



Characteristic Nassellaria of the lower Tuvalian (Upper Triassic) *Spongortilispinus moixi* Zone of the Huğlu Unit in the Mersin Mélange, southeastern Turkey

by

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Abstract.—KOZUR H.W., MOIX P. and OZSVÁRT P., 2007. Characteristic Nassellaria of the lower Tuvalian (Upper Triassic) *Spongortilispinus moixi* Zone of the Huğlu Unit in the Mersin Mélange, southeastern Turkey. *Bull. Soc. vaud. Sc. nat.* 90.3: 151-173.

Ruesticyrtiidae with large spines on the distal margin of the skirt and diverse Xiphothecaellidae characterize the Tethyan lower Tuvalian (Upper Triassic) *Spongortilispinus moixi* Zone. Two new genera, 19 new species and two new subspecies referable to these two groups are here described.

Keywords: Ruesticyrtiidae, Xiphothecaellidae (Nassellaria, Radiolaria), lower Tuvalian, Huğlu Unit, Mersin Mélange.

Résumé.—KOZUR H.W., MOIX P. et OZSVÁRT P., 2007. Nassellaires caractéristiques de la Zone à *Spongortilispinus moixi* du Tuvalien inférieur (Trias supérieur) de l'unité de Huğlu appartenant au mélange de Mersin (SE de la Turquie). *Bull. Soc. vaud. Sc. nat.* 90.3: 151-173.

Des Ruesticyrtiidae comprenant de larges épines sur la partie distale de la jupe ainsi que divers Xiphothecaellidae sont caractéristiques de la zone à *Spongortilispinus moixi* du Tuvalien inférieur (Trias supérieur) de la Téthys. Deux nouveaux genres, 19 nouvelles espèces et deux nouvelles sous-espèces en rapport avec ces deux groupes sont décrits ici.

Mots clés: Ruesticyrtiidae, Xiphothecaellidae (Nassellaires, Radiolaires), Tuvalien inférieur, unité d'Huğlu, mélange de Mersin.

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INTRODUCTION

In 2002 and 2003, Masset and Moix investigated the Mersin Mélange in southeastern Turkey. During these investigations they found a very rich and well preserved lower Tuvalian radiolarian fauna in the Tavuşçayırı Block belonging to the Huğlu Unit (MASSET and MOIX 2004). More than 2000 SEM pictures of these radiolarians were taken by KOZUR in 2003 and 2004. Some species of this very rich radiolarian fauna have already been described (MOIX *et al.* 2007) and more will be described in several further papers (KOZUR *et al.*, in press and in prep.). A comprehensive evaluation of this fauna will be published in a monographic paper. All described taxa are from a radiolarian-rich sample (G11) that came from the Tavuşçayırı Block (Fig. 1). This sample is from a limestone intercalation, within thick tuffs that belongs to the lower Tuvalian *Spongotortilispinus moixi* Zone. Therefore, there is no need to repeat the type locality and type strata species by species in the systematic part. The distribution of these species outside the type locality will be discussed in the forthcoming monographic paper (in prep.), where SEM pictures will document details of the inner structures of these new species. Geologic setting, derivation of the blocks in the Mersin Mélange and palaeogeographic setting are discussed in MOIX *et al.* (2007) and in MOIX *et al.* (in press). The illustrated material is deposited in the Hungarian Natural History Museum.

SYSTEMATICS

Remarks: The assignments of most Triassic Nassellaria families to superfamilies are either not yet established or disputed. Therefore only the families are listed.

Abbreviations: Mb = median bar, A = apical spine, D = dorsal spine, V = ventral spine, 2 L = two primary lateral spines, 2 l = two secondary lateral spines.

Order Nassellaria Ehrenberg, 1875

Family Ruesticyrtiidae Kozur & Mostler, 1979

Genus *Pararuesticyrtium* Kozur & Mock, 1981

(in KOZUR and MOSTLER 1981)

Type species: *Pararuesticyrtium densiporatum* Kozur & Mock, 1981

(in KOZUR and MOSTLER 1981)

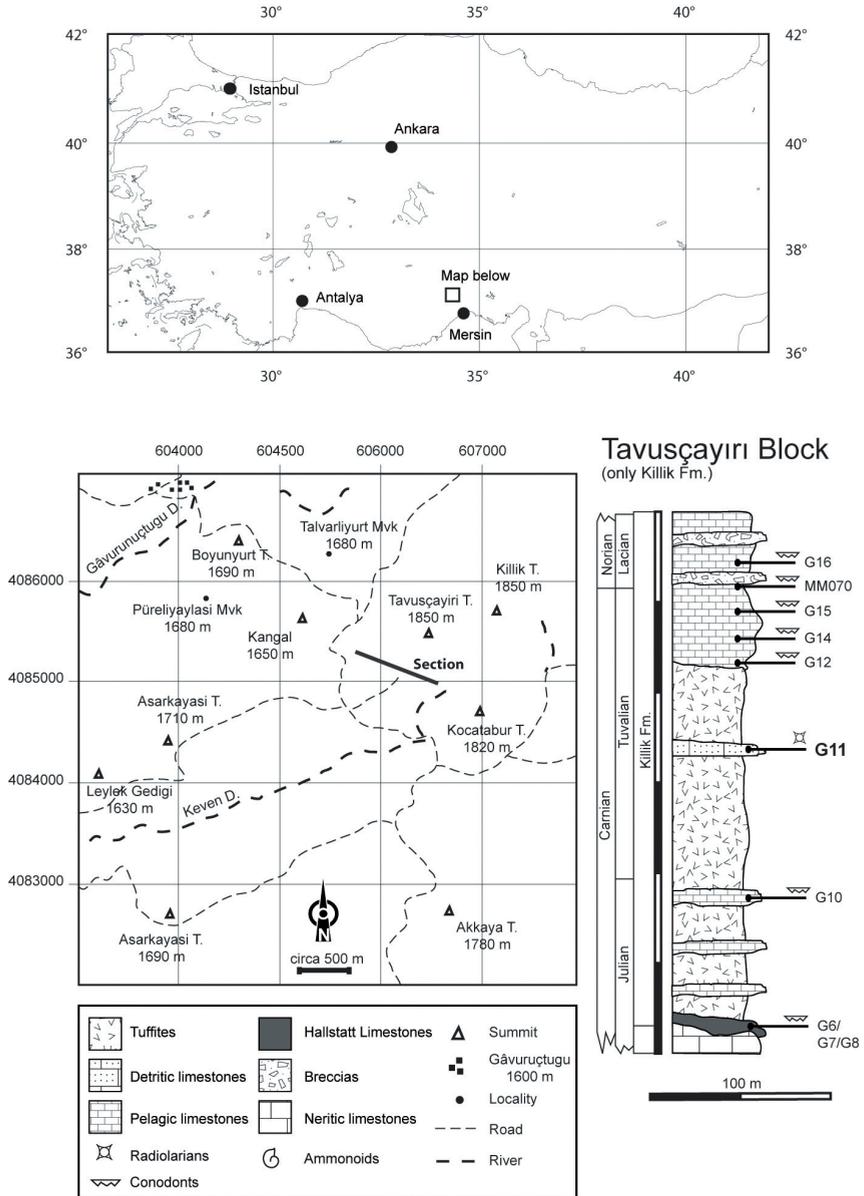


Figure 1.–Locality map and position of the radiolarian-rich sample G11 within the Killik Formation of the Tavusçayırı Block in the Mersin Mélange, southeastern central Turkey.

Pararuesticyrtium longispinosum n. sp.

(Plate 1, Figure 1)

Derivatio nominis: In allusion to the long spines on the distal margin of the skirt.

Holotypus: The specimen on Plate 1, Figure 1 (rep.-no. 23-9-04/III-79).

Material: 23 specimens.

Diagnosis: Multicyrtid conical Nassellaria, with strongly widened skirt and long spines on the distal margin of the skirt. Cephalis small, semiglobular, without pores. Eccentric apical horn proximally tube-like, short distal part needle-like. Thorax only slightly separated from the cephalis, subglobular, as high as and somewhat wider than the widest part of the cephalis, with minute pores closed by a layer of microgranular silica. A long, needle-like lateral horn (probably vertical horn) is present. Abdomen and following three post-abdominal segments hoop-like. Abdomen less high than thorax, in the distal direction the width and the height of the hoop-like post-abdominal segments increase gradually. Abdomen and post-abdominal segments are separated by smooth, narrow and rather shallow constrictions. Pores of the abdomen and the hoop-like post-abdominal segments closed by a layer of microgranular silica. Last segment much wider and higher than the hoop-like post-abdominal segments, strongly funnel-like and widened to a broad skirt with numerous (14-16) long and slender spines. Some of the spines may broaden to a slender triangular shape. The skirt has numerous, moderately large, roundish or oval open pores. The aperture is very wide.

Remarks: *Pararuesticyrtium densiporatum* Kozur & Mock, 1981 (in KOZUR and MOSTLER 1981) has open pores in the abdomen and hoop-like post-abdominal segments; the skirt is not so strongly widened and has much smaller denticles. *Pararuesticyrtium rariporatum* Kozur & Mostler, 1981 has four or five hoop-like post-abdominal segments, and the numerous denticles on the distal margin of the skirt are short. *Pararuesticyrtium mersinensis* n. sp. has much broader and shorter spines on the distal margin of the skirt.

Pararuesticyrtium mersinensis n. sp.

(Plate 1, Figure 2)

Derivatio nominis: In reference to its occurrence in the Mersin Mélange.

Holotypus: The specimen on Plate 1, Figure 2 (rep.-no. 23-9-04/V-56).

Material: 11 specimens.

Diagnosis: Multicyrtid conical Nassellaria, with strongly widened skirt and broad, rather short triangular spines on the distal margin of the skirt. Cephalis subglobular, poreless, with somewhat eccentric conical apical horn, proximally tube-like, distally needle-like and pointed. It extends gradually from the

cephalis. Vertical horn rather long and needle-shaped. Thorax cylindrical and not separated externally from the cephalis. Abdomen shorter than the thorax but with the same width and only indistinctly separated from the thorax. The next three more distal post-abdominal segments are hoop-like, becoming gradually but rapidly wider and somewhat higher. They are separated from each other by smooth, deep, narrow constrictions. The small pores in the thorax, abdomen and three hoop-like post-abdominal segments are covered by a layer of microgranular silica; in the distal hoop-like post-abdominal segment a few minute pores may remain open. Last segment only slightly separated from the distal hoop-like segments, much wider and higher than the hoop-like post-abdominal segments, strongly funnel-like and widened to a broad skirt with numerous (14-15) broad, rather short triangular spines. The skirt has numerous, moderately large, roundish open pores. The aperture is very wide.

Remarks: The Julian *Pararuesticyrtium densiporatum* Kozur & Mock, 1981 and *P. rariporatum* Kozur & Mostler, 1981 have smaller distal spines. Additionally, *P. densiporatum* has open pores on the abdomen and post-abdominal segments and *P. rariporatum* has more post-abdominal segments.

Genus *Ruesticyrtium* Kozur & Mostler, 1979

Type species *Ruesticyrtium rieberi* Kozur & Mostler, 1979

Ruesticyrtium coronatum n. sp.

(Plate 1, Figure 3)

Derivatio nominis: In allusion to the crown-like denticulation on the distal margin of the skirt.

Holotypus: The specimen on Plate 1, Figure 3 (rep.-no. 23-9-04/I-141).

Material: 7 specimens.

Diagnosis: Multicyrtid slender-coned Nassellaria with slightly widened distal skirt and short spines around the distal margin of the skirt. Cephalis small, semiglobular, without pores. Thorax slightly wider than cephalis, hoop-like, and only indistinctly separated from the cephalis. Its minute pores are closed by a layer of microgranular silica. Abdomen and the immediately following 5-7 post-abdominal segments are hoop-like and separated from each other by deep, smooth constrictions. The width of the segments increases slightly and gradually in the distal direction, but the height remains nearly constant except for the distalmost, somewhat higher hoop-like segment. The pores of the abdomen and of the three following post-abdominal segments are closed by a layer of microgranular silica. In the immediately following 2-4 hoop-like segments the pores of the two pore rings are partly open. The terminal segment is much higher and moderately widened distally to a skirt. The pores of the two pore rings mostly are open. The distal margin of the skirt bears 8-9 triangular,

relatively short denticles, that are directed outward and a little downward. The aperture is very large.

Remarks: Julian species of *Ruesticyrtium* are distinguished by a skirt with a smooth distal margin. The spines on the distal margin of the skirt in *Ruesticyrtium georgi* n. sp. and *R. latidentatum* n. sp. are directed strongly downward. *Ruesticyrtium mostleri* n. sp. has a much wider skirt and, in the first post-abdominal segment, some pores are open. In the other post-abdominal segments at least one pore ring is open and there are more (12-13) and larger denticles on the distal margin of the skirt. *Ruesticyrtium lobatum* n. sp. has lobe-like, broad and low denticles on the distal margin of the skirt.

Ruesticyrtium georgi n. sp.
(Plate 1, Figures 4, 5, 8, 9)

Derivatio nominis: For Georg Putzschke, grandson of H.W. Kozur, who is an enthusiastic fossil collector.

Holotypus: The specimen on Plate 1, Figure 5 (rep.-no. 23-9-04/I-129).

Material: More than 50 specimens.

Diagnosis: Multicyrtid slender-coned Nassellaria with large distal skirt and spines on the distal margin of the skirt. Cephalis small, semiglobular, without pores. Thorax hoop-like, only slightly separated from the cephalis. Its minute pores are closed by a layer of microgranular silica. Abdomen and following 4 post-abdominal segments are hoop-like and separated from each other by deep, smooth constrictions. They have two rings of very small pores, mostly closed by a layer of microgranular silica. The diameter of the segments becomes slowly and gradually larger in the distal direction, but their height remains nearly constant or increases only very slowly. The terminal segment is much higher and strongly widened distally to a funnel-like skirt that bears 4-5 rings of moderately large to small pores. Its distal margin bears 8-12 large, slender triangular denticles, which are directed downward. Proximally they are directed obliquely downward and outward. The aperture is very large.

Remarks: Julian species of *Ruesticyrtium* all have a skirt with a smooth distal margin. The lower Tuvalian *Ruesticyrtium latispinosa* n. sp. also has strongly downward-directed distal spines, but they are broader, rounded and lobate. The distal spines in *Ruesticyrtium coronatum* n. sp., *R. mostleri* n. sp. and *R. lobatum* n. sp. are directed outward and only a little downward.

Ruesticyrtium georgi georgi n. subsp.
(Plate 1, Figures 5, 8, 9)

Holotypus: As for the species. Material: 41 specimens.

Diagnosis: As for the species. Characteristically, 11-12 (rarely 10) large

denticles are present on the distal margin of the skirt.

Remarks: *Ruesticyrtium georgi novemdentatum* has only 9 (rarely 8) denticles on the distal margin of the skirt.

Ruesticyrtium georgi novemdentatum n. subsp.

(Plate 1, Figure 4)

Derivatio nominis: In allusion to the mostly 9 large denticles on the distal margin of the skirt.

Holotypus: The specimen on Plate 1, Figure 4 (rep.-no. 23-9-04/V-58).

Material: 18 specimens.

Diagnosis: As for the species. Characteristically, 9 (rarely 8) large denticles are present on the distal margin of the skirt.

Remarks: *Ruesticyrtium georgi georgi* n. subsp. has 11-12 (rarely 10) denticles on the distal margin of the skirt.

Ruesticyrtium latidentatum n. sp.

(Plate 1, Figure 7)

Derivatio nominis: In allusion to the very broad denticles on the distal margin of the skirt.

Holotypus: The specimen on Plate 1, Figure 7 (rep.-no. 23-9-04/VI-140).

Material: 5 specimens.

Diagnosis: Multicyrtid conical Nassellaria with large distal skirt and broad large spines on the distal margin of the skirt. Cephalis small, semiglobular, without pores. Thorax hoop-like, only slightly separated from the cephalis, its minute pores closed by a layer of microgranular silica. Abdomen and immediately following four post-abdominal segments are hoop-like and separated from each other by deep, smooth constrictions. The fourth post-abdominal segment is only slightly separated from the last segment. The pores of the abdomen and of the post-abdominal segments are closed by a layer of microgranular silica. The diameter of the segments becomes gradually larger in the distal direction, but their height remains constant until the second post-abdominal segment where it increases slightly in the next two segments. The terminal segment is much higher and strongly widened distally to a funnel-like skirt. In this segment, the small pores are also closed by a layer of microgranular silica. Its distal margin bears 9-10 large, very wide and broadly rounded distal denticles that are directed downward. Proximally, they are directed obliquely downward and outward. The aperture is very large.

Remarks: The most similar species is *Ruesticyrtium georgi* n. sp., which differs by having slender, pointed denticles on the distal margin of the skirt.

The distal spines in the lower Tuvalian species *Ruesticyrtium coronatum* n. sp., *R. mostleri* n. sp. and *R. lobatum* n. sp. are directed outward and only a little downward. Julian species of *Ruesticyrtium* have a skirt with a smooth distal margin.

Ruesticyrtium mostleri n. sp.
(Plate 1, Figure 12)

Derivatio nominis: In honour of Univ.-Prof. Dr. Helfried Mostler, Innsbruck for his outstanding contributions to geology and paleontology.

Holotypus: The specimen on Plate 1, Figure 12 (rep.-no. 23-9-04/III-153).

Material: 4 specimens.

Diagnosis: Multicyrtid conical Nassellaria with large distal skirt and numerous large spines around the distal margin of the skirt. Cephalis small, semiglobular, without pores. Thorax and abdomen hoop-like, pores covered by a layer of microgranular silica. 5 post-abdominal segments are hoop-like, separated from each other by deep, smooth constrictions. In the first post-abdominal segment, most of the pores are closed by a layer of microgranular silica. In the second to fifth post-abdominal segment, at least the pores of one pore ring are open. The diameter of the segments becomes gradually larger in the distal direction, but their height increases only very slowly in that direction. The terminal funnel-like segment is much higher, strongly widened distally to a wide skirt, and bears three rings of moderately large pores. Its distal margin bears 12-13 large, triangular denticles that are directed outward. The aperture is very large.

Remarks: The other two species with outward but only slightly downward directed denticles on the distal margin of the skirt (*R. coronatum* n. sp. and *R. lobatum* n. sp.) have fewer and shorter distal denticles and most of the pores on the hoop-like post-abdominal segments are closed by a layer of microgranular silica.

Ruesticyrtium lobatum n. sp.
(Plate 1, Figure 10)

Derivatio nominis: In allusion to the lobe-like distal denticles.

Holotypus: The specimen on Plate 1, Figure 10 (rep.-no. 23-9-04/I-140).

Material: 6 specimens.

Diagnosis: Multicyrtid conical Nassellaria with large distal skirt and broad, lobe-like denticles around the distal margin of the skirt. Cephalis small, semiglobular, without pores. Thorax only slightly separated from the cephalis, much lower and only indistinctly wider than the cephalis, poreless. Abdomen and immediately following four post-abdominal hoop-like segments separated by narrow, deep, smooth constrictions. Their diameter gradually increases in

the distal direction; most of the pores are covered by a layer of microgranular silica. The terminal funnel-like segment is much higher and strongly widened distally to a wide skirt. It bears 3-4 rings of moderately large pores. Its distal margin bears wide, irregular lobe-like denticles with rounded distal ends. The aperture is very large.

Remarks: *R. lobatum* n. sp. can be easily distinguished from other *Ruesticyrtium* species by the lobe-like denticles on the distal margin of the skirt.

Genus *Veloruesticyrtium* n. gen.

Type species: *Veloruesticyrtium palfyi* n. gen. n. sp.

Diagnosis: Multicyrtid slender-coned Nassellaria with skirt-like widened last segment. Cephalis small, semiglobular, poreless. Cephalic spicular system with Mb, V, 2L, D, 2I. Thorax only slightly separated from the cephalis. Abdomen and post-abdominal segments hoop-like, separated from each other by deep smooth constrictions. The segments have 2-3 rings of small pores, which are mostly closed by an imperforate layer of microgranular silica. The last post-abdominal segment is skirt-like with denticles around its distal margin. The wide aperture is narrowed by a short, inverted conical velum with small to moderately large pores.

Assigned species: *Veloruesticyrtium palfyi* n. gen. n. sp.

Remarks: *Ruesticyrtium* Kozur & Mostler, 1979 has no velum.

Veloruesticyrtium palfyi n. gen. n. sp.

(Plate 1, Figure 6)

Derivatio nominis: In honour of Dr. József Pálffy, Budapest, for his outstanding work around the T/J boundary and his help for our paper.

Holotypus: The specimen on Plate 1, Figure 6 (rep.-no. 23-9-04/I-49).

Material: 8 specimens.

Diagnosis: As for the genus. The test typically has 10 segments. The diameter of the segments increases slowly and continuously in the distal direction, but their height increases only very slowly. The skirt-like last post-abdominal segment is not strongly widened. Its distal margin has 10-13 short but broad, triangular denticles, which are directed outward.

Family Xiphothecaellidae Kozur and Mostler, 1981 nom. nov.

Remarks: As the nominate genus *Xiphotheca* De Wever, 1979 was replaced as a junior homonym by *Xiphothecaella* De Wever & O'Dogherty, 2007, also a

new family name must be introduced as no junior synonyms of Xiphothecidae Kozur & Mostler, 1981 are present (rules of ICZN, article 39). The diagnosis of the Xiphothecaellidae is the same as for the Xiphothecidae Kozur & Mostler, 1981 but it has to be emended because in this paper two additional genera are included, *Senelella* Tekin, 1999, and *Hypoxiphothecaella* n. gen.

Emended diagnosis: Test long to very long, slender, with 6-17 segments which show a tripartite subdivision. Proximal part slender-conical, ranging from the cephalis (or cephalothorax) to the strongly or very strongly expanded segment (abdomen or first post-abdominal segment). Rarely a second, also strongly inflated postabdominal chamber is included into the proximal part (only in *Senelella*), but it may shift toward the middle part. The middle part is the longest one or at least as long as the proximal part, often it is represented by an unsegmented tube or with very low and indistinct elongated segments, partly it consists of short subglobular segments and is then not strongly separated from the distal segment. The distal part has two to nine hoop-like segments, rarely one to three are inflated to subglobular segments. The entire test has small to very small, rarely moderately large, irregularly spaced pores that are on the cephalis, thorax and abdomen covered by a layer of microgranular silica, in the abdomen very few pores may remain open. In the middle and distal part of the test the pores may be arranged in often somewhat irregular pore rings. The inflated segment or rarely two segments of the proximal part, and, if present, inflated segments (mostly only one) in the distal part may bear needle-like spines. Otherwise the surface has no distinct sculpture, except indistinct, irregular, short, very narrow subvertical ribs that may be rarely present.

Occurrence: Middle Carnian to lower Norian of Tethys.

Remarks: DE WEVER *et al.* (2001) regarded the Xiphothecidae Kozur & Mostler, 1981 (now Xiphothecaellidae, see above) as junior synonym of the Ruesticyrthiidae Kozur & Mostler, 1979. However, these two families are in their entire range equidistant and the Xiphothecaellidae have not developed from the Ruesticyrthiidae or vice versa. The Ruesticyrthiidae are clearly distinguished by their conical test with a very wide distal skirt. The first postabdominal segment is never inflated.

The Xiphothecaellidae are closely related to the Triassocampidae Kozur & Mostler, 1981 which were also assigned to the Ruesticyrthiidae by De Wever *et al.* (2001). The Triassocampidae are the forerunner of the Xiphothecaellidae. Transition forms (*Elbistanium* Tekin, 2007) are present from the basal Tuvalian of Turkey, close to the FAD of the Xiphothecaellidae (upper Julian). In the Triassocampidae, neither the abdomen nor the first post-abdominal segment is inflated and there is no separation of the test into three parts with an often very distinct middle part. In *Elbistanium*, the first postabdominal segment is also not inflated as in the Triassocampidae. In one species, *Elbistanium productum* Tekin, 2007, no distinct middle part is developed and the entire

test is slender-cylindrical with a conical proximal part as in Triassocampidae. In the type species, *Elbistanium gracilum* Tekin, 2007, a different middle part is already developed, and therefore the test is tripartite, as in *Xiphothecaella* De Wever & O'Dogherty, 2007. However, the proximal part is longer (with two to four postabdominal segments) and no segment of the proximal part is strongly inflated. This species is a transition form between Triassocampidae and Xiphothecaellidae. Regarding the phylomorphogenetic development of the Xiphothecaellidae into the Syringocapsidae Foreman, 1973 emend. Pessagno, 1977, the development of a strongly inflated first postabdominal segment is the more important step. Therefore we put *Elbistanium* into the Triassocampidae.

The Xiphothecaellidae are equidistant to the Triassocampidae (with the transitional genus *Elbistanium* in stratigraphic order) and to the Syringocapsidae Foreman, 1973 emend. Pessagno (with the transitional genus *Hypoxiphothecaella* n. gen. in stratigraphic order). In the Syringocapsidae the first postabdominal segment is stronger inflated, but in some Xiphothecaellidae (*Hypoxiphothecaella inflata* n. sp.) the first postabdominal segmented is as much inflated as in Syringocapsidae. The real difference is the lost of the distal part (except the terminal spines around the aperture) in the Syringocapsidae. *Hypoxiphothecaella* n. gen. has transitional character between both families. We assign it to the Xiphothecaellidae because it has still at least one (inflated) distal segment and therefore a distinct tripartition in proximal, middle and distal parts, whereas the Syringocapsidae are only bipartite (proximal and distal part, the later corresponds to the middle part of the Xiphothecaellidae).

Genus *Xiphothecaella* De Wever & O'Dogherty, 2007

Synonym: *Xiphotheca* De Wever, 1979

Type species: *Xiphotheca karpenissionensis* De Wever, 1979

Remarks: *Xiphotheca* De Wever, 1979 is a junior homonym of *Xiphotheca* Agassiz, 1846 (fish, see De Wever and O'Dogherty, 2007).

Xiphothecaella brevicaudata n. sp.

(Plate 2, Figure 1)

Derivatio nominis: In allusion to its short terminal conical tube.

Holotypus: The specimen on Plate 2, Figure 1 (rep.-no. 23-9-04/II-117).

Material: 5 specimens.

Diagnosis: Test elongated, tubular. Wall smooth with irregularly arranged pores. Test approximately 6-8 times longer than broad. Cephalis conical, poreless. Thorax hoop-like, only slightly separated from the cephalis. Pores of thorax barely visible, closed by a layer of microgranular silica. Abdomen globular, slightly inflated with many small pores. Post-abdominal portion

consists of two parts: a moderately elongated tubular central part (after the abdomen and before the distinctly segmented part) and a short posterior segmented part. First and second post-abdominal segments spool-like and slightly inflated; third post-abdominal segment tubular. The posterior portion consists of two globular segments and a hoop-like segment separated from each other by a deep constriction; all of these have many irregularly arranged pores. Test terminates in a very short, latticed conical tube.

Remarks: *Xiphothecaella brevicaudata* n. sp. differs from *X. strigosa* n. sp. in having two globular segments and a hoop-like segment in the posterior portion, instead of double hoop-like segments.

Xiphothecaella elegans n. sp.

(Plate 2, Figure 2)

Derivatio nominis: In allusion to the smooth and very regular test.

Holotypus: The specimen on Plate 2, Figure 2 (rep.-no. 23-9-04/II-94).

Material: 11 specimens.

Diagnosis: Test elongated, cylindrical, approximately 6-9 times longer than wide. Cephalothorax small, conical, without distinct pores. Abdomen low and hoop-like, with minute pores mostly closed by a layer of microgranular silica. First post-abdominal segment globular and inflated, with small pores. Pore frames elevated, bearing small pointed nodes. Following part consists of 6 segments, separated by deep and broad, smooth constrictions: first and fourth ones ellipsoidal, second and third ones spool-like and slightly inflated. These 4 segments have a smooth wall and oval (mostly longitudinal) to roundish small pores. Last two segments subglobular with elevated pore frames. Test terminates in a short, latticed tube.

Remarks: *Xiphotheca longa* (Kozur & Mock, 1981) differs from this species in having uniform, globular post-abdominal segments and no terminal latticed tube.

Xiphothecaella longicaudata n. sp.

(Plate 2, Figures 3, 4)

Derivatio nominis: In allusion to its elongate terminal conical tube.

Holotypus: The specimen on Plate 2, Figure 3 (rep.-no. 23-9-04/V-158).

Material: More than 100 specimens.

Diagnosis: Test elongated, cylindrical, approximately 8-9 times longer than wide. Cephalothorax small, conical, without distinct pores. Abdomen hoop-like with minute pores, mostly closed by a layer of microgranular silica. First post-abdominal segment globular, inflated. Pore frames elevated, bearing short spines. Following part consists of 7-10 segments. These post-abdominal

segments are globular to ellipsoidal and slightly inflated. Distal 2-5 segments become gradually or abruptly hoop-like and are separated from each other by deep, smooth constrictions. All post-abdominal segments have small roundish to oval pores. In the two distal segments, the pore frames are elevated and bear small nodes or minute spines. The terminal latticed conical tube is elongate.

Remarks: *Xiphothecaella longa* (Kozur & Mock, 1981) is distinguished from *X. longicaudata* n. sp. by its uniform globular post-abdominal segments.

Xiphothecaella orchardi n. sp.

(Plate 2, Figure 5)

Derivatio nominis: In honour of Dr. Michael J. Orchard, Vancouver, for his outstanding work on Triassic conodonts and stratigraphy.

Holotypus: The specimen on Plate 2, Figure 5 (rep.-no. 23-9-04/II-93).

Material: 4 specimens.

Diagnosis: Test elongated, cylindrical, approximately 6-7 times longer than wide, with three well-defined portions. Cephalothorax conical, smooth proximally but with a rough surface distally. Abdomen hoop-like, distinctly lower and somewhat wider than cephalis, and with a rough surface. These segments have minute pores, mostly closed by a layer of microgranular silica. First post-abdominal segment globular, strongly inflated, with small roundish pores and elevated pore frames that bear very small short spines. Post-abdominal portion consists of three parts. First 4 segments are globular, with the second post-abdominal segment strongly inflated and only slightly smaller than the first post-abdominal segment, and the following three segments successively and gradually less inflated. The wall of this region is smooth, with pores that are roundish and small. The constrictions between these segments are smooth and become shallower in the distal direction. A tubular middle portion follows, which has somewhat larger, elongated pores. The distal portion consists of 4-5 distinct hoop-like segments that are separated by relatively deep, smooth constrictions. In the distal direction, the width of these segments at first slightly increases but then decreases again. All of these segments have rough surfaces and small roundish pores with pore frames that are slightly elevated. Test terminates in a short, latticed posterior tube with medium-sized pores.

Remarks: In *Xiphothecaella procera* n. sp. the first post-abdominal segments are ellipsoidally elongated and only slightly inflated, often indistinct, or not separated from the more distal tubular part.

Xiphothecaella procera n. sp.

(Plate 2, Figures 6, 7)

Derivatio nominis: In allusion to its exceptionally thin and gracefully elongated test.

Holotypus: The specimen on Plate 2, Figure 7 (rep.-no. 23-9-04/II-68).

Material: More than 100 specimens.

Diagnosis: Test gracefully elongated and cylindrical with three clearly differentiated portions, approximately 6-7 times longer than wide. On the proximal portion, the small cephalis is conical or dome-shaped. Thorax hoop-like, only slightly separated from the cephalis and abdomen, with a rough surface. Both cephalis and abdomen have minute pores, mostly closed by a layer of microgranular silica. Abdomen globular and inflated, with minute pores and elevated pore frames that may bear minute spines. The proximal post-abdominal part is tube-like and long, with mainly indistinct, elongated ellipsoidal segments usually visible until the third post-abdominal segment. The wall is smooth, except for the first post-abdominal segment, which is partly covered with minute spines. The small pores are irregularly arranged. The distal portion consists of 6-9 hoop-like segments, which are separated by relatively deep and smooth constrictions. These segments are equal in size except for the last segment, which is much smaller than the preceding ones. The small pores are irregularly arranged, with pore frames that are somewhat elevated and bear minute nodes or spines.

Remarks: DE WEVER *et al.* (1979) established *Xiphotheca karpenissionensis* De Wever, 1979 exclusively from fragmentary specimens. Among the illustrated fragments, Plate 7, Figure 3 may belong to *Xiphothecaella rugosa* (Bragin, 1991), Plate 7, Figure 4 may belong to *X. longa* (Kozur and Mock, 1981), Plate 7, Figure 5 does not belong to *Xiphothecaella*, and probably not even to Xiphothecaellidae. Thus, the definition of *Xiphothecaella karpenissionensis* (De Wever, 1979) needs to be restricted to the fragments illustrated by DE WEVER *et al.* (1979) on Plate 7, Figure 1 (the holotype) and Figure 2. *X. procera* n. sp. differs from *Xiphothecaella karpenissionensis* (De Wever) emend. in having very small spines on its abdomen, irregularly arranged pores on its post-abdominal segments, and not having pore rings in the second and partly in the first post-abdominal segment.

Xiphothecaella strigosa n. sp.

(Plate 2, Figure 9)

Derivatio nominis: In allusion to its slender test.

Holotypus: The specimen on Plate 2, Figure 9 (rep.-no. 23-9-04/II-116).

Material: More than 100 specimens.

Diagnosis: Test gracefully elongated and cylindrical, with three clearly differentiated portions, approximately 9 times longer than wide. Cephalothorax conical, distal (thoracic) part distinctly wider than proximal part. Thorax hoop-like, with a rough surface and a distinct collar stricture. These three segments have minute pores that are mostly closed by a layer of microgranular silica. First post-abdominal segment globular, inflated, with small pores that have elevated pore frames bearing minute nodes. The long central portion is tubular and has a smooth wall with small, irregularly arranged roundish to oval pores. The first segment in this portion is spindle-shaped and slightly inflated. Additional segments barely separated from each other. The posterior portion consists of two inflated hoop-like to subglobular segments that are separated from each other by a deep and smooth constriction. They have many small, irregularly arranged pores with elevated pore frames that may bear short spines. Test terminates in a short, latticed conical tube.

Remarks: In *Xiphothecaella karpenissionensis* (De Wever, 1979) the pores in the second post-abdominal segment, and partly also in the first post-abdominal segment, are arranged in rings. In *Xiphothecaella procera* n. sp. there are 6-9 hoop-like distal post-abdominal segments that are less inflated than in *X. strigosa*.

Genus *Hypoxiphothecaella* n. gen.

Type species: *Hypoxiphothecaella mersinensis* n. gen. n. sp.

Derivatio nominis: In allusion to its similarity to the genus *Xiphothecaella* De Wever & O'Dogherty, 2007.

Diagnosis: Test relatively elongate (500-550 μm long) and approximately 3-6 times longer than wide. Cephalothorax conical to dome-shaped. Thoracic part broader than cephalic part, with a rough surface, but otherwise not separated from the cephalic part. Abdomen hoop-like and only slightly separated from the thorax. All three segments have minute pores, mostly closed by a layer of microgranular silica. Pore frames in the thoracic part of the cephalothorax only slightly elevated, but in the abdomen distinctly elevated and typically arranged in indistinct short ribs. First post-abdominal segment globular, moderately or more typically strongly inflated with circular, oval or polygonal small pores and distinctly elevated pore frames that bear minute nodes or spines. The long, narrow, tubular central portion is unsegmented or indistinctly segmented and has small to medium-sized circular, oval or polygonal pores with slightly elevated pore frames. The posterior portion consists of one to three segments.

Remarks: *Hypoxiphothecaella* n. gen. differs from *Xiphothecaella* De Wever & O'Dogherty, 2007, in having a significantly shorter test and distinctive large pores in the post-abdominal segments. It is closely related to the Syringocapsidae Foreman, 1973 emend. Pessagno, 1977 that have no inflated distal segment(s)

after the long, narrow tube. By disappearance of the inflated distal segment(s) the Syringocapsidae evolved from *Hypoxiphothecaella* n. gen. Transitional forms are present (*Podobursa claviformis* Kozur, Moix & Ozsvárt n. sp. and *P. sceptrumides* Kozur, Moix & Ozsvárt n. sp.). In these forms remnants of a single distal segment are present, but it is no longer inflated, on the outer test surface not separated from the tube and only recognisable by the spines on its surface.

Assigned species: *Hypoxiphothecaella mersinensis* n. gen. n. sp.; *Hypoxiphothecaella claviformis* n. sp.; *Hypoxiphothecaella elongata* n. sp.; *Hypoxiphothecaella foezyi* n. sp.; *Hypoxiphothecaella inflata* n. sp.

Hypoxiphothecaella mersinensis n. gen. n. sp.
(Plate 2, Figure 10)

Derivatio nominis: In allusion to its occurrence in the Mersin Mélange, Turkey.

Holotypus: The specimen on Plate 2, Figure 10 (rep.-no. 23-9-04/II-86).

Material: More than 50 specimens.

Diagnosis: Test dumbbell-shaped, with a very thin tubular middle part. Cephalothorax dome-shaped, with a rough surface and some indistinct short vertical ribs. Abdomen subtrapezoidal in outline, with a rough surface and some narrow, short vertical ribs and minute nodes. First post-abdominal segment globular, strongly inflated, with small pores and polygonal elevated pore frames that bear numerous minute nodes and spines. The more distal long, very slender, tubular and unsegmented part has a smooth wall with small to large, roundish to oval pores. Distally, there follows a slightly inflated segment followed by a distinctly inflated segment, separated from each other by a shallow constriction. These segments have small to large, circular, oval and polygonal pores with elevated pore frames that may bear minute spines on the terminal segment.

Remarks: *Hypoxiphothecaella inflata* n. sp. is distinguished by the short tubular middle part of its test. *X. foezyi* n. sp. has a less inflated first post-abdominal segment and three distal segments behind the tubular middle portion.

Hypoxiphothecaella claviformis n. sp.
(Plate 2, Figure 11)

Derivatio nominis: In allusion to its club-shaped test.

Holotypus: The specimen on Plate 2, Figure 11 (rep.-no. 23-9-04/II-77).

Material: More than 50 specimens.

Diagnosis: Test elongated. Cephalothorax conical with a smooth, poreless wall.

Abdomen low, frustum-like with a rough surface and minute pores. First post-abdominal segment globular, strongly inflated, with many small to medium-sized pores and elevated polygonal pore frames that bear small pointed nodes and small spines. The more distal narrow tubular portion is unsegmented and has medium to large-sized roundish to oval pores. The distal portion of the test is moderately widened, has medium to large-sized roundish to oval pores and elevated polygonal pore frames that bear short needle-like spines. An aperture is present in the terminal position, surrounded by short needle-like spines.

Remarks: *Hypoxiphothecaella mersinensis* n. sp. has two distal globular segments.

Hypoxiphothecaella elongata n. sp.

(Plate 2, Figure 13)

Derivatio nominis: In allusion to its elongate, slender test.

Holotypus: The specimen on Plate 2, Figure 13 (rep.-no. 23-9-04/II-78).

Material: 9 specimens.

Diagnosis: Test elongated. Cephalothorax conical, abdomen cylindrical with a rough surface. The minute pores of the three segments are almost all closed by a layer of microgranular silica. First post-abdominal segment globular, only slightly inflated, with small circular pores. An outer layer with coarser polygonal pore frames has very small pointed nodes or spines. The more distal long tubular part is narrowest in the middle and widens toward the globular, slightly inflated terminal segment, which develops rather gradually from the tubular part. The tubular and distal parts have medium to large-sized pores that, in the tubular part, are predominantly oval and vertically elongated but, in the globular terminal segment, are roundish with slightly elevated pore frames that lack spines or nodes.

Remarks: *Hypoxiphothecaella claviformis* n. sp. is distinguished by its more strongly inflated first post-abdominal segment and the spiny distal part of its test.

Hypoxiphothecaella foezyi n. sp.

(Plate 2, Figure 12)

Derivatio nominis: In honour of Dr. István Főzy, Budapest for his outstanding taxonomic and biostratigraphic work on Cretaceous ammonites.

Holotypus: The specimen on Plate 2, Figure 12 (rep.-no. 23-9-04/II-87).

Material: More than 50 specimens.

Diagnosis: Test elongated. Cephalothorax dome-shaped, abdomen frustum-like, with a rough surface. The minute pores on these three segments are mostly closed by a layer of microgranular silica. First post-abdominal segment

globular, strongly inflated, with small pores and elevated polygonal pore frames that bear minute pointed nodes and rarely spines. The more distal tubular part is narrow and widens in the distal direction. It has medium-sized, mainly oval pores that are vertically elongate with slightly elevated pore frames. This part connects gradually with an ellipsoidal segment, which is slightly inflated and has medium-sized roundish pores and elevated polygonal pore frames. After a distinct constriction, a globular inflated segment follows which has medium-sized to large roundish pores with distinctly elevated polygonal pore frames that bear small nodes or spines. After an indistinct constriction there is a short, rather broad segment with small pores and elevated pore frames that bear numerous needle-like spines.

Remarks: *Hypoxiphothecaella foezyi* n. sp. differs from all other species of *Hypoxiphothecaella* by having three distal segments.

Hypoxiphothecaella inflata n. sp.

(Plate 1, Figure 11)

Derivatio nominis: In allusion to the strongly inflated first post-abdominal segment.

Holotypus: The specimen on Plate 1, Figure 11 (rep.-no. 23-9-04/II-98).

Material: 6 specimens.

Diagnosis: Cephalothorax dome-shaped and poreless, cephalic part smooth, thoracic part with a rough surface. Abdomen hoop-like with a rough surface, distal part with a few faint, indistinct short vertical ribs. Minute pores closed by a layer of microgranular silica. First post-abdominal segment globular, strongly inflated, with small to medium-sized roundish pores and elevated polygonal pore frames that bear minute spines. The following tubular segment is long, slender, proximally somewhat broader, and somewhat below the middle spindle-like widened. The pores are small to medium-sized and roundish to slightly oval. Distal segment globular, moderately inflated, with a subequatorial ring of needle-like spines. Pores medium to large-sized, roundish or slightly oval, with polygonal and slightly elevated pore frames.

Remarks: *Hypoxiphothecaella mersinensis* n. sp. is most similar to this species because it also has two distal segments that are globular and situated close to each other. The tubular part, however, is much longer and more slender.

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REFERENCES

- BRAGIN N.Y., 1991. Radiolaria and lower Mesozoic Units of the USSR, east regions. *Trans. Acad. Sci. USSR* 469: 125 p., Moskva.
- DE WEVER P., DUMITRICĂ P., CAULET J.-P., NIGRINI C., and CARIDROIT M., 2001. Radiolarians in the sedimentary record. 533 pp., Gordon and Breach Science Publishers.
- DE WEVER P., SANFILIPPO A., RIEDEL W.R. and GRUBER B., 1979. Triassic radiolarians from Greece, Sicily and Turkey. *Micropaleontology* 25, 1: 75-110.
- DE WEVER, P. & O'DOGHERTY, L., 2007. *Xiphothecaella*, a new name for the genus *Xiphotheca* De Wever, 1979, non Agassiz, 1846. *J. Paleont.* 81(5) 1146.
- KOZUR H. and MOSTLER H., 1979. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil III: Die Oberfamilien Actinommacea HAECKEL 1862 emend., Artiscacea HAECKEL 1882, Multiarcusellacea nov. der Spumellaria und triassische Nassellaria. *Geol.-Paläont. Mitt. Innsbruck* 9, 1-2: 1-132.
- KOZUR H. and MOSTLER H., 1981. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil IV: Thalassosphaeracea Haeckel, 1862, Hexastylacea Haeckel, 1882 emend. Petrushevskaya, 1979, Sponguracea Haeckel, 1862 emend. und weitere triassische Lithocycliacea, Trematodiscacea, Actinommacea und Nassellaria. *Geol.-Paläont. Mitt. Innsbruck, Sonderbd.* 1-208.
- MASSET O. and MOIX P., 2004. Les mélanges de l'ophiolite de Mersin (Turquie du Sud): unpublished MSc. thesis, Univ. Lausanne. 143 p.
- MOIX P., KOZUR H.W., STAMPFLI G.M. and MOSTLER H., 2007. New palaeontological, biostratigraphical and palaeogeographical results from the Triassic of the Mersin Mélange, SE Turkey: In LUCAS S.G. and SPIELMAN J.A., (Eds). The Global Triassic. *New Mexico Mus. Nat. Hist. Sci. Bull.* 41: 282-311.
- MOIX, P., BECCALETTO, L., KOZUR, H.W., HOCHARD, C., ROSSELET, F. and STAMPFLI, G.M., (in press). A New Classification of the Turkish Terranes and Sutures and its Implication for the Paleotectonic History of the Region. *Tectonophysics*. doi. 10.1016/j.tecto.2007.11.044.
- TEKIN U.K., 1999. Biostratigraphy and systematics of late Middle to Late Triassic radiolarians from the Taurus Mountains and Ankara region, Turkey. *Geol.-Paläont. Mitt. Innsbruck, Sonderbd* 5: 1-297.
- TEKIN, U.K. and BEDI, Y., 2007. Ruesticyrtiidae (Radiolaria) from the middle Carnian (Late Triassic) of Köseyahya Nappe (Elbistan, eastern Turkey). *Geol. Carpathica*, 58 (2), 153-167.

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PLATES 1-2

All illustrated specimens are from sample G11, a limestone intercalation within thick tuffs of the Tuvuşçayırı Block in the Mersin Mélange, southeastern central Turkey (see Figure 1), lower Tuvalian *Spongortilispinus moixi* Zone.

Plate 1

Figure 1.—*Pararuesticyrtium longispinosum* n. sp., holotype, oblique lateral-lower view, rep.-no. 23-9-04/III-79.

Figure 2.—*Pararuesticyrtium mersinensis* n. sp., holotype, rep.-no. 23-9-04/V-56, a) oblique upper view, b) lateral view.

Figure 3.—*Ruesticyrtium coronatum* n. sp., holotype, lateral view, slightly oblique from below, rep.-no. 23-9-04/I-141.

Figure 4.—*Ruesticyrtium georgi novemdentatum* n. subsp., holotype, rep.-no. 23-9-04/V-58, a) oblique lateral-upper view, b) upper view, slightly oblique.

Figure 5.—*Ruesticyrtium georgi georgi* n. sp., holotype, lateral-lower view, slightly oblique from below, rep.-no. 23-9-04/I-129.

Figure 6.—*Veloruesticyrtium palfyi* n. gen. n. sp., holotype, lateral view, slightly oblique from below, rep.- no. 23-9-04/I-49.

Figure 7.—*Ruesticyrtium latidentatum* n. sp., holotype, lateral view, rep.-no. 23-9-04/VI-140.

Figure 8.—*Ruesticyrtium georgi georgi* n. sp., upper view, rep.-no. 23-9-04/VI-169.

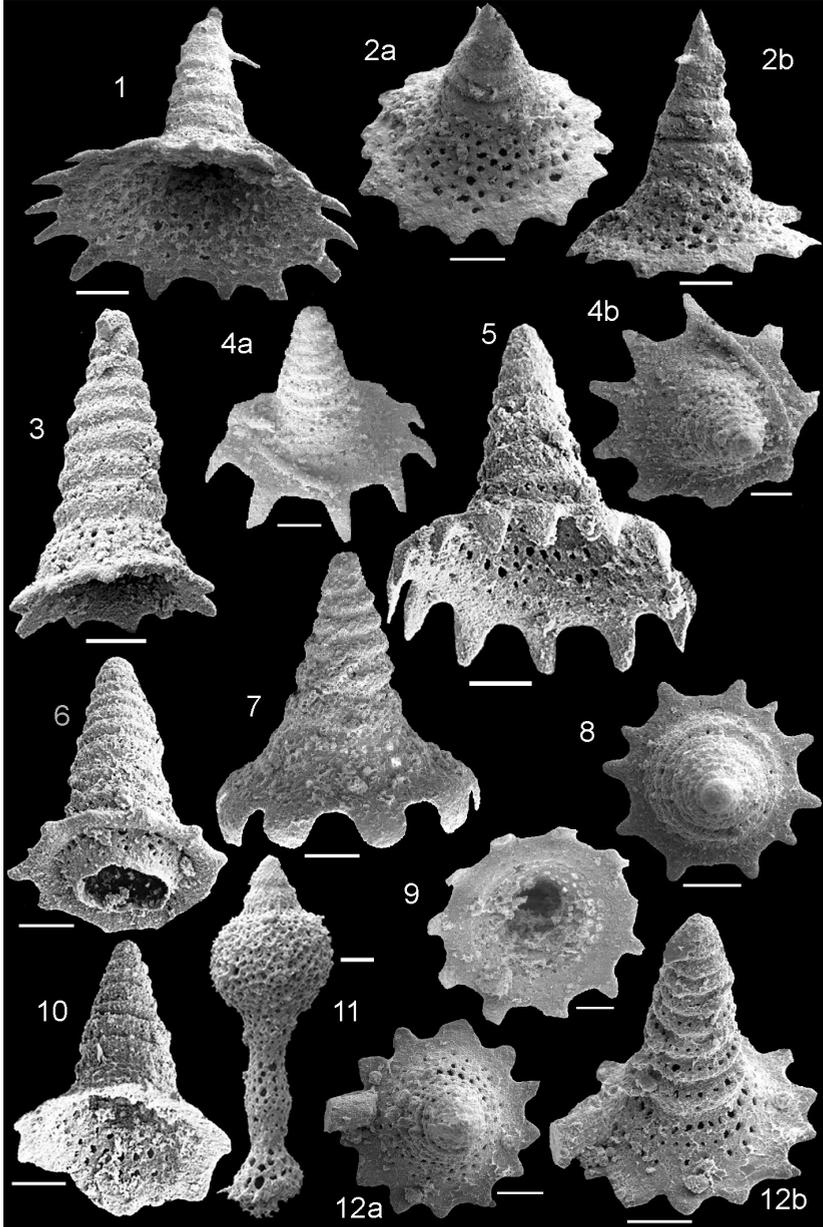
Figure 9.—*Ruesticyrtium georgi georgi* n. sp., lower view, rep.-no. 23-9-04/III-113.

Figure 10.—*Ruesticyrtium lobatum* n. sp., holotype, lateral view, slightly oblique from below, rep.- no. 23-9-04/I-140.

Figure 11.—*Hypoxiphothecaella inflata* n. sp., holotype, rep.-no. 23-9-04/II-98.

Figure 12.—*Ruesticyrtium mostleri* n. sp., holotype, rep.-no. 23-9-04/III-153, a) upper view, b) lateral view, slightly oblique from above.

Plate 1



Scale 50 μ m

Plate 2

Figure 1.—*Xiphothecaella brevicaudata* n. sp., holotype, rep.-no. 23-9-04/II-117.

Figure 2.—*Xiphothecaella elegans* n. sp., holotype, rep.-no. 23-9-04/II-94.

Figures 3, 4.—*Xiphothecaella longicaudata* n. sp., Figure 3: holotype, rep.-no. 23-9-04/V-158; Figure 4: rep.-no. 23-9-04/II-80.

Figure 5.—*Xiphothecaella orchardi* n. sp., holotype, rep.-no. 23-9-04/II-93.

Figure 6.—*Xiphothecaella procera* n. sp., rep.-no. 23-9-04/II-92.

Figure 7.—*Xiphothecaella procera* n. sp., holotype, rep.-no. 23-9-04/II-68.

Figure 8.—*Xiphothecaella* aff. *X. longa* Kozur and Mock, 1981 rep.-no. 23-9-04/II-105.

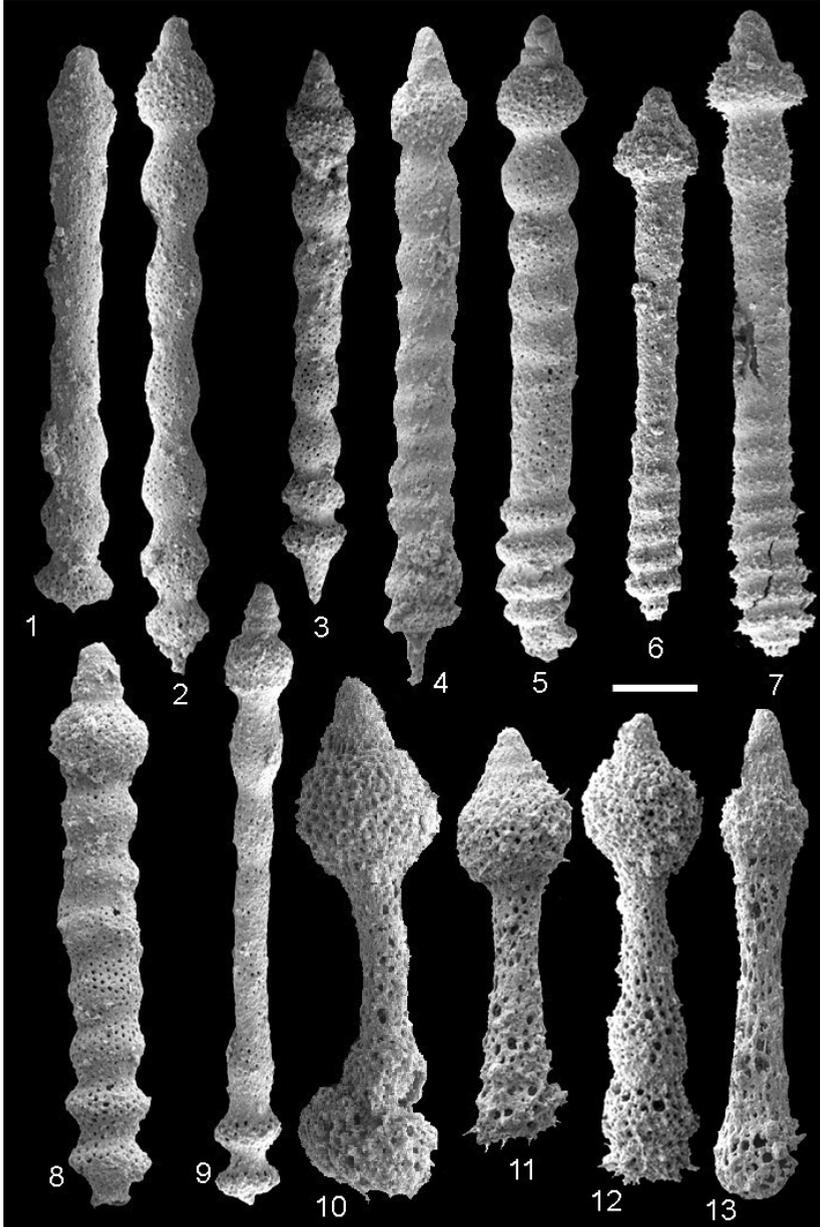
Figure 9.—*Xiphothecaella strigosa* n. sp., holotype, rep.-no. 23-9-04/II-116.

Figure 10.—*Hypoxiphothecaella mersinensis* n. gen. n. sp., holotype, rep.-no. 23-9-04/II-86.

Figure 11.—*Hypoxiphothecaella claviformis* n. gen. n. sp., holotype, rep.-no. 23-9-04/II-77.

Figure 12.—*Hypoxiphothecaella foezyi* n. sp., holotype, rep.-no. 23-9-04/II-87.

Figure 13.—*Hypoxiphothecaella elongata* n. sp., holotype, rep.-no. 23-9-04/II-78.



Scale 100 μ m