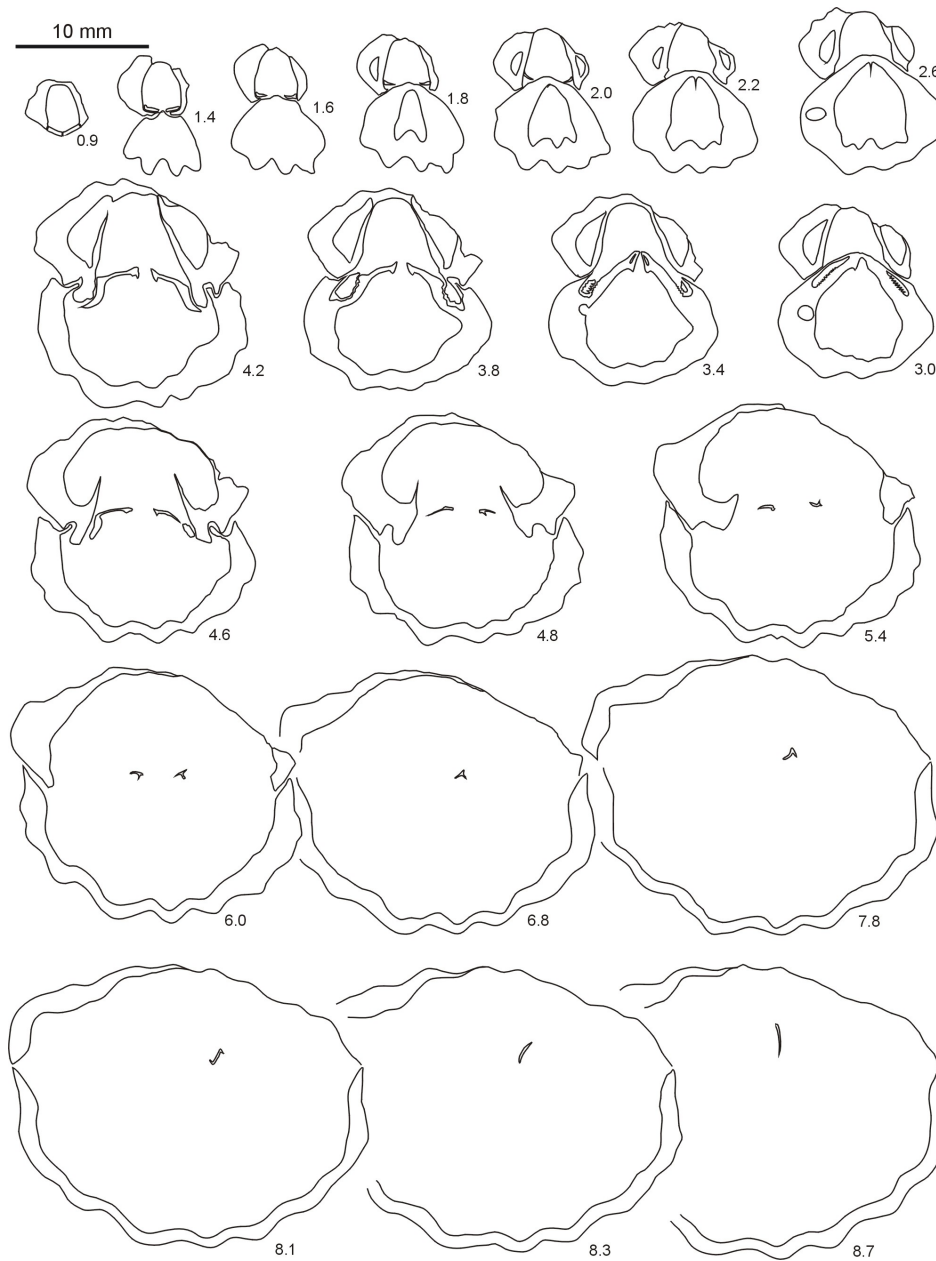
*Description* – External characters: Large *Cirpa* with rounded subpentagonal outline. The apical angle is around 115°. The maximum width is attained at

around the middle of the length or a little more posteriorly. The valves are moderately to strongly convex; the maximum convexity lies near mid-length. The ventral valve is more convex than the dorsal which is somewhat depressed at its middle portion. The beak is low, pointed, and erect. The foramen is poorly preserved but seems to be mesothyrid. The delthyrium is rather narrow and high; the deltidial plates are convex. The beak ridges are blunt but demarcate long, moderately deep planareas. In lateral view, the lateral commissures are gently sinuous: in their posterior part they are strongly arched dorsally, then they run straight in the middle of the planareas; near the anterolateral extremities they bear zig-zag deflections with increasing amplitude. The anterior commissure shows a high and trapezoidal uniplication. It is strongly serrated, with 2 to 4 zig-zag deflections of uniform strength. The valves are multicostate throughout, with only a few posterior intercalations. The number of ribs varies from 8 to 10 (9 in the type specimen); 2 to 4 of which are in the uniplication (3 in the type specimen). The anterior flattening, in spite of the large, adult specimens, is weak or absent.

Internal characters (Fig. 23): *Ventral valve*: The delthyrial cavity is high trapezoidal in cross-section. The umbonal cavities are narrow triangular. Pedicle collar was not observed. The posterior part of the deltidial plates are fused and arched; then they divide and seem to form double plates. The dental plates are strong and converge ventrally. The hinge teeth are rather elongated and strongly crenulated; denticula are marked. *Dorsal valve*: Cardinal process is low. Short, rudimentary dorsal median septum is seen posteriorly. The outer socket ridges are very strong. The inner socket ridges are high, oblique and poorly demarcated from the outer hinge plates. The outer hinge plates are directed ventrally then become subhorizontal. The crural bases emerge dorsolaterally and give rise to rather long, ventrally arched crura of hamiform type.

*Remarks* – From among other species of the genus, *Cirpa alkayae* sp. n. stands the closest to *C. briseis* (Gemmellaro, 1874), especially to the larger specimens figured by DI STEFANO (1891, pl. III, figs 9, 11). The present author examined the original material of Gemmellaro and Di Stefano in the collections of the Palermo University and made plaster casts of the figured specimens. The comparison convinced the author that *C. alkayae* is a separate species. Notably, the beak of *C. alkayae* is much more depressed and it is significantly larger than any known specimens of *C. briseis*. The close overall similarity to *C. briseis* (a typical species of the genus) and the internal features (double deltidial plates, hamiform crura) justify the attribution of the new species *alkayae* to the genus *Cirpa*.

*Occurrence* – Up to now, *C. alkayae* is known only from the type locality, Beytepe (Lodumlu), Ankara area, Turkey, from the Pliensbachian (50–70 cm thick layer, younger than Ibex Zone, according to the written communication by Füsün Alkaya, 1992).



**Fig. 23.** *Cirpa alkayae* sp. n. Twenty transverse serial sections through the posterior part of a specimen from Beytepe (Lodumlu), Pliensbachian. Paratype: PAL 2014.138. Distances from posterior end of the shell are given in mm. Original length of the specimen was ~36.0 mm

Genus *Salgirella* Moisseev, 1936*Salgirella alberti* (Oppel, 1861)  
(Figs 24–26)

- \* 1861 *Rhynchonella Albertii* Opp. – OPPEL, Brachiopoden des unteren Lias, p. 546, pl. XIII, fig. 4.  
 ? 1869 *Rhynchonella Alberti* (Oppel). – DUMORTIER, Bassin du Rhône, p. 332, pl. XLII, figs 14, 15.  
 v 1880 *Rhynchonella Albertii* Oppel. – UHLIG, Sospirolo, p. 32 (pars), pl. IV, fig. 1 (non fig. 2).  
 v 1889 *Rhynchonella Alberti* Opp. – GEYER, Hierlatz, p. 43, pl. V, figs 14–17.  
 v 1895 *Rhynchonella Alberti* Opp. – FUCINI, Calcari bianchi, p. 172, pl. VII, fig. 1.  
 v 1900 *Rhynchonella* sp. aff. *Alberti* Opp. – BÖSE & SCHLOSSER, Südtirol, p. 193, pl. XVIII, fig. 1.  
 1934 *Rhynchonella alberti* Opp. – MOISSEIEV, Crimea and Caucasus, p. 46, 179, pl. III, figs 5–7.  
 1949 *Rhynchonella Alberti* Opp. var. *tenuis* n. var. – NUTSUBIDZE, Dzirula Massif, p. 49, pl. I, fig. 5.  
 ? 2003 *Salgirella* cf. *alberti* (Oppel, 1861) – DULAI, Hettangian and Early Sinemurian, p. 29, pl. V, figs 7–10.  
 2008 *Salgirella albertii* (Oppel, 1861) – SIBLÍK, Mitterwand, p. 66, pl. 1, fig. 2.

*Material* – Three partly incomplete specimens from Beytepe (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.98.	26.3	33.5	14.6	7.9

*Remarks* – This is the type species of the genus *Salgirella*, and it was profusely and properly illustrated in the classical literature (OPPEL 1861, l.c.; GEYER 1889, l.c.) and even by MOISSEIEV (1934, l.c.). On this basis, our specimens were easily identified as *S. alberti*. The illustrations of *S. alberti* given by DUMORTIER (1869, l.c.) and DULAI (2003, l.c.) are not fully convincing; they probably represent some other species. The same holds true for one of the figures by UHLIG (1880, pl. IV, fig. 2); the present author examined this specimen in the collection of the Padova University, and concluded that it may belong rather to the genus *Prionorhynchia*.

The original spelling of the name *albertii* by OPPEL (l.c.) has been changed by GEYER (l.c.) to *alberti*; later this usage became prevailing, therefore, in accordance with the rules of the ICZN (ICZN 1999, Article 33.3), *alberti* is suggested as the correct spelling. *S. alberti* is a characteristic Sinemurian Alpine species, but it was recorded also from the Pliensbachian of other Mediterranean localities, the Crimea and Caucasus and now from Turkey.

Genus *Calcirhynchia* Buckman, 1918*Calcirhynchia? hungarica* (Böckh, 1874)  
(Figs 27–29)

- \* 1874 *Rhynchonella Hungarica* n. sp. – BÖCKH, Südlichen Theiles des Bakony, p. 160, pl. IV, figs 5, 6.  
 1884 *Rhynchonella Hungarica* Böckh. 1874. – HAAS, Südtirol und Venetien, p. 8, pl. II, fig. 12.



v 2009 *Calcirhynchia* ? *hungarica* (Böckh, 1874) – VÖRÖS, Bakony, p. 78, pl. VIII, fig. 11 (cum syn.).  
 v 2014 *Calcirhynchia hungarica* (Böckh, 1874) – VÖRÖS, Yakacik, p. 236, pl. I, fig. 4.

*Material* – Two moderately preserved specimens from Çalık (Gümüşhane area), loose from Lower Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.99.	12.1	14.0	9.2	4.8

*Remarks* – This rather globose, uniplicate and fully costate species was recently discussed by VÖRÖS (2009, 2014); that served the basis of the identification of our specimens.

“*R.* *hungarica* was described by BÖCKH (1874), who recognized its similarity to “*R.* *plicatissima* Quenstedt, 1852, but mentioned some differences between the two species. Subsequently, many authors regarded the two species as synonymous, with *plicatissima* as senior synonym. Recently, following the detailed revisions by TOMAŠOVÝCH (2006) and considering the data given by DULAI (1992, 2003), VÖRÖS (2009) restored Böckh’s species name *hungarica* for the forms which do not have planareas, but show fine riblets on their flat or gently convex lateral parts. The species *hungarica* is placed here to *Calcirhynchia* on the basis of serial sections of “*Calcirhynchia plicatissima*”, published by DULAI (1992, 2003). *C. hungarica* was widely recognized in the Sinemurian and Pliensbachian of the Alpine-Mediterranean region, but was recently recorded also in south Germany and Turkey.

Superfamily Rhynchonelloidea d’Orbigny, 1847

Family Rhynchonellidae d’Orbigny, 1847

Subfamily Rhynchonellinae d’Orbigny, 1847

Genus *Homoeorhynchia* Buckman, 1918

*Homoeorhynchia* cf. *maninensis* (Siblík, 1967)

(Figs 30–32)

\* 1967b *Slovenirhynchia maninensis* sp. n. – SIBLÍK, Domerian, p. 161, text-figs 4–9, pl. X, figs 1–4, pl. XI, figs 1–3.

1967b *Slovenirhynchia slovenica* sp. n. – SIBLÍK, Domerian, p. 165, text-figs 10–12, pl. XII, figs 2–4.

? 1989 *Homoeorhynchia almaensis* (Moisseiev, 1934) – TCHOUMATCHENCO, Kotel I, p. 18 (pars), pl. II, figs 1–5 (non figs 6–9).

*Material* – One slightly damaged specimen from Beytepe (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.100.	13.1	15.4	8.1	7.9

*Remarks* – Our specimen has laterally expanded subquadrangular outline, weak deflections on its lateral commissures and biplicate anterior margin with two, sharp, equidimensional (i.e. perfectly symmetrical) deflections. The characters of its beak also support its attribution to the genus *Homoeorhynchia*.

The Turkish specimen is extremely similar to those figured by SIBLÍK (1967b) on pl. X, fig. 1, as *Slovenirhynchia maninensis* and on pl. XII, fig. 3, as *S. slovenica* (the junior synonym of *maninensis*), therefore it was identified as *maninensis*. Siblík's genus *Slovenirhynchia* was taken as synonymous with *Homoeorhynchia* (SUČIĆ-PROTIĆ 1969; AGER 1983). This was also accepted by SIBLÍK (1999, and pers. comm.), who considered *maninensis* as a representative of a morphological group within *Homoeorhynchia*, which was characterized by less cynocephalous (i.e. somewhat depressed) shape and symmetrically developed biplication. This “*maninensis*-group” differs from the examples mentioned by AGER (1983) in the “marginal populations” of *H. acuta* (J. Sowerby, 1816), bearing two or three sharp deflexions in their anterior commissures. These specimens of the marginal population have always asymmetrically developed secondary riblets or weak deflexions on the sides of the high uniplication, as illustrated by MOISSEIEV (1934, pl. V, figs 10, 11), AGER (1959a, text-fig. 1) and VÖRÖS (2014, pl. I, figs 7, 8) from Yakacik (Turkey) and VÖRÖS (2009, pl. IX, fig. 5) from Hungary.

Some other species, as possible members of the “*maninensis*-group”, e.g. *H. steinmanni* (Haas & Petri, 1882) and *H. solitaria* Siblík, 1999 were mentioned by SIBLÍK (1999), who discussed the differences between them as well. Further related forms were illustrated by SUČIĆ-PROTIĆ (1969) under the name *Planirhynchia tantilla* sp. nov. and by TCHOUMATCHENCO (1989) as *Homoeorhynchia almaensis* (Moisseiev, 1934). Especially some specimens figured by TCHOUMATCHENCO (1989, pl. II, figs 1–5) seem very similar to *H. maninensis* by their highly and sharply biplicate anterior commissure. It has to be mentioned, that the original specimen of „*Rhynchonella*” *almaensis* figured by MOISSEIEV (1934, pl. III, figs 51–54) is not biplicate, but shows three zig-zag deflections of different altitude. *H. maninensis* was recorded from the Upper Pliensbachian of the West Carpathians and the Balkans (Kotel) and now from northern Anatolia.

Subfamily Piarorhynchiinae Shi & Grant, 1993

Genus *Cuneirhynchia* Buckman, 1918

*Cuneirhynchia?* aff. *palmata* (Oppel, 1861)

(Figs 33–35)

*Material* – Three rather well-preserved specimens from Köşrelik Kızıği (Ankara area), loose, from Sinemurian to Pliensbachian interval.

*Measurements –*

	L	W	T	Ch
INV 2014.101.	13.9	16.0	7.7	3.8

*Remarks* – This species probably belongs to the genus *Cuneirhynchia* on the basis of the planareas bordered by sharp ventral beak ridges; the slightly arched lateral commissures running close to the ventral beak ridges; the strongly deflected and nearly straight anterior commissure and the few (4 to 5), strong ribs, which appear only anteriorly. It stands close to *C. palmata* (Oppel, 1861), portrayed properly by OPPEL (1861, pl. XIII, fig. 2), UHLIG (1880, pl. V, fig. 4) and partly by GEYER (1889, pl. VI, figs 11, 13, 14), but differs from that by having fewer ribs (4-5, in contrast to 6-12 in *C. palmata*) and by undulate anterior commissure in contrast to the sharp deflections of *C. palmata*. Therefore, this species is described here as a separate taxon and only the affinity indicated.

*Cuneirhynchia* cf. *retusifrons* (Oppel, 1861)  
(Figs 36–38)

- \* 1861 *Rhynchonella retusifrons* Opp. – OPPEL, Brachiopoden des unteren Lias, p. 544, pl. XII, fig. 5.  
 v 1874 *Rhynchonella retusifrons*, Opp. – GEMMELLARO, Zona con Terebratula Aspasia, p. 76, pl. XI, fig. 17.  
 v 1889 *Rhynchonella retusifrons* Opp. – GEYER, Hierlatz, p. 62 (pars), pl. VII, figs 8, 9, 11, 12 (non fig. 10).  
 1993 *Cuneirhynchia retusifrons* (Oppel, 1861) – SIBLÍK, Steinplatte, p. 968, pl. 1, fig. 10.  
 2003 *Cuneirhynchia retusifrons* (Oppel, 1861) – DULAI, Hettangian and Early Sinemurian, p. 37, pl. VI, figs 11–13.  
 v 2003 *Cuneirhynchia retusifrons* (Oppel, 1861) – VÖRÖS *et al.*, Schafberg, p. 72, pl. VI, figs 38–40.  
 2012 *Cuneirhynchia retusifrons* (Oppel 1861) – HÖFLINGER, Deutsch. Lias, p. 63 + fig. (unnumbered).  
 2012 *Cuneirhynchia* cf. *retusifrons* (Oppel 1861) – HÖFLINGER, Deutsch. Lias, p. 64 + fig. (unnumbered).

*Material* – One partly broken specimen from Köşrelik Kızığı (Ankara area), loose, from Sinemurian to Pliensbachian interval.

*Measurements –*

	L	W	T	Ch
INV 2014.102.	~11.0	15.4	7.8	2.3

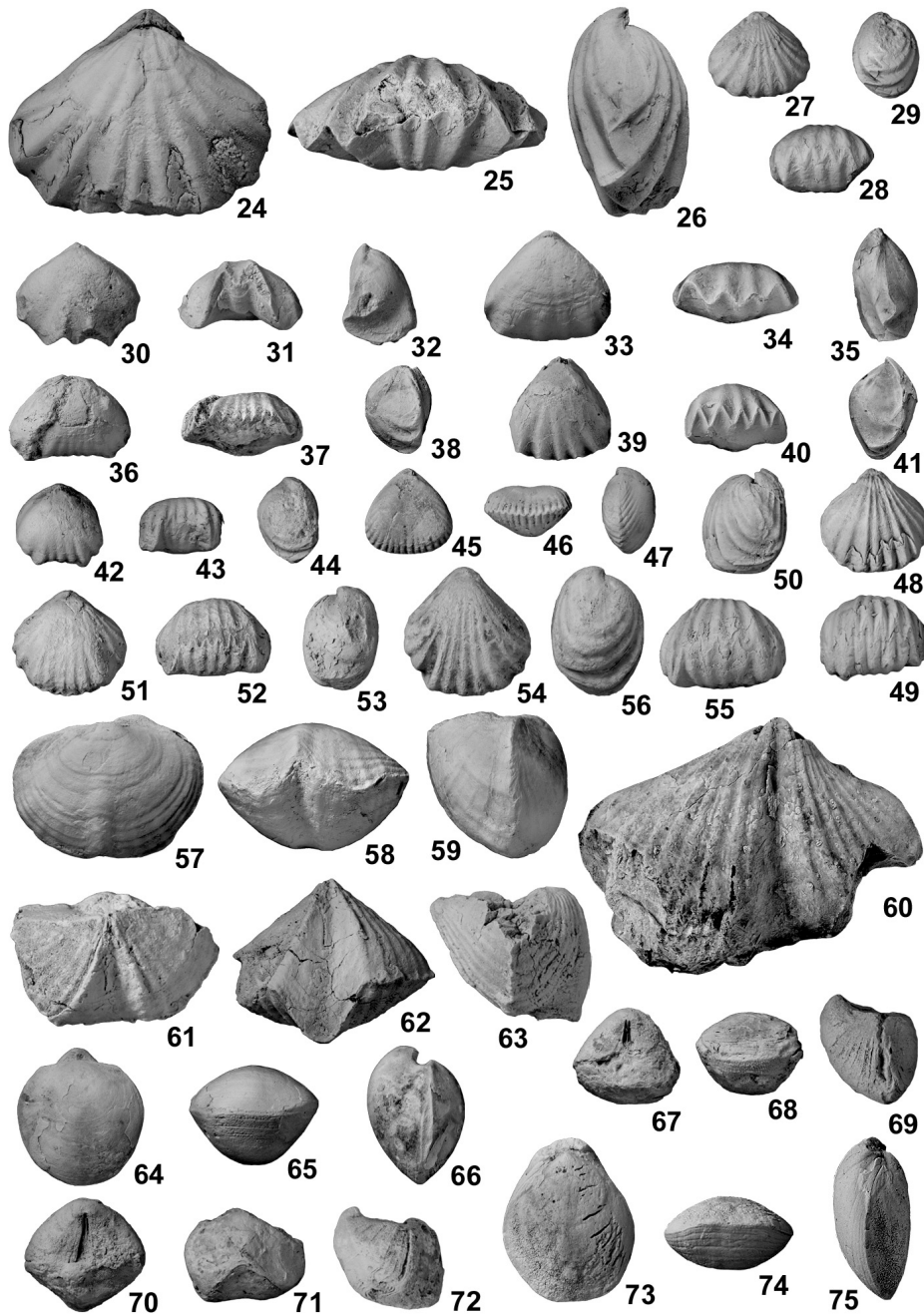
*Remarks* – This species of *Cuneirhynchia* differs from *C. palmata* (Oppel, 1861) by its low but marked, trapezoidal uniplication and more numerous but weak ribs. Our specimen has 13 ribs, 7 of which are in the uniplication. The anterior segment of the wide subtrigonal outline is truncated or even slightly concave. *C. retusifrons* was reported from the Sinemurian to the Pliensbachian. It is typically Alpine-Mediterranean in distribution, though HÖFLINGER (2012, l.c.)

reported it from southern Germany with the notion that the extra-Alpine forms have more numerous ribs. The Turkish specimen is also densely ribbed.

*Cuneirhynchia dalmasi* (Dumortier, 1869)  
(Figs 39–41)

- \* 1869 *Rhynchonella Dalmasi* (Nov. spec.). – DUMORTIER, Bassin du Rhône, p. 331, pl. XLII, figs 3–5.  
1962 *Cuneirhynchia dalmasi* (Dumortier). – AGER, British Rhynchonellidae, p. 126, text-figs 77–80, pl. XI, figs 4, 5.  
2012 *Cuneirhynchia dalmasi* (Dumortier 1869) – HÖFLINGER, Deutsch. Lias, p. 62 + fig. (unnumbered).  
v 2014 *Cuneirhynchia dalmasi* (Dumortier, 1869) – VÖRÖS, Yakacik, p. 238, pl. I, figs. 9, 10 (cum syn.).

**Figs 24–26.** *Salgirella alberti* (Oppel, 1861), INV 2014.98., Beytepe, Pliensbachian, 24 = dorsal view, 25 = anterior view, 26 = lateral view. – **Figs 27–29.** *Calcirhynchia? hungarica* (Böckh, 1874), INV 2014.99., Çalık, loose from Lower Pliensbachian, 27 = dorsal view, 28 = anterior view, 29 = lateral view. – **Figs 30–32.** *Homoeorhynchia cf. maninensis* (Siblík, 1967), INV 2014.100., Beytepe, Pliensbachian, 30 = dorsal view, 31 = anterior view, 32 = lateral view. – **Figs 33–35.** *Cuneirhynchia? aff. palmata* (Oppel, 1861), INV 2014.101., Köşrelik Kızıği, loose, from Sinemurian to Pliensbachian interval, 33 = dorsal view, 34 = anterior view, 35 = lateral view. – **Figs 36–38.** *Cuneirhynchia cf. retusifrons* (Oppel, 1861), INV 2014.102., Köşrelik Kızıği, loose, from Sinemurian to Pliensbachian interval, 36 = dorsal view, 37 = anterior view, 38 = lateral view. – **Figs 39–41.** *Cuneirhynchia dalmasi* (Dumortier, 1869), INV 2014.103., Köşrelik Kızıği, loose, from Sinemurian to Pliensbachian interval, 39 = dorsal view, 40 = anterior view, 41 = lateral view. – **Figs 42–44.** *Cuneirhynchia cf. persinuata* (Rau, 1905), INV 2014.104., Çalık, Lower Pliensbachian, 42 = dorsal view, 43 = anterior view, 44 = lateral view. – **Figs 45–47.** *Holcorhynchia? meneghinii* (Zittel, 1869), INV 2014.105., Yakacik, Pliensbachian, 45 = dorsal view, 46 = anterior view, 47 = lateral view. – **Figs 48–50.** *Gibbirhynchia cf. curviceps* (Quenstedt, 1856), INV 2014.106., Beytepe, Pliensbachian, 48 = dorsal view, 49 = anterior view, 50 = lateral view. – **Figs 51–53.** *Gibbirhynchia cf. muirwoodae* Ager, 1954, INV 2014.107., Günüviran, loose from uppermost Sinemurian to lower Pliensbachian interval, 51 = dorsal view, 52 = anterior view, 53 = lateral view. – **Figs 54–56.** *Gibbirhynchia cf. muirwoodae* Ager, 1954, INV 2014.108., Yakacik, Pliensbachian, 54 = dorsal view, 55 = anterior view, 56 = lateral view. – **Figs 57–59.** *Callospiriferina cf. tumida* (Buch, 1837), INV 2014.109., Günüviran, Upper Sinemurian to Pliensbachian, 57 = dorsal view, 58 = anterior view, 59 = lateral view. – **Fig. 60.** *Callospiriferina haueri* (Suess, 1854), INV 2014.111., Beytepe, Pliensbachian, ventral view. – **Figs 61–63.** *Callospiriferina haueri* (Suess, 1854), INV 2014.110., Alacaatlı, Pliensbachian, 61 = posteroventral view, 62 = anteroventral view, 63 = lateral view. – **Figs 64–66.** *Liospiriferina alpina* (Oppel, 1861), INV 2014.112., Günüviran, Sinemurian to Pliensbachian, 64 = dorsal view, 65 = anterior view, 66 = lateral view. – **Figs 67–69.** *Liospiriferina alpina* (OPPEL, 1861), INV 2014.113., Gökdere, Pliensbachian, 67 = posterior view, 68 = anterior view, 69 = lateral view. – **Figs 70–72.** *Liospiriferina obtusa* (Oppel, 1861), INV 2014.114., Gökdere, Pliensbachian, 70 = posterior view, 71 = anterior view, 72 = lateral view. – **Figs 73–75.** *Lobothyris cf. punctata* (J. Sowerby, 1813), INV 2014.115., Çalık, Pliensbachian, 73 = dorsal view, 74 = anterior view, 75 = lateral view. (All figures are in natural size. Specimens have been coated with ammonium chloride before photography.)



*Material* – Eleven variously preserved specimens from Yakacik and Köşrelik Kızığı (Ankara area) and Kelkit and Çalık (Gümüşhane area), from Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.103.	13.0	12.7	8.5	3.8

*Remarks* – This is the type species of the genus *Cuneirhynchia* with an outline close to an equilateral triangle, lateral commissures running near the extremely sharp ventral beak ridges. Further important characters are the very wide, low trapezoidal uniplication with sharp zig-zag deflections and the few, strong ribs, which appear only after a posterior smooth area. *C. dalmasi* is a Pliensbachian species cosmopolitan in distribution from the NW-European and Mediterranean regions to Turkey.

*Cuneirhynchia* cf. *persinuata* (Rau, 1905)  
(Figs 42–44)

- \* 1905 *Rhynchonella persinuata* n. sp. – RAU, Lias Schwabens, p. 296, pl. XXII, figs 62–69.  
 1934 *Rhynchonella persinuata* Rau. – MOISSEIEV, Crimea and Caucasus, p. 55, 182, pl. IV, figs 1–8.  
 1964 *Cuneirhynchia* ? *persinuata* (Rau, 1905) – SIBLÍK, Belanska Dolina, p. 175, text-fig. 6, pl. VIII, fig. 2.  
 1967a *Cuneirhynchia persinuata* (Rau, 1905) – SIBLÍK, Slov. domer, p. 15, text-fig. 2, pl. I, fig. 2.  
 1989 *Cuneirhynchia persinuata* (Rau, 1905) – TCHOUMATCHENCO, Kotel I, p. 21, text-fig. 14, pl. III, figs 7–9.  
 2012 *Cuneirhynchia persinuata* (Rau 1905) – HÖFLINGER, Deutsch. Lias, p. 60 + figs. (unnumbered).

*Material* – One rather poorly preserved specimen from Çalık (Gümüşhane area), Lower Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.104.	10.6	11.3	7.7	4.9

*Remarks* – This species was well-documented by profuse illustrations by RAU (1905, l.c.) and HÖFLINGER (2012, l.c.) and on this basis, the identification of our specimen seems satisfactory. *C. persinuata* stands very close to the type species of the genus, *C. dalmasi* (Dumortier, 1869), but it is more convex, has more numerous ribs, weaker deflections in the uniplication, and its outline is more pentagonal in dorsal view, with somewhat concave anterior part. *C. persinuata* is a characteristic late Pliensbachian brachiopod of the NW-European (German) region but it was recorded also from the Pliensbachian of the West Carpathians, the Balkans (Kotel), the Crimea and now from the Pontides (Turkey).

Superfamily Norelloidea Ager, 1959  
 Family Norellidae Ager, 1959  
 Subfamily Diholcorhynchiinae Xu & Liu, 1983  
 Genus *Holcorhynchia* Buckman, 1918

*Holcorhynchia? meneghinii* (Zittel, 1869)  
 (Figs 45–47)

v \* 1869 *Rhynchonella Meneghinii* Zitt. – ZITTEL, Central-Appenninen, p. 130, pl. XIV, figs 10, 11.  
 v 2014 *Holcorhynchia meneghinii* (Zittel, 1869) – VÖRÖS, Yakacik, p. 238, text-fig. 2, pl. I, fig. 12  
 (cum syn.).

*Material* – One well preserved specimen from Yakacik (Ankara area), Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.105.	11.1	11.3	6.5	1.8

*Remarks* – This is a rarely illustrated species, which was previously known only from the Central Appennines. Now it seems that *H. meneghinii* is rather frequent in Turkey: besides the present record, it was mentioned by VADÁSZ (1918) and documented in details by Vörös (2014). The author examined the original material of ZITTEL (1869) in the Bayerische Staatssammlung (München) and confirmed that the tiny “*Rhynchonella*” *meneghinii* is characterized by subtriangular outline, faint ribs which develop just near the anterior margin and a shallow dorsal sulcus; the anterior margin is only slightly sulcate. On these grounds our specimens from Yakacik can definitely be identified with *Holcorhynchia meneghinii*. AGER (1959a) described a closely related species, *H. yakacikensis* Ager, 1959 from Yakacik, which is, however, significantly more elongated than *meneghinii*. *H. meneghinii* was recorded from the Pliensbachian of the Central Appennines and Turkey.

Superfamily Hemithyridoidea Rzhonsnitskaia, 1956  
 Family Tetrarhynchiidae Ager, 1959  
 Subfamily Gibbirhynchiinae Manceñido & Owen, 2002  
 Genus *Gibbirhynchia* Buckman, 1918

*Gibbirhynchia cf. curviceps* (Quenstedt, 1856)  
 (Figs 48–50)

\* 1856 *Terebratula curviceps* – QUENSTEDT, Der Jura, p. 138, pl. 17, figs 13–15.  
 v 2009 *Gibbirhynchia cf. curviceps* (Quenstedt, 1858) – VÖRÖS, Bakony, p. 103, pl. XI, fig. 16 (cum syn.).  
 2010 *Gibbirhynchia curviceps* (Quenstedt, 1856) – ALMÉRAS *et al.*, Massif Armoricain, p. 28, text-figs 8, 9, pl. 3, figs 1, 2, pl. 5, fig. 5.

- v 2011 *Gibbirhynchia cf. curviceps* (Quenstedt, 1856) – VÖRÖS & KANDEMİR, Eastern Pontides, p. 354, fig. 4/4.  
 2012 *Gibbirhynchia curviceps* (Quenstedt 1858) – HÖFLINGER, Deutsch. Lias, p. 86 + figs. (un-numbered).  
 2013 *Gibbirhynchia curviceps* (Quenstedt, 1858) – ALMÉRAS & FAURÉ, Quercy, p. 45, pl. 3, figs 15, 16.  
 2013 *Gibbirhynchia curviceps* (Quenstedt, 1856) – ALMÉRAS & COUGNON, Principaux genres, p. 127, pl. 14, figs 9–11.

*Material* – Four variously preserved specimens from Beytepe and Alacaatlı (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.106.	12.4	14.7	6.7	5.2

*Remarks* – *G. curviceps* is perhaps the most frequently cited Pliensbachian rhynchonellid species in Europe. It was profusely illustrated by ALMÉRAS *et al.* (2010, l.c.), ALMÉRAS & COUGNON (2013, l.c.) and HÖFLINGER (2012, l.c.) what served a firm basis for the identification of our specimens. *G. curviceps* was recorded in a great number of localities in the Mediterranean region as well and when I was able to check personally in the respective collections, I recognized that *G. curviceps* became a comfortably used collective taxon among the numerous and partly vaguely defined species of the genus *Gibbirhynchia*. The date of publication of this species is inconsistently cited by different authors as 1856 or 1858. Quenstedt's "Der Jura" was published in several parts in different years; the species *curviceps* was described in the first part (p. 138) therefore the proper date is 1856. *G. curviceps* is a Pliensbachian species with cosmopolitan geographical distribution.

*Gibbirhynchia cf. muirwoodae* Ager, 1954  
(Figs 51–53, 54–56)

- \* 1954 *Gibbirhynchia muirwoodae* sp. nov. – AGER, *Gibbirhynchia*, p. 40, pl. 1, figs 5, 6.  
 1962 *Gibbirhynchia muirwoodae* Ager. – AGER, *British Rhynchonellidae*, p. 99, text-fig. 60, pl. VIII, fig. 8.

*Material* – Six variously preserved specimens from Günüviran (Bilecik area), Yakacik, Köşrelik Kızığı and Alacaatlı (Ankara area), Upper Sinemurian to Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.107.	13.8	14.8	9.9	~5.5
INV 2014.108.	16.6	16.2	11.7	7.7

*Remarks* – This medium-sized *Gibbirhynchia* differs from *G. curviceps* (Quenstedt, 1856) in the lower degree of convexity of its valves and in some fea-



tures what approach to the genus *Tetrarhynchia*, e.g. the shape of the fold and the costation. Considering the illustrations given by AGER (1954, l.c. and 1962, l.c.), our specimens seem to show the greatest similarity to *G. muirwoodae* from among the many species of *Gibbirhynchia*. *G. muirwoodae* was recorded from the upper Pliensbachian of the NW-European region and Turkey.

Order Spiriferinida Ivanova, 1972  
Suborder Spiriferinidina Ivanova, 1972  
Superfamily Pennospiriferinoidea Dagys, 1972  
Family Lepismatinidae Xu & Liu, 1983  
Subfamily Dispiriferininae Carter, 1994  
Genus *Callospiriferina* Rousselle, 1965

*Callospiriferina* cf. *tumida* (Buch, 1837)  
(Figs 57–59)

- \* 1837 *Spirifer tumidus*. – BUCH, Über Delthyris, p. 53.  
1971 *Spiriferina tumida* var. *typica* var. nov. – SUČIĆ-PROTIĆ, Mid. Lias. Brach. Yugosl. Carpatho-Balkanids (II), p. 51, pl. XVIII, figs 1–5, pl. XXXVI, fig. 2.  
1977 *Callospiriferina tumida* (v. Buch) – ROUSSELLE, Spiriférines, p. 157, text-figs 1-B, 3, 4, pl. 1, fig. 2.  
2000 *Callospiriferina tumida* (v. Buch, 1836) – ALMÉRAS & FAURÉ, Pyrénées, p. 206, text-fig. 38, pl. 22, figs 7, 8.  
2003 *Callospiriferina tumida* (Buch, 1836) – DULAI, Hettangian and Early Sinemurian, p. 66, pl. XII, figs 1–4.  
2010 *Callospiriferina tumida* (V. Buch, 1836) – ALMÉRAS *et al.*, Massif Armoricain, p. 65, pl. 4, fig. 15, pl. 5, fig. 3.  
2012 *Callospiriferina tumida* (v. Buch 1837) – HÖFLINGER, Deutsch. Lias, p. 93 + fig. (unnumbered).  
2013 *Callospiriferina tumida* (V. Buch, 1834) – ALMÉRAS & COUGNON, Principaux genres, p. 21, pl. 1, figs 1, 2.

*Material* – Two specimens; one fragmentary specimen from Günüviran (Bilecik area), and a disarticulated ventral valve from Alacaatlı (Ankara area), loose from Upper Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.109.	~20.0	24.2	16.2	~4.0

*Remarks* – This is the type species of the genus *Callospiriferina*, defined by ROUSSELLE (1977) as comprising the weakly ribbed spiriferinides with well-demarcated, smooth dorsal fold and ventral sulcus. Despite that its ventral beak is broken away, our specimens, especially the figured one, corresponds very well to the above description and to the figures cited in the synonymy.

In the original description of *C. tumida* (under the name “*Spirifer tumidus*”) BUCH (1837, p. 53) made reference to “*Spirifer pinguis* Ziethen, 1830”, and introduced the name *tumidus* for substituting the name *pinguis*, which was preoccupied for a Carboniferous species of “*Spirifer*”. Nevertheless, the name *pinguis* remained popular for a long time, and many authors used it, until SUČIĆ-PROTIĆ (1971, p. 50) then ROUSSELLE (1977) cleared up this confusion. *C. tumida* is a Sinemurian to Pliensbachian species of widespread distribution from the NW-European and Alpine-Mediterranean regions to North Africa and Turkey.

*Callospiriferina haueri* (Suess, 1854)  
(Figs 60, 61–63)

- \* 1854 *Spirifer Haueri* Suess. – SUESS, Kössener Schichten, p. 52, pl. II, fig. 6.  
 v 1886 *Sp. Haueri* Suess 1854 – ROTHPLETZ, Vilser-Alpen, p. 162, pl. XIII, figs 1–5.  
 ? 1934 *Spiriferina* ex gr. *tumida* Corroy. – MOISSEIEV, Crimea and Caucasus, p. 28, 175, pl. I, figs 26–28.  
 1934 *Spiriferina haueri* Suess. – MOISSEIEV, Crimea and Caucasus, p. 28, 175, pl. I, figs 29, 30, pl. II, figs 1–4.  
 1971 *Spiriferina tumida* (Buch) var. *haueri* Corroy – SUČIĆ-PROTIĆ, Mid. Lias. Brach. Yugosl. Carpatho-Balkanids (II), p. 52, pl. XIX, figs 1–4.  
 1990 *Spiriferina haueri* Suess, 1854 – TCHOUMATCHENCO, Brach. jur. Kotel II., p. 4 (pars), text-fig. 1, pl. I, figs 1, 5, 7 (? non figs 2, 4, 6), pl. II, figs 3–5 (? non figs 1, 2).  
 1999 *Callospiriferina haueri* (Suess 1854) – SIBLÍK, Northern Calcareous Alps, p. 429, pl. 3, figs 2, 3.  
 2012 *Callospiriferina haueri* (Suess 1854) – HÖFLINGER, Deutsch. Lias, p. 95 + fig. (unnumbered).

*Material* – Three fragmentary specimens from Beytepe and Alacaatlı (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.110.	>18.0	26.4	19.2	7.7
INV 2014.111.	>30.0	~44.0	–	–

*Remarks* – This is a large *Callospiriferina* with laterally expanded oval to sub-trigonal outline. The hinge margin is straight and very wide, its length attains the whole width of the shell, and protrudes from the outline. The valves are almost equally convex. The dorsal valve is more inflated posteriorly. The ventral umbo is wide, very high and strongly apsacline. The interarea is a little wider than high and almost flat. The dorsal umbo is well developed. The lateral commissures are poorly preserved. The anterior commissure is highly uniplicate forming a narrow, rather sharp, unbroken arch. The linguiform extension is distinctly protracted anterodorsally. The lateral flanks of the valves are covered by 7 to 9 strong but blunt ribs; the central fold and sulcus are smooth.

*C. haueri* is well-documented by classical authors (SUESS 1854; ROTHPLETZ 1886) and our specimens from the Ankara area fit well to these illustrations. The

specimen illustrated by MOISSEIEV (1934, pl. I, figs 26–28) as *Spiriferina* ex gr. *tumida* Corroy seems rather similar to *C. haueri*. From among the numerous specimens illustrated by TCHOUMATCHENCO (1990) as *haueri*, some items are queried in the above synonymy because their figures are of very poor quality, or they are almost smooth. This species has a cosmopolitan distribution from the Alpine region to Turkey and from the Hettangian to the Pliensbachian.

Superfamily Spiriferinoidea Davidson, 1884  
 Family Spiriferinidae Davidson, 1884  
 Subfamily Spiriferininae Davidson, 1884  
 Genus *Liospiriferina* Rousselle, 1977

*Liospiriferina alpina* (Oppel, 1861)  
 (Figs 64–66, 67–69)

- \* 1861 *Spiriferina alpina* Opp. – OPPEL, Brachiopoden des unteren Lias, p. 541, pl. XI, fig. 5.  
 v 2009 *Liospiriferina alpina* (Oppel, 1861) – VÖRÖS, Bakony, p. 112, pl. XII, fig. 2 (cum syn.).  
 non 2013 *Liospiriferina alpina* (Oppel, 1861) – ALMÉRAS & COUGNON, Principaux genres, p. 30, pl. 2, fig. 6.  
 v 2014 *Liospiriferina alpina* (Oppel, 1861) – VÖRÖS, Yakacik, p. 240, pl. I, fig. 14.

*Material* – Nine partly incomplete specimens from Günüviran (Bilecik area), Alacaatlı (Ankara area), Gökdere and Çalık (Gümüşhane area), Upper Sinemurian and Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.112.	17.5	15.6	12.2	–
INV 2014.113.	13.1	12.7	10.2	–

*Remarks* – This frequently cited and figured Alpine species of the genus *Liospiriferina* was recently discussed in detail by VÖRÖS (2009). *L. alpina* is easily identified on the basis of its circular outline, the simple, smooth biconvex valves, the straight anterior commissure and the elevated ventral beak with rather high, trigonal interarea. ALMÉRAS & COUGNON (2013, p. 30) suggested that the item *L. alpina* by VÖRÖS (2009) should be referred to *L. hartmanni* (Zieten, 1830). However, this can not be accepted, because *L. hartmanni* clearly differs from *L. alpina* by having transversely elongated outline, uniplicate anterior commissure and massive dorsal umbo. The specimen figured by ALMÉRAS & COUGNON (2013, l.c.) does not correspond to the typical *L. alpina* because its anterior commissure is not straight but definitely uniplicate. *L. alpina* is a typical Sinemurian to Pliensbachian Alpine-Mediterranean species but it was rarely recorded also from NW-Europe, Algeria and Turkey.

*Liospiriferina obtusa* (Oppel, 1861)  
(Figs 70–72)

\* 1861 *Sp. obtusa* – OPPEL, Brachiopoden des unteren Lias, p. 542, pl. XI, fig. 8.  
v 2009 *Liospiriferina obtusa* (Oppel, 1861) – VÖRÖS, Bakony, p. 115, pl. XIII, fig. 1 (cum syn.).

*Material* – One moderately preserved specimen from Gökdere (Gümüşhane area), Lower Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.114.	15.3	14.6	12.0	6.9

*Remarks* – *L. obtusa* is closely related to *L. alpina* but it is markedly uniplicate and its ventral beak is strongly apsacline and slightly incurved. The relationship of *L. obtusa* to other species of *Liospiriferina* was discussed recently by VÖRÖS (2009). *L. obtusa* is a typical Sinemurian to Pliensbachian Alpine-Mediterranean species but it was rarely recorded also from the southern regions of NW-Europe, the Crimea and Turkey.

Order Terebratulida Waagen, 1883  
Suborder Terebratulidina Waagen, 1883  
Superfamily Loboithyridioidea Makridin, 1964  
Family Loboithyrididae Makridin, 1964  
Subfamily Loboithyridinae Makridin, 1964  
Genus *Loboithyris* Buckman, 1918

*Loboithyris* cf. *punctata* (J. Sowerby, 1813)  
(Figs 73–75)

\* 1813 *Terebratula punctata*. – J. SOWERBY, Mineral Conchology I, p. 46, pl. XV, fig. 4.  
1926 *Terebratula punctata* Sow. – MOISSEIEV, Crimea, p. 975, pl. XXVIII, figs 23–25.  
v 2009 *Loboithyris* cf. *punctata* (J. Sowerby, 1813) – VÖRÖS, Bakony, p. 137, pl. XV, fig. 6 (cum syn.).  
v 2011 *Loboithyris punctata* (Sowerby, 1813) – VÖRÖS & KANDEMİR, Eastern Pontides, p. 357, figs 5/1–2.  
v 2014 *Loboithyris* cf. *punctata* (J. Sowerby, 1813) – VÖRÖS, Yakacik, p. 242, pl. II, fig. 3.

*Material* – Five specimens of various state of preservation from Alacaatlı (Ankara area), Elma Tepe and Çalık (Gümüşhane area), Upper Sinemurian to Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.115.	21.2	15.8	9.3	–

*Remarks* – This widespread Early Jurassic terebratulid species was very frequently recorded and figured in the classical and recent literature. In spite of its very simple morphology: elongated oval outline, somewhat flattened dorsal valve, rectimarginate commissures, and relatively small, depressed ventral umbo, *L. punctata* is easy to recognize and the identification of our specimens seems justified. *L. punctata* is a Pliensbachian species of cosmopolitan distribution.

Superfamily Dyscolioidea Fischer & Oehlert, 1892

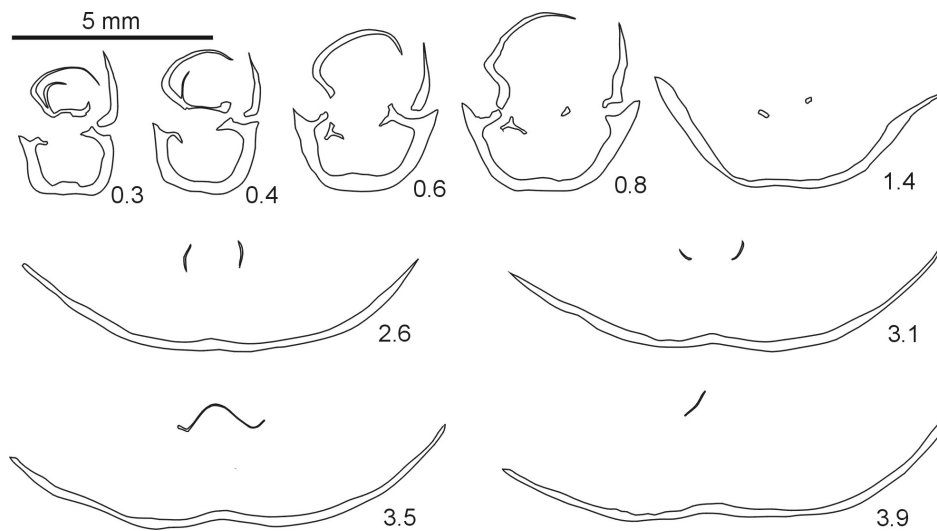
Family Nucleatidae Schuchert, 1929

Genus *Linguithyris* Buckman, 1918

*Linguithyris aspasia* (Zittel, 1869)

(Figs 76, 77–79, 80–82, 83–85)

- v \* 1869 *Terebratula Aspasia*. Menegh. – ZITTEL, Central-Appenninen, p. 126, pl. XIV, figs 1–4.  
 v 2009 *Linguithyris aspasia* (Zittel, 1869) – VÖRÖS, Bakony, p. 169, text-figs 96–104, pl. XXIV, figs 5–13, pl. XXV, figs 1–11, pl. XXVI, figs 1–6 (cum syn.).  
 2012 *Linguithyris aspasia* (Meneghini 1853) – HÖFLINGER, Deutsch. Lias, p. 144 + fig. (unnumbered).  
 2013 *Linguithyris aspasia* (Zittel, 1869) – BAEZA-CARRATALÁ, Subbetic, p. 84, fig. 5/10.  
 v 2014 *Linguithyris aspasia* (Zittel, 1869) – VÖRÖS, Yakacik, p. 242, pl. II, fig. 5.



**Fig. 76.** *Linguithyris aspasia* (Zittel, 1869). Nine transverse serial sections through the posterior part of a specimen from Bilecik, Günüviran (Turkey), loose from Upper Sinemurian to Carixian interval, INV 2014.119. Distances from posterior end of the shell are given in mm. Original length of the specimen was 11.0 mm. (The umbonal part of the ventral valve was seriously damaged)

*Material* – Four specimens of various state of preservation from Günüviran (Bilecik area) and Hasanoğlan (Ankara area), loose from Upper Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.116.	~13.0	14.6	10.0	–
INV 2014.117.	10.0	12.5	7.0	4.9
INV 2014.118.	12.9	14.1	9.8	7.5

*Remarks* – This species was profusely illustrated and exhaustively discussed by VÖRÖS (2009) and the identification of our specimens is beyond doubt. It is worth mentioning that all Turkish specimens, including those figured by AGER (1959a, 1991) and VÖRÖS (2014) represent the isometric variants of *L. aspasia*; they did not reach the bilobate growth stage. Nevertheless, they definitely belong to *L. aspasia*, what is further supported by the internal features illustrated by AGER (1991, fig. 2) and by the present paper (Fig. 76). Both series of cross sections show the reduced hinge plates, the indistinct crural bases, triangular in cross section and the simple loop with arched transverse band. One specimen figured by TCHOUMATCHENCO (1990, pl. VII, fig. 3) from Kotel, may represent a juvenile *L. aspasia*. This is a long-ranging species, from the Sinemurian to the early Toarcian.

Its frequent occurrence in the lower Pliensbachian of the Mediterranean region initiated the classical term “Strati con *T. aspasia*”. Later on, the geographical distribution of this species was proved to extending to a wider area, including North Africa and Turkey.

Suborder Terebratellidina Muir-Wood, 1955

Superfamily Zeillerioidea Allan, 1940

Family Zeilleriidae Allan, 1940

Subfamily Zeilleriinae Allan, 1940

Genus *Zeilleria* Bayle, 1878

*Zeilleria* cf. *waterhousi* (Davidson, 1851)

(Figs 86–88)

\* 1851 *Terebratula Waterhousii*, Dav. – DAVIDSON, Oolitic and Liasic, p. 31, pl. V, figs 12, 13.

1869 *Terebratula Waterhousi* (Davidson). – DUMORTIER, Bassin du Rhône, p. 324, pl. XLI, figs 11, 12.

2012 *Zeilleria waterhousi* (Davidson 1851) – HÖFLINGER, Deutsch. Lias, p. 169 + fig. (unnumbered).

v 2014 *Zeilleria* cf. *waterhousi* (Davidson, 1851) – VÖRÖS, Yakacik, p. 243, pl. II, fig. 6.

*Material* – One moderately preserved specimen from Çalık (Gümüşhane area), Lower Pliensbachian.

*Measurements –*

	L	W	T	Ch
INV 2014.120.	14.6	11.0	5.8	–

*Remarks* – In the identification of this species the comprehensive synthesis on zeilleriids by DELANCE (1974) and the monographs by ALMÉRAS & FAURÉ (2000, 2013) have been taken into account. In the original concept by DAVIDSON (1851) *T. waterhousi* was characterized by gently sulcate anterior commissure. Later, by synonymizing the species *subdigona* (Opell, 1853) the forms with straight anterior commissure were also included (DELANCE 1974; ALMÉRAS & FAURÉ 2013). Our specimen shows gently strangulate, straight anterior commissure, therefore stands closer to the “*subdigona*”-type.

ANTOSHTCHENKO (1970) ranged this species into the genus *Keratothyris* Tuluweit, 1965, but it was not accepted by DELANCE (1974) and later French authors, and this latter opinion is followed by the present author. *Z. waterhousi* was most frequently recorded in northwest Europe, but occurs also in the Crimea, the Balkans and Turkey; therefore, it seems to be cosmopolitan in distribution.

*Zeilleria cf. lycetti* (Davidson, 1851)  
(Figs 89–91)

\* 1851 *Terebratula Lycetii*, Dav. – DAVIDSON, Oolitic and Liasic, p. 44, pl. VII, figs 17–19 (non figs 20–22).

non 1878 *Waldheimia Lycetti*, Dav. – DAVIDSON, Supplement, p. 175, pl. XXIV, figs 30, 31.

1974 *Zeilleria lycetti* (Davidson 1851, sensu Buckman 1904) – DELANCE, Zeilleridés, p. 158, pl. 2, figs 11, 12.

? 1994 *Zeilleria (Zeilleria) lycetti* (Davidson, 1851) – TCHOUMATCHENCO, Ouarsenis, p. 55, pl. V, figs 4, 5.

2010 *Zeilleria lycetti* (Davidson, 1851 sensu Buckman, 1904) – ALMÉRAS *et al.*, Massif Armoricain, p. 58, text-fig. 18, pl. 4, figs 3, 4.

v 2011 *Zeilleria cf. lycetti* (Davidson, 1851) sensu Ager – VÖRÖS & KANDEMİR, Eastern Pontides, p. 358, fig. 5/5 (cum syn.).

v 2014 *Zeilleria cf. lycetti* (Davidson, 1851) – VÖRÖS, Yakacik, p. 244, pl. II, fig. 7.

*Material* – Two partly incomplete specimens from Kösrelik Kızığı (Ankara area), loose from Upper Sinemurian to Pliensbachian interval.

*Measurements –*

	L	W	T	Ch
INV 2014.121.	17.7	14.5	8.3	–

*Remarks* – This species of *Zeilleria* has very simple morphology. Its outline is slightly drop-shaped, oval; the valves are moderately and nearly equally convex. The beak is highly elevated and suberect, with sharp beak ridges. The commissures are rectimarginate. Dental plates are visible in specimens with broken umbo. By these morphological features, our specimens were easily identified as *Z. cf. lycetti*.

*Z. lycetti* is frequently cited and illustrated but its correct interpretation bears some uncertainty. DAVIDSON (1851, pl. VII, figs 17–22) figured several different specimens under the name *lycetti*. BUCKMAN (1904) revised the material and designated the specimen on fig. 17 by DAVIDSON (1851) as the type specimen of “*Ornithella Lycetti*”. DELANCE (1974) and later French authors (ALMÉRAS *et al.* 2010; ALMÉRAS & FAURÉ 2013) followed this practice. On the other hand, AGER (1959a) used a wider interpretation and included the figs 17–19 of DAVIDSON (1851) as representing the species *Z. lycetti*. This was accepted by VÖRÖS & KANDEMİR (2011) and VÖRÖS (2014) and is followed here as well. *Z. lycetti* is widespread in the Pliensbachian in Northwest Europe but was also recorded in Turkey and perhaps in North Africa.

*Zeilleria cf. subnumismalis* (Davidson, 1851)  
(Figs 92–94)

- \* 1851 *Terebratula numismalis*, Lamarck var. *subnumismalis* – DAVIDSON, Oolitic and Liasic, p. 36, 38, pl. V, fig. 10.  
 1869 *Terebratula subnumismalis* (Davidson). – DUMORTIER, Bassin du Rhône, p. 326, pl. XLI, figs 8–9 (? 10).  
 1878 *Waldheimia sub-numismalis*, Dav. – DAVIDSON, Supplement, p. 62, pl. XXI, figs 1–7.  
 1885 *Waldheimia (Zeilleria) subnumismalis*, Dav. – PARONA, Saltrio e Arzo, p. 257, pl. V, figs 8–14.  
 1893 *Waldheimia subnumismalis*, Dav. – PARONA, Revisione Gozzano, p. 52, pl. I, fig. 26.  
 ? 1926 *Waldheimia subnumismalis* Opp. – MOISSEIEV, Crimea, p. 980, pl. XXVIII, figs 34–36.  
 ? 1934 *Zeilleria subnumismalis* Dav. E. Desl. – MOISSEIEV, Crimea and Caucasus, p. 131, 198, pl. XVII, figs 27–33.  
 1966 *Zeilleria subnumismalis* (Davidson, 1852) – SIBLÍK, Ramenon. Kostelec. bradla, p. 140, pl. II, fig. 1.  
 1974 *Zeilleria (Zeilleria) subnumismalis* (Davidson 1851) – DELANCE, Zeilleridés, p. 202, pl. 3, figs 16, 17.  
 1990 *Zeilleria (Zeilleria) subnumismalis* (Davidson 1851) – TCHOUMATCHENCO, Brach. jur. Kotel II, p. 24, text-fig. 14, pl. X, figs 6–11, pl. XI, figs 1–4.  
 2012 *Zeilleria subnumismalis* (Davidson 1851) – HÖFLINGER, Deutsch. Lias, p. 166 + fig. (un-numbered).

*Material* – Five partly incomplete specimens from Beytepe (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.122.	34.5	31.6	21.4	–

*Remarks* – This species of *Zeilleria* was profusely and well illustrated by some classical authors (DAVIDSON 1878, l.c.; PARONA 1885, l.c.) and was exhaustively revised by DELANCE (1974). On this basis the identification of our specimens seems justified. *Z. subnumismalis* is a rather large, conservative form, with



subcircular outline, moderate convexity and straight commissures. Some items of the above synonymy do not conform to these basic features, e.g. the specimen figured by MOISSEIEV (1926, l.c.) is too elongated; another item by MOISSEIEV (1934, l.c.) is too small; their attribution to *Z. subnumismalis* is questionable. This is a Pliensbachian species of the NW-European region but it was recorded also from the Alpine-Carpathian region, the Balkans (Kotel), perhaps from the Crimea and now from Turkey.

*Zeilleria cf. mutabilis* (Oppel, 1861)  
(Figs 95–97)

- \* 1861 *Terebratula mutabilis* Opp. (*Waldheimia*.) – OPPEL, Brachiopoden des unteren Lias, p. 538, pl. X, fig. 7.  
 v 2009 *Zeilleria mutabilis* (Oppel, 1861) – VÖRÖS, Bakony, p. 183, text-figs 110, 111, pl. XXVIII, figs 5, 6 (cum syn.).  
 v 2014 *Zeilleria cf. mutabilis* (Oppel, 1861) – VÖRÖS, Yakacik, p. 244, pl. II, fig. 8.

*Material* – Five rather well-preserved specimens from Kösrelik Kızıği (Ankara area), loose from Upper Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.123.	14.2	13.7	6.7	–

*Remarks* – This species is one of the most frequently illustrated and best known Alpine Early Jurassic zeilleriid. Recently VÖRÖS (2009) gave a detailed external and internal morphological description and discussion of *Z. mutabilis*. Externally, it is easy to recognize by its very simple but constant morphology (sub-pentagonal outline, moderately flat valves, straight commissures, erect to slightly incurved beak), and on the basis of these features, the identification of our specimens seems to be justified. *Z. mutabilis* is frequent in the Sinemurian and Pliensbachian of the Alpine-Mediterranean region, but occurs also in North Africa, the Balkans and Turkey; therefore, it tends to be cosmopolitan in distribution.

Genus *Aulacothyris* Douvillé, 1879

*Aulacothyris resupinata* (J. Sowerby, 1816)  
(Figs 98–100)

- \* 1816 *Terebratula resupinata*. – J. SOWERBY, Mineral Conchology II, p. 116, pl. CL, figs. 3, 4.  
 1851 *Terebratula resupinata*, Sow. – DAVIDSON, Oolitic and Liassic, p. 31, pl. IV, figs 1–5.  
 1959a *Aulacothyris cf. A. resupinata* (J. Sowerby) – AGER, Turkey, p. 1025, pl. 129, fig. 5.  
 1974 *Aulacothyris resupinata* (Sowerby 1816) – DELANCE, Zeilleridés, p. 317, pl. 6, figs 14–26.  
 1975 *Aulacothyris resupinata* (Sowerby 1818) – COMAS-RENGIFO & GOY, Ribarredonda, p. 320, pl. 2, figs 5, 6.

- 1990 *Aulacothyris resupinata* (J. Sowerby, 1816) – TCHOUMATCHENCO, Brach. jur. Kotel II, p. 35, text-figs 21, 22, pl. XI, figs 6–10.  
 2010 *Aulacothyris resupinata* (Sowerby, 1818) – ALMÉRAS *et al.*, Massif Armoricain, p. 62, text-fig. 21.  
 v 2014 *Aulacothyris resupinata* (J. Sowerby, 1816) – VÖRÖS, Yakacik, p. 245, pl. II, fig. 10.

*Material* – One rather well-preserved specimen from Günüviran (Bilecik area), loose from Upper Sinemurian to Lower Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.124.	11.3	10.3	4.9	2.7

*Remarks* – *A. resupinata* is a frequently illustrated and well-known European zeileriid species and it was thoroughly discussed by DELANCE (1974) and ALMÉRAS *et al.* (2010). On the basis of its elongated oval outline, erect beak with well-developed beak ridges and the shallow but long dorsal sulcus, starting very posteriorly, our specimen was easy to identify with this species. *A. resupinata* differs from *A. anatolica* (Vadász, 1913) by its narrower sulcus and by its oval outline, in contrast to the subpentagonal outline of *A. anatolica*, where the greatest width is near the anterior end of the shell. *A. resupinata* occurs frequently in the Pliensbachian of the NW-European region, but was recorded also in North Africa, the Balkans (Kotel) and Turkey; therefore, it tends to be cosmopolitan in distribution.

*Aulacothyris anatolica* (Vadász, 1913)

(Figs 101–103, 104–106)

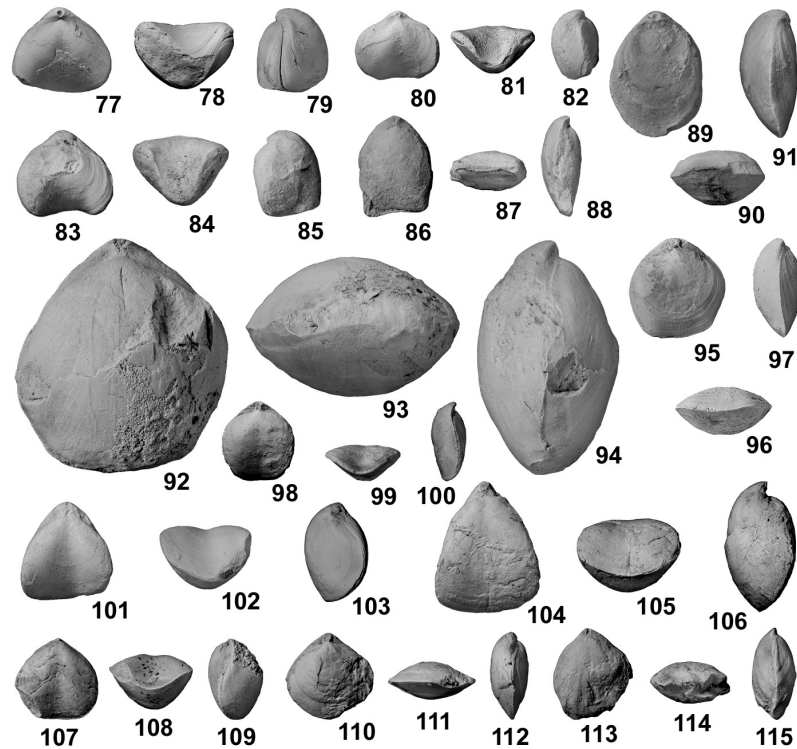
- v \* 1913a *Waldheimia anatolica* nov. f. – VADÁSZ, Kisázsia, p. 61, text-fig. 5.  
 v 1913b *Waldheimia anatolica* nov. f. – VADÁSZ, Kleinasien, p. 69, text-fig. 6.  
 ? 1926 *Waldheimia (Aulacothyris) salgirensis* n. sp. – MOISSEIEV, Crimea, p. 983, 993, pl. XXVIII, figs 40–42.  
 ? 1934 *Aulacothyris salgirensis* Mois. – MOISSEIEV, Crimea and Caucasus, p. 153, 202, pl. XIX, figs 22–25.  
 1959a *Aulacothyris anatolica* (Vadász) – AGER, Turkey, p. 1025, pl. 129, fig. 1.  
 v 2014 *Aulacothyris anatolica* (Vadász, 1913) – VÖRÖS, Yakacik, p. 245, text-fig. 3, pl. II, fig. 11.

*Material* – Seven moderately preserved specimens from Günüviran (Bilecik area), Köşrelik Kızığı (Ankara area) and Çalık (Gümüşhane area), loose from Upper Sinemurian to Pliensbachian interval.

*Measurements* –

	L	W	T	Ch
INV 2014.125.	14.3	12.9	8.8	6.5
INV 2014.126.	19.2	15.4	10.5	5.1

*Remarks* – This typical species of the genus *Aulacothyris* was first described by VADÁSZ (1913a, b) from Yakacik (Turkey), and a detailed revision of the same toptotypical material was given recently by VÖRÖS (2014), including the demon-



**Figs 77–79.** *Linguothyris aspasia* (Zittel, 1869), INV 2014.116., Günüviran, Sinemurian to Pliensbachian, 77 = dorsal view, 78 = anterior view, 79 = lateral view. – **Figs 80–82.** *Linguothyris aspasia* (Zittel, 1869), INV 2014.117., Günüviran, Sinemurian to Pliensbachian, 80 = dorsal view, 81 = anterior view, 82 = lateral view. – **Figs 83–85.** *Linguothyris aspasia* (Zittel, 1869), INV 2014.118., Hasanoğlan, Pliensbachian, 83 = dorsal view, 84 = anterior view, 85 = lateral view. – **Figs 86–88.** *Zeilleria cf. waterhousi* (Davidson, 1851), INV 2014.120., Çalık, Pliensbachian, 86 = dorsal view, 87 = anterior view, 88 = lateral view. – **Figs 89–91.** *Zeilleria cf. lycetti* (Davidson, 1851), INV 2014.121., Köşrelik Kızıği, Sinemurian to Pliensbachian, 89 = dorsal view, 90 = anterior view, 91 = lateral view. – **Figs 92–94.** *Zeilleria cf. subnumismalis* (Davidson, 1851), INV 2014.122., Beytepe, Pliensbachian, 92 = dorsal view, 93 = anterior view, 94 = lateral view. – **Figs 95–97.** *Zeilleria cf. mutabilis* (Opper, 1861), INV 2014.123., Köşrelik Kızıği, Sinemurian to Pliensbachian, 95 = dorsal view, 96 = anterior view, 97 = lateral view. – **Figs 98–100.** *Aulacothyris resupinata* (J. Sowerby, 1816), INV 2014.124., Günüviran, Sinemurian to Pliensbachian, 98 = dorsal view, 99 = anterior view, 100 = lateral view. – **Figs 101–103.** *Aulacothyris anatolica* (Vadász, 1913), INV 2014.125., Günüviran, Sinemurian to Pliensbachian, 101 = dorsal view, 102 = anterior view, 103 = lateral view. – **Figs 104–106.** *Aulacothyris anatolica* (Vadász, 1913), INV 2014.126., Köşrelik Kızıği, Sinemurian to Pliensbachian, 104 = dorsal view, 105 = anterior view, 106 = lateral view. – **Figs 107–109.** *Bakonythyris cf. apenninica* (Zittel, 1869), INV 2014.127., Alacaatlı, Pliensbachian, 107 = dorsal view, 108 = anterior view, 109 = lateral view. – **Figs 110–112.** *Cincta numismalis* (Lamarck, 1819), INV 2014.128., Alacaatlı, Pliensbachian, 110 = dorsal view, 111 = anterior view, 112 = lateral view. – **Figs 113–115.** *Fimbriothyris cf. guerangeri* (Deslongchamps, 1856), INV 2014.129., Yakacık, Pliensbachian, 113 = dorsal view, 114 = anterior view, 115 = lateral view. (All figures are in natural size. Specimens have been coated with ammonium chloride before photography.)

stration of the internal morphology of *A. anatolica*. It was also shown that *A. salgirensis* introduced by MOISSEIEV (1926), was very similar externally and probably conspecific with *A. anatolica*. This view was strongly supported by the serial sections of *A. salgirensis* published by ANTOSHTCHENKO (1970, fig. 4), which are particularly similar to those of *A. anatolica*. Our species differs from *A. resupinata* (J. Sowerby, 1816) by its broad and shallow sulcus and that its greatest width is attained near the anterior end of the shell. From this point of view, *A. anatolica* is somewhat similar to *A. ballinensis* (Haas, 1912; see in VÖRÖS 2009), but it is more elongated and its sulcus starts more posteriorly and is significantly deeper. *A. anatolica* was known only from Yakacik (Turkey), but in the light of the new data presented here, it seems to be widespread in other parts of northern Anatolia.

Genus *Bakonyithyris* Vörös, 1983

*Bakonyithyris* cf. *apenninica* (Zittel, 1869)  
(Figs 107–109)

\* 1869 *Terebratula (Waldheimia) Apenninica*. Zitt. – ZITTEL, Central-Appenninen, p. 127, pl. XIV, fig. 9.

v 2009 *Bakonyithyris apenninica* (Zittel, 1869) – VÖRÖS, Bakony, p. 198, text-figs 121–124, pl. XXIX, figs 5–8 (cum syn.).

*Material* – Two poorly preserved specimens from Alacaatlı (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.127.	11.4	11.7	7.5	3.2

*Remarks* – This species is very closely related to *B. pedemontana* (Parona, 1893), the type species of *Bakonyithyris* and was recently revised and discussed in detail by VÖRÖS (2009). One of our specimens, illustrated in figs. 107–109, is a typical representative of *B. apenninica*, whereas the anterior commissure of the other specimen tends to be somewhat trapezoidal and reminding in this respect to *B. meneghinii* (Parona, 1880). *B. apenninica* is a dominantly Pliensbachian species, typical for the Alpine-Mediterranean region but it was recorded also from North Africa and now from Turkey.

Genus *Cincta* Quenstedt, 1868

*Cincta numismalis* (Lamarck, 1819)  
(Figs 110–112)

\* 1819 *Terebratula numismalis*. – LAMARCK, Histoire naturelle, p. 249, no. 17.

- 1926 *Waldheimia numismalis* Lam. – MOISSEIEV, Crimea, p. 980, pl. XXVIII, figs 31–33.  
 v 2011 *Cincta numismalis* (Lamarck, 1819) – VÖRÖS & KANDEMİR, Eastern Pontides, p. 358, fig. 5/6 (cum syn.).

*Material* – One moderately preserved specimen from Alacaatlı (Ankara area), probably Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.128.	12.1	12.4	5.1	–

*Remarks* – This species has a very characteristic, flat, lenticular shape and a marked ventral umbo, bordered by sharp beak ridges. *C. numismalis* was discussed in details by DELANCE (1974) and ALMÉRAS & FAURÉ (2000), who illustrated the rather wide morphological variability and cleared up its generic attribution. On this basis, the identification of our specimen, though it is rather small, seems to be confirmed. *C. numismalis* is a characteristic NW-European species, long-ranging from the late Sinemurian to the Pliensbachian. It was described and illustrated from the Balkans (Kotel) and Crimea and another localities of Turkey by AGER (1959a) and VÖRÖS & KANDEMİR (2011).

Genus *Fimbriothyris* Deslongchamps, 1884

*Fimbriothyris* cf. *guerangeri* (Deslongchamps, 1856)  
 (Figs 113–115)

- 1856 *Terebratula (Waldheimia) guerangeri*, E.-D. – DESLONGCHAMPS, Précigné, p. 304, pl. XVII, fig. 1.  
 1871 *Terebratula Guerangeri* – QUENSTEDT, Petrefactenkunde, p. 301, pl. 45, fig. 92.  
 1907 *Waldheimia tranzensis* n. f. – DAL PIAZ, Sospirolo, p. 62, text-fig. 4.  
 1942 *Zeilleria Guerangeri* E. Desl. sp. – DUBAR, Multiplissées, p. 51, text-fig. 15, pl. II, fig. 16.  
 1974 *Fimbriothyris guerangeri* (Deslongchamps 1856) – DELANCE, Zeilleridés, p. 279, pl. 6, figs 1–5.

*Material* – One poorly preserved specimen from Yakacık, Pliensbachian.

*Measurements* –

	L	W	T	Ch
INV 2014.129.	13.4	11.7	6.1	–

*Remarks* – Our specimen is rather poorly preserved, but by its oval outline, straight commissures, the beak characters, the presence of the median septum and first of all the radial multiplication render it the closest to *F. guerangeri*. The original figures by DESLONGCHAMPS (1856, l.c.) portray a specimen with rather angular anterior part trapezoidal in outline and the illustration of “*Waldheimia tranzensis*” by DAL PIAZ (1907, l.c.) also corresponds to this. Later authors

(DUBAR 1942; DELANCE 1974), on the basis of larger material, expanded the concept of this species and included forms with more oval outlines.

Similar forms, where, in contrast to the typical *F. guerangeri*, the marginal multiplication appeared only at the anterior margin, have been described and illustrated by TCHOUMATCHENCO (1990, p. 33, pl. V, fig. 1, pl. VII, fig. 7) from Kotel as *Fimbriothyris* sp. indet., and by VÖRÖS & KANDEMİR (2011, p. 359, figs 5/7, 5/8) from the Eastern Pontides as *Fimbriothyris* sp., aff. *guerangeri*. These probably represent another, closely allied species of *Fimbriothyris*. *F. guerangeri* is a Pliensbachian species, rather cosmopolitan in geographical distribution, from the NW-European and the Mediterranean regions to Turkey.

### CONCLUSIONS

The Early Jurassic brachiopods collected by Füsün Alkaya from diverse localities of northern Anatolia (Turkey) have been examined in detail. The taxonomic and nomenclatural study of the 93 specimens resulted in 32 brachiopod taxa. They represent 18 genera and 31 nominal species; these have been shortly described and documented by photographs and partly by serial sections. One species: *Cirpa alkayae* is introduced and described as new.

The brachiopods have been collected from 10 localities, from the Bilecik, the Ankara and the Gümüşhane areas. All localities fall to the Sakarya Zone of northern Anatolia, most of them are associated to the occurrences of the Karakaya Complex which was contiguous with the Taurian series of the Crimea (OKAY *et al.* 2006, p. 398).

A detailed palaeobiogeographical evaluation of this brachiopod fauna was beyond the scope of the present paper. Nevertheless, considering only the simple presence vs. absence data of the identified species in the major Tethyan palaeogeographic provinces (NW-European, vs. Mediterranean) we obtain the following numbers: besides 6 endemic and 3 cosmopolitan species, 11 species have NW-European, and 11 species have Mediterranean affinity. The preliminary conclusion is that the Early Jurassic brachiopod fauna of the Sakarya Zone has a transitional character between the two major faunal provinces. This is in accordance with the previous results from the eastern Pontides (VÖRÖS & KANDEMİR 2011, p. 351) and further emphasises the faunal similarity between Sakarya/Pontides and the Crimea.

\*

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