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# Mono- and dicyrtid Nassellaria (Radiolaria) from the Upper Carnian of the Sorgun Ophiolitic Mélange, Southern Turkey and Kopría Mélange, Rhodes, Greece

*Radiolaires nassellaires mono- et dicyrtides du Carnien supérieur du Mélange Ophiolitique de Sorgun, Turquie Méridionale et du Mélange de Kopría, Rhodes, Grèce*

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## Abstract

Four new genera (*Circopoulpus* nov. gen., *Aropeon* nov. gen., *Tekinium* nov. gen., *Caponabolella* nov. gen.) and 19 new characteristic mono- and dicyrtid Nassellarian species are described herein from two of the most diverse and best preserved Carnian (Late Triassic) radiolarian faunas of the world, which are the lower Tuvalian sequence of the Sorgun Ophiolitic Mélange, southern Turkey, and the Kopría Mélange, Rhodes, Greece. © 2016 Elsevier Masson SAS. All rights reserved.

**Keywords:** Radiolaria; Nassellaria; Carnian; Sorgun Ophiolitic Mélange; Kopría Mélange; New Taxa

## Résumé

Quatre nouveaux genres (*Circopoulpus* nov. gen., *Aropeon* nov. gen., *Tekinium* nov. gen., *Caponabolella* nov. gen.) et 19 nouvelles espèces de Nassellaires mono- et dicyrtides sont décrits à partir de matériel provenant de deux des plus diverses et mieux préservées faunes de radiolaires du monde d'âge Tuvalien inférieur (Carnien, Trias supérieur). Les faunes proviennent du Mélange ophiolitique de Sorgun, Turquie méridionale, et du Mélange de Kopría, Rhodes, Grèce.

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**Mots clés :** Radiolaires ; Nassellaires ; Carnien ; Mélange ophiolitique de Sorgun ; Mélange de Kopría ; Nouveaux Taxons

## 1. Introduction

The Carnian was one of the most important intervals in the evolution of Triassic radiolarian faunas (O'Dogherty et al., 2010) at generic and family levels (De Wever et al., 2003). Radiolarian genera reached their highest diversity (Fig. 1) during the Julian and early Tuvalian, after the decrease of the number of new taxa around the Ladinian–Carnian boundary (Fig. 1). This

period was particularly important especially for spumellarians and entactinarians, when started the diversification of special groups bearing tumidaspinae (families Capnuchosphaeridae De Wever, Eptingiidae Dumitrica) or saturnalid ring (Saturnalidae Deflandre, Spongosaturnalidae Kozur & Mostler), whose first appearance took place in fact during the Longobardian. The causes and consequences of these unique evolutionary innovations and accelerated rates of evolutionary changes in Carnian radiolarians are still unclear. Fortunately, perfectly preserved Carnian radiolarian faunas are known from different localities (e.g. Lagonegro Basin, Italy; Sosio Valley, Sicily; Göstling and Großreifling, Northern Calcareous Alps, Austria; Nosztor

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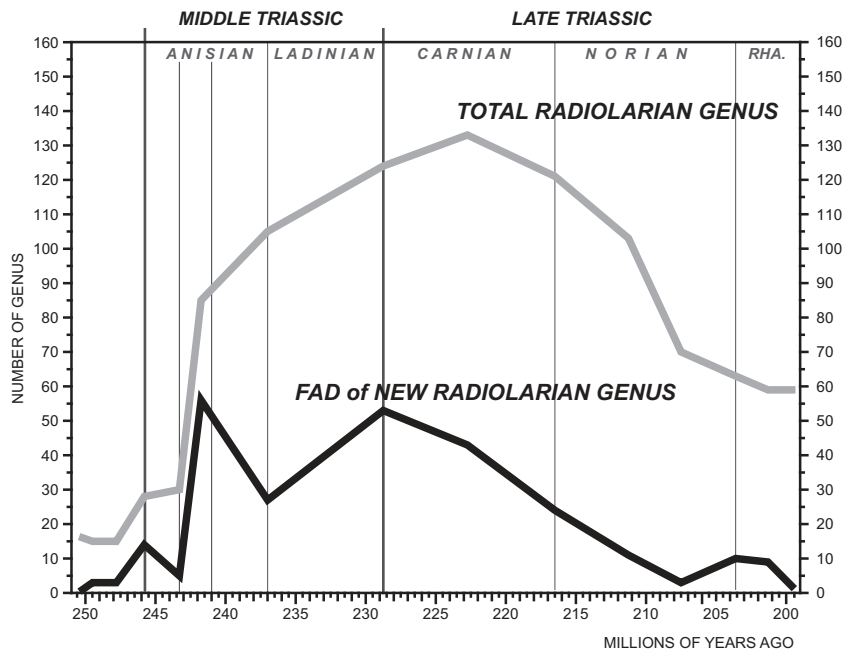


Fig. 1. Radiolarian genus diversity through Triassic after O'Dogherty et al., 2010 (FAD and LAD of some genera were modified in some cases).

Valley, Hungary; Mersin Ophiolitic Complex, and Elbistan, Köseyahya Nappe, Turkey; Zulla Formation, Hawasina Complex, Oman) in the Tethyan realm from the lower Julian to the lower Tuvallian. One such extremely well-preserved and particularly diverse lower Tuvallian (Upper Carnian) radiolarian fauna is known from the Sorgun Ophiolitic Mélange (Mersin Ophiolitic Complex), Turkey, which was discovered near to Sorgun village in 2003 by Masset and Moix. Moix et al. (2007) established the lower Tuvallian *Spongortilispinus moixi* radiolarian zone and described several radiolarian species from this zone. Numerous additional radiolarian taxa were subsequently described from the type locality of the *S. moixi* zone in a series of papers by Kozur et al. (Kozur et al., 2007a, b, c; Kozur et al., 2009) and Ozsvárt et al. (2015). Thus far, three new families, 11 new genera, and 113 new species and subspecies have been described. Another lower Tuvallian radiolarian fauna of practically equal composition, preservation, lithology and age has been also found close to the Kritinia village in Kopría Mélange, Rhodes, Greece (Moix et al., 2008b). These similarities prove doubtlessly that both faunas come from the same paleogeographic area. These two faunas have many elements in common with the upper Carnian (*Tetraporobrachia haeckeli* Zone) fauna from the Köseyahya Nappe in Elbistan (Tekin and Bedi, 2007a, b; Dumitrica et al., 2010, 2013a, b). In this paper, we continue the taxonomic work of the exceptionally preserved lower Tuvallian radiolarians by the description of several new taxa of Nassellaria from the Sorgun Ophiolitic Mélange and from the Kopría Mélange, Rhodes (Greece).

## 2. General geology of the ophiolitic mélanges

The ophiolites and related mélanges in the Eastern Mediterranean region (Fig. 2) provide one of the most important clues for the reconstruction of the geodynamic evolution of the

Paleotethyan and Neotethyan series (e.g. Gawlick et al., 2016). The ophiolites in the Eastern Mediterranean formed in a variety of tectonic settings (Robertson, 2002). The mainly Triassic and Jurassic ophiolites and related oceanic magmatic units are exposed in the Dinarides - Hellenides (Dinaridic Ophiolite belt - Mirdita - Pindos - Vourinos) belt, while the mainly Cretaceous ophiolites and associated units are represented in the Taurides of southern Turkey. Several dismembered ophiolite units and related ophiolitic mélange of this Cretaceous belt appear in the Mersin Ophiolitic Complex, Southern Turkey (Mersin) and on the Rhodes Island, Greece. The Mersin Ophiolitic Complex belongs to the South-Taurides exotic units (Moix et al., 2008a) and exhibits typical oceanic fragments with ophiolitic series, sub-ophiolitic metamorphic sole and associated infra-ophiolitic mélange. The Mersin ophiolite formed in a supra-subduction zone tectonic setting during the Late Cretaceous (Parlak and Delaloye, 1996) and includes two major independent mélange units identified in the Mersin Ophiolitic Complex: the Upper Cretaceous Sorgun Ophiolitic Mélange and the Middle to Upper Triassic Hacıalanı Mélange (Moix et al., 2011). One of the most important and well-developed tectonic blocks of the Sorgun Ophiolitic Mélange is the Tavuşçayırı Block where the well-preserved and particularly diverse lower Tuvallian radiolarian fauna was found (Masset and Moix, 2004). This tectonic block contains several typical deep-sea sedimentary units of the Huğlu-Pindos series, which are well known from the Hellenides-Taurides belt.

The Upper Cretaceous ophiolites of Rhodes, which represent a displaced fragment of the major Cretaceous ophiolite belt of the Eastern Mediterranean region, were also formed in a supra-subduction zone (Koepeke et al., 2002). The associated infra-ophiolitic Kopría Mélange occurs discontinuously and is tectonically sandwiched between the Pindos Zone (Profitis Ilias Zone) and the underlying Gavrovo-Tripolitza Zone

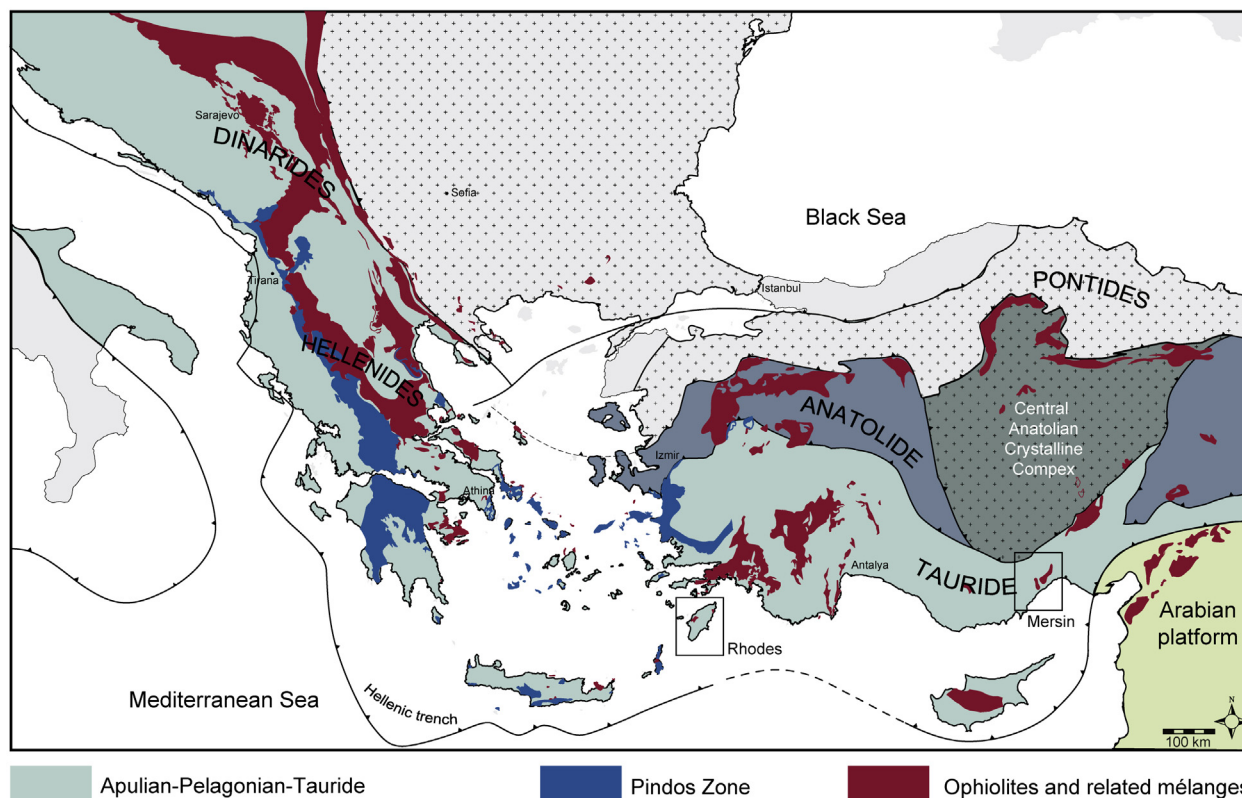


Fig. 2. Schematic tectonic map of Eastern Mediterranean region. Simplified after Moix et al. (2008a) and Schmid et al., unpublished tectonic units of the Alpine collision zone between Eastern Alps and Western Turkey.

(Lindos-Archangelos Group) in an allochthonous series (Lekkas et al., 2002). This radiolarian study provides important clues for the knowledge of the geodynamic evolution of the Tethyan sequences by dating infra-ophiolitic mélangé elements.

### 2.1. Sorgun Ophiolitic Mélange

The geological setting of the investigated Tavuşçayırı block was discussed in detail by Moix et al. (2007); Moix et al. (2011) and the section was published in several additional papers (Kozur et al., 2007a; Kozur et al., 2009; Ozsvárt et al., 2015). The sequence starts with polymictic breccia and polygenic clast-supported conglomerate in a red micritic and silty matrix, which is mostly composed of neritic limestone blocks. Some elements yielded Middle Triassic pelagic faunas. It is followed by 15 m of black Middle Triassic (Anisian?) calciturbidites, which contains reworked foraminifers, corals (Permian?), algae and megalodontid-type bivalves. The series continues with a brownish, medium-bedded Upper Triassic (Carnian?) limestone containing typical reefal organisms. This shallow water carbonate is covered by typical Hallstatt Limestone, which yielded an upper Julian ammonoid assemblage of the *Austrotrachyceras austriacum* Zone, foraminifera, echinoderms, crinoids, fish remains, brachiopods and conodonts of middle Carnian age. In the reference section, the Hallstatt Limestone is conformably overlain by 130 m of thin-bedded Huğlu-type redeposited green tuffites (Pietra Verde-like tuffs). The tuffitic series is interspersed with alternations of micritic limestone and calciturbidites. One

micritic limestone level (Sample G11, see section with sample numbers in Kozur et al., 2007a; Moix et al., 2007; Ozsvárt et al., 2015) contains conodonts, sponge spicules, ostracods and a well-preserved radiolarian fauna of the lower Tuvalian *Spongotortilispinus moixi* Zone.

### 2.2. Kopría Mélange, Rhodes (Greece)

Rhodes is composed of several thrust sheets (Fig. 3) characterized by continental margin to oceanic series (e.g. Mutti et al., 1970, Koepke et al., 2002). The Profitis Ilias Zone is composed of Upper Triassic flysch type deposits with *Aulacoceras* sp., marls and *Halobia*-bearing pelagic limestones, followed by a pelagic Mesozoic sequence underlying a lower to middle Maastrichtian flysch unit. The Kopría Mélange, located between the lower Oligocene Katavia flysch and the Carnian to Cretaceous slope to basin series of the Profitis Ilias Group, represents locally dismembered units of the latter (Fig. 3).

## 3. Radiolarian fauna

### 3.1. Age of the radiolarian fauna

The age of the radiolarian fauna of the Sorgun Ophiolitic Mélange is based on the occurrence of *Paragondolella noah* (Hayashi) in sample G11 (see section with sample numbers in Kozur et al. (2007a); Moix et al. (2007); Ozsvárt et al. (2015)) and data from several other conodont studies from the underlying

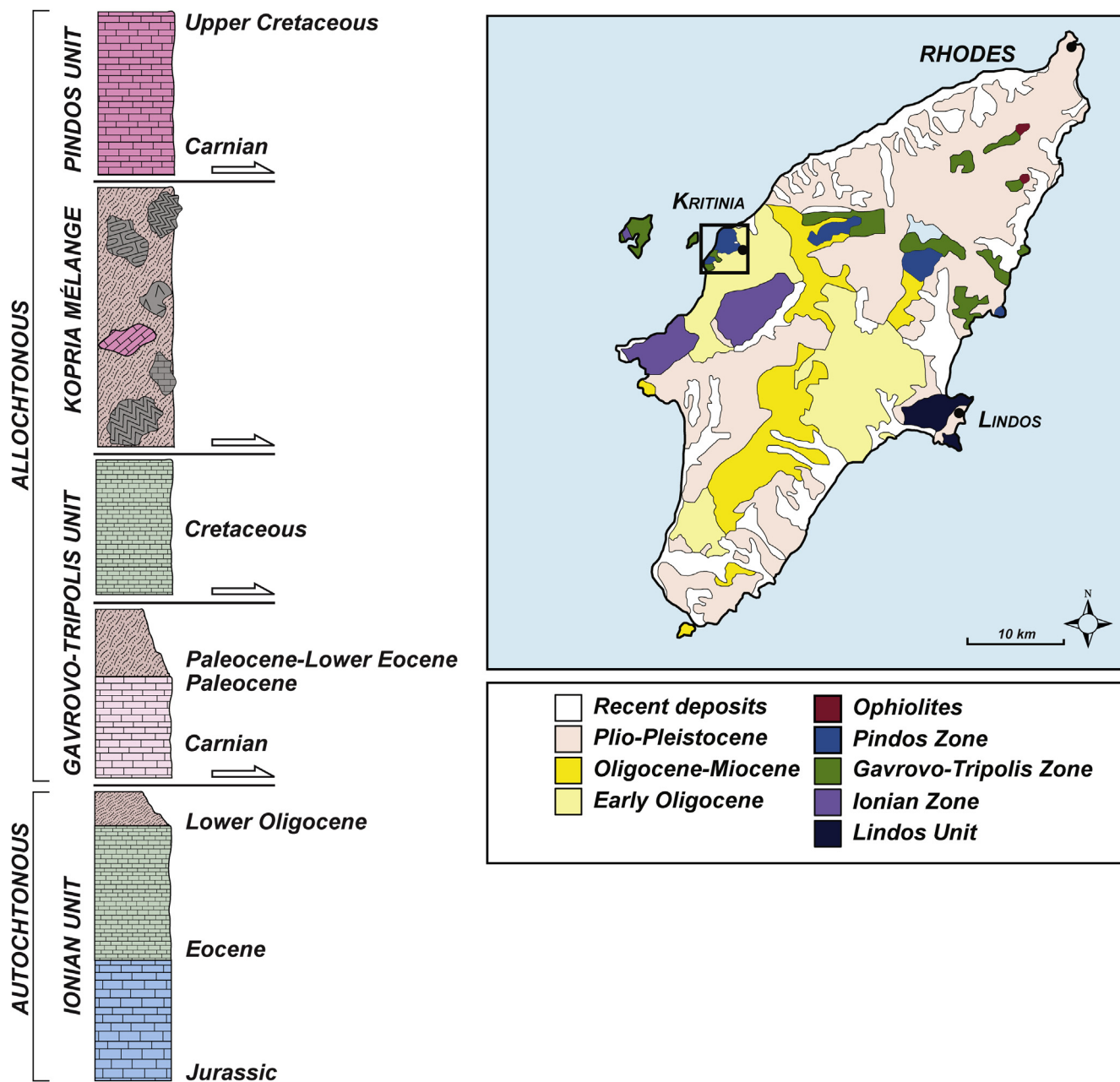


Fig. 3. Simplified geological map and generalized log of tectonic units of Rhodes, Greece (after Moix et al., 2008b).

Hallstatt Limestone of the section. Sample G7 contains a relatively rich conodont association with *Carnepigondolella nodosa* (Hayashi) s. s. (= *Epigondolella carnica* (Krystyn), *Gladigondolella tethydis* (Huckriede) and *Paragondolella noah* (Hayashi) indicating an early Julian age. An unpublished ammonite fauna from the underlying Hallstatt Limestone succession confirms the same age (*Austrotrachyceras austriacum* ammonoid Zone). Sample G 11 contains the best-preserved and most diverse radiolarian fauna of the basal Tuvalian (*Spongortilispinus moixi* Zone) in the world (Fig. 4). An equivalent but not so rich radiolarian fauna has been partly described by Dumitrica et al. (2010, 2013a, b) and Dumitrica and Hungerbühler (2007) from cherts of the Zulla Formation, Hawasina Complex, Oman.

### 3.2. Radiolarian faunal composition

As mentioned above, radiolarian fauna from the Sorgun Ophiolitic Mélange (Mersin Ophiolitic Complex) is very well preserved and very diverse. Thus far, 198 different species have been identified, of which 113 have been described as new species and subspecies (Table 1). Spumellarians dominate the fauna (approximately 45% of the whole fauna belongs to spumellarians), although the diversity of nassellarians and entactinarians is also extremely high (~ 35% of taxa belongs to nassellarians and ~20% belongs to the entactinarians, although these values may change after subsequent studies). The radiolarian fauna from the Kopría Mélange, Rhodes, Greece (Moix et al., 2008b), is very

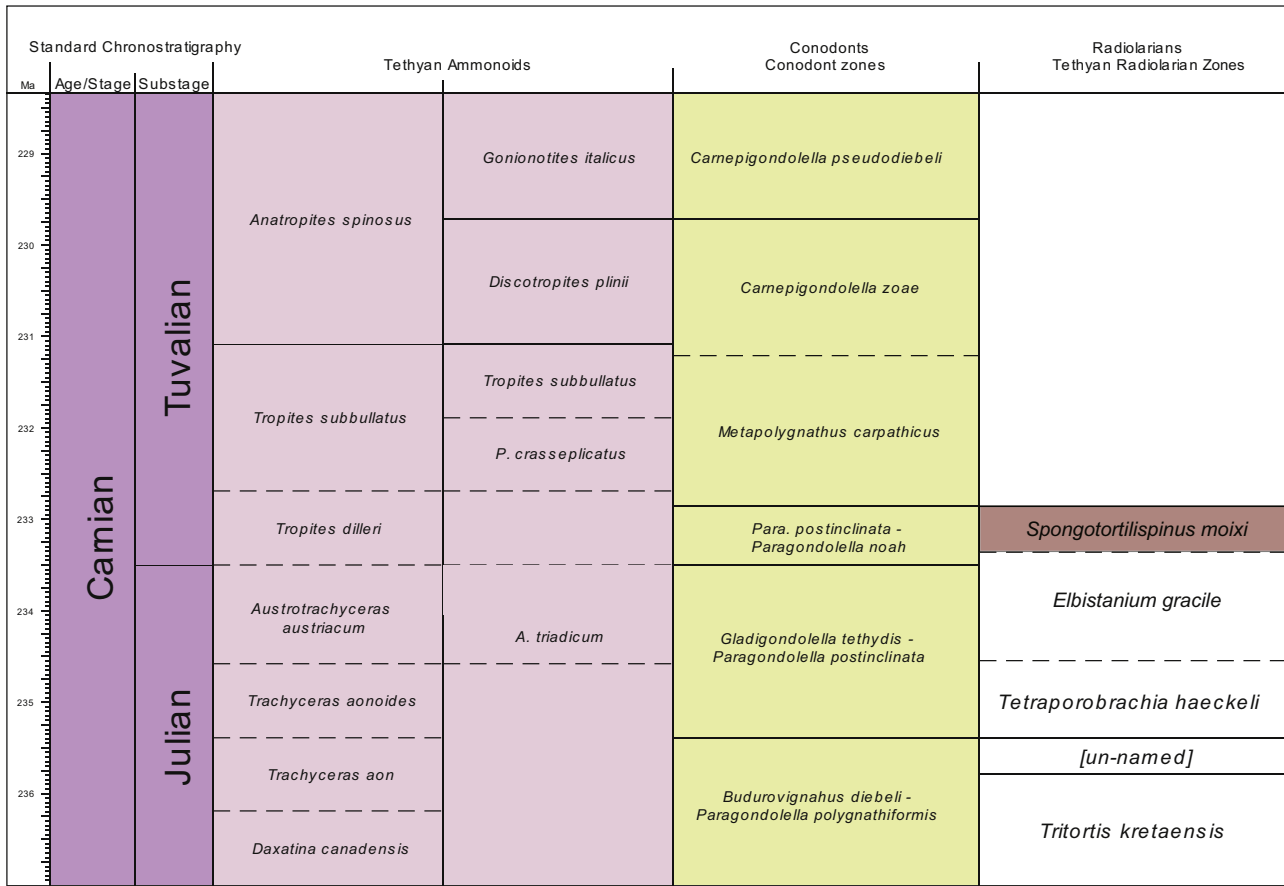


Fig. 4. Ammonite, Conodonts and Radiolarian zonation for the Carnian.

similar to the radiolarian fauna of Sorgun Ophiolitic Mélange in both diversity and preservation, the difference between them being insignificant.

#### 4. Systematic paleontology

The holotypes and paratypes from the Sorgun Ophiolitic Mélange has been deposited in the Hungarian Natural History Museum in Budapest, Hungary (HNHM) and those from the Kopría Mélange in the Musée Géologique de Lausanne (MGL). The authors of the new taxa are Ozsvárt, Dumitrica & Hungerbuhler.

Class Radiolaria Müller, 1858  
 Subclass Polycystina Ehrenberg 1838 emend. Riedel, 1967  
 Order Nassellaria Ehrenberg, 1875  
 Family Poulpidae De Wever, 1981  
 Genus *Poulpus* De Wever, 1979  
 Type species: *Poulpus piabyx* De Wever, 1979

*Poulpus compactus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 1, figs. 1–2

Description: Test hemispherical with three strong curved feet. Cephalis slightly compressed with polygonal pore frames and

without apical horn. On its cupola the three cephalic arches (AV and 2A1) are well marked by ridges. Base of cephalis with a circumferential ridge below which a thin, fragile, tubular thorax may be developed; thorax wears many, tiny polygonal pores and its distal end is ragged. Feet are strongly inwardly bent with a large, oval pore at the proximal part, and are distally pointed; they are T-shaped in cross-section with flat or convex outer surface and wide lateral ridges.

Material: More than 10 specimens.

Holotype: The specimen in Pl. 1, fig. 2, HNHM, PAL 2016.17.1.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis 69–83, diameter of cephalis 83–111, length of feet 222–277.

Remarks: Although the presence of the apertural circumferential ridge would suggest that this species should belong to the genus *Veghia* Kozur and Mostler, 1981, this species, as well as the following two ones, has more characters suggesting that they are closer to *Poulpus*, such as the presence of a large cephalic pore at the base of feet and the position of the feet blades. With *Veghia* and its synonym, *Triarcopoulpus* Kozur, Moix and Ozsvárt, 2007, the feet have one blade external and two lateral, and no pore at the base of feet. *Poulpus elegans* nov. sp. differs from *P. compactus* nov. sp. by lacking the proximal pore on feet and by significantly different (angular) shaped feet. *P. compactus* nov. sp. differs from *P. oertlii* (Kozur and Mostler, 1979) by the presence of a large cephalic pore at the base of feet

Table 1

Occurrence chart of the radiolarian taxa from the Sorgun Ophiolitic Mélange, Turkey and from the Kopría Mélange, Rhodes, Greece.

Radiolarian species from	Sorgun Ophiolitic Mélange	Kopría Mélange, Rhodes
Order Spumellaria Ehrenberg 1875		
<i>Archaeoacanthocircus angustiannulatus</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Archaeoacanthocircus latiannulatus</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Archaeoacanthocircus ovalis</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Archaeoacanthocircus rectangularis</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Archaeoacanthocircus transitus</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Archaeocenosphaera clathrata</i> (Parona, 1890)	+	+
<i>Archaeocenosphaera parvispinosa</i> (Kozur, Krainer and Mostler, 1996)	+	+
<i>Astrocentrus pulcher</i> Kozur and Mostler, 1979	+	+
<i>Astrocentrus robustus</i> (Kozur and Mostler, 1981)	+	+
<i>Capnuchosphaera barnabasi</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera borbala</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera bragini</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera</i> sp. cf. <i>C. palawanensis</i> Yeh, 1990	+	
<i>Capnuchosphaera ciliciensis</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera concava</i> De Wever, 1979	+	+
<i>Capnuchosphaera crassa</i> Yeh, 1990	+	+
<i>Capnuchosphaera crassa yforma</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera cylindrica</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera cylindrica retusaspinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera deweveri</i> (Kozur and Mostler, 1979)		+
<i>Capnuchosphaera goestlingensis</i> Kozur, Mostler and Ozsvárt, 2009	+	
<i>Capnuchosphaera gracilispinosa</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera gracilispinosa turkensis</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera mersinensis</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera mostleri</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera multispinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera oesii</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera ottomanensis carterae</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera ottomanensis</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera puncta</i> De Wever, 1979		+
<i>Capnuchosphaera</i> sp. cf. <i>C. bragini</i> Kozur, Moix and Ozsvárt, 2010	+	+
<i>Capnuchosphaera tortouspinosa</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Capnuchosphaera tortuosa</i> Yeh, 1990	+	+
<i>Capnuchosphaera tumorspinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Capnuchosphaera tualica</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Goricanela hexaspinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Hexaporobrachia riedeli</i> Kozur and Mostler, 1979	+	+
? <i>Hexastylus carnicus</i> Kozur and Mostler, 1979	+	+
<i>Huglusphaera aperta</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Huglusphaera weemsi</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Huglusphaera yini</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Huglusphaera zakharovi</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Huglusphaeta aspinosa</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Icrioma tetrancistrum</i> De Wever, 1979	+	+
<i>Karnospongella multispinosa</i> Kozur, Moix and Mostler, 2007	+	+
<i>Monocapnuchosphaera subtornata</i> Tekin, 1999	+	
<i>Monocoronella spinifera</i> n. gen., n. sp.	+	
<i>Paramonocapnuchosphaera fusiformis</i> n. gen., n. sp.	+	
<i>Paraweverella tenuispinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Paronaella</i> aff. <i>P. norica</i> Kozur and Mock in Kozur and Mostler, 1981		+
<i>Praeorbiculiformella polyspinosa</i> Kozur and Mostler, 1978	+	+
<i>Spinocapnuchosphaera hantkeni</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera odoghertyi</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera szentei</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera szivesae</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera tekini hugluensis</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera tekini</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera tekini marginospinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera tricuspadata</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spinocapnuchosphaera venusta</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Spongortilispinus aequicurvistylus</i> (Lahm, 1984)	+	+
<i>Spongortilispinus inaequispinosus</i> Kozur, Moix and Mostler, 2007	+	

Table 1 (Continued)

Radiolarian species from	Sorgun Ophiolitic Mélange	Kopría Mélange, Rhodes
<i>Spongortilispinus moixi</i> Kozur and Mostler, 2007	+	+
<i>Spongortilispinus ozsvarti</i> Kozur, Moix and Mostler, 2007	+	+
<i>Spongortilispinus tortilis</i> Moix and Mostler, 2006	+	+
<i>Spongortilispinus turkensis</i> Kozur, Moix and Mostler, 2007	+	+
<i>Spongortilispinus tuvalicus</i> Moix and Mostler, 2007	+	
<i>Tamonella aspinosa</i> n. sp.	+	
<i>Tamonella multispinosa</i> Dumitrica, Kozur and Mostler, 1980	+	
<i>Tetracapnuchosphaera? voeroesi</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Triassobullasphaera hemisphaerica</i> Kozur and Mostler, 2006	+	+
<i>Triassobullasphaera miriae</i> Ozsvárt, Moix and Kozur, 2015	+	
<i>Triassocrucella baloghi</i> (Kozur and Mostler, 1978)	+	+
<i>Tubospongopallium inaequispinosum</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Weverella gracilispinosa</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Weverella longispinosa curvata</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Weverella longispinosa</i> Kozur, Moix and Ozsvárt, 2009	+	+
<i>Weverella longispinosa subrectangularis</i> Kozur, Moix and Ozsvárt, 2009	+	
<i>Weverella tetrabrachiata</i> Kozur and Mostler, 1979	+	+
<i>Zhamojdasphaera latispinosa</i> Kozur and Mostler, 1979	+	+
<i>Zhamojdasphaera latispinosa mersinensis</i> Kozur, Moix and Mostler, 2007	+	+
<i>Zhamojdasphaera rigoi brevispinosa</i> Kozur, Moix and Mostler, 2007	+	+
<i>Zhamojdasphaera rigoi</i> Kozur, Moix and Mostler, 2007	+	+
Order Entactinaria Kozur and Mostler 1982		
<i>Carinaheliosoma carinata</i> (Kozur and Mostler, 1979)		+
<i>Coronatubopyle denticulata</i> Dumitrica and Tekin, 2010	+	
<i>Coronatubopyle omanensis</i> Dumitrica and Tekin, 2009	+	
<i>Coronatubopyle</i> sp. cf. <i>C. omanensis</i> Dumitrica and Tekin, 2010	+	
<i>Coronatubopyle spelae</i> Dumitrica and Tekin, 2010	+	
<i>Hexapylomella carnica</i> Kozur and Mostler, 1979	+	
<i>Hindeosphaera burri</i> Ozsvárt, Moix and Kozur, 2015	+	+
<i>Hindeosphaera</i> cf. <i>H. goestlingensis</i> Kozur and Mostler, 1979	+	
<i>Hindeosphaera djani</i> Ozsvárt, Moix and Kozur, 2015	+	
<i>Hindeosphaera foremanae</i> Kozur and Mostler, 1979	+	
<i>Hindeosphaera naomiae</i> Ozsvárt, Moix and Kozur, 2015	+	
<i>Hindeosphaera</i> sp.	+	
<i>Kahlerosphaera abnormis</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Kahlerosphaera faludyi</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Kahlerosphaera hamvasi</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Kahlerosphaera karinthyi</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Kahlerosphaera kerteszi</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Kahlerosphaera koestleri</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Kahlerosphaera pamuki</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Kahlerosphaera rejtoei</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Kahlerosphaera szerbi</i> Kozur, Moix and Ozsvárt, 2007b	+	
<i>Kahlerosphaera vonneguti</i> Kozur, Moix and Ozsvárt, 2007b	+	+
<i>Pentactinia pugnax</i> Dumitrica, 1978	+	+
<i>Pentactinocarpus acanthicus</i> Dumitrica, 1978	+	+
<i>Pentactinocarpus magnus</i> (Kozur and Mostler, 1979)	+	
<i>Pentactinocarpus tetracanthus</i> Dumitrica, 1978	+	
<i>Pentactinorbis</i> cf. <i>P. megasphaera</i> (Sugiyama, 1997)	+	
<i>Pentactinorbis pessagnoii</i> Kozur and Mostler, 1994	+	
<i>Pseudostylosphaera dumitricai</i> Ozsvárt, Moix and Kozur, 2015	+	+
<i>Pseudostylosphaera longispinosa</i> Kozur and Mostler, 1981	+	
<i>Spinostylosphaera andrasi</i> Ozsvárt, Moix and Kozur, 2015	+	+
<i>Spinostylosphaera andrasi brevispinata</i> Ozsvárt, Moix and Kozur, 2015	+	+
<i>Spinostylosphaera masseti</i> n. sp.	+	
<i>Spinostylosphaera mesotriassica</i> (Dumitrica, Kozur and Mostler, 1980)	+	
<i>Spinostylosphaera michelae</i> n. sp.	+	
<i>Spinostylosphaera sengoeri</i> n. sp.	+	
<i>Spinostylosphaera vachardi</i> Ozsvárt, Moix and Kozur, 2015	+	
<i>Spinostylosphaera vachardi elongata</i> Ozsvárt, Moix and Kozur, 2015	+	
Order Nassellaria Ehrenberg 1875		
<i>Alatipicapora latoalata</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Alatipicapora spinosa</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Alatipicapora tetrapedis</i> Kozur, Moix and Ozsvárt, 2007c	+	

Table 1 (Continued)

Radiolarian species from	Sorgun Ophiolitic Mélange	Kopría Mélange, Rhodes
<i>Annulohaeckeliella curvispina</i> nov. sp.		+
<i>Annulohaeckeliella rectospina</i> nov. sp.		+
<i>Annulopoulpus gibber</i> nov. sp.		+
<i>Annulopoulpus parviapertura</i> (Kozur and Mostler, 1979)	+	+
<i>Annulopoulpus reticulatus</i> Kozur and Mostler, 1981	+	+
<i>Archaeosemantis multispinosa</i> n. sp.	+	
<i>Aropeon cingulatus</i> nov. sp.		+
<i>Aropeon cinguloporatus</i> nov. sp.		+
<i>Aropeon graecorus</i> nov. sp.		+
<i>Bulbocyrtium reticulatum</i> Kozur and Mostler, 1981		+
<i>Caponabolella brevispinosa</i> nov. gen. nov. sp.	+	+
<i>Caponabolella longispinosa</i> nov. gen. nov. sp.	+	+
<i>Circopoulpus cornubovis</i> nov. sp.	+	+
<i>Circopoulpus dulaii</i> nov. sp.	+	+
<i>Circulopoulpus bisulcatus</i> nov. sp.		+
<i>Coronatubopyle denticulata</i> Dumitrica and Tekin, 2010	+	
<i>Coronatubopyle omanensis</i> Dumitrica and Tekin, 2010	+	
<i>Coronatubopyle spelae</i> Dumitrica and Tekin, 2010	+	
<i>Eonapora pulchra</i> Kozur and Mostler, 1979	+	
<i>Hinedorcus elegantissimus</i> (Tekin, 1999)	+	
<i>Hinedorcus robustus</i> (Kozur and Mostler, 1981)	+	+
<i>Hypoxiphothecaella claviformis</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Hypoxiphothecaella elongata</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Hypoxiphothecaella foezyi</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Hypoxiphothecaella inflata</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Hypoxiphothecaella mersinensis</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Minicrampus longispinosus</i> n. gen. n. sp.	+	
<i>Nabolella thoraxaca</i> nov. sp.	+	+
<i>Neopylentonema procera</i> Sugiyama, 1997	+	
<i>Pararuesticyrtium longispinosum</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Pararuesticyrtium mersinensis</i> Kozur, Moix and Ozsvárt, 2007a	+	+
<i>Podobursa claviformis</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Podobursa fusiformis</i> Kozur, Moix and Ozsvárt, 2007c	+	+
<i>Podobursa longiceras</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Podobursa longiceras tetraspinosa</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Podobursa mersinensis</i> Kozur, Moix and Ozsvárt, 2007c	+	+
<i>Podobursa sceptrumides</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Podobursa tuvalica</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Poulpus compactus</i> nov. sp.	+	
<i>Poulpus elegans</i> nov. sp.	+	
<i>Poulpus kozuri</i> nov. sp.	+	
<i>Poulpus norica</i> (Kozur, Moix and Ozsvárt, 2007c)	+	
<i>Poulpus oertlii</i> (Kozur and Mostler, 1979)	+	
<i>Poulpus phasmatodes</i> De Wever, 1979	+	
<i>Poulpus piabyx</i> De Wever in De Wever et al., 1979	+	+
<i>Poulpus rhodoensis</i> nov. sp.		+
<i>Poulpus sulcatospinosus</i> nov. sp.	+	
<i>Poulpus transitus</i> Kozur and Mostler, 1981	+	
<i>Poulpus transitus</i> Kozur and Mostler, 1981	+	
<i>Pseudosaturiniforma carnica</i> Kozur and Mostler, 1979	+	
<i>Ruesticyrtium coronatum</i> Kozur, Moix and Ozsvárt, 2007a	+	+
<i>Ruesticyrtium georgi</i> Kozur, Moix and Ozsvárt, 2007a	+	+
<i>Ruesticyrtium georgi novemdentatum</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Ruesticyrtium latidentatum</i> Kozur, Moix and Ozsvárt, 2007a	+	+
<i>Ruesticyrtium lobatum</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Ruesticyrtium mostleri</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Silicarmiger longospinosus</i> nov. sp.	+	+
<i>Spinomersinella goricanae</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Spinomersinella multispinosa</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Spinoprotunuma? constricta</i> Kozur, Moix and Ozsvárt, 2007c	+	+
<i>Spinoprotunuma? furcatostriata</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Spinoprotunuma triassica</i> Kozur, Moix and Ozsvárt, 2007c	+	+
<i>Stampfliella tuvalica</i> Kozur, Moix and Ozsvárt, 2007c	+	
<i>Syringocapsa glabra</i> Kozur, Moix and Ozsvárt, 2007c	+	



Table 1 (Continued)

Radiolarian species from	Sorgun Ophiolitic Mélange	Kopría Mélange, Rhodes
<i>Tekinium bragini</i> nov. sp.	+	
<i>Tekinium robustum</i> nov. sp.	+	+
<i>Veghicyclia reiflingensis</i> Kozur and Mostler, 1972		+
<i>Veloruesticyrtium palfyi</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Xiphothecaella brevicaudata</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Xiphothecaella elegans</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Xiphothecaella longicaudata</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Xiphothecaella orchardi</i> Kozur, Moix and Ozsvárt, 2007a	+	
<i>Xiphothecaella procera</i> Kozur, Moix and Ozsvárt, 2007a	+	+
<i>Xiphothecaella strigosa</i> Kozur, Moix and Ozsvárt, 2007a	+	+

and by the fact that the three cephalic arches are well marked by ridges.

Etymology: In allusion to its dumpy appearance.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Poulpus elegans* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.  
 Plate 1, fig. 3

Description: Cephalis hemispherical, very small and low, without apical horn and with nodulose surface. Collar ridge thick with high rim-like structure. Cephalic pore at base of feet not visible but it should have existed. Thorax long, its length approximately three times the length of cephalis, cylindrical, smooth surfaced, with tiny irregularly shaped pores and ragged distal end. Feet long, pointed, three-bladed, with two blades external and one internal and slightly twisted. Their external groove is only visible on the proximal end after which it gradually disappears. Feet start in lateral direction and soon bend in distal direction about 90° or more tending to get nearer to one another distally.

Material: More than 10 specimens.

Holotype: The specimen in pl. 1, fig. 3, HNHM, PAL 2016.18.

Dimensions (in µm based on 2 specimens): Height of cephalis 63–68, diameter of cephalis 93–111, length of feet 298–333.

Remarks: *Poulpus elegans* nov. sp. differs from all the other species of *Poulpus* with apertural ridge by having significantly smaller cephalis and characteristically bent feet.

Etymology: In allusion to its graceful appearance.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Poulpus kozuri* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.  
 Plate 1, figs. 4–5

Description: Cephalis large, globular without apical horn; its wall is smooth-surfaced and has tiny and rare pores. Feet equal, downwardly curved and distally pointed; they have, it seems, only two blades that bend sideways creating a deep internal groove. Collar ring thick running between two feet and forming a narrow tunnel where the feet are connected to the cephalis. Probable pores on cephalis accompanying the rays D and 2 L not observed due to the position of feet on photo or covered by foreign material.

Material: More than 5 specimens.

Holotype: The specimen in Pl. 1, figs. 4–5, HNHM, PAL 2016.19.

Dimensions (in µm based on 2 specimens): Height of cephalis 69–73, diameter of cephalis 64–74, length of feet 148–185.

Remarks: *Poulpus kozuri* nov. sp. differs from the other species of the genus with bladed feet in having only two blades and these blades being rolled up to form a groove.

Etymology: In honour of Heinz W. Kozur, who was an outstanding expert on radiolarians, conodonts, ostracods, conchostracans and on the Triassic System.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Poulpus oertlii* (Kozur and Mostler, 1979)  
 Plate 2, fig. 3

1979 *Parapoulpus oertlii* nov. sp. - Kozur and Mostler, p. 88, pl. 7, fig. 5.

1981 *Parapoulpus oertlii* Kozur & Mostler - Kozur and Mostler, p. 81, pl. 26, fig. 2.

2009 *Poulpus oertlii* (Kozur & Mostler) - O'Dogherty et al., p. 249, fig. 258.

Remarks: According to O'Dogherty et al. (2009) the genus *Parapoulpus* Kozur and Mostler (1979) is a synonym of *Poulpus* De Wever. We use herein this new generic status. It is, however, strange that all specimens of this species have a long cylindrical thorax, proving that the presence of this segment is characteristic of this species.

Range and occurrence: Upper Cordevolian, *Tetraporobrachia haeckeli* Zone, Großreifling (Northern Calcareous Alps, Austria) and lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Poulpus piabyx* De Wever, 1979  
 Plate 1, figs. 6–11

1979 *Poulpus piabyx* nov. sp. - De Wever in De Wever et al., p. 98, pl. 7, fig. 12.

1979 *Poulpus piabyx* De Wever - Kozur and Mostler, p. 87, pl. 4, fig. 3.

1981 *Poulpus piabyx* De Wever - Kozur and Mostler, pl. 30, fig. 5.

1982 *Poulpus piabyx* De Wever - De Wever, p. 328, pl. 48, figs. 5, 6.

1984 *Poulpus piabyx* De Wever - De Wever, pl. 3, figs. 3, 4.



Plate 1. 1–2. *Poulpus compactus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Sorgun Ophiolitic Mélange, Turkey). 3. *Poulpus elegans* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Sorgun Ophiolitic Mélange, Turkey). 4–5. *Poulpus kozuri* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Sorgun Ophiolitic Mélange, Turkey). 6–11. *Poulpus piabyx* De Wever (6. from Kopría Mélange, Rhodes, Greece; 7–11. Sorgun Ophiolitic Mélange, Turkey). 12. *Poulpus phasmatodes* De Wever. Scale bar = 50  $\mu\text{m}$ .

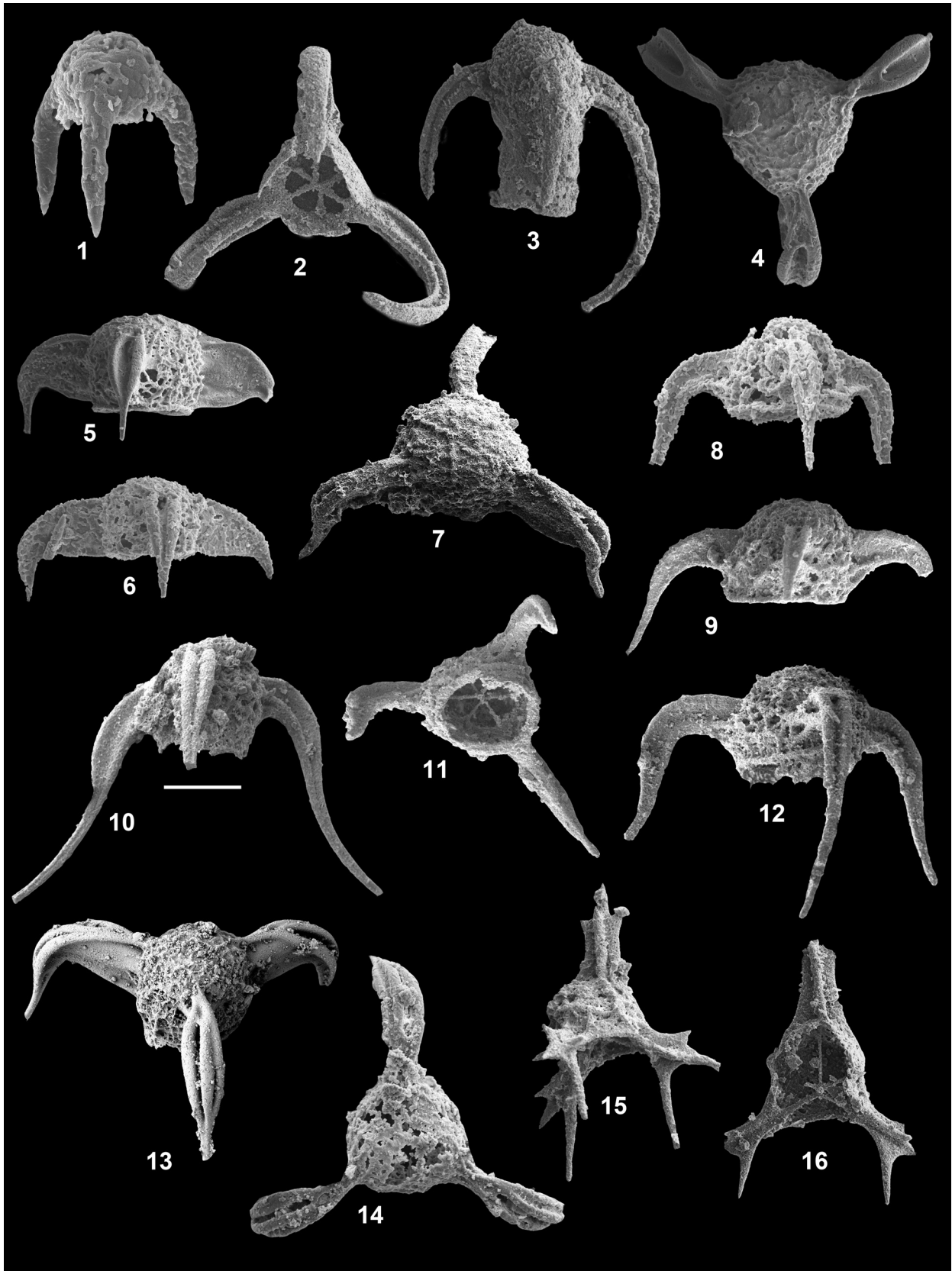


Plate 2. 1. *Poulpus rhodoensis* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). 2. *Poulpus transitus* Kozur and Mostler (Sorgun Ophiolitic Mélange, Turkey). 3. *Poulpus oertlii* (Kozur & Mostler) (Sorgun Ophiolitic Mélange, Turkey). 4–7. *Circopoulpus dulaii* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (4–6. Kopría Mélange, Rhodes, Greece; 7. Sorgun Ophiolitic Mélange, Turkey). 8–12. *Circopoulpus cornubovis* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (8. Kopría Mélange, Rhodes, Greece; 9–12. Sorgun Ophiolitic Mélange, Turkey). 13–14. *Circopoulpus bisulcatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). 15–16. *Neopylentonema procera* Sugiyama (Sorgun Ophiolitic Mélange, Turkey). Scale bar = 100  $\mu\text{m}$ .

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1990 *Poulpus piabyx* De Wever - Yeh, pl. 8, figs. 3, 7, 9.

1997 *Poulpus piabyx* De Wever - Sugiyama, fig. 49–15.

1999 *Poulpus piabyx* De Wever - Bragin & Krylov, p. 558, figs. 10A–C.

1999 *Poulpus piabyx* De Wever - Tekin, p. 160, pl. 38, figs. 3, 4.

2002 *Poulpus piabyx* De Wever - Wang et al., p. 331, pl. 2, figs. 30–34.

2007 *Poulpus piabyx* De Wever - Bragin, p. 1004, pl. 16, fig. 6.

2007a *Poulpus piabyx* De Wever–Tekin and Bedi, p. 183, pl. 3, figs. 16, 17.

Remarks: However, in the original description (De Wever, in De Wever et al., 1979) it is clearly pointed out that the test contains a subhemispherical cephalis and three downwardly curved feet and that the circular mouth is smooth, without lobes, the perfectly preserved radiolarian fauna from the Sorgun Ophiolitic Mélange contains many specimens of *Poulpus piabyx* De Wever that wear a fragile thorax (Pl. 1, figs. 8, 10) with extremely thin wall that can or cannot be preserved in case of poorer preservation. In some cases, a partially preserved thin wall on the mouth can be observed (Pl. 1, fig. 9), and only in few cases, the thorax is complete (Pl. 1, figs. 8, 10). The thorax is tubular, smooth with tiny irregularly disposed pores.

Range and occurrence: Lower Carnian to lower Norian, cosmopolitan species in the tropical region.

*Poulpus phasmatodes* De Wever, 1979

Plate 1, fig. 12

1979 *Poulpus phasmatodes* nov. sp. - De Wever in De Wever et al., p. 96, pl. 7, figs. 10, 11

1979 *Poulpus phasmatodes* De Wever - Kozur and Mostler, p. 87, pl. 7, fig. 6, pl. 16, fig. 1

1981 *Poulpus phasmatodes* De Wever - Kozur and Mostler, pl. 33, fig. 1

1982 *Poulpus phasmatodes* De Wever - De Wever, p. 327, pl. 48, figs. 2, 3

Remarks: The illustrated specimen wears a slightly compressed and smooth cephalis with six triangular-shaped protuberances. The three long feet are strongly curved and T-shaped in cross-section, and wear sharp ridges with a slightly widening groove at the proximal end.

Range and occurrence: Lower Carnian to lower Norian in the Tethyan realm.

*Poulpus rhodoensis* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 2, fig. 1

Description: Test rather simple consisting of a hemispherical cephalis with a very short cylindrical skirt and 3 three-bladed pointed feet. Cephalis rather smooth, without apical horn. It bears 3 stout feet arising in antapical direction from the base of cephalis so that they are practically parallel. Feet rounded in cross section in the proximal half or third and hollow, than they become three-bladed having a narrow groove externally between two thick blades and also an internal blade. The opening of the

inner cavity of the proximal part of feet is well marked at the beginning of the groove. In the distal half feet are gradually pointing. Under the cephalic collar, a very short cylindrical skirt is developed. Its structure is not well visible because of poor preservation.

Material: More than 10 specimens.

Holotype: The specimen in Pl. 2, fig. 1, coll. MGL nr. 97929.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis 30–45, diameter of cephalis 50–58, length of feet 60–80.

Remarks: This species differs from the other species of the genus *Poulpus* by having short and antapically directed feet, which are practically parallel. With its short skirt it reminds the species *Parapoulpus oertlii* (Kozur and Mostler, 1979), a genus which is now considered a synonym of *Poulpus* (O'Dogherty et al., 2009).

Etymology: The species is named from its occurrence in the Rhodes Island.

Range and occurrence: Very rare in the lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes Island, Greece.

*Poulpus transitus* Kozur and Mostler, 1981

Plate 2, fig. 2

1981 *Poulpus transitus* nov. sp. –Kozur and Mostler, p. 81, pl. 29, fig. 2, pl. 31, fig. 3.

1999 *Poulpus transitus* Kozur & Mostler - Tekin, p. 160, pl. 38, fig. 5.

2007 *Poulpus transitus* Kozur & Mostler - Bragin, p. 1005, pl. 12, figs. 7, 8.

Remarks: One of the illustrated specimens from the Sorgun Ophiolitic Mélange differs from the holotype of *P. transitus* Kozur and Mostler, 1981 by having a complete, tubular thorax with rounded pores. The strongly curved feet wear three, narrow grooves. The specimens from the Sorgun Mélange resemble perfectly the topotype specimens.

Range and occurrence: Lower Carnian (Julian) of Großreifling (Northern Calcareous Alps, Austria) and lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey to lower Norian from the Yaylakuzdere Measured section, Alakircay Nappe, Antalya Nappes, Kemer, Antalya, Turkey and from Mamonia Complex, southwestern Cyprus.

Genus *Circopoulpus* Ozsvárt, Dumitrica & Hungerbuhler nov. gen.

Type species: *Circopoulpus dulaii* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Diagnosis: Skeleton consisting of a hornless cephalis with 3 feet and a wide distal apertural ring. Feet situated above the apertural ring, three- or four-bladed and separated by grooves. External groove that can start in the vicinity of cephalis or at a certain distance from it, is connected with the pore that accompanies the rays D and 2L either directly or through a canal inserted in the feet. Collar plate with its 6 pores is above the apertural ring. A velum-like cylindrical thoracic segment may be sometimes developed.

Remarks: This new genus is somehow intermediary between the genera *Poulpus* De Wever, *Veghia* Kozur & Mostler, and *Annulopoulpus* Kozur and Mostler, 1981. With *Poulpus*, it has in common the pore near the feet D and 2L, an external groove and a rather low cephalis. With *Veghia*, it has in common the general shape, the presence of an apertural ring, but differs from it because *Veghia* has no cephalic pore connected with feet D and 2L and the odd blade is external. With *Annulopoulpus*, it has in common the circular aperture, the similar position of the blades of feet, but differs in having no cephalic pore connected to feet. Also, the species of this new genus differs from the species of the other 3 genera in the shape of feet, their distal ends being outwardly recurved.

Etymology: From the Latin *circus*—circle, and the genus name *Poulpus*. Masculine gender.

Range: Lower Tuvalian so far as known.

*Circopoulpus dulaii* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 2, figs. 4–7.

Description: Test subglobular in lateral view but triangular in apical view, without apical horn. Outer layer of cephalic wall consisting of larger polygonal pore frames; inner layer with tiny circular pores. Cephalic spicular system located at the upper part of the cephalis. Thorax, when present, fragile, thin-walled with polygonal pores connected to the characteristic ring-like collar structure. The three feet in prolongation of D and 2L are similar, three-bladed and very broad in vertical plane, extended from above the apertural ring to the upper part of cephalis. Outer groove through which the cephalic cavity is connected with the exterior starts at a certain distance from cephalis. Up to that distance the connection is effected through a canal situated toward the upper part of feet, which is easily recognized externally by a thickness of the vertical blade. Feet short, broad and outwardly directed on a short portion, then are quickly narrowing and bent downwardly at about 90°, and terminated in a needle-shaped spine.

Material: More than 5 specimens.

Holotype: The specimen in Pl. 2, fig. 5, coll. MGL nr. 97930.

Dimensions (in  $\mu\text{m}$  based on 5 specimens): Height of cephalis 100–125, diameter of cephalis 83–125, length of feet 138–277.

Remarks: *Circopoulpus dulaii* nov. sp. resembles very much *Circopoulpus bisulcatus* nov. sp. from which it only differs by having a single external groove on feet. One illustrated specimen (pl. 2, fig. 4) exhibits on the surface of the apical part of cephalis the three arches AV and 2A1 well expressed on some species of *Poulpus*.

Etymology: In honor of Dr. Alfréd Dulai, Head of the Department of Paleontology and Geology, Hungarian Natural History Museum, Budapest.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Kopría Mélange, Rhodes, and Sorgun Ophiolitic Mélange, Turkey.

*Circopoulpus cornubovis* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 2, figs. 8–12

Description: Cephalis hemispherical, small with a more or less well marked apertural ring. Surface as with the genus, consisting of two layers, of which the outer one has polygonal pores. Feet long, four-bladed on the proximal portion, with two bladed external and two internal and directed laterally in the short proximal portion, than fast downwardly curved and thinning gradually distally and also gradually curving outward. Thoracic velum cylindrical, thin and not always preserved.

Material: More than 20 specimens.

Holotype: The specimen in Pl. 2, fig. 12, HNHM, PAL 2016.21.1.

Dimensions (in  $\mu\text{m}$  based on 7 specimens): Height of cephalis 100–118, diameter of cephalis 85–102, length of feet 246–296.

Remarks: This new species resembles *Circopoulpus dulaii* nov. sp. from which it differs in having longer feet and a much narrower proximal portion that does not extend on the whole height of cephalis.

Etymology: In Latin, from the resemblance of its feet with the horns of a beef.

Range and occurrence: Lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes Island, Greece, and Sorgun Mélange, Turkey.

*Circopoulpus bisulcatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 2, fig. 13–14

Description: Cephalis hemispherical prolonged into a short and thin-walled cylindrical thorax. Cephalis thick-walled with nodular surface, nodule interconnected by very thin crests, when very well preserved, giving its surface a star covered aspect. Same ornamentation on thorax the ornamentation of which consists usually of transversal ribs with usually square and very small pores. Distal margin of thorax ragged. Shape of cephalic opening unknown due to the position of the specimen on the stub. Without apical horn. Feet robust, very broad in vertical plane, bearing on the outer part 3 unequal ribs, two starting in the vicinity of the cephalic wall, the third resulting from the bifurcation of one rib, which is always the rib behind the simple one in apical view and in clockwise sense. This results in feet having a deeper and longer groove and a less deep and shorter one. Axial part of proximal portion of feet thickened proximally; this thickened part along spines seems to correspond to a canal connecting the inner cavity of cephalis with the external groove of the feet. This longitudinal thickness is well visible when the feet are laterally viewed. Distal part of feet narrower and pointed. Due to the bifurcation of one rib feet are navicular in apical view. On the proximal half they are straight, completely laterally directed and very broad in vertical plane, after which they are suddenly downwardly bent at about 90°, thinning and terminated in a thin beak-shaped and slightly recurved distal spine.

Material: Two specimens from the Kopría Mélange, Rhodes, Greece.

Holotype: The specimen in Pl. 2, fig. 13, coll. MGL nr. 97932.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis 115–125, diameter of cephalis 100–110, length of feet 210–225.

Remarks: The species was compared to *Circopoulpus dulaii* nov. sp. under the latter, with which it resembles significantly. Due to this resemblance, at the beginning, when we had had a single specimen we had thought that it represent an anomaly of *C. dulaii*. Finding of a second specimen, the paratype, proved that it represents an independent species.

Etymology: In Latin, from having two grooves (*sulcus*, *-sulci*) on the external side of feet.

Range and occurrence: Extremely rare in the lower Tuvalian (*Spongortilispinus moixi* Zone) of the Kopría Mélange, Rhodes, Greece.

#### Genus *Neopylentonema* Kozur, 1984

Type species: *Neopylentonema mesotriassica* Kozur, 1984

#### *Neopylentonema procera* Sugiyama, 1997

Plate 2, figs. 15–16

1989 *Poulpus* (?) sp. C - Yeh, p. 74, pl. 6, figs. 5, 10.

1997 *Neopylentonema procera* nov. sp. - Sugiyama, p. 161, figs. 46-3a, b.

1999 *Neopylentonema* sp. aff. *N. procera* Sugiyama, 1997 - Bragin and Krylov, p. 558, fig. 10E.

2007 *Neopylentonema procera* Sugiyama - Bragin, p. 1005, pl. 12, fig. 9.

Remarks: The broken specimen illustrated in pl. 2, fig. 16 exhibits the initial spicule system with MB, A, 2L, 2I, and D. In describing this species Sugiyama mentioned erroneously that the spines have a verticil of 3 branches. In fact, the spines of this species have 4 blades and the verticils of 4 spinules, respectively.

Range and occurrence: Cosmopolitan species in the tropical region from the lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, to lower Norian.

#### Genus *Annulopoulpus* Kozur and Mostler, 1981

Type species: *Annulopoulpus costatus* Kozur and Mostler, 1981

#### *Annulopoulpus parviapertura* (Kozur and Mostler, 1979)

Plate 3, figs. 1–5

1979 *Parapoulpus parviapertura* nov. sp. - Kozur and Mostler, p. 89, pl. 7, fig. 4; pl. 16, fig. 2.

1981 *Annulopoulpus parviapertura* (Kozur & Mostler) - Kozur and Mostler, p. 84, pl. 32, fig. 1.

1981 *Annulopoulpus reticulatus* nov. sp. - Kozur and Mostler, p. 84, pl. 31, fig. 2.

1999 *Annulopoulpus reticulatus* Kozur & Mostler - Tekin, p. 158, pl. 37, fig. 4.

?1999 *Annulopoulpus antalyaensis* nov. sp. - Tekin, p. 158, pl. 37, figs. 1–3, 5.

2007 *Annulopoulpus parviapertura* (Kozur & Mostler) - Tekin and Bedi, p. 183, pl. 3, figs. 13, 14.

Remarks: We synonymize herein the species *Annulopoulpus reticulatus* Kozur and Mostler, 1981 with *Parapoulpus parviapertura* Kozur and Mostler, 1979 because we see

no differences between the holotypes of the two species, and the latter has priority. Both have the same superficial ornamentation, the same double apertural ring and the same type of feet. The early Norian species *Annulopoulpus antalyaensis* Tekin, 1999 with its wider apertural ring and larger cephalis, could be a different species; unfortunately, the basal positions in which this species have been illustrated do not allow seeing the shape of the cephalis in lateral view because some images would suggest that the cephalis is not perfectly spherical but flat. In our samples we found two morphotypes: spherical (pl. 3, figs. 1, 4, 5) and ovate (pl. 3, figs. 2, 3). Since all the other characters are similar we considered them conspecific in the present state of knowledge.

Range and occurrence: Lower Carnian (Julian) of Großreifling (Northern Calcareous Alps, Austria) and upper Carnian (early Tuvalian, *Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, Greece, to probably lower Norian from the Yaylakuzdere Measured section, Alakircay Nappe, Antalya Nappes, Kemer, Antalya, Turkey.

*Annulopoulpus gibber* Ozsvárt, Dumitrica & Hungerbühler nov. sp.

Plate 3, figs. 6–7

Description: Cephalis short, conical above the feet, with the widest diameter at the level of the base of feet and constricted distally, with a wide aperture with double circular rings. Wall double-layered; inner layer with small, circular to ovate small pores, outer layer strongly reticulate, reticulations representing the outer layer wall and consisting of nodes interconnected by bars that form triangular to quadrangular meshes. Feet short, robust, antapically directed; they are four-bladed, with two inner blades and two external. Grooves between internal blades and between internal and external blades deep and narrow. Space between outer blades is convex on the proximal half, than slightly concave and at the same time feet start narrowing to terminate in a thin conical spine.

Material: Two specimens from the Kopría Mélange, Rhodes, Greece.

Holotype: The illustrated specimen in Pl. 3., figs. 6–7 (same specimen in two views), coll. MGL nr. 97933.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis 130–140, diameter of cephalis 120–130, length of feet 120–140.

Remarks: *Annulopoulpus gibber* nov. sp. resembles *Annulopoulpus parviapertura* (Kozur & Mostler) in having a reticulate surface but differs from it in having a shorter and hunched cephalis, and feet shorter and thicker.

Etymology: From the Latin *gibber*, *-era*, *-erum*—hunched.

Range and occurrence: Very rare in the lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes, Greece.

#### Genus *Eonapora* Kozur and Mostler, 1979

Type species: *Eonapora pulchra* Kozur and Mostler, 1979

*Eonapora pulchra* Kozur and Mostler, 1979

Plate 3, fig. 8

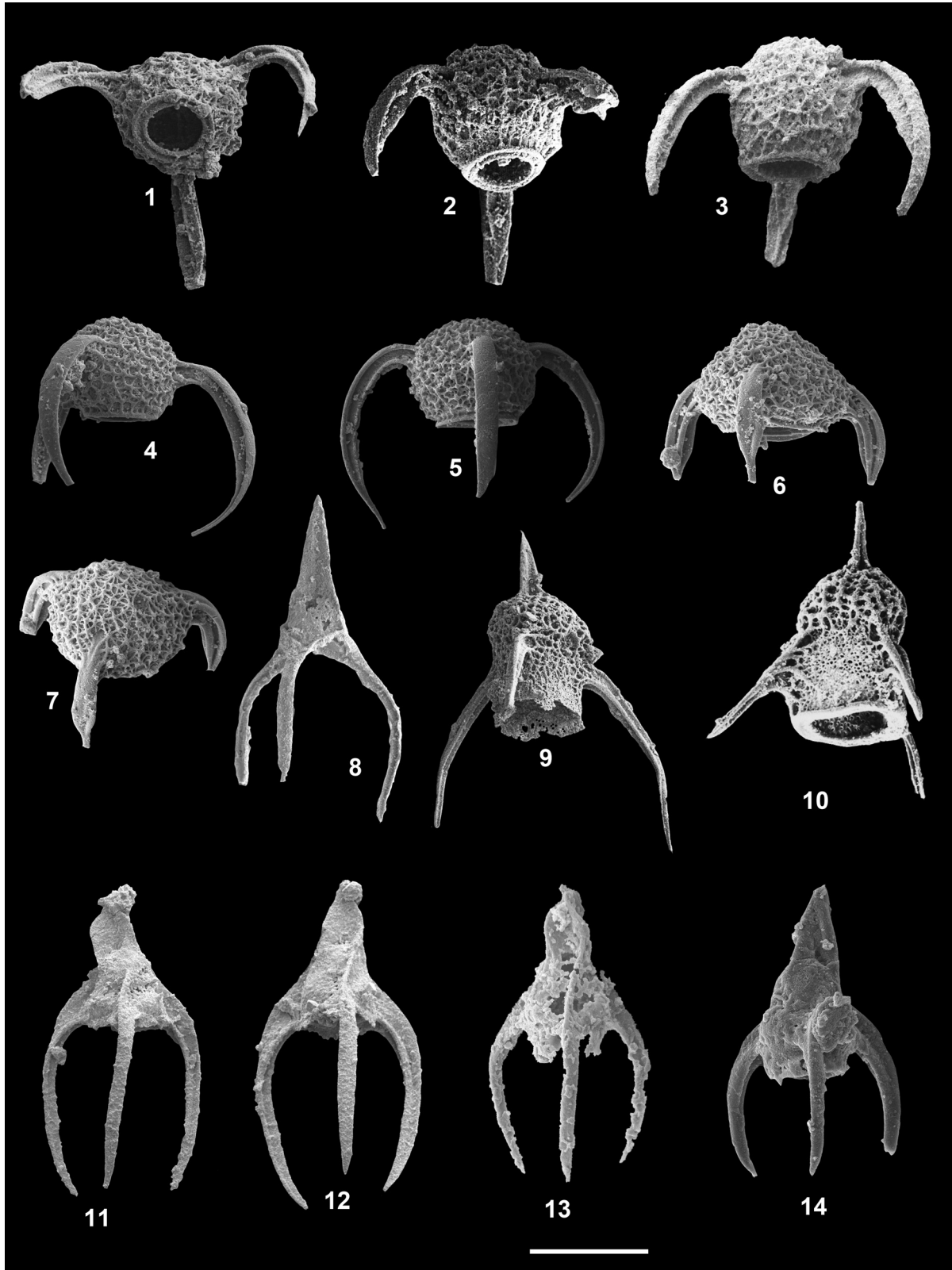


Plate 3. 1–5. *Annulopoulpus parviapertura* (Kozur & Mostler) (1–3. Sorgun Ophiolitic Mélange, Turkey; 4–5. Kopría Mélange, Rhodes, Greece) 6–7. *Annulopoulpus gibber* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. 8. *Eonapora pulchra* Kozur and Mostler, 1979 (Sorgun Ophiolitic Mélange, Turkey). 9. *Annulohaeckeliella curvispina* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Sorgun Ophiolitic Mélange, Turkey) 10. *Annulohaeckeliella rectospina* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Sosio valley, Sicily, Italy). 11–13. *Tekinium bragini* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (11–12. Sorgun Ophiolitic Mélange, Turkey, 13. Kopría Mélange, Rhodes, Greece). 14. *Tekinium robustum* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). Scale bar = 100  $\mu$ m.

1979 *Eonapora pulchra* nov. sp. - Kozur and Mostler, p. 90, pl. 19, fig. 11.

Remarks: This species is very rare in our samples; we found it only in the Sorgun fauna. Except for its poorer preservation, the specimen illustrated resembles perfectly the holotype from the early Carnian of Austria.

Range and occurrence: Lower Carnian (upper Julian), *Tetraporobrachia haeckeli* Zone of Großreifling (Northern Calcareous Alps, Austria) and lower Tuvalian, *Spongortilispinus moixi* Zone of the Sorgun Ophiolitic Mélange, Turkey.

Family Deflandrecyrtiidae Kozur and Mostler, 1979

Type genus: *Deflandrecyrtium* Kozur and Mostler, 1979

Genus *Aropeon* nov. gen.

Type species: *Aropeon graecorus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Diagnosis: Skeleton dicyrtid, bell-shaped with a small cephalis armed with an apical horn. Initial spicule without D ray and with V ray extend outside into a small spine. Collar plate with 5 pores. Thorax bell-shaped, large, wide open, with flared distal part and bearing a peripheral girdle, at least in the two species herein described.

Remarks: Of the three species herein described we know the initial spicular structure only in one of them. However, since the external morphology of these species is rather similar we suppose that their initial structure is also similar. Generally the morphology of the species of this genus resembles the morphology of the genus *Haeckelicyrtium* Kozur and Mostler, 1979 from which it differs in having an apical horn and the initial spicule without D ray. Similar species as the ones described herein have been described by Tekin (1999) under the genus *Deflandrecyrtium* Kozur and Mostler, 1979. However, we interpret the genus *Deflandrecyrtium* as in De Wever et al. (2001) comprising dicyrtid nassellarians with D ray and skeleton more or less curved in dorsal direction. In this situation, we assign questionably the genus *Aropeon* to the family Deflandrecyrtiidae.

Etymology: Name formed by an arbitrary combination of letters. Masculine gender.

Range: Early Tuvalian to early Norian so far as known.

*Aropeon cingulatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 4, figs. 1–2

Description: Test conical, hat-shaped with a flared, widely open distal part. Cephalis hemispherical and imperforate, bearing a conical spine of unknown length. Ventral ray well marked outside by a very short and multi-bladed spine from which radiate many ribs with very small pores in between. Primary lateral rays and probably the dorsal one marked outside by shallow depressions at the place of their connection to the shell. Thorax conical on proximal and middle part with numerous circular or oval pores somehow arranged in longitudinal rows on the upper part and in oblique rows on the lower part, their size increasing gradually in distal direction. Distal part strongly

flared, practically coplanar consisting of an inner imperforate circular zone of and a peripheral circle of wide elongated pores. This circle of pores is closed at the periphery by a narrow circular ring below which is a broad vertical and imperforate girdle. The diameter of this girdle is smaller than the border of the circular ring that forms a kind of projecting roof above it.

Material: 3 specimens from the Kopría Mélange, Rhodes, Greece.

Holotype: The illustrated specimen in Pl. 4, figs. 1–2 (same specimen in two views), coll. MGL nr. 97935.

Dimensions (in  $\mu\text{m}$  based on 3 specimens): Height of cephalis 30–40, diameter thorax at base 160–185 diameter of thoracic skirt 310–410.

Remarks: As already remarked above the genus, although we do not know the structure of the initial skeleton, the morphological similarity with the species *Aropeon graecorus* nov. sp. suggests that it should be similar, without D ray.

Etymology: From the Latin *cingulatus*—having a belt.

Range and occurrence: Very rare in lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes, Greece.

*Aropeon cinguloporatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 4, fig. 3

Description: Cephalis small, hemispherical and imperforate, bearing a long needle-shaped apical horn. Ventral spine very short, multi-bladed. Thorax bell-shaped with distal part strongly flared and distalmost border practically subvertical and perforate. Distal margin circular. The whole thorax has numerous circular or subcircular pores which are usually quincuncially arranged. Pores are very small on the upper part of thorax and increase suddenly in diameter distally. On the flared portion pores are usually irregularly or quincuncially arranged. Boundary between the porous flared portion and the vertical girdle abrupt. As in the other two species, but in this one more evident, pores increase rather quickly in size at the lower part of the conical portion and remain larger up to the border of shell.

Material: Two specimens from the Kopría Mélange, Rhodes, Greece.

Holotype: The illustrated specimen in Pl. 4, fig. 3, coll. MGL nr. 97936.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis (without apical horn) 25–35, diameter of thorax at base 160–185, diameter of thoracic skirt 330–390.

Remarks: Although similar in shape with the other two new species of this genus, *Aropeon cinguloporatus* is morphologically closer to *A. graecorus* than to *A. cingulatus* by having the whole thorax perforated except the vertical distal belt.

Etymology: For having a porous distal belt.

Range and occurrence: Very rare in lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes, Greece.

*Aropeon graecorus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 4, figs. 4–6



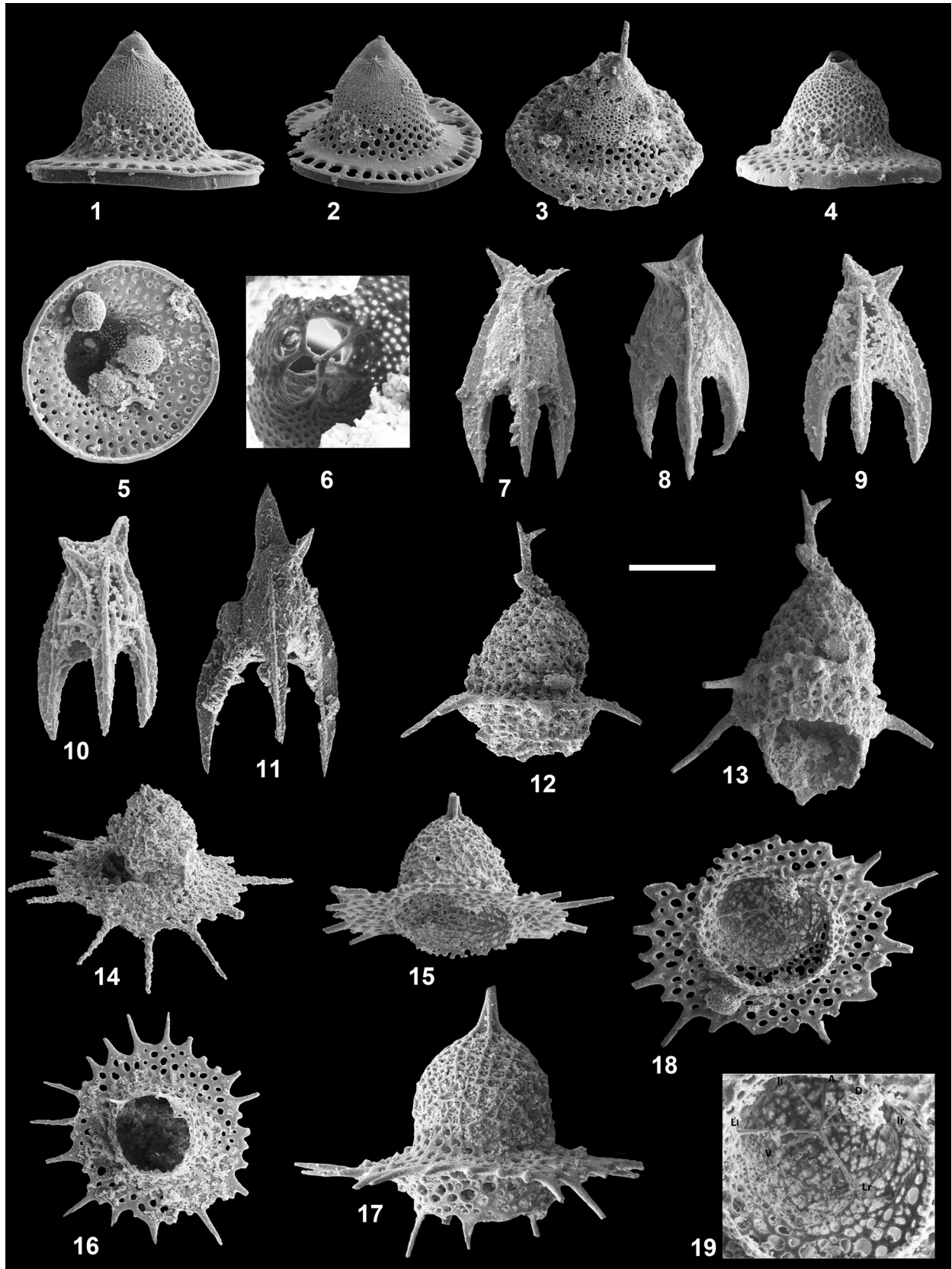


Plate 4. 1–2. *Aropeon cingulatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). 3. *Aropeon cinguloporatus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). 4–6. *Aropeon graecorus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (Kopría Mélange, Rhodes, Greece). 7–10. *Hinedorcus elegantissimus* (Tekin) (Sorgun Ophiolitic Mélange, Turkey) 11. *Hinedorcus robustus* (Kozur & Mostler) (Sorgun Ophiolitic Mélange, Turkey). 12–19. *Nabolella thoraxaca* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (12–13. Sorgun Ophiolitic Mélange, Turkey 14–19. Kopría Mélange, Rhodes, Greece). Scale bar = 100  $\mu$ m (except fig. 6 whose scale bar = 25  $\mu$ m).

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Description: Cephalis small, hemispherical and imperforate. Although the upper part of cephalis is broken off, the cephalis should bear a probably conical apical horn. Ventral spine very short, multi-bladed. Thorax bell-shaped with distal part strongly flared bordered by a vertical and imperforate belt. Except this belt thorax has numerous circular or subcircular pores which are usually quincuncially arranged and increase in diameter distally. On the flared portion pores are usually irregularly arranged. Boundary between the porous flared portion and the vertical girdle abrupt.

Material: 3 specimens from the Kopría Mélange, Rhodes, Greece.

Holotype: The illustrated specimen in **Pl. 4, f. 4, coll. MGL nr. 97934.**

Dimensions (in  $\mu\text{m}$  based on 3 specimens): Height of cephalis 32–38, diameter thorax at base 156–179, diameter of thoracic skirt 330–425.

Remarks: This new species differs from *A. cingulatus* nov. sp. by having pores on thorax more regularly arranged, by having the whole thorax perforated, without a distal circular imperforate zone and a distal circular row of large pores, and by not having a protecting roof at the boundary with the vertical distal belt. A closely related species (specimen) to *A. graecorus* is the paratype of the species *Deflandrecyrtium pessagnoii* Tekin (1999, pl. 30, fig. 13) from the early Norian (*E. abneptis* Conodont Zone) of Turkey. This specimen does not seem to belong to the same species as the holotype because the outline of the thorax and its pores are different, and the distal expanded part is much wider.

Etymology: From its occurrence in Greece.

Range and occurrence: Very rare in lower Tuvalian, *Spongortilispinus moixi* Zone, Kopría Mélange, Rhodes, Greece.

Genus *Annulohaeckeliella* Kozur and Mostler, 2006

Type species: *Annulohaeckeliella longipedis* Kozur and Mostler, 2006

Range: Upper Fassanian (Longobardian) to lower Tuvalian so far as known.

*Annulohaeckeliella curvispina* Ozsvárt, Dumitrica & Hungerbühler nov. sp.

Plate 3, fig. 9

Description: Cephalis subglobular to hemispherical bearing a relatively long pointed pyramidal apical horn with thin blades and wide grooves. Cephalic wall double-layered, with an inner layer of very small pores and an outer layer of thick bars of various thickness forming triangular, quadrangular or oval pores. Thorax cylindrical, relatively short, with wall thinning distally due to the outer layer of cephalic pore frames that continues on the thorax and disappears gradually distally. Distal end of thorax without a ring. Feet three-bladed, very long, pointing distally, downwardly directed and slightly curved. Feet free, without additional connections to the thorax.

Material: More than 50 specimens.

Holotype: The illustrated specimen in **Pl. 3, fig. 9, NHMH, PAL 2016.22.**

Dimensions (in  $\mu\text{m}$  based on 6 specimens): Height of cephalis 115–122, of apical horn 112–130, diameter of cephalis 120–130, length of feet 420–550.

Remarks: This new species differs from *A. rectospina* nov. sp. in having the apical spine pyramidal and with thinner blades, feet much longer, slightly curved inward, and free, without connections with the tubular thorax, and in having the distal end of thorax very thin, without a thoracic ring.

Etymology: From the Latin *curvus*–curved and *spina*–spine.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Annulohaeckeliella rectospina* Ozsvárt, Dumitrica & Hungerbühler nov. sp.

Plate 3, fig. 10

Description: Cephalis globular bearing a straight, tricarinate apical horn with thick blades and very narrow grooves. It has two layers of meshwork, an inner layer of very small pores and an outer layer with thick pore frames of variable thickness forming larger oval or triangular pores of variable shape and size with small nodes at vertices of pore frames. Thorax slightly longer than cephalis, cylindrical and terminated in a distal imperforated ring. It is thin-walled consisting of a single layer with very small circular and irregularly arranged pores. This wall is the continuation of the inner layer of the cephalis. Feet straight, pointed, slightly longer than thorax and three-bladed, arising from the base of cephalis and connected with thorax on most part of its length through many obliquely directed bars.

Material: More than 5 specimens.

Holotype: The illustrated specimen in **Pl. 3, f. 10, HNHM, PAL 2016.23**

Dimensions (in  $\mu\text{m}$  based on 3 specimens): Height of cephalis 110–120, of apical horn 100–110, diameter of cephalis 120–130, length of feet 225–250.

Remarks: However, this species is also present in the Sorgun material, its preservation is not so perfect than the illustrated specimen from Sosio valley, Sicily, Italy. Therefore, we have chosen this specimen as holotype of *A. rectospina* nov. sp. This new species resembles the upper Ladinian species *Annulohaeckeliella longipedis* Kozur & Mostler and *A. pulchra* Kozur & Mostler in having thorax terminated in a ring and feet straight and closely connected to the thoracic wall by a series of bars. However it differs essentially from them in not having bladed and twisted apical horn. *A. rectospina* n. sp. is compared with *A. curvispina* n. sp. under the latter species.

Etymology: From the Latin *rectus*–straight and *spina*–spine.

Range and occurrence: Lower Julian from Sosio valley, Sicily, Italy; lower Tuvalian, Sorgun Ophiolitic Mélange, Turkey.

Family Ultraporidae Pessagno 1977

Genus *Hinedorcus* Dumitrica, Kozur & Mostler, 1980

syn. *Picapora* Kozur and Mostler, 1981

Type species: *Hinedorcus alatus* Dumitrica, Kozur & Mostler, 1980

*Hinedorcus elegantissimus* (Tekin, 1999)

Pl. 4, figs. 7–10

1999 *Picapora elegantissima* nov. sp. - Tekin, p. 147, pl. 32, figs. 7, 11

2007 *Picapora robusta* Kozur & Mostler - Bragin, p. 1005, pl. 12, fig. 10

Remarks: The specimens from the Sorgun Ophiolitic Mélange, Turkey have a more dumpy test with smaller apical and ventral horn and wear smaller feet than the holotype (Tekin, 1999).

Range and occurrence: Lower Tuvallian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey, to lower Norian from the Yaylakuzdere Measured section, Alakircay Nappe, Antalya Nappes, Kemer, Antalya, Turkey, and Mamonia Complex, southwestern Cyprus.

*Hinedorcus robustus* (Kozur and Mostler, 1981)

Pl. 4, fig. 11

1981 *Picapora robusta* nov. sp. - Kozur and Mostler, p. 110, pl. 7, figs. 1, 2.

1999 *Picapora robusta* Kozur & Mostler - Tekin, p. 147, pl. 32, figs. 8, 9.

Remarks: The illustrated specimen from the Sorgun Ophiolitic Mélange, Turkey, has a bit sharper apical horn than the holotype of the species, and the feet are more divergent.

Range and occurrence: Middle Julian of Göstling and Großreifling (Northern Calcareous Alps, Austria) to lower Tuvallian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Huğlu Unit, Beyşehir-Hoyran Nappe, Bozkir, Konya, Turkey.

Genus *Tekinium* Ozsvárt, Dumitrica & Hungerbuhler nov. gen.

Type species: *Sanfilippoella lengeranlii* Tekin, 1999.

Diagnosis: Test dicyrtid with a well-developed, three-bladed apical horn and 3 tri-bladed feet. Cephalis small, globular, usually imperforate with initial spicule comprising MB, A, V, D, 2L and 2I. Dorsal and primary lateral rays extended into three-bladed feet, ventral spine very short and pyramidal, and secondary rays not expressed outside. Thorax larger than cephalis, perforate and open distally. The third segment, when developed, is velum-like, thin, cylindrical and usually preserved as remains at the base of thorax.

Remarks: The type species was erroneously assigned to *Sanfilippoella* Kozur and Mostler 1979. As Kozur and Mostler (1994) remarked, *Sanfilippoella* is a dicyrtid with a large cephalis that can be globular or conical and perforated, and thorax is regarded structurally as a velum. We include in this new genus *Sanfilippoella lengeranlii* Tekin, *Tekinium bragini* nov. sp., both very closely related species, and *Tekinium robustum* nov. sp.

Etymology. The genus is named for Dr. Ugur Kagan Tekin, who first illustrated the type species, for his outstanding contribution to the knowledge of Mesozoic radiolarians.

Range and occurrence: Upper Carnian to lower Norian, Turkey and Cyprus, so far as known.

*Tekinium bragini* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 3, figs. 11–13

Description: Cephalis globular imperforate with a broad tricarinate apical horn with thin and broad blades and pointed tip. Blades may extend obliquely along cephalic and thoracic wall and continue on the three feet where they form their external blades. Thorax short but much wider than cephalis with 3 dome-shaped lobes developed in the 3 intercostal areas. It is perforated by many small pores and its boundary with abdomen is marked by a constriction. Following segment is velum shaped but very short in our specimens due to the poor preservation, but its presence is marked by some lamellar remains. Feet very long, downwardly directed, pointing distally and curved, converging so that their distal ends tend to near.

Material: More than 100 specimens.

Holotype: The illustrated specimen in Pl. 3, fig. 12, NHMH, PAL 2016.24.1

Dimensions (in  $\mu\text{m}$  based on 9 specimens): Height of cephalis (with apical horn) 125–139, diameter of cephalis 74–80, length of feet: 148–187.

Remarks: The proximal part of this species resembles the respective part of the younger species *Sanfilippoella lengeranlii* Tekin illustrated by both Tekin (1999) and Bragin (2007) from which it differs by having very long, downwardly directed and curved feet. One of the specimens illustrated by Bragin (2007, pl. 12, fig. 4) as *S. lengeranlii* seems to be well comparable to the Longobardian species *Annulohaeckeliella longipedis* Kozur and Mostler, 2006, because no small cephalis at the base of apical horn is visible and because it has a long distal segment terminated in a ring. The specimens from the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, differ from the type species of the genus by having much longer and converging feet.

Etymology: The species is named for Dr. Nikita Yu. Bragin, Moscow, for his contribution to the knowledge of Triassic and Jurassic radiolarians.

Range and occurrence: Lower Tuvallian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, Greece.

*Tekinium robustum* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 3, fig. 14

Description: Test dicyrtid with a robust three-bladed, pointed and slightly sinistrally twisted apical horn. Blades of horn broad at base. Cephalis globular, practically imperforated except for a few tiny pores at the base of ventral spine, which is pyramidal, three-bladed and very small. Collar constriction well visible. Thorax sensibly larger than cephalis, especially on the proximal part, with which it forms a bell-shaped body. Wall of thorax perforated by rare and very small pores. Distal part wide open, cylindrical. Feet arched, three-bladed on the proximal half with one blade external and two lateral, and conical on the distal half.

Material: Two specimens from Kopría Kopría Mélange, Rhodes, Greece.

Holotype: The illustrated specimen in **Pl. 3, fig. 14, coll. MGL nr. 97937**.

Dimensions (in  $\mu\text{m}$  based on 2 specimens): Height of cephalis (with apical horn) 107–115, diameter of cephalis 45–55, length of feet 90–120.

Remarks: *Tekinium robustum* is well distinguished from *T. bragini* nov. sp. in having a more robust apical spine, non lobated thorax and shorter feet. It resembles somehow the holotype of *T. lengeranlii* (Tekin) from which it differs in having another type of twisting of the apical spine, cephalis better distinguished from thorax, curved feet and a much shorter cylindrical distal segment.

Etymology. From the Latin *robustus*, -a, -um—robust.

Range and occurrence: Very rare in Kopría Mélange, Rhodes, Greece.

Family Naboellidae (Kozur and Mostler, 1979)  
syn.: Fueloepicyrtidae Kozur and Mostler, 1981  
Genus *Naboella* Petrushevskaya, 1981

Hom.: *Squinaboella* Kozur and Mostler, 1979

Type species: *Naboella longispinosa* (Kozur and Mostler, 1979)

Remarks: The position of the initial spicule would suggest that the genus *Naboella* could be also considered a dicyrtid with no collar segmentation as the genus *Caponaboella* nov. gen. The shell wall with its double-layered structure and the reticulate structure of the outer layer are also characters in common of both genera.

Range: Middle Julian to lower Tuvalian.

*Naboella thoraxaca* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 4, figs. 12–19

Description: Cephalis large, bell-shaped with dome-shaped apical part and cylindrical lateral sides. Spicule as with the genus, thin, situated at the upper part of cephalis. No spicule rays are extended outside except the apical one. Apical horn long, four-bladed and pyramidal proximally, cylindrical distally and pointed. Wall of cephalis two layered, with an inner layer made of circular to oval pores and an outer layer made of polygonal, usually quadrangular or triangular areas within which there are very small pores. These areas result from a network of differently directed crests that intersect, and that developed very small nodes at the nodal points of the network. Distal part of cephalis strongly expanded laterally forming a circumferential plate of variable diameter with circular to oval pores and numerous spines of various length, most of them coplanar. Thorax shorter than cephalis, cylindrical, of the same diameter as cephalis and widely open. It consists of a single layer wall with numerous circular or oval pores of various arrangements. Distal end prolonged into several conical spines of various lengths.

Material: Three specimens in Kopría Mélange, Rhodes, Greece, and more than 10 specimens in the Sorgun Mélange, Turkey.

Holotype: The specimen in **Pl. 4, fig. 17, coll. MGL nr. 97938**.

Dimensions (in  $\mu\text{m}$  based on 9 specimens): Height of cephalis (without apical horn) 115–127, apical horn 95–110, diameter of cephalis 195–210, height of thorax 100–120, diameter of thorax at base 80–100.

Remarks: This new species differs from *N. longispinosa* (Kozur and Mostler, 1979) in having a well-developed cephalic skirt, spines of various lengths, border of skirt not thickened, and a well-developed thorax. The difference between the specimen from the Sorgun Mélange and those from the Kopría Mélange is interpreted as variation within the species. The presence of a well-developed thorax seems to be characteristic of this species, since the three species Kozur and Mostler (1979, 1981) described from the upper Julian either have no thorax or it is just sketched.

Etymology: For having a well-developed thorax.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) from the Kopría Mélange, Rhodes, Greece, and Sorgun Mélange, Turkey.

Genus *Caponaboella* Ozsvárt, Dumitrica & Hungerbuhler nov. gen.

Type species: *Caponaboella longispinosa* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Diagnosis: Test cone-shaped, dicyrtid without apical horn. Cephalis hemispherical with complete spicular system (MB, A, 2L, 2I, D, V). Spicule centre (MB) at the base of cephalis. Collar boundary marked by a weak external constriction, which corresponds internally with the arches LI, DI and partly LV. Rays D and L may be prolonged along the thorax and beyond its distal end into spines. Thorax gradually widening, lacking thoracic skirt; oral opening circular, constricted, with thickened ring. Spines present or absent around distal edge of thorax.

Remarks: This genus differs from *Naboella* Petrushevskaya, 1981 by lacking the apical horn, thoracic skirt and by the presence of a terminal thickened ring around the oral opening. It is, however, very close to this genus in having no collar plate at the base of cephalis, the rays of the initial spicule being rather free inside shell cavity.

Etymology: In allusion to its similarity to the genus *Naboella* Petrushevskaya and the hat-shaped test.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey.

*Caponaboella longispinosa* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

Plate 5, figs. 1–5

Description: Test cone-shaped, dicyrtid. Cephalis hemispherical to globular without apical horn. Thorax cone-shaped, widening gradually and separated from cephalis by a collar constriction. Meshwork of cephalis and thorax double-layered. Outer layer consists of circular to polygonal pore frames and inner layer is smooth perforated by circular pores. Base of thorax composed of same meshwork as that of cephalis and thorax; it is armed with 5–7 spines, three of which being prolongation of rays D and 2L. Oral opening large, circular with a thick, smooth ring.

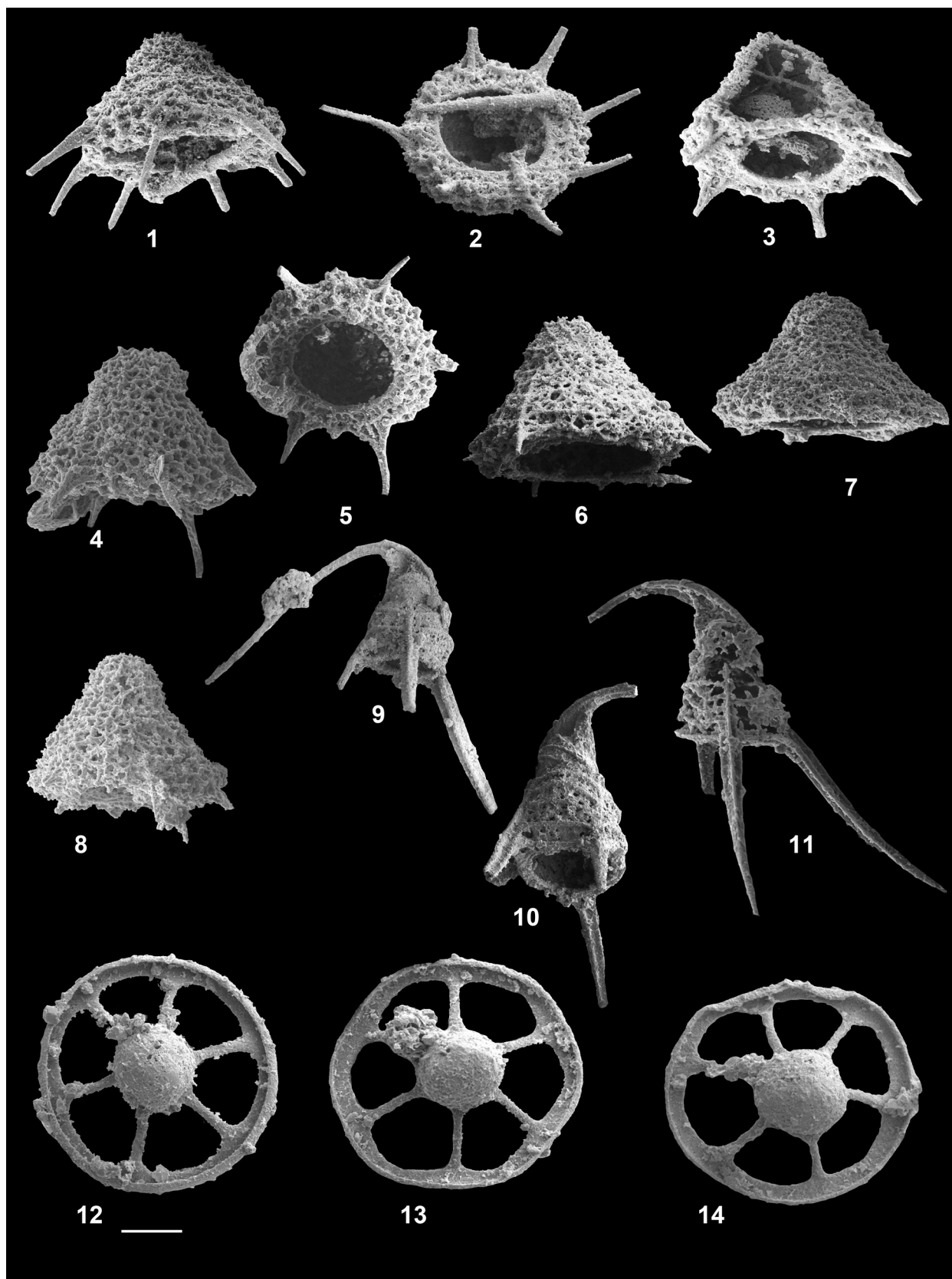


Plate 5. 1–5. *Caponabolella longispinosa* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (1–3. Sorgun Ophiolitic Mélange, Turkey; 4–5. Kopría Mélange, Rhodes, Greece) 6–8. *Caponabolella brevispinosa* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (6–7. Sorgun Ophiolitic Mélange, Turkey 8. Kopría Mélange, Rhodes, Greece). 9–11. *Silicarmiger longospinosus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp. (9–10. Sorgun Ophiolitic Mélange, Turkey; 11. Kopría Mélange, Rhodes, Greece). 12–14. *Pseudosaturiniforma carnica* Kozur and Mostler (Sorgun Ophiolitic Mélange, Turkey). Scale bar = 100  $\mu$ m.

Material: More than 50 specimens.

Holotype: The specimen in [pl. 5, figs. 1–2](#) (same specimen in two different views), HNHM, PAL 2016.26.1

Dimensions (in  $\mu\text{m}$  based on 7 specimens): Height of cephalis: 50–65, diameter of cephalis 60–75, height of thorax 73–85, diameter of thorax at base 200–225.

Remarks: *Caponabolella longispinosa* nov. sp. differs from *C. brevispinosa* nov. sp. by having longer spines around the distal end of thorax.

Etymology: In allusion to its long spines around the distal part of thorax.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey; Kopría Mélange, Rhodes, Greece.

*Caponabolella brevispinosa* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

[Plate 5](#), figs. 6–8

Description: Test dicyrtid, conical or hat-shaped; cephalis hemispherical without apical horn. Thorax gradually expanding. Meshwork of cephalis and thorax double-layered, outer layer consisting of circular to polygonal pore frames and the inner layer consisting of polygonal to circular pores. Oral opening slightly constricted, circular with a smooth ring; the widest distal part of thorax with 4–5 small, pointed spines, three of which are prolongation of D and 2L.

Material: More than 10 specimens.

Holotype: The specimen in [Pl. 5, fig. 6](#), NHMH, PAL 2016.27.1

Dimensions (in  $\mu\text{m}$  based on 5 specimens): Height of cephalis 55–68, diameter of cephalis 62–78, height of thorax 73–85, diameter of thorax at base 198–225.

Remarks: *Caponabolella brevispinosa* nov. sp. differs from *C. longispinosa* nov. sp. by having significantly smaller and fewer spines around the distal end of thorax, and collar constriction less marked.

Etymology: In allusion to its short and rare spines around the distal part of thorax.

Range and occurrence: Lower Tuvalian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, Greece.

Family Silicarmigeridae Kozur & Mostler, 1980

Genus *Silicarmiger* Dumitrica, Kozur & Mostler, 1980

Type specie: *Silicarmiger costatus* Dumitrica, Kozur & Mostler, 1980

*Silicarmiger longospinosus* Ozsvárt, Dumitrica & Hungerbuhler nov. sp.

[Plate 5](#), figs. 9–11

aff. 1984 *Silicarmiger curvatus* (Kozur & Mostler) - Kozur, p. 63, pl. 4, fig. 3.

aff. 1994 *Silicarmiger curvatus* (Kozur & Mostler) - Kozur and Mostler, p. 119, pl. 33, figs. 11, 12, 14.

aff. 1999 *Silicarmiger curvatus* (Kozur & Mostler) - Tekin, p. 162, pl. 38, figs. 12, 13.

2007 *Silicarmiger curvatus* (Kozur & Mostler) - Tekin and Bedi, p. 178, pl. 2, figs. 7, 8.

Description: Shell conical, dicyrtid as the genus. Thorax conical increasing in diameter constantly and divided externally into segments by 2–4 or possibly more high circumferential ridges. Cephalis well distinguished from thorax, globular, with ribbed surface and perforated by a variable number of pores. Apical horn broad proximally, with a broad triangular blade on the ventral side that disappears quickly on the curved portion of the spine. Horn strongly curved downwardly in ventral direction and very long, thin and circular in cross-section, and slightly curved outwardly on the terminal part. Feet also very long, pointed, three-bladed, divergent and slightly curved outwardly on the distal half.

Material: More than 10 specimens.

Holotype: The specimen in [Pl. 5, fig. 9](#), HNHM, PAL 2016.28.2.

Dimensions (in  $\mu\text{m}$  based on 6 specimens): Height of cephalis (without apical horn) 50–65, length of apical horn 213–250, diameter of cephalis 55–72, height of thorax 60–78, diameter of thorax at base 83–98.

Remarks: This new species has been usually erroneously determined as *Silicarmiger curvatus* (Kozur and Mostler, 1979b) from the lower Julian from Göstling, Austria, originally described as *Eonapora curvata* and poorly illustrated under binocular. This Austrian species does not seem at all to be a *Silicarmiger* species because it shows no segmented postcephalic body. The only species that seems somehow to belong to this new species is that illustrated by [Tekin and Bedi \(2007a\)](#) from the Köseyahya Nappe near Elbistan, but its spines are not yet so long as this species from the Moixi Zone. The upper Julian species from Elbistan seems to be, in fact, the forerunner of the present one. Possibly the specimens from the Moixi Zone and those from Haeckeli Zone are subspecies of the species *S. longospinosus* nov. sp.

Range and occurrence: Lower Julian from Sosio valley, Sicily, Italy, Upper Julian, *Tetraporobrachia haeckeli* Zone, from the Köseyahya Nappe, Elbistan, Turkey, to lower Tuvalian, *Spongortilispinus moixi* Zone, from the Sorgun Ophiolitic Mélange, Turkey, and Kopría Mélange, Rhodes, Greece.

Family Pseudosaturniiformidae Kozur and Mostler, 1979

Genus *Pseudosaturniiforma* Kozur and Mostler, 1979 emend. Blome, 1984

Type species: *Pseudosaturniiforma latimarginata* Kozur and Mostler, 1979

*Pseudosaturniiforma carnica* Kozur and Mostler, 1979

[Plate 5](#), figs. 12–14

1979 *Pseudosaturniiforma carnica* nov. sp. - Kozur and Mostler, p. 92, pl. 17, fig. 3.

1981 *Pseudosaturniiforma carnica* Kozur & Mostler - Kozur and Mostler, pl. 22, fig. 3.

1984 *Pseudosaturniiforma carnica* Kozur & Mostler - Blome, p. 318, pl. 13, figs. 5, 9, 11, 18.

1999 *Pseudosaturiniforma carnica* Kozur & Mostler - Bragin and Krylov, p. 558, figs. 10I, K, L.

1999 *Pseudosaturiniforma carnica* Kozur & Mostler - Tekin, p. 156, pl. 34, figs. 7–10.

Remarks: Cephalis relatively small, circular in outline with tiny pores. Shape of thoracic ring ranges from circular (pl. 5, fig. 12) to hexagonal (pl. 5, fig. 13) in outline in our material. The specimen in pl. 5, fig. 14 shows some malformations or regenerations of the edge of the ring.

Range and occurrence: Lower Carnian (lower to middle Julian) of Göstling and Großreifling (Northern Calcareous Alps, Austria); Carnian? - Norian (lower to upper middle) of Oregon, USA, lower Tuvallian (*Spongortilispinus moixi* Zone) of the Sorgun Ophiolitic Mélange, Turkey and lower Norian from the Yaylakuzdere section, Alakircay Nappe, Antalya Nappes, Kemer, Antalya, Turkey.

### Disclosure of interest

The authors declare that they have no competing interest.

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