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Middle Triassic radiolarians from Slovenia (Yugoslavia)

Srednjetriasni radiolariji Slovenije (Jugoslavija)

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Abstract

The radiolarian fauna presented derives from five Middle Triassic localities in NW and central Slovenia. The sections consist of tuff and tuffite alternating with micritic limestone with chert.

On the basis of radiolarians extracted from the limestone beds, an Upper Illyrian-Fassanian age is assumed for the Zaklanec, Bohinj and Vojsko localities and a Langobardian age for Vršič and Mokronog. 89 species are included in the investigation, four of them are newly described: *Dumitricasphaera ? pennata, Falcispongus uncus, Hozmadia pyramidalis, Plafkerium ? firmum.*

Kratka vsebina

Predstavljena je radiolarijska favna petih nahajališč srednjetriasnih radiolarijev v severozahodni in osrednji Sloveniji. Profile z radiolariji sestavljajo tufi in tufiti v menjavanju z mikritnimi apnenci z roženci.

V apnencu smo našli dobro ohranjene radiolarije, s pomočjo katerih smo plasti nahajališč Zaklanec, Bohinj in Vojsko uvrstili v zgornji ilir-fassan, nahajališči Vršič in Mokronog pa v langobard. Določili smo 89 radiolarijskih vrst. Med njimi so opisane štiri nove: *Dumitricasphaera ? pennata, Falcispongus uncus, Hozmadia pyramidalis* in *Plafkerium ? firmum.*

Introduction

Limestone beds alternating with pyroclastites represent a very characteristic Middle Triassic lithological unit in Slovenia. All sequences containing primary volcanic rocks or tuffs were assigned to the Ladinian until recently. Jurkovšek (1983, 1984) proved by means of daonellas and posidonias that the Fassanian and the Langobardian Substages are present in the unit. On the basis of the fossil association fund, some authors assumed an Upper Anisian-Ladinian age for this formation (Premru, 1974, 1980, 1983). The question arises whether the volcanic activity related to the disintegration of the Slovenian Carbonate Platform started as early as during the Upper Anisian or not until the Ladinian.

The well-known radiolarian assemblages from the lithologically similar sequences in Northern Italy, Hungary and Romania stimulated us to include radiolarians in our investigations. We wanted to confirm that the volcanic rocks accumulated during the Fassanian and the Langobardian as well. First of all we tried to find more evidence for the presence of the Fassanian Substage, which has been paleontologically proved only by Bittner (1884) and Jurkovšek (1983) so far. The question whether volcanic activity on the territory of Slovenia started during the Anisian or Ladinian cannot be satisfactorily solved with the present knowledge of the Triassic radiolarians.

Paleogeographic evolution of the studied part of Slovenia during the Ladinian

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A period of relative stability, which started in the Upper Permian with the formation of a large Slovenian Carbonate Platform comprising almost the whole area of Slovenia and which was even more stable in the Lower Triassic, began to cease in the Upper Anisian. Long and deep fractures occurred in some places of the former stable carbonate platform. Soon after that they were widened into narrow intraplatform channels. On the major part of the carbonate platform the deposition of shallow-water limestone, later altered into dolomite, continued during the Upper Anisian. Deep intraplatform channels were characterized by the deposition of reddish nodular limestone of the Han Bulog Type (=Bučka Type) with ammonites (Kühn & Ramovš, 1965) or marly limestone bearing conodonts and marl with *Posidonia* (Ramovš & Jurkovšek, 1983 a).

In the Lower Ladinian the Slovenian Carbonate Platform disintegrated into several large blocks along deep faults of predominantly E-W direction (Buser, 1986). This structural differentation was caused by the Idrija Tectonic Phase, which represented one of the most significant tectonic events on the territory of Slovenia (Buser, 1980 a). During the initial tectonic activity most of the newly formed blocks subsided deeper than the former carbonate platform. Later on some of them were raised again, in some parts they were even subaerially exposed (Placer & Čar, 1975, 1977; Buser, 1986). On the elevated parts erosion cut down to the Carboniferous. Eroded rocks are encountered in the Ladinian conglomerates spread over a large area near Idrija and in the Southern Karavanke Mountains, where they occur in the variegated conglomerates comparable to the Ugovizza Breccia (Buser, 1980 b).

The central part of Slovenia represented an area of major subsidence. It was assigned to the eugeosyncline by Premru (1980, 1983), while Buser (1989) ascribed it to the initial and thus the oldest part of the Slovenian Basin. The area situated southwards from the eugeosyncline was attributed to the miogeosyncline by Premru (1980, 1983). According to Buser (1989) it represents the realm of the later Dinaric Carbonate Platform, which was built up only in the Lower Carnian.

Larger blocks did not remain as uniform subsided or raised areas. They were also more or less disintegrated so that the sedimentary pattern within the same paleogeographic unit or block was not perfectly uniform. Placer and Čar (1975, 1977) described an example of such a differentiated area on the territory around Idrija.

Different paleogeographic conditions caused the deposition of different rock sequences, which exhibit great lateral changes over small distances. In the most deeply subsided zone, in the Slovenian Basin, lateral changes in the rock composition are less pronounced than south from the basin, in the area of the subsequent Dinaric Carbonate Platform, where completely different rock sequences are found at a distance of some hundred meters.

Ladinian rock sequences with tuff in Slovenia

In the central part of present-day Slovenia, that is, in the Slovenian Basin, some hundred meters thick Pseudizilian Beds (synonym of Pseudogailthal Beds) were deposited. They consist of shale alternating with graywake and tuff. Local intercalations of thin-bedded micritic limestone with more or less frequent chert sheets or nodules occur.

Volcanic activity played a very important role in the Ladinian. The major part of the spilite-keratophyre association (Grafenauer, 1985) is restricted to the middle part of Slovenia, to the Slovenian Basin. Large masses of primary volcanites, which extrude through the sediments of the Pseudozilian Formation and dominate over pyroclastites, were confined to the deep faults along the margins of the basin.

The area situated south from the Slovenian Basin is characterized by the deposition of thin-bedded limestone with chert, shale and marl. Intercalated in these rock sequences are numerous tuff and tuffite layers. They often dominate over other rock units and represent the most characteristic type of rock in the Ladinian. Tuffs are undoubtedly derived from the volcanic centers in the Slovenian Basin, for outcrops of primary volcanites south from the basin are very rare. Also the thickness of the Ladinian beds in the southern zone is much smaller than in the Slovenian Basin. Generally it reaches only o few meters, exceptionally it exceeds one hundred meters.

Description of samples and localities

Twelve sections have been systematically sampled to obtain as much data as possible about the age and the beginning of the Middle Triassic volcanic activity. With field work we covered the major part of Slovenia, where radiolarians can be expected in appropriate rocks. Five localities revealed radiolarians preserved well enough for paleontolological research. In the other sections the samples contained none or very poorly preserved radiolarian fauna. The location and lithology of the sections studied are presented in Fig. 1 and Fig. 2 respectively. The age based on radiolarians is indicated in Table 1. Other sections are itemized only in the Slovene summary.

1. Locality name: **Zaklanec** (Fig. 2)
   Paleogeographic unit: southern part of the Slovenian Basin
   Location and access: 1,5 km north from Zaklanec near Horjul by the Zaklanec–Koreno road. The same section has already been described by Jurkovšek (1984) under the name Gradišče.
   Lithology of samples: dark grey micritic limestone with chert crusts.
   Radiolarian fauna: rich, diverse, well preserved.
   Other fossils: *Daonella lommeli* (Wissmann) (Jurkovšek, 1984) 30 m above the highest radiolarian sample.

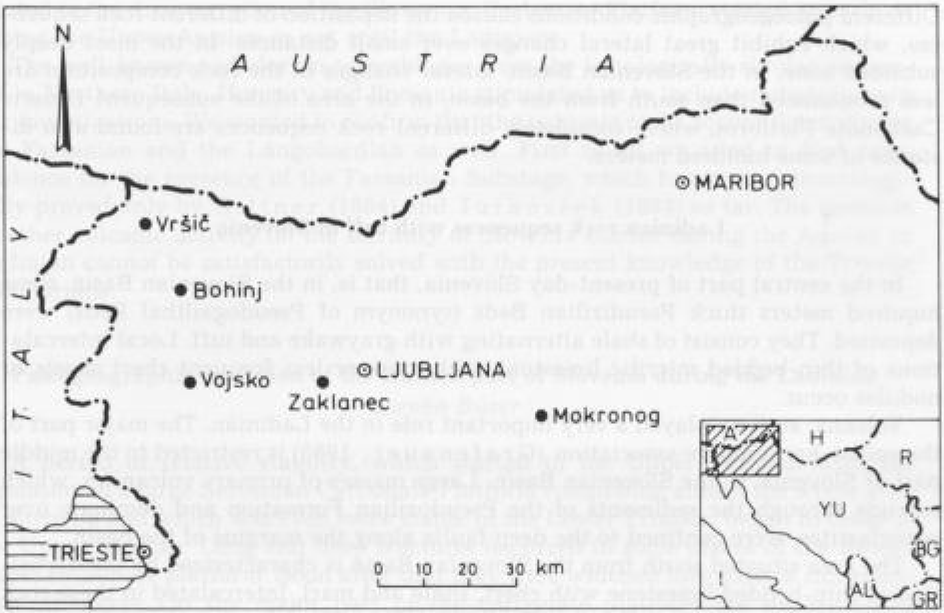


Fig. 1. Location of sections: Zaklanec, Bohinj, Vojsko, Vršič and Mokronog

Sl. 1. Položaj nahajališč: Zaklanec, Bohinj, Vojsko, Vršič in Mokronog

2. Locality name: **Bohinj** (Fig. 2)
   Paleogeographic unit: Slovenian Basin, tectonic window cropping out beneath the Julian Carbonate Platform.
   Location and access: 1 km in a direct line south from Sveti Duh at Lake Bohinj, 850 m above sea-level. The section is exposed in a narrow mountain-gorge under a small waterfall.
   Lithology of samples: greenish-grey micritic cherty limestone.
   Radiolarian fauna: extremely diverse and very well preserved.
3. Locality name: **Vojsko** (Fig. 2)
   Paleogeographic unit: Dinaric Carbonate Platform
   Location and access: Vojskarska planota, by the Idrija–Vojsko road, 3 km east from Vojsko, approximately 100 m west from the Gnezda farm.
   Lithology of samples: dark grey and dark red micritic limestone with cherts.
   Radiolarian fauna: common, fairly well preserved.
4. Locality name: **Vršič** (Fig. 2)
   Paleogeographic unit: Julian Carbonate Platform
   Location and access: 1.5 km south from the Vršič mountain-pass by the road to Trenta, above a scarp approximately 300 m north from the Šupca viewpoint. The section has been described by Ramovš and Jurkovšek (1983 b).
   Lithology of samples: greenish-grey micritic nodular cherty limestone.
   Radiolarian fauna: rare but relatively diverse, preservation moderate, inner structure commonly recrystallized.
   Other fossils: *Daonella pichleri* Mojsisovics (Ramovš & Jurkovšek, 1983 b).

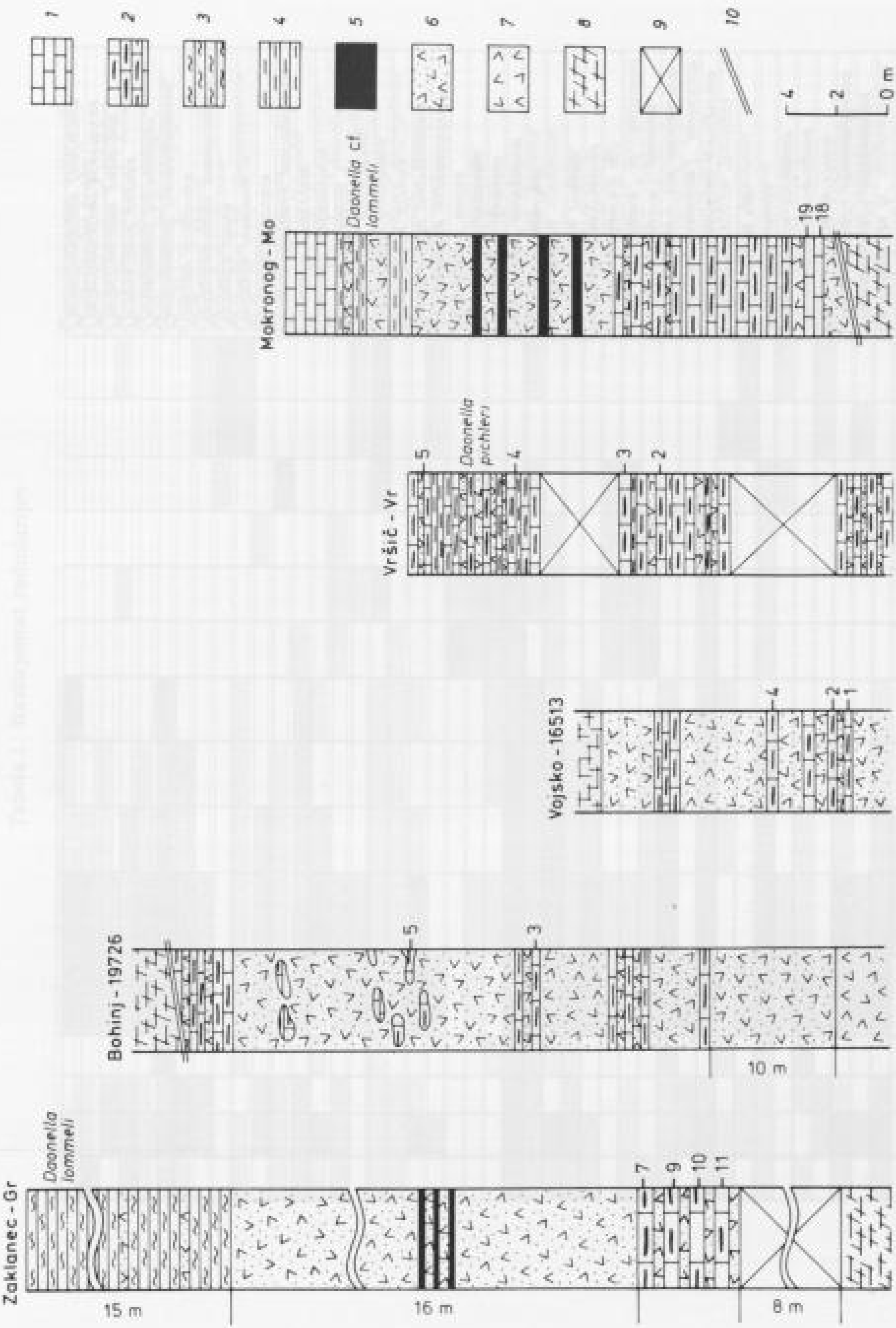


Fig. 2. Lithological columns of sections showing the position of radiolarian samples and co-occurring bivalves. The Zaklanec and Vršič sections are generalized according to Jurkovšek (1984) and Ramovš and Jurkovšek (1983 b) respectively

1 limestone; *2* limestone with chert; *3* shale; *4* marl; *5* chert; *6* tuff, tuffite; *7* keratophyre; *8* massive dolomite; *9* covered interval; *10* fault

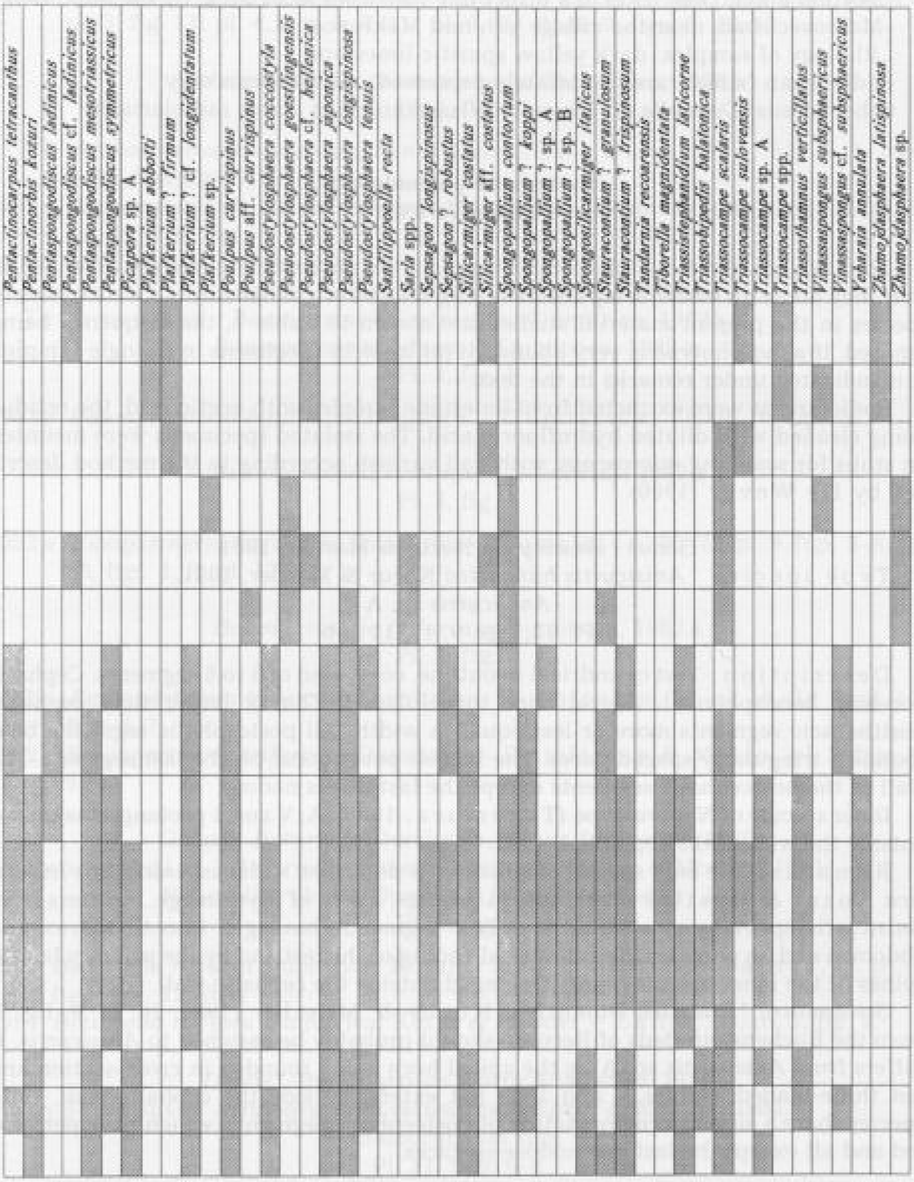
Sl. 2. Litološki stolpci s položajem radiolarijskih vzorcev in spremljajočimi školjkami. Profil Zaklanec je prirejen po Jurkovšku (1984), Vršič po Ramovšu in Jurkovšku (1983 b)

1 apnenec; *2* apnenec z roženci; *3* skrilavi glinovec; *4* lapor; *5* roženec; *6* tuf, tufit; *7* keratofir; *8* masivni dolomit; *9* pokrito; *10* prelom

Table 1. Occurrence of radiolarians

Locality / Nahajališče — Species / Vrste	Zaklanec U.Illyrian-Fassanian				Bohinj U.Illyrian-Fassanian		Vojsko U.Illyrian-Fassanian			Vršič U.Fassanian?-Langobardian		Vršič Langobardian		Mokronog Langobardian	
	Gr 11	Gr 10	Gr 9	Gr 7	19726/3	19726/5	16513/1	16513/2	16513/4	Vr 2	Vr 3	Vr 4	Vr 5	Mo 18	Mo 19
Anisicyrtis sp. A	x	x	x		x	x	x								
Archaeosemantis cristianensis		x			x	x									
Archaeosemantis pterostephanus	x	x			x	x									
Baumgartneria bifurcata		x	x		x										
Baumgartneria retrospina				x	x										
Baumgartneria trifurcata					x										
Beturiella robusta					x	x	x								
Bulbocyrtium spp.					x									x	x
Crucella sp.														x	
Cryptostephanidium cornigerum	x	x	x		x	x	x	x	x	x	x	x			
Cryptostephanidium ? *japonicum*		x	x		x										
Cryptostephanidium verrucosum				x	x	x	x								
Dumitricasphaera ? *pennata*										x	x	x			
Dumitricasphaera ? cf. *trispinosa*										x	x	x	x		
Dumitricasphaera ? spp.										x	x	x	x		
Eonapora mesotriassica	x	x			x	x	x	x							
Eonapora aff. *robusta*.	x	x	x		x										
Eonapora sp.	x	x			x	x	x	x							
Eptingium manfredi	x	x	x	x	x	x	x	x	x						
Falcispongus calcaneum	x	x	x	x	x	x	x	x	x	x	x				
Falcispongus hamatus										x	x				
Falcispongus rostratus										x	x				
Falcispongus uncus										x					
Foremanellina expansolabrum		x			x										
Foremanellina macrocephala		x			x	x									
Goestlingella illyrica					x										
Gomberellus bispinosus											x		x	x	x
Gomberellus hircicornus					x	x									
Hinedorcus alatus	x	x	x		x	x									
Hozmadia pyramidalis		x				x	x								
Hozmadia reticulata	x	x	x		x	x	x	x	x						
Hungarosaturnalis multispinosus													x		
Katorella bifurcata		x	x		x	x	x								
Natraglia luminosa														x	x
Natraglia unica														x	x
Neopylentonema mesotriassica		x	x		x	x									
Nofrema trispinosa		x	x		x	x	x	x							
Oertlispongus inaequispinosus	x	x	x	x	x	x	x	x	x						
Parasepsagon tetracanthus					x	x									
Parentactinia pugnax	x	x	x		x	x	x								
Pentactinocapsa quadripes		x	x		x	x									
Pentactinocarpus acanthicus	x				x	x									
Pentactinocarpus fusiformis					x	x			x						

Tabela 1. Razširjenost radiolarijev



5. Locality name: **Mokronog** (Fig. 2)
Paleogeographic unit: southern part of the Slovenian Basin.
Location and access: 3 km in a direct line east from Mokronog, by the Mokronog–Malkovec road, near the village Vrh nad Mokronogom.
Lithology of samples: dark yellow sparitic limestone.
Radiolarian fauna: rare, moderately preserved, robust forms only.
Other fossils: *Daonella* cf. *lommeli* (Wissmann) 18 m above radiolarians.

Systematic paleontology
Špela Goričan

The taxa are listed in alphabetical order. In the plates the figures are arranged so that they allow an easier comparison among related or similar forms. Occurrences of species in the present material studied are shown in Table 1, the frequency being ignored. If a mofphotype is very abundant (at least 15 specimens in a single sample), it is indicated under remarks in the text.

Radiolarians were extracted from limestone samples with acetic acid, the residue being cleaned with diluted hydrofluoric acid. The isolated specimens were mounted on stubs for scanning microscopy with nail varnish according to the method described by De Wever (1980).

Genus *Anisicyrtis* Kozur & Mostler, 1981
Type species *Anisicyrtis hungarica* Kozur & Mostler, 1981.
Anisicyrtis sp. A
Pl. 12, figs. 9, 10, 11 a–b

Description: Test cylindrical in outline, composed of 5 to 6 segments. Cephalis poreless, hemispherical. Apical horn three-bladed. Thorax larger than cephalis, postthoracic segments more or less equal in width. All postcephalic segments bear rounded, irregularly spaced pores. The largest pores occur on the last segment. The wall of the postcephalic segments except the last one is nodose.

Inner spicule of *Napora*-type (Takemura, 1986). A, V and 1 prolonged as thorns outside the wall of the cephalis.

Remarks: The only species of *Anisicyrtis* described so far is *Anisicyrtis hungarica* Kozur & Mostler (1981, 105, pl. 13, figs. 2 a, b) of Illyrian age. It differs from *Anisicyrtis* sp. A by consisting of only 3 segments, having a smooth thorax and abdomen and no pores on the cylindrical ending of the test and by the primary lateral spines of the inner spicule being prolonged outside the cephalic wall.

Stichomitra ? *triassica* Dumitrica, Kozur & Mostler (1981, 25, pl. 9, fig. 7) from the Buchenstein Beds of Recoaro should probably be assigned to *Anisicyrtis*. It differs from *Anisicyrtis* sp. A by the apical horn being rounded in cross-section and not three-bladed. Spines V and 1 do not extend outside the cephalic wall. Both species share a similar ornamentation of postcephalic segments, which have perforated and all except the last one nodose surfaces.

Genus *Archaeosemantis* Dumitrica, 1978 b
Type species *Archaeosemantis pterostephanus* Dumitrica, 1978 b.
Archaeosemantis cristianensis Dumitrica, 1982 c
Pl. 7, fig. 1

1978 b *Archaeosemantis pterostephanus* Dumitrica – Dumitrica, 52, pl. 5, figs. 7, 8, non figs. 9–12.

1982 c *Archaeosemantis cristianensis* Dumitrica – Dumitrica, 423, pl. 1, fig. 11; pl. 3, fig. 11; pl. 4, figs. 5, 7, 11; pl. 6, fig. 2; pl. 7, figs. 3, 12, 13.

Archaeosemantis pterostephanus Dumitrica, 1978 b
Pl. 7, fig. 2

1978 b *Archaeosemantis pterostephanus* Dumitrica – Dumitrica, 52, pl. 5, figs. 9–12, non figs. 7, 8.

1982 c *Archaeosemantis pterostephanus* Dumitrica – Dumitrica, 423–424, pl. 5, fig. 1; pl. 6, figs. 1, 4, 5; pl. 7, fig. 1.

Genus *Baumgartneria* Dumitrica, 1982 a

Type species *Baumgartneria retrospina* Dumitrica, 1982 a.

Baumgartneria bifurcata Dumitrica, 1982 a
Pl. 3, fig. 1

1982 a *Baumgartneria bifurcata* Dumitrica – Dumitrica, 71, pl. 10, figs. 3, 4.

Baumgartneria retrospina Dumitrica, 1982 a
Pl. 3, fig. 3

1982 a *Bumgartneria retrospina* Dumitrica – Dumitrica, 70–71, pl. 9, figs. 3–8; pl. 10, figs. 1, 2; pl. 12, fig. 3.

Baumgartneria trifurcata Dumitrica, 1982 a
Pl. 3, fig. 2

1982 a *Baumgartneria trifurcata* Dumitrica – Dumitrica, 71, pl. 10, fig. 6; pl. 11, figs. 4–7.

1982 *Baumgartneria trifurcata* Dumitrica – Dumitrica & Mello, pl. 2, figs. 4, 5.

Genus *Beturiella* Dumitrica, Kozur & Mostler, 1980

Type species *Beturiella robusta* Dumitrica, Kozur & Mostler, 1981.

Beturiella robusta Dumitrica, Kozur & Mostler, 1980
Pl. 1, fig. 3

1980 *Beturiella robusta* Dumitrica, Kozur & Mostler – Dumitrica et al., 11, pl. 3, fig. 5; pl. 12, figs. 1–3.

1984 *Beturiella robusta* Dumitrica, Kozur & Mostler – Lahm, 29, pl. 3, fig. 9.

Genus *Bulbocyrtium* Kozur & Mostler, 1981

Type species *Bulbocyrtium reticulatum* Kozur & Mostler, 1981.

Bulbocyrtium spp.
Pl. 11, figs. 6–8

Remarks: Various forms consisting of a large inflated reticular cephalis with a three-bladed apical horn and two to three perforated postcephalic segments are frequent in our Fassanian and Langobardian samples. The illustrated specimens differ from each other in the number and the relative width of the segments. They all differ from the two species described so far (*Bulbocyrtium reticulatum* Kozur & Mostler, 1981, 106, pl. 11, fig. 1; *Bulbocyrtium cordevolicum* Kozur & Mostler, 1981, 107, pl. 11, fig. 2; pl. 13, fig. 1) in having a cylindrical ending of the test instead of a flaring imperforate skirt.

Genus *Crucella* Pessagno, 1971 emend. Baumgartner, 1980
Type species *Crucella messinae* Pessagno, 1971.

Crucella sp.
Pl. 1, fig. 8

Genus *Cryptostephanidium* Dumitrica, 1978 a
Type species *Cryptostephanidium cornigerum* Dumitrica, 1978 a.

Cryptostephanidium cornigerum Dumitrica, 1978 a
Pl. 8, figs. 1–3

1978 a *Cryptostephanidium cornigerum* Dumitrica – Dumitrica, 31, pl. 1, figs. 1–4; pl. 4, fig. 4.

1982 *Cryptostephanidium* cf. *cornigerum* Dumitrica – Yao, pl. 1, fig. 16.

Remarks: Pl. 8, fig. 3 represents an abnormal form with a pylome. Only one specimen of this type was found.

Cryptostephanidium ? *japonicum* (Nakaseko & Nishimura), 1979
Pl. 8, fig. 5

1979 *Trilonche japonica* Nakaseko & Nishimura – Nakaseko & Nishimura, 72, pl. 4, figs. 8, 10.

1986 ? *Tripocyclia japonica* Nakaseko & Nishimura – Blome et al., pl. 8.3, figs. 13, 18.

Remarks: The species is questionably assigned to *Cryptostephanidium*. The inner structure was not illustrated by Nakaseko and Nishimura (1979) and it also could not be observed in our material.

Cryptostephanidium ? *japonicum* differs from *C. verrucosum* Dumitrica in that the horns are three-bladed only on the proximal part. Distally they are rounded in cross-section.

Cryptostephanidium verrucosum Dumitrica, 1978 a
Pl. 8, fig. 4

1978 a *Cryptostephanidium verrucosum* Dumitrica – Dumitrica, 31, pl. 1, figs. 7, 8; pl. 4, fig. 8.

Genus *Dumitricasphaera* Kozur & Mostler, 1979 emend. Lahm, 1984
Type species *Dumitricasphaera goestlingensis* Kozur & Mostler, 1979.

Remarks: Included are morphotypes with a spongy outer shell and two polar spines, which have three wings or three spinules on their tips. Most of the forms are new. The inner structure is not preserved in the material studied. The original definition of *Dumitricasphaera* (Kozur & Mostler, 1979, 60) also lacks the description of the inner structure, therefore the generic name is determined with a question mark.

Dumitricasphaera ? pennata Goričan n. sp.
Pl. 4, figs. 9a-b, 10

Etymology: pennatus, a, um (Latin) = winged.
Type locality: Vršič, NW Yugoslavia.
Diagnosis: Three thorny wings on the spine tips.
Description: Shell spherical, spongy. Two short polar spines. Spines strong, three-bladed, slightly torsioned distally. Blades rounded, grooves deep. The blades are distally widened to form three flattened wings. Outer edge of wings convex, ornamented with small thorns. Spines constricted at the beginning of wings. Length of spines together with wings approximately equal to the diameter of the shell.
Remarks: Three species of *Dumitricasphaera* have been described so far: *D. goestlingensis* Kozur & Mostler (1979, 60, pl. 3. fig. 1), *D. latispinosa* Kozur & Mostler (1979, 61, pl. 3. fig. 3) and *D. planustyla* Lahm (1984, 71, pl. 12, fig. 9). They all have three very long backward twisted thorny spinules on the spine tips instead of small flattened wings as with *D. ? pennata*.
Occurrence: Upper Fassanian?–Langobardian from NW Yugoslavia.
Dimensions (in μm): diameter of shell: 100–140 (holotype: 117, average of 10 specimens: 112); length of spines (including wings): 90–140 (holotype: 113, 127, average: 125); width of spines (at base): 45–60 (holotype: 50, average: 51).

Dumitricasphaera ? cf. trispinosa (Kozur & Mostler), 1979
Pl. 4, fig. 14

cf. 1979 *Spongostylus trispinosus* Kozur & Mostler – Kozur & Mostler, 57, pl. 5. fig. 3.

Remarks: Our specimens differ from the holotype by spinules being turned towards the shell and not in the opposite direction.

Dumitricasphaera ? spp.
Pl. 4, figs. 11–13

Remarks: Beside *Dumitricasphaera ? pennata*, wich is the most frequent representative of the genus, there occur other similar forms with wings on the spine-tips. They differ from each other in the shape of the wings and length of the spines.

Genus *Eonapora* Kuzur & Mostler, 1979 emend. Dumitrica, Kozur & Mostler, 1980
Type species *Eonapora pulchra* Kozur & Mostler, 1979.

Eonapora mesotriassica Kozur & Mostler, 1981
Pl. 10, fig. 1

1981 *Eonapora mesotriassica* Kozur & Mostler – Kozur & Mostler, 81–82, pl. 27, fig. 1 a–d.

Eonapora aff. *robusta* Kozur & Mostler, 1981
Pl. 10, fig. 2a–b

aff. 1981 *Eonapora robusta* Kozur & Mostler – Kozur & Mostler, 82, pl. 29, fig. 1a–c.

Remarks: *Eonapora* aff. *robusta* has thinner and shorter feet and apical horn than typical representatives of *E. robusta*. The ridges representing arches AV and Al on the outer surface of the cephalis are also slenderer. The whole test therefore looks more delicate.

Eonapora sp.

Pl. 10, fig. 3

1980 *Eonapora* n. sp. – Dumitrica et al., 21, pl. 9, figs. 3, 4.

Genus *Eptingium* Dumitrica, 1978a

Type species *Eptingium manfredi* Dumitrica, 1978a.

Eptingium manfredi Dumitrica, 1978a

Pl. 8, figs. 7–8

1978a *Eptingium manfredi* Dumitrica – Dumitrica, 33–34, pl. 3, figs, 3, 4; pl. 4, figs. 1, 2, 5–7.
? 1979 *Tripocyclia japonica* Nakaseko & Nishimura – Nakaseko & Nishimura, 73, pl. 4, figs. 4–6.
1979 *Eptingium manfredi* Dumitrica – Pessagno et al., pl. 6, figs, 9, 10, 11.
1980 *Eptingium manfredi manfredi* Dumitrica – Dumitrica et al., 19, pl. 3, figs. 1–3; pl. 6, figs. 5–7.
1980 *Eptingium manfredi robustum* Kozur & Mostler – Dumitrica et al., 20, pl. 6, figs, 1–4, 8.
1982 *Eptingium manfredi* Dumitrica – De Wever, 275–276, pl. 35, fig. 5.
1982 *Eptingium manfredi* Dumitrica – Dumitrica & Mello, pl. 2, figs. 6, 7.
1982 *Eptingium* cf. *manfredi* Dumitrica – Matsuda & Isozaki, pl. 3, fig. 25.
1982 *Eptingium manfredi* Dumitrica – Sato et al., pl. 2, fig. 13.
1982 *Eptingium* cf. *manfredi manfredi* Dumitrica – Takashima & Koike, pl. 1, figs. 7, 8.
1982 *Eptingium* cf. *manfredi* Dumitrica – Yao, pl. 1, fig. 17.
1982 *Eptingium* cf. *manfredi* Dumitrica – Yao et al., pl. 1, fig. 12.
non 1984 *Eptingium manfredi* Dumitrica ? – De Wever, pl. 2, fig. 5.
1986 *Eptingium manfredi robustum* Kozur & Mostler – Kozur & Réti, fig. 5A.
1989 *Pseudostylosphaera sudari* Kolar–Jurkovšek – Kolar–Jurkovšek, 158, fig. 2, no. 5a, b.

Remarks: *Eptingium manfredi robustum* is not distinguished from *E. manfredi manfredi*, because in the material studied both subspecies occur together. The morphotype is very frequent in all Upper Illyrian–Fassanian samples.

Genus *Falcispongus* Dumitrica, 1982a

Type species *Falcispongus falciformis* Dumitrica, 1982a.

Falcispongus calcaneum Dumitrica, 1982a

Pl. 3, figs. 4–6

1982a *Falcispongus calcaneum* Dumitrica – Dumitrica, 65, pl. 1, fig. 1; pl. 2, figs. 2, 4–6, 8.
1982 *Falcispongus calcaneum* Dumitrica – Dumitrica & Mello, pl. 2, fig. 3.
1984 *Falcispongus calcaneum* Dumitrica – De Wever, pl, 3, fig. 1.
1984 *Falcispongus calcaneum* Dumitrica – Lahm, 49–50, pl. 8, fig. 5.

Remarks: Specimens from the Vršič locality (upper Fassanian–Langobardian) (pl. 3, fig. 6) have a shorter stem, the spine is less thick, the passage between the external wing and the rest of the spine less pronounced. The spine is therefore more flattened than the typical forms from the uppermost Illyrian–Fassanian.

Falcispongus uncus Goričan n. sp.
Pl. 3, figs. 8–9

Etymology: uncus, a, um (Latin) = hooked, bent in.
Type locality: Vršič, NW Yugoslavia.
Diagnosis: flattened spine with large external wing.
Description: Spine long, flattened, asymmetrical. Outer wing large. It widens abruptly at a right angle to the stem or it is even slightly curved downwards. Inner wing much smaller. The indentation on the inner wing can result in a craw-like form (pl. 3, fig. 8). Distal part of main spine long, needle shaped.
Remarks: The general shape of the spine is more flattened than with *Falcispongus falciformis* Dumitrica (1982a). The transition between the wing and the median part of the spine is less pronounced. The outer wing is broader.
Falcispongus uncus n. sp. has a smaller inner wing than *F. rostratus* Dumitrica (1982a).
It further differs from *F. hamatus* Dumitrica (1982a) in having a bigger spine with a proportionally much longer stem and an abrupt transition between the stem and the outer wing.
Occurrence: Upper Fassanian?–Langobardian from NW Yugoslavia.
Dimensions (in µm, based on 4 specimens): total length of spine: 265–360 (holotype: 360), length of radius: 130–190 (holotype: 190), breadth of spine with wings: 105–150 (holotype 135), diameter of stem: 25–35 (holotype: 30).

Falcispongus hamatus Dumitrica, 1982a
Pl. 3, fig. 7

1982a *Falcispongus hamatus* Dumitrica – Dumitrica, 66–67, pl. 3, figs. 1, 4; pl. 4, fig. 1.

Falcispongus rostratus Dumitrica, 1982a
Pl. 3, fig. 12

1982a *Falcispongus rostratus* Dumitrica – Dumitrica, 66, pl. 3, figs. 8, 9; pl. 4, figs. 2, 3, 5, 6; pl. 5, figs. ?2, 4.
1984 *Falcispongus rostratus* Dumitrica – De Wever, pl. 3, fig. 2.

Genus *Foremanellina* Dumitrica, 1982b
Type species *Foremanellina helenae* Dumitrica, 1982b.
Foremanellina expansolabrum Dumitrica, 1982b
Pl. 11, fig. 4

1982b *Foremanellina expansolabrum* Dumitrica – Dumitrica, 79–80, pl. 2, figs. 4, 5.

Foremanellina macrocephala Dumitrica, 1982b
Pl. 11, fig. 5

1982b *Foremanellina macrocephala* Dumitrica – Dumitrica, 78, pl. 1, fig. 3; pl. 2. fig. 2; pl. 3, figs. 1–4.

Genus *Goestlingella* Kozur & Mostler, 1979
Type species *Goestlingella cordevolica* Kozur & Mostler, 1979.

Goestlingella illyrica Kozur 1984
Pl. 11, fig. 9

1984 *Goestlingella illyrica* Kozur – Kozur, 67, pl. 4, fig. 1.

Genus *Gomberellus* Dumitrica, Kozur & Mostler, 1980
Type species *Gomberellus hircicornus* Dumitrica, Kozur & Mostler, 1980.

Gomberellus bispinosus (Kozur & Mostler), 1981
Pl. 1, fig. 10

1979 Spumellaria gen. et spec. inc. – Kozur & Mostler, pl. 21, fig. 2.
1981 *Karnospongella bispinosa* Kozur & Mostler – Kozur & Mostler, 42, pl. 50, figs. 1a–d, 2.

Remarks: *Karnospongella* Kozur & Mostler is considered a younger synonym of *Gomberellus* Dumitrica, Kozur & Mostler. Both genera have an oval spongy shell with two main spines and some shorter additional spines in the opposite side of the shell. *Gomberellus bispinosus* (Kozur & Mostler) probably evolved from *G. hircicornus* by stronger torsion of the main spines.

Gomberellus hircicornus Dumitrica, Kozur & Mostler, 1980
Pl. 1, fig. 9

1980 *Gomberellus hircicornus* Dumitrica, Kozur & Mostler – Dumitrica et al., 6, pl. 10, fig. 6; pl. 14, fig. 3.
1984 *Gomberellus hircicornus* Dumitrica, Kozur & Mostler – Lahm, 52, pl. 8, fig. 11.

Genus *Hinedorcus* Dumitrica, Kozur & Mostler, 1980
Type species *Hinedorcus alatus* Dumitrica, Kozur & Mostler, 1980.

Hinedorcus alatus Dumitrica, Kozur & Mostler, 1980
Pl. 10, fig. 5

1980 *Hinedorcus alatus* Dumitrica, Kozur & Mostler – Dumitrica et al., 24, pl. 9, figs. 2, 8; pl. 15, fig. 4.

Genus *Hozmadia* Dumitrica, Kozur & Mostler, 1980
Type species *Hozmadia reticulata* Dumitrica, Kozur & Mostler, 1980.

Hozmadia pyramidalis Goričan n. sp.
Pl. 9, figs. 4, 5a–b, 6, 7a–b

Etymology: pyramidalis, e (Latin) = pyramidal.
Type locality: Bohinj, NW Yugoslavia.

Diagnosis: small pyramidal *Hozmadia* with straight feet.

Description: Cephalis small, subspherical, constricted at the feet. Its surface perforated, covered with a reticulate network of ribs. Apical horn stout, three-bladed. Feet strong, straight, three-bladed distally. On the proximal part of the feet the outer ridge bifurcates, the ridges are prolonged on the outer surface of the cephalis. The other two blades of the adjacent feet connected to form a relatively wide poreless collar edge.

Remarks: *Hozmadia pyramidalis* differs from *H. reticulata* Dumitrica, Kozur & Mostler by being much smaller in size and by having straight pyramidal feet and a wide poreless collar edge. Apical horn is three-bladed.

Hozmadia longobardica Kozur & Mostler (1981, 82, pl. 28, figs. 1a, b, 3) has no collar edge and should probably be assigned to *Eonapora* Kozur & Mostler. *Hozmadia parva* Kozur & Mostler (1981, 83, pl. 32, fig. 2) has a smooth surface and slightly curved feet.

Occurrence: Upper Illyrian–Fassanian (equivalent of the Buchenstein Beds) from NW Yugoslavia.

Dimensions (in µm): width of cephalis: 52–76 (holotype: 62, average of 9 specimens: 62); height of cephalis without collar edge: 50–72 (holotype: 57, average: 59); height of apical horn: 40–60 (holotype: 55, average: 50) length of feet: 50–67 (holotype: 57, average: 56).

Hozmadia reticulata Dumitrica, Kozur & Mostler, 1980
Pl. 9, figs. 8–10

1980 *Hozmadia reticulata* Dumitrica, Kozur & Mostler – Dumitrica et al., 21–22, pl. 9, figs. 9, 10.

Remarks: *Hozmadia reticulata* is one of the most frequent species in the Upper Illyrian–Fassanian. Two slightly different forms occur together. A typical one is illustrated in pl. 9, fig. 8. Included are also forms with a larger cephalis, thinner cephalic wall and ridges, and slimmer apical horn and feet (pl. 9, figs. 9, 10).

Genus *Hungarosaturnalis* Kozur & Mostler, 1983
Type species *Hungarosaturnalis multispinosus* Kozur & Mostler, 1983.
Hungarosaturnalis multispinosus Kozur & Mostler, 1983
Pl. 1, fig. 5

1983 *Hungarosaturnalis multispinosa* Kozur & Mostler – Kozur & Mostler, 8, pl. 4, figs. 1a, b, 2; pl. 5, fig. 5; pl. 6; fig. 1a, b; pl. 7, figs. 2, 3.

Genus *Katorella* Kozur & Mostler, 1981
Type species *Katorella bifurcata* Kozur & Mostler, 1981.
Katorella bifurcata Kozur & Mostler, 1981
Pl. 1, fig. 11

1979 *Staurodoras dercourti* De Wever – Nakaseko & Nishimura, 71, pl. 3, fig. 7.

1981 *Katorella bifurcata* Kozur & Mostler – Kozur & Mostler, 51, pl. 3, figs. 4, 5; pl. 60, fig. 2a, b.

1984 *Katorella bifurcata* Kozur & Mostler – Lahm, 52–53, pl. 9, fig. 2.

1984 *Katorella* sp. – Lahm, 53, pl. 9, fig. 3.

Genus *Natraglia* Pessagno, 1979

Type species *Natraglia luminosa* Pessagno, 1979.

Natraglia luminosa Pessagno, 1979
Pl. 1, fig. 7

1979 *Natraglia luminosa* Pessagno – Pessagno et al., 172, pl. 6, fig. 8.
1982 *Natraglia luminosa* Pessagno – De Wever, 266, pl. 33, fig. 5.
1984 *Natraglia unica* Pessagno – Kozur, pl. 2, fig. 2.

Natraglia unica Pessagno, 1979
Pl. 1, fig. 6

1979 *Natraglia unica* Pessagno – Pessagno et al., 172, pl. 6, fig. 7.
1982 *Ntraglia unica* Pessagno – De Wever, 265–266, pl. 33, fig. 6.

Genus *Neopylentonema* Kozur, 1984

Type species *Neopylentonema mesotriassica* Kozur, 1984.

Neopylentonema mesotriassica Kozur, 1984
Pl. 8, fig. 11

1984 *Neopylentonema mesotriassica* Kozur – Kozur, 71, pl. 4, fig. 5; pl. 5, fig. 1a–c; pl. 6, fig. 1.

Genus *Nofrema* Dumitrica, Kozur & Mostler, 1980

Type species *Nofrema trispinosa* Dumitrica, Kozur & Mostler, 1980.

Nofrema trispinosa Dumitrica, Kozur & Mostler, 1980
Pl. 10, fig. 6

1980 *Nofrema trispinosa* Dumitrica, Kozur & Mostler – Dumitrica et al., 25, pl. 9, fig. 1; pl. 15, fig. 3.

Genus *Oertlispongus* Dumitrica, Kozur & Mostler, 1980

Type species *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler 1980.

Oertlispongus inaequispinosus Dumitrica, Kozur & Mostler, 1980
Pl. 3, figs. 10–11

1980 *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler – Dumitrica et al., 5, pl. 10, fig. 7.
1982a *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler – Dumitrica, 64–65, pl. 1, figs. 2, 4, 6. 9; non fig. 7.
1982 *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler – Dumitrica & Mello, pl. 2, figs. 1, 2.
1983 *Oertlispongus annulatus* Kozur & Mostler – Kozur & Mostler, 33, pl. 1, fig. 6.
1983 *Oertlispongus longirecurvatus* Kozur & Mostler – Kozur & Mostler, 33–34, pl. 1, fig. 5.
1984 *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler – Lahm, 48, pl. 8, fig. 2.
1984 n. gen. n. sp. – Lahm, 48, pl. 8, fig. 4.
1986 *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler – Kozur & Réti, fig. 5F.

Remarks: In our samples the specimens of *Oertlispongus inaequispinosus* are abundant but mostly represented by broken spines without a shell, the distinction of *O. annulatus* Kozur & Mostler and *O. longirecurvatus* Kozur & Mostler from *O. inaequispinosus* is not possible. Moreover, all our specimens are found in the Upper Illyrian-Fassanian, the difference in the stratigraphic range of the three morphotypes thus could not have been assumed.

The spines of *Oertlispongus inaequispinosus* are resistant to the dissolutional processes. In the poorly preserved Gr 7 sample they absolutely predominate in the assemblage.

Genus *Parasepsagon* Dumitrica, Kozur & Mostler, 1980

Type species *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler, 1980.

Parasepsagon tetracanthus Dumitrica, Kozur & Mostler, 1980

Pl. 6, fig. 1

1980 *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler – Dumitrica et al., 13, pl. 1, fig. 8; pl. 2, fig. 7.

1981 *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler – Kozur & Mostler, 36, pl. 36, fig. 2; pl. 51, fig. 3.

1984 *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler – Lahm, 41, pl. 6, fig. 11.

Genus *Parentactinia* Dumitrica, 1978b

Type species *Parentactinia pugnax* Dumitrica, 1978b.

Parentactinia pugnax Dumitrica, 1978b

Pl. 7, fig. 6

1978b *Parentactinia pugnax* Dumitrica – Dumitrica, 50–51, pl. 4, figs. 4?, 5; pl. 5, figs. 1–3.

Genus *Pentactinocapsa* Dumitrica, 1978b

Type species *Pentactinocapsa quadripes* Dumitrica, 1978b.

Pentactinocapsa quadripes Dumitrica, 1978b

Pl. 7, fig. 5

1978b *Pentactinocapsa quadripes* Dumitrica – Dumitrica, 45–46, pl. 1, figs. 2–4.

Genus *Pentactinocarpus* Dumitrica, 1978b

Type species *Pentactinocarpus fusiformis* Dumitrica, 1978b.

Pentactinocarpus acanthicus Dumitrica, 1978b

Pl. 7, fig. 12

1978b *Pentactinocarpus acanthicus* Dumitrica – Dumitrica, 44–45, pl. 3, fig. 3.

1980 *Pentactinocarpus acanthicus* Dumitrica – Dumitrica et al., 7–8, pl. 4, fig. 7.

1981 *Pentactinocarpus bispinosus* Kozur & Mock – Kozur & Mostler, 21, pl. 52, fig. 2 a–b.

1984 *Pentactinocarpus acanthicus* Dumitrica – Lahm, 22–23, pl. 2, figs. 9, 10.

Remarks: *Pentactinocarpus bispinosus* Kozur & Mostler is considered an aberrant form of *P. acanthicus* with a bifurcate apical spine.

Pentactinocarpus fusiformis Dumitrica, 1978b
Pl. 7, fig. 11

1978b *Pentactinocarpus fusiformis* Dumitrica – Dumitrica, 44, pl. 2, fig. 2.
1980 *Pentactinocarpus fusiformis* Dumitrica – Dumitrica et al., 8, pl. 4, figs. 2, 3, 5, 6, 8.
1982 *Pentactinocarpus fusiformis* Dumitrica – Yao, pl. 1, fig. 20.
1982 *Pentactinocarpus fusiformis* Dumitrica – Yao et. al., pl. 1, fig. 13.
1984 *Pentactinocarpus fusiformis* Dumitrica – Lahm, 24–25, pl. 3, fig. 1.
1986 *Pentactinocarpus fusiformis* Dumitrica – Kozur & Réti, fig. 6C.

Pentactinocarpus tetracanthus Dumitrica, 1978b
Pl. 7, figs. 8–10

1978b *Pentactinocarpus tetracanthus* Dumitrica – Dumitrica, 44, pl. 2, fig. 1.
1979 *Sethophaena* (?) sp. A – Nakaseko & Nishimura, 79, pl. 8, fig. 7, non fig. 8.
1980 *Pentactinocarpus tetracanthus* Dumitrica – Dumitrica et al., 8, pl. 4, figs. 1, 4.
1984 *Pentactinocarpus tetracanthus* Dumitrica – Lahm, 23–24, pl. 2, fig. 11.
1984 *Pentactinocarpus* cf. *tetracanthus* Dumitrica – Lahm, 24, pl. 2, fig. 12.
1984 *Pentactinocarpus bispinosus* Kozur & Mock – Lahm, 24, pl. 2, fig. 13.

Remarks: *Pentactinocarpus* cf. *tetracanthus* and *P. bispinosus* described by Lahm (1984) are aberrant forms of *P. tetracanthus*. Two aberrant specimens from our material are illustrated in pl. 7, figs. 9, 10. The first one has two antapical spines, the second has five basal spines. Aberrant forms of *P. tetracanthus* are rather frequent but differ one from another.

The frequency of *P. tetracanthus* is about half of that of *P. fusiformis* in the Buchenstein Limestone of Recoaro (Dumitrica, 1978b). In the present studied material from NW Yugoslavia the situation is the opposite. *P. tetracanthus* is relatively abundant but *P. fusiformis* very rare.

Genus *Pentactinorbis* Dumitrica, 1978
Type species *Pentactinorbis kozuri* Dumitrica, 1978b.

Pentactinorbis kozuri Dumitrica 1978b
Pl. 7, fig. 7

1978b *Pentactinorbis kozuri* Dumitrica – Dumitrica, 46–47, pl. 3, figs. 4–5.
non 1982 *Pentactinorbis kozuri* Dumitrica – De Wever, 119–121, pl. 1, fig. 4.
1984 *Pentactinorbis kozuri* Dumitrica – Lahm, 26, pl. 3, fig. 2.

Genus *Pentaspongodiscus* Kozur & Mostler, 1979 emend. Dumitrica, Kozur & Mostler, 1980
Type species *Pentaspongodiscus tortilis* Kozur & Mostler, 1979.

Pentaspongodiscus ladinicus Dumitrica, Kozur & Mostler, 1980
Pl. 2, fig.3

1980 *Pentaspongodiscus tortilis ladinicus* Dumitrica, Kozur & Mostler – Dumitrica et al., 10, pl. 8, fig. 5.

1981 *Pentaspongodiscus ladinicus* Dumitrica, Kozur & Mostler – Kozur & Mostler, 62, pl. 45, fig. 2.
1984 *Pentaspongodiscus ladinicus* Dumitrica, Kozur & Mostler – Lahm, 55, pl. 9, fig. 8.

Pentaspongodiscus cf. *ladinicus* Dumitrica, Kozur & Mostler, 1980
Pl. 2, fig. 4

Remarks: It differs from the type material by having a larger shell, relatively shorter and broader spines, which are more torsioned, especially on their distal part. According to the occurrence in NW Yugoslavia (Table 1) *P.* cf. *ladinicus* could be younger than *P. ladinicus*.

Pentastpongodiscus mesotriassicus Dumitrica, Kozur & Mostler, 1980
Pl. 2, figs. 1–2

1980 *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur & Mostler – Dumitrica et al., 10, pl. 8, fig. 7.
? 1981 *Pentaspongodiscus ? ruesti* Kozur & Mostler – Kozur & Mostler, 62–63, pl. 59, figs. 2, 3.
? 1984 *Pentaspongodiscus ruesti* Kozur & Mostler – Lahm, 55–56, pl. 9, fig. 9.
? 1984 *Pentaspongodiscus* cf. *ruesti* Kozur & Mostler – Lahm, 56, pl. 9, fig. 10.
1984 *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur & Mostler – Lahm, 56, pl. 9, fig. 11.

Remarks: *Pentaspongodiscus ruesti* Kozur & Mostler is questionably assigned to *P. mesotriassicus*. The additional spine does not lie at the same angle and in the same place with all the specimens. It seems more probable that *P. ruesti* is an aberrant representative of *P. mesotriassicus*.

P. mesotriassicus is very frequent.

Pentaspongodiscus symmetricus Dumitrica, Kozur & Mostler 1980
Pl. 2, fig. 5

1980 *Pentaspongodiscus symmetricus* Dumitrica, Kozur & Mostler – Dumitrica et al., 10, pl. 8, fig. 4.
1984 *Pentaspongodiscus symmetricus* Dumitrica, Kozur & Mostler – Lahm, 57–58, pl. 10, fig. 2.
1984 *Pentaspongodiscus heptastylus* Lahm – Lahm, 58, pl. 10, fig. 3.

Remarks: *Pentaspongodiscus heptastylus* is considered an aberrant form of *P. symmetricus*.

Genus *Picapora* Kozur & Mostler, 1981
Type species *Picapora robusta* Kozur & Mostler, 1981.

Remarks: *Picapora* was originally defined as having a closed thorax (Kozur & Mostler, 1981, 109). This criterium is now discarded, because in the material studied there occur otherwise identical specimens with a closed or open mouth.

Picapora sp. A
Pl. 11, figs. 1a–b, 2a–b, 3a–b

Description: Test dicyrtid. Cephalis small, its surface covered with ribs. Thorax pyramidal, thoracic wall smooth. Apical horn and feet three-bladed. Feet visible on external side of the thorax. Vertical spine penetrates the cephalic wall as a short thorn. Thorax distally closed with a thin plate (pl. 11, figs. 1b, 2b) or it has a rounded aperture with a strong rim (pl. 11, fig. 3b).

Remarks: Two morphotypes are included – one with a closed and the other with an open mouth. The difference in the stratigraphic range of these two types has not yet been stated. It is possible that they represent only two different onthogenetic stages of the same species.

Picapora robusta Kozur & Mostler (1981, 110, pl. 7, fig. 1a–d, 2a–b) differs from *Picapora* sp. A in having a fourbladed apical horn and a longer prolongation of the vertical spine.

Genus *Plafkerium* Pessagno, 1979

Type species *Plafkerium abbotti* Pessagno, 1979.

Remarks: The inner structure of *Plafkerium* has not yet been described or illustrated. The bad preservation of our material does not allow this either. The cortical shell is double-layered as with *Parasepsagon*. For this reason the newly described species *Plafkerium? firmum* is questionably ascribed to this genus.

Plafkerium abboti Pessagno, 1979
Pl. 6, figs. 7–8

1979 *Plafkerium abbotti* Pessagno – Pessagno et al., 179–180, pl. 9, figs. 6, 10, 14.
1982 *Plafkerium abboti* Pessagno – De Wever, 172–173, pl. 9, fig. 3.

Remarks: The test is somewhat smaller than with the type material, the spines are relatively thicker.

Plafkerium ? firmum Goričan n. sp.
Pl. 6, figs. 3–6

Etymology: firmus, a, um (Latin) = firm, solid, strong.
Type locality: Vršič, NW Yugoslavia.
Diagnosis: Four straight spines with primary and secondary ridges and grooves.

Description: Cortical shell square in outline, slightly convex, two-layered. Outer layer consisting of irregular nodes and connecting rays. Four spines extending from the corners of the square at right angles, not always absolutely coplanar (pl. 6, fig. 4). One spine longer. All the spines straight or only very slightly twisted (pl. 6, fig. 5). Spines with three primary and three relatively deep secondary grooves. Ridges wide, rounded. Spine-tips rounded, terminating with a short needle, circular in cross-section.

The size of the test, especially the lenght of the spines, displays great variability. With the biggest specimens the spines are nearly twice as long as with the smallest ones. In the material studied the two extreme types occur together, therefore they are defined as the same species.

Remarks: *Plafkerium ? firmum* differs from *Plafkerium abbotti* Pessagno (Pessagno et al., 1979), *Plafkerium hindei* Pessagno (Pessagno et al., 1979), *Emiluvia ? cochleata* Nakaseko & Nishimura (1979) and *Stauracontium minoense* Nakaseko & Nishimura (1979) in that all four spines are straight and have distinctive secondary grooves beside primary ones.

Occurrence: Langobardian of NW Yugoslavia, very frequent.

Dimensions (in μm): width of shell (bettween adjacent spines): 115–140 (holotype: 120, average of 19 specimens: 129); length of shorter spines: 73–165 (holotype: 77, average: 100); length of longer spine: 110–240 (holotype: 110, average: 143); maximum width of spines: 47–66 (holotype: 47, average: 56).

Plafkerium ? cf. *longidentatum* Kozur & Mostler, 1981
Pl. 6, fig. 2

cf. 1981 *Plafkerium ? longidentatum* Kozur & Mostler – Kozur & Mostler, 71, pl. 51, fig. 1.
1984 *Staurosphaera ? fluegeli* Kozur & Mostler – Lahm, 75, pl. 13, fig. 7.
cf. 1984 *Plafkerium longidentatum* Kozur & Mostler – Lahm, 87, pl. 15, fig. 12.

Remarks: The form differs from the type material in that all the four spins are equal in length. The whole test is somewhat larger, the spines are relatively narrower.

Plafkerium sp.
Pl. 6, fig. 9

1982 *Plafkerium* sp. – De Wever, pl. 9, fig. 4.

Remarks: The form differs from *P. abbotti* Pessagno in having very strong and broad spines, which widen distally and terminate abruptly. Primary grooves wide, secondary ones insignificant.

Genus *Poulpus* De Wever, 1979

Type species *Poulpus piabyx* De Wever, 1979.

Poulpus curvispinus Dumitrica, Kozur & Mostler, 1980
Pl. 9, figs. 1–2

1980 *Poulpus curvispinus* Dumitrica, Kozur & Mostler – Dumitrica et al., 22, pl. 2, fig. 1; pl. 15, figs. 5, 6.

Remarks: One abnormal specimen with a foot being split along the whole length was found (pl. 9, fig. 2).

Poulpus aff. *curvispinus* Dumitrica, Kozur & Mostler, 1980
Pl. 9, fig. 3

1982 *Poulpus* aff. *curvispinus* Dumitrica, Kozur & Mostler – Yao, pl. 1, fig. 18.

Description: Large hemispherical cephalis with an irregular meshwork of widely open rounded pores, pore frames pentagonal to hexagonal.

Genus *Pseudostylosphaera* Kozur & Mostler, 1981

Type species *Pseudostylosphaera gracilis* Kozur & Mostler, 1981.

Pseudostylosphaera coccostyla (Rüst), 1892
Pl. 5, fig. 1

1892 *Spongatractus coccostylus* Rüst – Rüst, 160, pl. 21, fig. 8.
1981 *Pseudostylosphaera coccostyla* (Rüst) – Kozur & Mostler, 31–32, pl. 15, fig. 3; pl. 46, fig. 5.
1981 *Pseudostylosphaera* ? sp. – Kozur & Mostler, 33, pl. 47, fig. 5.
1948 *Pseudostylosphaera coccostyla* (Rüst) – Lahm, 33–34, pl. 4, figs. 7, 8.
1986 *Pseudostylosphaera coccostyla* (Rüst) – Kozur & Réti, fig. 6E.

Remarks: The test is much larger and more robust than with other representatives of *Pseudostylosphaera*. On the spines there are prominent secondary ridges and grooves beside primary ones. The illustration of the holotype (Rüst, 1892, pl. 21, fig. 8) is not very clear. Our material corresponds well to other descriptions and photographs cited in the synonymy.

Pseudostylosphaera goestlingensis (Kozur & Mostler), 1979
Pl. 5, fig. 7

1979 *Stylosphaera ? goestlingensis* Kozur & Mostler – Kozur & Mostler, 54, pl. 17, fig. 5; pl. 18, fig. 1.
non 1984 *Pseudostylosphaera goestlingensis* (Kozur & Mostler) – Lahm, 35–36, pl. 5, figs. 3, 4.

Remarks: The shell structure of *P. goestlingensis* described by Lahm (1984) does not correspond to *Pseudostylosphaera*. The spines have sharp blades and not rounded as with the type material.
The species is frequent.

Pseudostylosphaera cf. *hellenica* (De Wever), 1979
Pl. 5, fig. 8

cf. 1979 *Archaeospongoprunum* (?) *hellenicum* De Wever – De Wever et al., 78, pl. 1, fig. 8.
cf. 1979 *Stylosphaera* ? cf. *hellenica* (De Wever) – Kozur & Mostler, 55, pl. 1, fig. 4; pl. 17, fig. 4.
cf. 1982 *Archaeospongoprunum hellenicum* De Wever – De Wever, 179–180, pl. 10, figs. 4, 5?.
cf. 1984 *Pseudostylosphaera hellenica* (De Wever) – Lahm, 35, pl. 5, figs. 1, 2.

Remarks: Included are forms with spines being distally more torsioned than proximally. With the type material this difference is even more pronounced.

Pseudostylosphaera japonica (Nakaseko & Nishimura), 1979
Pl. 5, fig. 2

1979 *Archaeospongoprunum japonicum* Nakaseko & Nishimura – Nakaseko & Nishimura, 67, pl. 1, figs. 2, 4, 9.
1982 *Archaeospongoprunum japonicum* Nakaseko & Nishimura – Mizutani & Koike, pl. 3, fig. 3.
1982 *Archaeospongoprunum japonicum* Nakaseko & Nishimura – Sato et al., pl. 2, figs. 1, 2.
1982 *Archaeospongoprunum japonicum* Nakaseko & Nishimura – Yao, pl. 1, fig. 21.
1984 *Pseudostylosphaera japonica* (Nakaseko & Nishimura) – Lahm, 34, pl. 4, figs. 9, 10.

1986 *Pseudostylosphaera japonica* (Nakaseko & Nishimura) – Blome et al., pl. 8.3, figs. 1–2.

Remarks: In the Upper Illyrian-Fassanian assemblages *P. japonica* prevails over other representatives of the genus.

Pseudostylosphaera longispinosa Kozur & Mostler, 1981
Pl. 5, figs. 3–5

1981 *Pseudostylosphaera longispinosa* Kozur & Mostler – Kozur & Mostler, 32, pl. 1, fig. 6.
1981 *Pseudostylosphaera longobardica* Kozur & Mostler – Kozur & Mostler, 33, pl. 49, fig. 3.
1984 *Pseudostylosphaera longispinosa* Kozur & Mostler – Lahm, 34–35, pl. 4, figs. 11, 12.
1986 Transitional form between *Pseudostylosphaera longispinosa* Kozur & Mostler 1981 and *P. longobardica* – Kozur & Réti, fig. 6D.

Remarks: Included are forms with two straight polar spines being more or less equal in length and at least 1.5 times longer than the main axis of the shell (with *P. japonica* this ratio is approximately 1:1).

P. longobardica Kozur & Mostler is not considered a different species. The difference between the spherical to subspherical shell of *P. longispinosa* and the ellipsoidal to subellipsoidal shell of *P. longobardica* is difficult to recognize. Most specimens represent transitional forms.

Pseudostylosphaera tenuis (Nakaseko & Nishimura), 1979
Pl. 5, fig. 6

1979 *Archaeospongoprunum tenue* Nakaseko & Nishimura – Nakaseko & Nishimura, 68–69, pl. 1, figs. 8, 10.
1982 *Archaeospongoprunum tenue* Nakaseko & Nishimura – Mizutani & Koike, pl. 3, fig. 2.
1984 *Pseudostylosphaera tenue* (Nakaseko & Nishimura) – Lahm, 36, pl. 5, figs. 5, 6.

Genus *Sanfilippoella* Kozur & Mostler, 1979
Type species *Sanfilippoella tortilis* Kozur & Mostler, 1979.

Sanfilippoella recta Kozur & Mostler, 1981
Pl. 10, fig. 4

1981 *Sanfilippoella recta* Kozur & Mostler – Kozur & Mostler, 101, pl. 21, fig. 1a–c; pl. 22, figs. 1, 2.

Genus *Sarla* Pessagno, 1979
Type species *Sarla prietoensis* Pessagno, 1979.

Sarla spp.
Pl. 5, figs. 11–12

Remarks: Various forms with a double-layered cortical shell and three coplanar spines (one of them of different size and sometimes structure than the other two) were found in the Upper Fassanian?-Langobardian from Vršič. They differ in the relative length and structure of the spines.

Sarla ? kretaensis Kozur & Krahl (1984) has well-pronounced secondary ridges and grooves on the spines, the shorter spines are more twisted than in our material. *Sarla ariana* Cordey et al. (1988), *S. integrita* Cordey et al. (1988) and *S. soustra* Cordey et al. (1988) have longer spines.

Genus *Sepsagon* Dumitrica, Kozur & Mostler, 1980

Type species *Triactoma longispinosum* Kozur & Mostler, 1979.

Sepsagon longispinosus (Kozur & Mostler), 1979

Pl. 5, fig. 9.

1979 *Triactoma longispinosum* Kozur & Mostler – Kozur & Mostler, 59, pl. 1, fig. 6; pl. 11, fig. 3, 8; pl. 12, fig. 6; pl. 13, fig.1.

1980 *Sepsagon longispinosus* (Kozur & Mostler) – Dumitrica et al., 15, pl. 5, figs. 1, 2, 5, 6; pl. 15, fig. 1.

1983 *Sarla longispinosum* (Kozur & Mostler) – Blome, 19–20, pl. 3, figs. 5, 7, 10, 18; pl. 11, fig. 4.

1984 *Sarla longispinosa* (Kozur & Mostler) emend. Blome – Blome, 31, pl. 4, fig. 3.

1984 *Sepsagon longispinosus longispinosus* (Kozur & Mostler) – Lahm, 39, pl. 6, figs. 3, 4, 5.

1984 *Sepsagon* cf. *longispinosus longispinosus* (Kozur & Mostler) – Lahm, 39, pl. 6, figs. 6, 7.

1984 *Sepsagon longispinosus recoarensis* Lahm – Lahm, 40, pl. 6, fig. 8.

Sepsagon ? robustus Lahm, 1984

Pl. 5, fig. 10

1984 *Sepsagon ? robustus* Lahm – Lahm, 40–41, pl. 6, fig. 10.

Genus *Silicarmiger* Dumitrica, Kozur & Mostler, 1980

Type species *Silicarmiger costatus* Dumitrica, Kozur & Mostler, 1980.

Silicarmiger costatus Dumitrica, Kozur & Mostler, 1980

Pl. 10, fig. 8

1980 *Silicarmiger costatus* Dumitrica, Kozur & Mostler – Dumitrica et al., 23, pl. 7, figs. 1–6; pl. 14, fig. 4; pl. 15, fig. 2.

1981 *Silicarmiger costatus anisicus* Kozur & Mostler – Kozur & Mostler, 104, pl. 10, fig. 1 a, b.

Remarks: *Silicarmiger costatus anisicus* is included in the synonymy. In the number of transverse ribs and lack of velum it resembles the juvenile stage of *S. costatus costatus* illustrated by Dumitrica et. al. (1980, pl. 15, fig. 2).

Silicarmiger aff. *costatus* Dumitrica, Kozur & Mostler, 1980

Pl. 10, fig. 9

Remarks: It differs from the type material by having a smaller cephalis and a shorter apical horn. According to the occurrence in NW Yugoslavia *Silicarmiger* aff. *costatus* seems to be younger than *S. costatus*.

Genus *Spongopallium* Dumitrica, Kozur & Mostler, 1980
Type species *Spongopallium contortum* Dumitrica, Kozur & Mostler, 1980.

Remarks: Included are forms with a spongy cortical shell and two polar spines, which can be straight, torsioned or even hollow.

According to the original definition of *Spongopallium* (Dumitrica et al., 1980, 15) it has a spongy cortical mantle and two latticed inner shells. With most of our material the inner structure has not been observed, with the others it differs from that of *Spongopallium* (*Spongopallium* cf. *koppi*, pl. 4, fig. 4). For the sake of simplicity and an easier survey the forms are assigned to the same genus. The generic name is thus mostly determined with a question mark.

Spongopallium contortum Dumitrica, Kozur & Mostler, 1980
Pl. 4, figs. 7–8

1980 *Spongopallium contortum* Dumitrica, Kozur & Mostler – Dumitrica et al., 16, pl. 2, fig. 5; pl. 11, fig. 1.
1984 *Spongopallium contortum* Dumitrica, Kozur & Mostler – Lahm, 109, pl. 19, figs. 8, 9.

Spongopallium ? *koppi* (Lahm), 1984
Pl. 4, fig. 1

1984 *Cromyostylus* ? *koppi* Lahm – Lahm, 68, pl. 12, figs. 1, 2.
1986 *Spongopallium* n. sp. – Kozur & Réti, fig. 6H.

Remarks: The outer outlook of the form is most similar to *Spongopallium* but the inner structure as illustrated by Lahm (1984, pl. 12, fig. 2) is different (see remarks under the generic name).

In the same samples as *S.* ? *koppi* there occur forms with completely straight or very slightly twisted spines, which have wider grooves and sharp blades. They are determined as *Spongopallium* ? cf. *koppi* (pl. 4, figs. 2–4). Their occurrence is not included in Table 1.

Spongopallium ? sp. A
Pl. 4, fig. 5

Description: Spherical shell with two polar spines of somewhat unequal length. Outer layer of the shell spongy. Spines three-bladed, ending with a needle. Blades sharp, twisted.

Remarks: This morphotype occurs in the Upper Illyrian-Fassanian. It probably represents an ancestral species of *Spongostylus carnicus* Kozur & Mostler (1979, 56, pl. 9, figs. 5, 6) and *Spongostylus tortilis* Kozur & Mostler (1979, 56, pl. 4. fig. 2), wich differ by having more torsioned spines. The inner structure of none of these species has been observed so far, thus the phylogenetic relationship among them cannot be confirmed.

A very closely related species has recently been described as *Pseudostylosphaera slovenica* Kolar–Jurkovšek (1989, 158, fig. 2, no 1–3).

Spongopallium ? sp. B
Pl. 4, fig. 6

1982 Spumellaria gen. et sp. indet. with tubular spines – Dumitrica & Mello, pl. 2, fig. 13.

Genus *Spongosilicarmiger* Kozur, 1984
Type species *Spongosilicarmiger italicus* Kozur, 1984.
Spongosilicarmiger italicus Kozur, 1984
Pl. 10, fig. 7

1979 *Stichopterium* (?) sp. B – Nakaseko & Nishimura, 80–81, pl. 11, figs. 2, 5.
1984 *Spongosilicarmiger italicus* Kozur – Kozur, 64, pl. 6, fig. 2; pl. 7, fig. 1a, b.

Remarks: The apical horn of the holotype ends with a short three-bladed spine. In our material the distal portion of the apical horn is long, curved, circular in cross-section.

Genus *Stauracontium* Haeckel, 1881
Type species *Stauracontium cruciferum* Haeckel, 1887.
Stauracontium ? *granulosum* Dumitrica, Kozur & Mostler, 1980
Pl. 1, fig. 1

1980 *Stauracontium* ? *granulosum* Dumitrica, Kozur & Mostler – Dumitrica et al., 16, pl. 1, fig. 7; pl. 11, fig. 5.
1980 *Plafkerium* ? *muelleri* Dumitrica, Kozur & Mostler – Dumitrica et al., 14, pl. 1, fig. 3.
1984 *Stauracontium granulosum* Dumitriča, Kozur & Mostler – Lahm, 76–77, pl. 13, fig. 9.
1984 *Plafkerium muelleri* Dumitrica, Kozur & Mostler – Lahm, 87, pl. 15, fig. 11.

Remarks: According to the original definition *Stauracontium* ? *granulosum* (Dumitrica et al., 1980, 16) has a latticed shell while the shell of *Plafkerium* ? *muelleri* (Dumitrica et al., 1980, 14) is somewhat spongy. The spines are identical with both species. So far no difference in the stratigraphic range of these two morphotypes has been recorded. They most probably represent only two different ontogenetic stages of the same species.

Stauracontium ? *trispinosum* (Kozur & Mostler), 1979
Pl. 1, fig. 2

1979 *Staurosphaera trispinosa* Kozur & Mostler – Kozur & Mostler, 58, pl. 21, fig. 3.
1979 *Staurosphaera triloba* Nakaseko & Nishimura – Nakaseko & Nishimura, 72, pl. 5, figs. 1, 2.
1980 *Stauracontium* ? *trispinosum ladinicum* Dumitrica, Kozur & Mostler – Dumitrica et al., 17, pl. 1, fig. ?5; pl. 2, fig. 4; pl. 3, figs. 6, 7; pl. 5, fig. 4; pl. 14, fig. 5.
1984 *Stauracontium* ? *trispinosum* (Kozur & Mostler) – Lahm, 76, pl. 13, fig. 8.

Genus *Tandarnia* Dumitrica, 1982c

Type species *Tandarnia recoarense* Dumitrica 1982c.

Tandarnia recoarensis Dumitrica, 1982c

Pl. 7, fig. 4

1982c *Tandarnia recoarense* Dumitrica – Dumitrica, 415, pl. 3, figs. 6–10.

Genus *Tiborella* Dumitrica, Kozur & Mostler, 1980

Type species *Tiborella magnidentata* Dumitrica, Kozur & Mostler, 1980

Tiborella magnidentata Dumitrica, Kozur & Mostler, 1980

Pl. 1, fig. 4

1980 *Tiborella magnidentata* Dumitrica, Kozur & Mostler – Dumitrica et al., 18, pl. 1, figs. 2, 6; pl. 11, figs. 2–4; pl. 12, fig. 4.

1984 *Tiborella magnidentata* Dumitrica, Kozur & Mostler – Lahm, 108, pl. 19, fig. 7.

Genus *Triassistephanidium* Dumitrica, 1978a

Type species *Triassistephanidium laticornis* Dumitrica, 1978a.

Triassistephanidium laticorne Dumitrica, 1978a

Pl. 8, fig. 6

1978a *Triassistephanidium laticornis* Dumitrica – Dumitrica, 32, pl. 1, figs. 5, 6; pl. 2, fig. 1; pl. 4, fig. 3.

1980 *Triassistephanidium laticornis* Dumitrica – Dumitrica et al., 20, pl. 6, fig. 9.

1986 *Triassistephanidium laticorne* Dumitrica – Kozur & Réti, fig. 6F.

Genus *Triassobipedis* Kozur, 1984

Type species *Triassobipedis balatonica* Kozur, 1984.

Triassobipedis balatonica Kozur, 1984

Pl. 8, figs. 9–10

1984 *Triassobipedis balatonica* Kozur – Kozur, 69, pl. 4, fig. 4a, b.

Genus *Triassocampe* Dumitrica, Kozur & Mostler, 1980

Type species *Triassocampe scalaris* Dumitrica, Kozur & Mostler 1980.

Triassocampe scalaris Dumitrica, Kozur & Mostler, 1980

Pl. 12, figs. 2–3

? 1979 *Dictyomitrella deweveri* Nakaseko & Nishimura – Nakaseko & Nishimura, 77, pl. 10, figs. 8, 9.

1980 *Triassocampe scalaris* Dumitrica, Kozur & Mostler – Dumitrica et al., 26, pl. 9, figs. 5, 6, 11; pl. 14, fig. 2.

1982 *Triassocampe scalaris* Dumitrica, Kozur & Mostler– Dumitrica & Mello, pl. 2, figs. 8, 9a–b.

1982 *Triassocampe scalaris* Dumitrica, Kozur & Mostler – Mizutani & Koike, pl. 4, fig. 4.

1986 *Triassocampe deweveri* (Nakaseko & Nishimura) – Kozur & Réti, fig. 5E.

1986 *Triassocampe* sp. – Kozur & Réti, fig. 6A.

Triassocampe sulovensis Kozur & Mock, 1981
Pl. 12, figs. 4–5

1981 *Triassocampe sulovensis* Kozur & Mock – Kozur & Mostler, 99, pl. 13, fig. 3.

Triassocampe sp. A
Pl. 12, fig. 1

Description: Test composed of 12 to 13 segments. First four segments poreless. Other segments with irregularly spaced small pores, surface smooth. Constrictions between segments well-pronounced, poreless. No thickened rings. All postabdominal segments approximately of equal height and width.

The species is relatively frequent and easily recogizable due to its distinctive shape of a long narrow cylinder.

Triassocampe spp.
Pl. 12, figs. 7–8

Remarks: Various forms with an irregular nodose surface appear in the Langobardian samples.

Cephalis and thorax poreless. The following segments have small pores, covered by node-like thickenings. Nodes of different size, joined together vertically and not arranged in horizontal rows as for example with *T. scalaris* Dumitrica, Kozur & Mostler. Constrictions among segments weakly pronounced externally.

Genus *Triassothamnus* Kozur & Mostler, 1981

Type species *Palacantholithus ? verticillatus* Dumitrica, 1978b.

Triassothamnus verticillatus (Dumitrica), 1978b
Pl. 7, fig. 3

1978b *Palacantholithus* (?) *verticillatus* Dumitrica – Dumitrica, 42–43, pl. 1, fig. 1; pl. 2, fig. 5.

1982c *Archaeothamnulus verticillatus* (Dumitrica) – Dumitrica, 418, pl. 5, figs. 3, 4; pl. 7, fig. 4.

Genus *Vinassaspongus* Kozur & Mostler, 1979

Type species *Vinassaspongus subsphaericus* Kozur & Mostler, 1979.

Vinassaspongus subsphaericus Kozur & Mostler, 1979
Pl. 2, fig. 6

1979 *Vinassaspongus subsphaericus* Kozur & Mostler – Kozur & Mostler, 66, pl. 3, figs. 5–7; pl. 5, fig. 5.

1984 *Vinassaspongus subsphaericus* Kozur & Mostler – Lahm, 73–74, pl. 13, fig. 2.

Vinassaspongus cf. *subsphaericus* Kozur & Mostler, 1979
Pl. 2, fig. 7

Remarks: Included are forms found in the Upper Illyrian-Fassanian. They show less torsioned spines with a more gradual transition to the needle-like tip.

Genus *Yeharaia* Nakaseko & Nishimura, 1979

Type species *Yeharaia elegans* Nakaseko & Nishimura, 1979.

Yeharaia annulata Nakaseko & Nishimura, 1979

Pl. 12, fig. 6

1979 *Yeharaia annulata* Nakaseko & Nishimura – Nakaseko & Nishimura, 82–83, pl. 10, figs. 1, ?7; pl. 12, fig. 5.
1982 *Yeharaia annulata* Nakaseko & Nishimura – Kido, pl. 1, fig. 10.
1982 *Yeharaia annulata* Nakaseko & Nishimura – Kojima, pl. 2, fig. 5.
1982 *Triassocampe* (?) *annulata* (Nakaseko & Nishimura) – Yao, pl. 1, fig. 11.
1982 *Triassocampe* (?) *annulata* (Nakaseko & Nishimura) – Yao et al., pl. 1, fig. 8.
1986 *Triassocampe annulata* (Nakaseko & Nishimura) – Blome et al., pl. 8.3, fig 11.

Remarks: Postthoracic segments in the material studied display more than one row of pores in distinction from the original description by Nakaseko and Nishimura (1979).

Genus *Zhamojdasphaera* Kozur & Mostler, 1979

Type species *Zhamojdasphaera latispinosa* Kozur & Mostler, 1979.

Zhamojdasphaera latispinosa Kozur & Mostler 1979

Pl. 2, fig. 8

1979 *Zhamojdasphaera latispinosa* Kozur & Mostler – Kozur & Mostler, 67, pl. 7, figs. 7–9; pl. 12, fig. 5.
1984 *Zhamojdasphaera latispinosa* Kozur & Mostler – Lahm, 74–75, pl. 13, fig. 5.

Zhamojdasphaera sp.

Pl. 2, fig. 9

Remarks: The form differs from *Zhamojdasphaera latispinosa* Kozur & Mostler by the shell being smaller, somewhat triangular in outline and by the spines being narrower.

Age assignment and correlation with other radiolarian assemblages

The radiolarian fauna from the localities Zaklanec, Bohinj and Vojsko (Table 1) corresponds to the well known assemblage from the Buchenstein Beds in Northern Italy, described by Dumitrica (1978a; 1978b; 1982a; 1982b; 1982c), Dumitrica et al. (1980), Kozur and Mostler (1981) and Lahm (1984). The characteristic species are: *Archaeosemantis pterostephanus* Dumitrica, *Baumgartneria bifurcata* Dumitrica, *Cryptostephanidium verrucosum* Dumitrica, *Falcispongus calcaneum* Dumitrica, *Foremanellina macrocephala* Dumitrica, *Hozmadia reticulata* Dumitrica, Kozur & Mostler, *Parentactinia pugnax* Dumitrica, *Pentactinocarpus tetracanthus* Dumitrica, *Pentactinorbis kozuri* Dumitrica, *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur & Mostler, *Poulpus curvispinus* Dumitrica, Kozur & Mostler, *Pseudostylosphaera japonica* (Nakaseko & Nishimura), *Silicarmiger costatus* Dumitrica, Kozur & Mostler, *Tiborella magnidentata* Dumitrica, Kozur & Mostler, *Triassistephanidium laticorne* Dumitrica, *Triassothamnus verticillatus* (Dumitrica). All the samples from each locality contain more or less the same radiolarian assemblage, the slight differences being explicable as a result of selective dissolutional processes.

The age of the radiolarian-bearing beds is assumed to be Upper Illyrian to Fassanian, which is the maximum range of the Buchenstein Formation. Mietto and Petroni (1979) proved on the basis of conodonts that the Upper Illyrian (Avisianus Zone) and the Fassanian (Reitzi and Curionii Zones) are represented in the Buchenstein Beds, where these are thickest.

Similar assemblages were also found in chert and limestone olistoliths in the wildflysch of the Rarau Syncline in the Eastern Carpathians (Dumitrica, 1978a; 1978b; 1982a; 1982c). Their Upper Illyrian-Fassanian age was determined on the basis of radiolarians.

Our assemblage can be correlated with the assemblage found in the ophiolitic sequence of NNE Hungary (Kozur & Réti, 1986). The species common to both assemblages are: *Eptingium manfredi* Dumitrica, *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler, *Pentactinocarpus fusiformis* Dumitrica, *Pseudostylosphaera coccostyla* (Rüst) and *Triassistephanidium laticorne* Dumitrica. The authors assigned this radiolarian assemblage to a higher Fassanian.

Some species present in our assemblage are also reported from the *Tripocyclia* cf. *acythus* assemblage from SW Japan (Nakaseko & Nishimura, 1979). These species are *Pseudostylosphaera japonica* (Nakaseko & Nishimura), *Pseudostylosphaera tenuis* (Nakaseko & Nishimura), *Katorella bifurcata* Kozur & Mostler, *Cryptostephanidium ? japonicum* (Nakaseko & Nishimura), and *Yeharaia annulata* Nakaseko & Nishimura. Although the *Tripocyclia* cf. *acythus* assemblage was originally assigned to the Upper Triassic (Nakaseko & Nishimura, 1979), it is more probable that it belongs at least to the Lower Ladinian if not even to the Anisian.

The radiolarian association from the Vršič locality (Table 1) is quite differrent from the above mentioned associations. Most species show an evolutionary higher stage. *Oertlisponginae* with flattened spines (*Falcispongus hamatus* Dumitrica, *F. rostratus* Dumitrica, *F. uncus* n. sp.) and representatives of *Pseudostylosphaera* Kozur & Mostler with twisted spines (*Pseudostylosphaera goestlingensis* (Kozur & Mostler), *P.* cf. *hellenica* (De Wever)) occur. In spite of the rather poor preservation, the species of *Dumitricasphaera*? Kozur & Mostler with wings or spinules on the spine-tips (*Dumitricasphaera ? pennata* n. sp., *D. ? trispinosa* (Kozur & Mostler), *Dumitricasphaera* ? spp.) are frequent. They probably evolved from *Spongopallium* Dumitrica, Kozur & Mostler by the specialisation of spines, which would allow them a better flotation. *Zhamojdasphaera* Kozur & Mostler is also present.

In the upper part of the Vršič section (samples Vr 4 and Vr 5) representatives of *Plafkerium* Pessagno (*Plafkerium ? firmum* n. sp., *Plafkerium* ? sp.) are most abundant. *Hungarosaturnalis multispinosus* Kozur & Mostler, known from the Langobardian (Kozur & Mostler, 1983) is present. The assumed age is thus Langobardian, the lower part of the section perhaps ranges to the Fassanian.

From the same section a bivalve *Daonella pichleri* Mojsisovics, indicating a Ladinian age, was reported by Ramovš and Jurkovšek (1983b).

At the Gorenja Trenta locality, situated 4 km SW in a direct line from Vršič, five radiolarian species were described from a lithologicaly identical sequence (Kolar-Jurkovšek, 1989). On the basis of the genera *Praeheliostaurus* Kozur & Mostler and *Pterospongus* Dumitrica a more or less the same age of radiolarian-bearing rocks can be assumed for both localities.

The exact correlation with other assemblages described so far is difficult, because many of our forms are new. On the basis of *Oertlisponginae* the assemblage can be compared with the assemblages from two olistoliths from the wildflysch of the Rarau

Syncline (Dumitrica, 1982a, samples R 114/4 and R 78/6). The species found in NW Yugoslavia as well as in the Eastern Carpathians are *Falcispongus hamatus* Dumitrica and *Falcispongus rostratus* Dumitrica. The representatives of *Spongoserrula* Dumitrica and *Pterospongus* Dumitrica are missing in our material probably only because of a rather poor preservation.

The recorded radiolarians show some similarities with the *Emiluvia ? cochleata* assemblage from SW Japan (Nakaseko & Nishimura, 1979). The representatives of *Plafkerium* Pessagno are somewhat similar to *Emiluvia ? cochleata* Nakaseko & Nishimura, and *Stauracontium minoense* Nakaseko & Nishimura, *Hungarosaturnalis multispinosus* Kozur & Mostler resembles *Saturnosphaera pileata* Nakaseko & Nishimura and *Saturnosphaera triassica* Nakaseko & Nishimura. The age of *Emiluvia ? cochleata* assemblage is probably Ladinian and not Upper Triassic as suggested by Nakaseko and Nishimura (1979).

In the Camp Cove Formation in Canada, Cordey et al. (1988) found a radiolarian assemblage with representatives of *Sarla* Pessagno (comparable to *Sarla* spp. pl. 5, figs. 11, 12) and *Pseudostylosphaera* Kozur & Mostler with twisted spines. On the basis of conodonts the concluded age of their radiolarian assemblage is Upper Anisian-Lower Ladinian.

The radiolarian assemblage from the locality Mokronog (Table 1) is characterized by abundant *Plafkerium ? firmum* n. sp. and *Plafkerium abbotti* Pessagno. There occur also *Crucella* sp., *Gomberellus bispinosus* (Kozur & Mostler), *Sanfilippoella recta* Kozur & Mostler, *Vinassaspongus subsphaericus* Kozur & Mostler and *Zhamojdasphaera latispinosa* Kozur & Mostler. The radiolarian content is similar to that of the Cordevolian assemblages described by Kozur and Mostler (1979; 1981) and Lahm (1984). According to the stratigraphic position in the Mokronog section below the bivalve *Daonella* cf. *lommeli* (Wissmann), the probable age is Langobardian.

The Cordevolian fauna from the Reifling Limestone (Lahm, 1984) contains two species in common with the assemblage from Mokronog: *Vinassaspongus subsphaericus* Kozur & Mostler and *Zhamojdasphaera latispinosa* Kozur & Mostler. Beside there are various representatives of *Capnuchosphaera* De Wever, still missing in our material, but representatives of *Plafkerium* Pessagno very common at Mokronog have not been recorded from Grossreifling.

The radiolarian assemblage from Mokronog can be correlated with the radiolarians from the Tourla locality in the Inner Hellenides of Greece (Ladinian to Middle Carnian) (De Wever, 1982). The species both assemblages have in common are: *Natraglia luminosa* Pessagno, *N. unica* Pessagno and *Plafkerium abbotti* Pessagno.

The same three species were also found in the *Pantanellium silberlingi* Zone defined by Pessagno et al. (1979) in the San Hipolito Formation of Baja California. They occur together with representatives of *Capnuchosphaera* De Wever and *Pantanellium* Pessagno. The age of the assemblage is supposed to be upper middle Norian (Pessagno et al., 1979).

Conclusion: In the studied sections from northwestern Yugoslavia, consisting of micritic cherty limestone alternating with piroclastits Upper Illyrian-Fassanian and Langobardian age was determined on the basis of radiolarians. The older assemblage compares well with the assemblage from the Buchenstein Formation of the Southern Alps and its equivalents from the Carpathians. The age of the Langobardian assemblage was assumed on the basis of the evolutionary stage of selected species and a certain similarity with the Upper Triassic assemblages. The data on Langobardian radiolarians are still too scarce to make an exact correlation possible.

The associations investigated do not derive from a continuous section, so that a direct transition of the radiolarian fauna from the Lower to the Upper Ladinian has not been recorded.

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Srednjetriasni radiolariji Slovenije

Povzetek

Uvod

Plasti apnenca z roženci, ki nastopajo med piroklastičnimi kamninami, predstavljajo v Sloveniji zelo značilen litološki člen v srednjem triasu. Do nedavna smo uvrščali vse plasti, ki so vsebovale primarne vulkanske kamnine ali tufe, v ladinij. Jurkovšek (1983, 1984) je z daonelami in pozidonijami dokazal, da sta v tem razvoju zastopana tako fassan kot tudi langobard. Nekateri raziskovalci so na podlagi fosilne združbe iz teh plasti uvrstili le-te v obdobje zgornji anizij-ladinij (Premru, 1974; 1980; 1983). S tem se je odprlo vprašanje, ali se je vulkansko delovanje in torej razpad Slovenske karbonatne platforme pričelo že v zgornjem aniziju ali šele v ladiniju.

Dobro znane radiolarijske združbe v litološko podobnih razvojih severne Italije, Madžarske in Romunije so nas spodbudile, da smo v svoje raziskave vključili tudi to fosilno skupino. Želeli smo potrditi, da so vulkanske kamnine nastajale v fassanu in langobardu, predvsem pa smo želeli najti več dokazov za obstoj fassanske podstopnje, ki sta jo pri nas do sedaj paleontološko dokazala le Bittner (1984) in Jurkovšek (1983). Vprašanja, ali se je vulkansko delovanje na ozemlju Slovenije začelo že v aniziju ali šele v ladiniju, pa na sedanji stopnji poznavanja triasnih radiolarijev v svetu še ne moremo zadovoljivo rešiti.

Paleogeografski razvoj dela Slovenije v ladiniju

Stanko Buser

Mirno geološko obdobje, ki se je v Sloveniji pričelo v zgornjem permu z nastankom velike Slovenske karbonatne platforme, ki je obsegala skoraj celoten prostor Slovenije in se je v spodnjem triasu še bolj stabilizirala, je pričelo pojenjevati v zgornjem aniziju. Na nekaterih mestih dotakratne stabilne karbonatne platforme so se pojavile dolge in globoke razpoke, ki so bile kmalu razširjene v ozka intraplatformna korita. Na večjem delu karbonatne platforme pa so v zgornjem aniziju še naprej nastajali plitvomorski apnenci, ki so bili kasneje zvečine spremenjeni v dolomit. V globokih intraplatformskih koritih so nastajali gomoljasti rdečkasti apnenci tipa Han Bulog oziroma Bučka (Kühn & Ramovš, 1965), lapornati apnenci s konodonti in laporji s pozidonijskimi školjkami (Ramovš & Jurkovšek, 1983 a).

V spodnjem ladiniju je Slovenska karbonatna platforma ob globokih prelomih prevladujoče smeri vzhod-zahod razpadla na večje grude (Buser, 1986). Ta razpad karbonatne platforme je povzročila idrijska tektonska faza, ki je bila ena najpomembnejših faz na slovenskih tleh (Buser, 1980 a). V večini primerov so bile te grude pri začetnem tektonskem delovanju globlje pogreznjene, kot je bila prejšnja karbonatna platforma. Vendar so bile kasneje nekatere grude ponovno dvignjene, ponekod celo iznad morja (Placer & Čar, 1975, 1977; Buser, 1986). Na teh dvignjenih predelih je erozija odstranila kamnine celo do karbonske podlage. Erodirane kamnine najdemo presedimentirane v ladinijskih konglomeratih na večjem predelu Idrije in Južnih Karavank, kjer jim pripada pisani konglomerat tipa ugoviške breče (Buser, 1980 b).

Predel, ki predstavlja današnji del osrednje Slovenije, je bil kot gruda pogreznjen najgloblje in ga je Premru (1980, 1983) uvrstil v evgeosinklinalno območje. Buser (1989) pa uvršča ta predel v začetni in s tem najstarejši del Slovenskega bazena. Južneje ležeči predel od evgeosinklinale je Premru (1980, 1983) prištel k miogeosinklinali. Po mnenju Buserja (1989) pa je to predel kasnejše Dinarske karbonatne platforme, ki je nastala šele v spodnjem karniju.

Večje grude pa niso ostale kot enoviti pogreznjeni ali dvignjeni predeli. Tudi na njih je prišlo do manjših ali večjih razkosanj, ki so povzročila nastanek diferenciranih sedimentacijskih prostorov v okviru iste paleogeografske enote oziroma grude. O takih razčlenjenih in neenotnih sedimentacijskih prostorih na idrijskem ozemlju sta pisala Placer in Čar (1975, 1977). Zaradi teh pestrih paleogeografskih razmer so nastale tudi izredno pestre kamnine, ki se lateralno spreminjano že na majhnih razdaljah. V najgloblje pogreznjenem predelu, to je v Slovenskem bazenu, so lateralne spremembe v sestavi kamnin manj občutne kot na prostoru, ki leži južno od tega bazena oziroma na kasnejši Dinarski karbonatni platformi. Tukaj je že redkost, če ne dobimo na dolžini nekaj sto metrov popolnoma drugačnega zaporedja kamninskih različkov.

Razvoj ladinijskih plasti s tufi v Sloveniji

V osrednjem delu današnje Slovenije oziroma Slovenskem bazenu se je v ladiniju odložila nekaj sto metrov debela skladovnica kamnin psevdoziljske formacije. Sestavljajo jo skrilavi glinovci v menjavanju z drobami in tufi, poredki pa so vmesni vložki ploščastega mikritnega apnenca z bolj ali manj pogostnimi polami in gomolji rožénca.

Izredno pomembno vlogo je v ladiniju imelo vulkansko delovanje. Večina vulkanitov spilitno-aretofirske asociacije (Grafenauer, 1985) je vezana na osrednji del Slovenije oziroma Slovenski bazen. Velike gmote primarnih vulkanskih kamnin, ki v Slovenskem bazenu prebijajo sedimente psevdoziljske formacije in prevladujejo nad piroklastiti, so vezane pretežno na globoke prelome ob robovih bazena.

Na območju, ki je ležalo južno od Slovenskega bazena, so v ladiniju nastali ploščasti apnenci z gomolji in polami rožena, glinovci in laporji. Med temi kamninami so številne plasti tufov in tufitov, ki mnogokje prevladujejo nad drugimi kamninami in so v bistvu najbolj značilni kamninski člen ladinija. Tufi imajo brez dvoma svoj izvor v vulkanskem delovanju v Slovenskem bazenu, saj dobimo primarne vulkanite na izredno redkih mestih južno od Slovenskega bazena. V primerjavi s Slovenskim bazenom so tudi debeline ladinijskih plasti v južneje ležeči grudi občutno manjše. Običajno so debele le nekaj metrov in redko presegajo debelino sto metrov.

Mesta vzorčevanih srednjetriasnih plasti z radiolariji v Sloveniji

Da bi dobili čimveč podatkov o starosti oziroma začetku vulkanskega delovanja v srednjem triasu v Sloveniji, smo opravili sistematično vzorčevanje za radiolarije na dvanajstih mestih. S tem smo »pokrili« pretežni del Slovenije, kjer v primernih kamninah lahko pričakujemo radiolarije. Na vseh lokacijah smo opravili sistematično in enako natančno vzorčevanje, vsi vzorci so bili tudi enako natančno preiskani na radiolarije. Žal pa so vsebovale določljive in zadostno število radiolarijev kamnine le na petih vzorčevanih mestih. Na preostalih sedmih mestih so bili vzorci prazni ali pa so vsebovali slabo ohranjene in nedoločljive radiolarije. Pretežno smo vzorčevali kremenaste apnence med polami rožencev, manj vzorcev pa smo vzeli v rožènčevih polah in gomoljih med apnenci, še manj v tufih. Na radiolarijih pozitivne lokalnosti so opisane v angleškem delu besedila in prikazane tudi v stolpcih (sl. 1, 2). Druge vzorčevane lokalnosti pa so še naslednje:

Mišji dol pri Primskovem

Ob cesti, ki pelje iz Temenice na Primskovo, smo vzorčevali dobro odkriti profil v dolini vzhodno od vasice Mišji dol severno od Primskovega. V nižjem delu profila so značilno zeleni tufi pietra verde, ki leže na anizijskem dolomitu. Navzgor sledi menjavanje tufa in kalkarenita, ki višje preide v mikritni apnenec s polami rožènca. Še više prevlada apnenec nad tufom. V vrhnjem delu profila pa je tudi ploščasti dolomit s polami rožènca. Vsega skupaj smo v tem profilu vzeli 19 vzorcev pretežno apnenca za radiolarije, vendar so bili vsi prazni.

Trebelno

Južno od vasice Trebelno leži nad anizijskim dolomitom rožnato sivi do zelenkasti gomoljasti mikritni apnenec tipa Han Bulog oziroma Bučka. Apnenec vsebuje gomolje temno sivega in rdečega rožènca. Nad apnencem, ki je debel nekaj metrov, leži zelenkasti tuf, ki se višje menjava s plastmi temno sivega mikritnega apnenca. Za radiolarije smo vzeli vzorce v rožnato sivem gomoljastem apnencu v najvišjem delu profila. Pet vzetih vzorcev pa žal ni vsebovalo radiolarijev.

Zgornja Idrijca

Okoli 500 metrov NW od kmetije Riže v Zgornji Idrijci smo ob cesti vzeli v dveh ločenih profilih 13 vzorcev za radiolarije. V vzhodnem profilu leži nad belim masivnim anizijskim dolomitom z vložki tufa okoli 4 metre menjavanja rdečkasto zelenega apnenca in rdečega glinovca. Višje sledi dolomit v menjavanju z rdečim glinovcem. V osmih vzorcih, ki smo jih vzeli v apnencu in dolomitu, ni bilo radiolarijev.

Drugi vzorčevani profil leži prav tako ob omenjeni cesti približno 80 metrov zahodneje od prej imenovanega profila. Čeprav sta profila tako blizu skupaj in v enako starih plasteh, si kamninsko nista prav nič podobna. V drugem profilu se menjavajo plasti okremenelega gomoljastega mikritnega apnenca s sivkasto zelenimi laporji in tufi. Še posebno značilni so gomoljasti apnenčevi vključki v laporju, sivem glinovcu in tufu. Pet vzorcev apnenca ni vsebovalo radiolarijev.

Idrske Krnice

Južno od kmetije Petrnel je v potoku Otuška razkrit gomoljasti rožnati in svetlo sivi apnenec tipa Han Bulog oziroma Bučka, ki vsebuje amonite. V apnencu so tudi vložki zelenega tufa pietra verde. Nad apnencem slede sivkasto zeleni tufi (Buser, 1986). V gomoljastem apnencu je Kolar-Jurkovšek (1983) določila zgornjeanizijske konodonte. V devetih vzorcih iz vrhnjega dela apnenca pa so bili določeni naslednji radiolariji: *Baumgartneria retrospina* Dumitrica, *Falcispongus calcaneum* Dumitrica in *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler. Pri radiolarijih so ohranjene večinoma samo bodice brez lupin in material ni primeren za podrobno paleontološko analizo. Radiolariji kažejo na zgornjeanizijsko-spodnjeladinijsko starost.

Jagršče

Ob izdelavi nove ceste med Želinom in Jagrščami so bile krasno odkrite ladinijske plasti, katerih kamninska sestava se že na nekaj sto metrov hitro spreminja. Tik pod Jagrščami pričenjajo ladinijske plasti z lapornato-glinenimi kameninami, navzgor pa se menjava črni ploščasti mikritni apnenec, ki vsebuje pole in gomolje rožénca s plastmi tufa. V nižjem delu profila prevladujejo tufi, v srednjem pa apnenec, ki se v vrhnjem delu, že blizu meje s cordevolskim dolomitom, zopet menjava s tufi. Med dvajsetimi vzetimi vzorci apnenca in rožénca sta samo dva vsebovala slabo ohranjene radiolarije.

Severozahodno od opisanega zaporedja kamenin pa so ob cesti skoraj sami tufi, ki obsegajo celotno skladovnico med anizijskim dolomitom v podlagi in cordevolskim dolomitom v krovnini. Blizu stika s cordevolskim dolomitom so v tufu večji gomolji črnega okremenelega apnenca. Tik pod cordevolskim dolomitom so v tufu in laporju razmeroma številni lepo ohranjeni amoniti in školjke *Daonella lommeli* (Wissmann).

Korošica v Savinjskih Alpah

Profil je razkrit vzhodno od Korošice ob križišču planinskih poti, ki pripeljeta iz Robanovega kota in Luč. Anizijski apnenec z algami normalno prehaja v ploščast in temno sivkasto rjav, precej bituminozen apnenec z rožénci, ki verjetno pripada že ladiniju. Približno 30 metrov nad kontaktom se med apnencem začnejo pojavljati trši zeleni tufi tipa pietra verde. Posamezni horizonti tufa so debeli do 3 metre. V vrhnjem delu skladovnice je apnenec svetlejši, debeleje plastovit, med njim so plasti drobnozrnate okremenjene apnenčeve breče. V apnencu smo vzeli 14 vzorcev, ki so vsebovali le močno prekristaljene in poškodovane radiolarije. Profil je 700 m vzhodno od tam, kjer je Jurkovšek (1984) našel langobardske školjke in amonite.

Sistematska paleontologija
Špela Goričan

Določili smo 89 radiolarijskih vrst. Navedene so po abecedi rodov s sinonimiko in opombami v angleškem delu besedila. Opisane so štiri nove vrste: *Dumitricasphaera ? pennata*, *Falcispongus uncus Hozmadia pyramidalis* in *Plafkerium ? firmum*. Združba posameznih vzorcev je prikazana v tabeli 1.

Starost plasti z radiolariji in primerjava z drugimi nahajališči

Radiolarijsko združbo nahajališč Zaklanec, Bohinj in Vojsko (tabela 1) lahko vzporejamo z dobro znano združbo buchensteinskih plasti severne Italije (Dumitrica, 1978a, 1978b, 1982a, 1982b, 1982c; Dumitrica et al., 1980; Kozur & Mostler, 1981; Lahm, 1984). Značilne vrste so: *Archaeosemantis pterostephanus* Dumitrica, *Baumgartneria bifurcata* Dumitrica, *Cryptostephanidium verrucosum* Dumitrica, *Falcispongus calcaneum* Dumitrica, *Foremanellina macrocephala* Dumitrica, *Hozmadia reticulata* Dumitrica, Kozur & Mostler, *Parentactinia pugnax* Dumitrica, *Pentactinocarpus tetracanthus* Dumitrica, *Pentactinorbis kozuri* Dumitrica, *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur & Mostler, *Poulpus curvispinus* Dumitrica, Kozur & Mostler, *Pseudostylosphaera japonica* (Nakaseko & Nishimura), *Silicarmiger costatus* Dumitrica, Kozur & Mostler, *Tiborella magnidentata* Dumitrica, Kozur & Mostler, *Triassistephanidium laticorne* Dumitrica, *Triassothamnus verticillatus* (Dumitrica). Vsi vzorci z enega nahajališča vsebujejo bolj ali manj enako združbo radiolarijev, manjše razlike so lahko samo posledica različne ohranjenosti favne v teh vzorcih. V slabše ohranjenih vzorcih najdemo le odpornejše oblike, vrste s krhkim skeletom se med diagenezo raztopijo.

Mietto in Petroni (1979) sta s konodonti dokazala, da buchensteinske plasti, kjer je serija najdebelejša, segajo od zgornjega ilira do fassana. Določila sta vse tri cone tega intervala: zgornjeilirsko cono avisianus in fassanski coni reitzi in curionii. Plasti z radiolariji na nahajališčih Zaklanec, Bohinj in Vojsko smo torej uvrstili v zgornji ilir-fassan, kar je najširša možna starost buchensteinskih plasti severne Italije.

Enake združbe so bile najdene tudi v olistolitih v vildflišu vzhodnih Karpatov Dumitrica, 1978a, 1978b, 1982a, 1982c). Uvrščene so v zgornji ilir-fassan po primerjavi s favno buchensteinskih plasti.

Podobno združbo, najdeno v rožencih ofiolitne serije na severovzhodu Madžarske, sta Kozur in Réti (1986) uvrstila v zgornji del fassana.

Nekatere vrste, ki nastopajo v naših vzorcih, sta opisala Nakaseko in Nishimura (1979) na Japonskem v združbi *Tripocyclia* cf. *acythus*. Te vrste so: *Pseudostylosphaera japonica* (Nakaseko & Nishimura), *Pseudostylosphaera tenuis* (Nakaseko & Nishimura), *Katorella bifurcata* Kozur & Mostler, *Cryptostephanidium ? japonicum* (Nakaseko & Nishimura) in *Yeharaia annulata* Nakaseko & Nishimura. Čeprav je bila združba *Tripocylia* cf. *acythus* prvotno uvrščena v zgornji trias (Nakaseko & Nishimura, 1979), je bolj verjetno, da pripada spodnjemu ladiniju ali celo aniziju.

Združba nahajališča Vršič (tabela 1) se od prej omenjenih združb precej razlikuje. Večina rodov kaže evolucijsko naprednejše znake. Predstavniki poddružine *Oertlisponginae* imajo sploščene bodice (*Falcispongus hamatus* Dumitrica, *F. rostratus*

Dumitrica, *F. uncus* n. sp.). Poleg vrst z ravnimi bodicami (*Pseudostylosphaera longispinosa* Kozur & Mostler) se med predstavniki rodu *Pseudostylosphaera* pojavljajo tudi vrste z zavitimi bodicami (*Pseudostylosphaera goestlingensis* (Kozur & Mostler), *P.* cf. *hellenica* (De Wever)). Za združbo je značilen rod *Dumitricasphaera* ? Kozur & Mostler, ki ima na koncu bodic krilca ali spinule (*Dumitricasphaera ? pennata* n. sp., *D. ? trispinosa* (Kozur & Mostler), *Dumitricasphaera* ? spp.). Verjetno se je razvil iz rodu *Spongopallium* Dumitrica Kozur & Mostler. Specializacija bodic predstavlja prilagoditev na planktonski način življenja. V združbi je najden tudi rod *Zhamojdasphaera* Kozur & Mostler.

V zgornjem delu profila Vršič (vzorca Vr 4 in 5) prevladujejo predstavniki rodu *Plafkerium* Pessagno z zelo širokimi, lahko tudi zavitimi bodicami (*Plafkerium ? firmum* n. sp., *Plafkerium* ? sp.). Najdena je bila tudi langobardska vrsta *Hungarosaturnalis multispinosus* Kozur & Mostler. Sklepamo lahko, da so plasti nahajališča Vršič langobardske starosti, spodnji del profila morda sega še v fassan.

V istem profilu sta Ramovš in Jurkovšek (1983 b) našla školjko *Daonella pichleri* Mojsisovics, ki kaže ladinijsko starost.

Iz litološko enakega zaporedja plasti z nahajališča Gorenja Trenta je opisanih pet radiolarijskih vrst (Kolar-Jurkovšek, 1989). Najdena sta bila rodova *Praeheliostaurus* Kozur & Mostler in *Pterospongus* Dumitrica, na podlagi katerih lahko domnevamo, da gre na nahajališčih Vršič in Gorenja Trenta za približno enako stare plasti.

Združbo nahajališča Vršič je nemoče z gotovostjo vzporejati z drugimi nahajališči v svetu. Do sedaj namreč ni bila opisana ali vsaj kot celota ilustrirana še nobena langobardska radiolarijska združba. Poznane so le posamezne vrste. Vrsti *Falcispongus hamatus* Dumitrica in *Falcispongus rostratus* Dumitrica sta bili na primer najdeni tudi v langobardskih združbah vzhodnih Karpatov Romunije (Dumitrica, 1982 a).

Radiolariji kažejo nekatere skupne značilnosti z združbo *Emiluvia ? cochleata*, ki sta jo opisala Nakaseko in Nishimura (1979) na Japonskem. Naše vrste rodu *Plafkerium* so podobne vrstama *Emiluvia ? cochleata* Nakaseko & Nishimura in *Stauracontium minoense* Nakaseko & Nishimura. Podobno velja za vrsto *Hungarosaturnalis multispinosus* Kozur & Mostler, ki jo lahko uvrstimo v isti rod kot vrsti *Saturnosphaera pileata* Nakaseko & Nishimura in *Saturnosphaera triassica* Nakaseko & Nishimura. Starost združbe *Emiluvia ? cochleata* je verjetno ladinij, čeprav sta jo Nakaseko in Nishimura (1979) uvrstila v zgornji trias.

Iz Kanade je Cordey s sodelavci (1988) prikazal združbo s predstavniki rodu *Sarla* Pessagno (podobnimi vrsti *Sarla* spp., tab. 5, sl. 11, 12) in *Pseudostylosphaera* Kozur & Mostler z zavitima bodicama in jo na podlagi konodontov uvrstil v zgornji anizij-spodnji ladinij.

V radiolarijski združbi nahajališča Mokronog (tabela 1) sta najbolj tipični vrsti *Plafkerium ? firmum* n. sp. in *Plafkerium abbotti* Pessagno. Najdene so še vrste: *Crucella* sp., *Gomberellus bispinosus* (Kozur & Mostler), *Sanfilippoella recta* Kozur & Mostler, *Vinassaspongus subsphaericus* Kozur & Mostler in *Zhamojdasphaera latispinosa* Kozur & Mostler. Združba je precej podobna cordevolskim združbam, ki sta jih opisala Kozur in Mostler (1979, 1981) in Lahm (1984). Kljub temu lahko plasti nahajališča Mokronog uvrstimo v langobard, saj smo nekaj metrov nad radiolariji našli školjko *Daonella* cf. *lommeli* (Wissmann).

Od vrst, ki jih Lahm (1984) našteva iz cordevolske združbe v reiflinških apnencih, smo pri Mokronogu določili vrsti *Vinassaspongus subsphaericus* Kozur & Mostler in *Zhamojdasphaera latispinosa* Kozur & Mostler. Poleg teh je avtor našel številne primerke rodu *Capnuchosphaera* De Wever, ki pri Mokronogu manjkajo. Vrst rodu *Plafkerium* Pessagno z zavitimi bodicami ali z zelo širokimi ravnimi bodicami, ki so pri Mokronogu pogoste, pa ne omenja.

Združba iz Mokronoga je primerljiva z združbo nahajališča Tourla v Notranjih Helenidih Grčije (ladinij do srednji karnij) (De Wever, 1982). Skupne vrste so: *Natraglia luminosa* Pessagno, *Natraglia unica* Pessagno in *Plafkerium abbotti* Pessagno.

Iste tri vrste so znane tudi iz radiolarijske cone *Pantanellium silberlingi*, ki jo je določil Pessagno s sodelavci (1979) na Kalifornijskem polotoku. Pojavljajo se skupaj s predstavniki rodu *Capnuchosphaera* De Wever in *Pantanellium* Pessagno. Pessagno s sodelavci (1979) domneva, da je združba norijske starosti.

Sklep

V severozahodni in osrednji Sloveniji smo podrobneje preiskali radiolarije petih profilov v srednjetriasnih plasteh s tufi.

Našli smo dve očitno različni združbi. Starejša se lepo ujema z združbami buchensteinskih plasti severne Italije in njihovih ekvivalentov v Karpatih in smo jo zato uvrstili v zgornji ilir-fassan. Druga je mlajša, verjetno langobardska. Njena starost je določena na podlagi evolucijsko naprednejših znakov pri nekaterih rodovih. Združba kaže tudi določeno podobnost z zgornjetriasnimi združbami. Natančna primerjava zaradi preskopih podatkov o langobardskih radiolarijih ni možna.

Vsi vzorci iz posameznega profila vsebujejo bolj ali manj enako radiolarijsko združbo, tako da neposrednega favnističnega prehoda med fassanom in langobardom žal nismo našli.

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Plate 1 – Tabla 1

1 *Stauracontium ? granulosum* Dumitrica, Kozur & Mostler, 150 ×, 16513/2, 87/170/3
2 *Stauracontium ? trispinosum* (Kozur & Mostler), 150 ×, 19726/3, 87/231/2
3 *Beturiella robusta* Dumitrica, Kozur & Mostler, 150 ×, 19726/3, 87/206/3
4 *Tiborella magnidentata* Dumitrica, Kozur & Mostler, 150 ×, 19726/3, 87/228/8
5 *Hungarosaturnalis multispinosus* Kozur & Mostler, 150 ×, Vr 5, 87/266/2
6 *Natraglia unica* Pessagno, 150 ×, Mo 18, 87/192/4
7 *Natraglia luminosa* Pessagno, 150 ×, Mo 18, 87/192/1
8 *Crucella* sp., 150 ×, Mo 18, 87/193/7
9 *Gomberellus hircicornus* Dumitrica, Kozur & Mostler, 150 ×, 19726/5, 87/219/6
10 *Gomberellus bispinosus* (Kozur & Mostler), 150 ×, Mo 18, 87/192/8
11 *Katorella bifurcata* Kozur & Mostler, 150 ×, 19726/3, 87/231/9

Plates 1-12: The illustrations are not in accordance with the alphabetical order followed in the text. Related or similar forms are presented together to allow an easier comparison. Designations of each illustration are indicated in this sequence: magnification, sample number, SEM/optical-negative number.

Scanning electron micrographs were taken on a Jeol JSM P-15 at the Montanistika department, Edvard Kardelj University of Ljubljana. All the illustrated material is deposited at the Ivan Rakovec Paleontological Institute, Slovenian Academy of Sciences and Arts.

Table 1-12: Razporeditev slik se ne ujema z abecednim vrstnim redom, po katerem so taksoni urejeni v besedilu. Podobne ali sorodne oblike so zaradi lažje primerjave predstavljene skupaj. Oznake za vsako sliko so navedene v naslednjem zaporedju: povečava, številka vzorca, številka negativa.

Fotografije so posnete na elektronskem vrstičnem mikroskopu Jeol JSM P-15 na VTOZD Montanistika Univerze Edvarda Kardelja v Ljubljani. Material je shranjen na Paleontološkem inštitutu Ivana Rakovca, ZRC SAZU v Ljubljani.

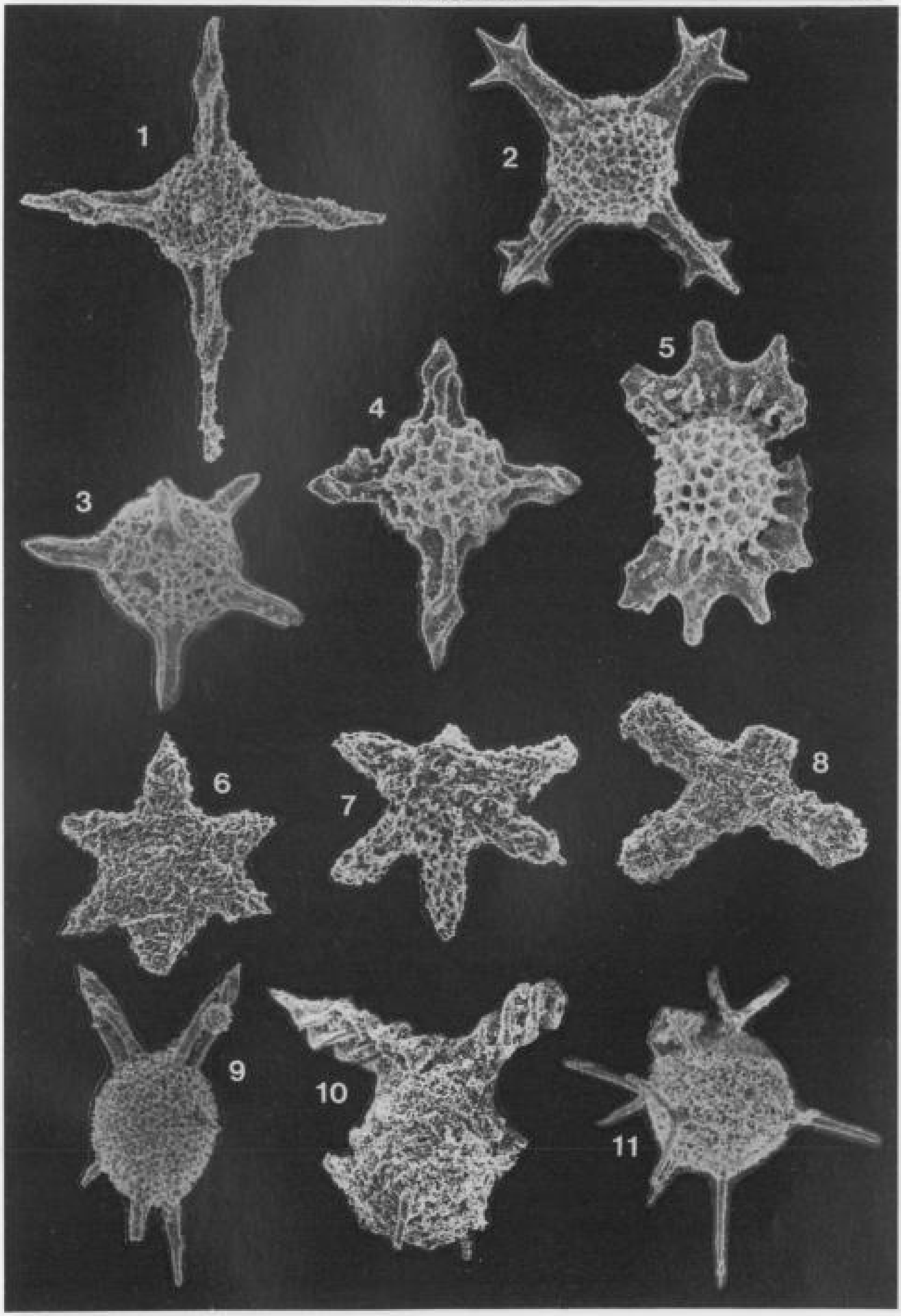
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Plate 2 – Tabla 2

1, 2 *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur & Mostler, *1*: 100 ×, Gr 10, 87/224/4; *2*: 150 ×, 19726/3, 87/211/3
3 *Pentaspongodiscus ladinicus* Dumitrica, Kozur & Mostler, 150 ×, 16513/2, 87/170/10
4 *Pentaspongodiscus* cf. *ladinicus* Dumitrica, Kozur & Mostler, 150 ×, Mo 19, 87/196/2
5 *Pentaspongodiscus symmetricus* Dumitrica, Kozur & Mostler, 150 ×, 19726/3, 87/211/4
6 *Vinassaspongus subsphaericus* Kozur & Mostler, 150 ×, Mo 18, 87/192/6
7 *Vinassaspongus* cf. *subsphaericus* Kozur & Mostler, 150 ×, 19726/3, 87/206/2
8 *Zhamojdasphaera latispinosa* Kozur & Mostler, 200 ×, Mo 19, 87/196/4
9 *Zhamojdasphaera* sp., 200 ×, Vr 3, 87/178/7

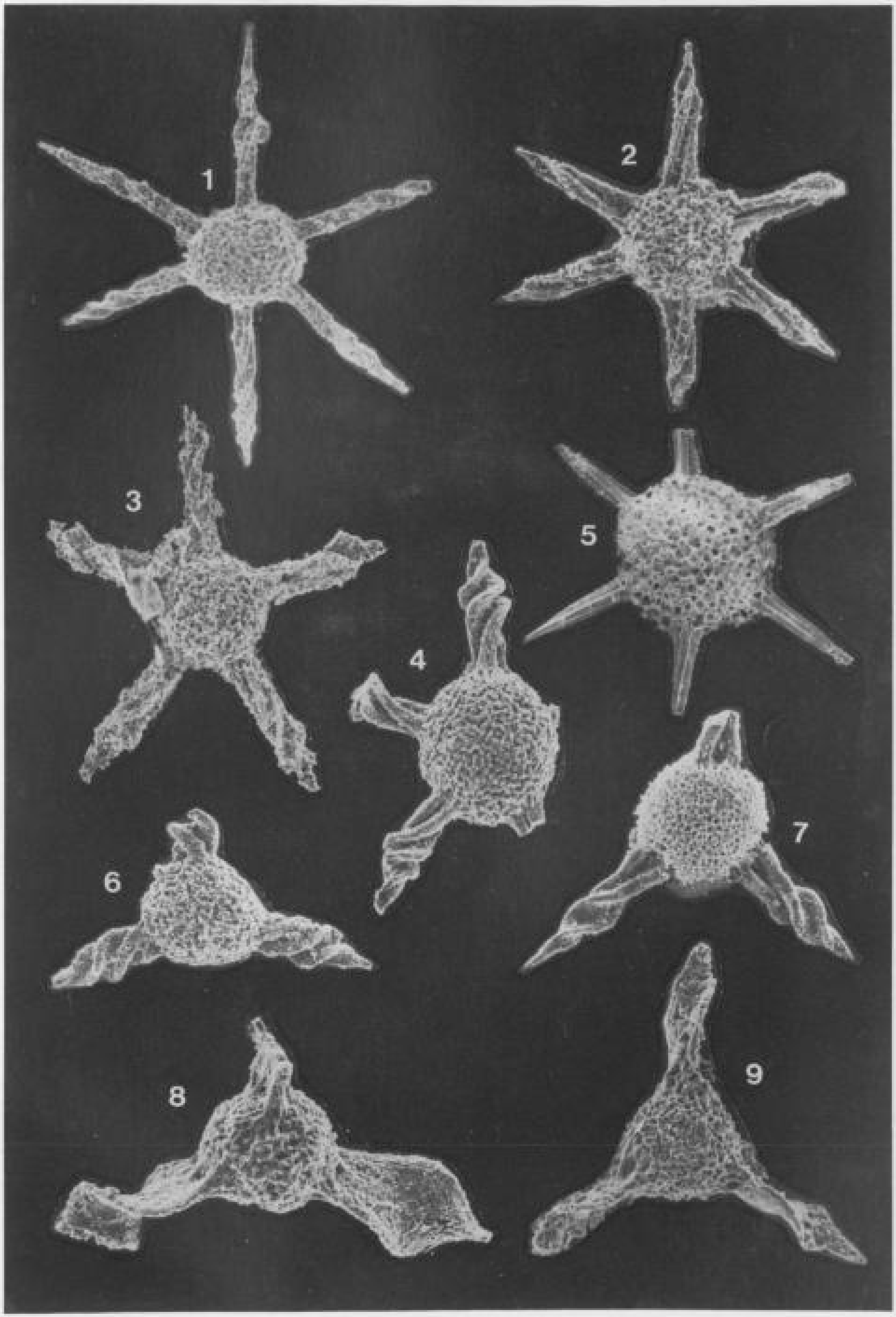
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Plate 3 – Tabla 3

1 *Baumgartneria bifurcata* Dumitrica, 100 ×, Gr 10, 87/238/3
2 *Baumgartneria trifurcata* Dumitrica, 100 ×, 19726/3, 84/1/7
3 *Baumgartneria retrospina* Dumitrica, 100 ×, 19726/3, 84/1/5
4, 5, 6 *Falcispongus calcaneum* Dumitrica, 100 ×, *4*: Gr 10, 87/232/10; *5*: 19726/3, 84/1/3; *6*: Vr 2, 87/4/9
7 *Falcispongus hamatus* Dumitrica, 150 ×, Vr 2, 87/183/8
8, 9 *Falcispongus uncus* Goričan n. sp., 100 ×, Vr 2, *8*: 87/5/1; *9*: holotype, 87/5/2
10, 11 *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler, 100 ×, *10*: 16513/1, 87/6/7; *11*: 16513/4, 87/6/3
12 *Falcispongus rostratus* Dumitrica, 100 ×, Vr 2, 87/4/2

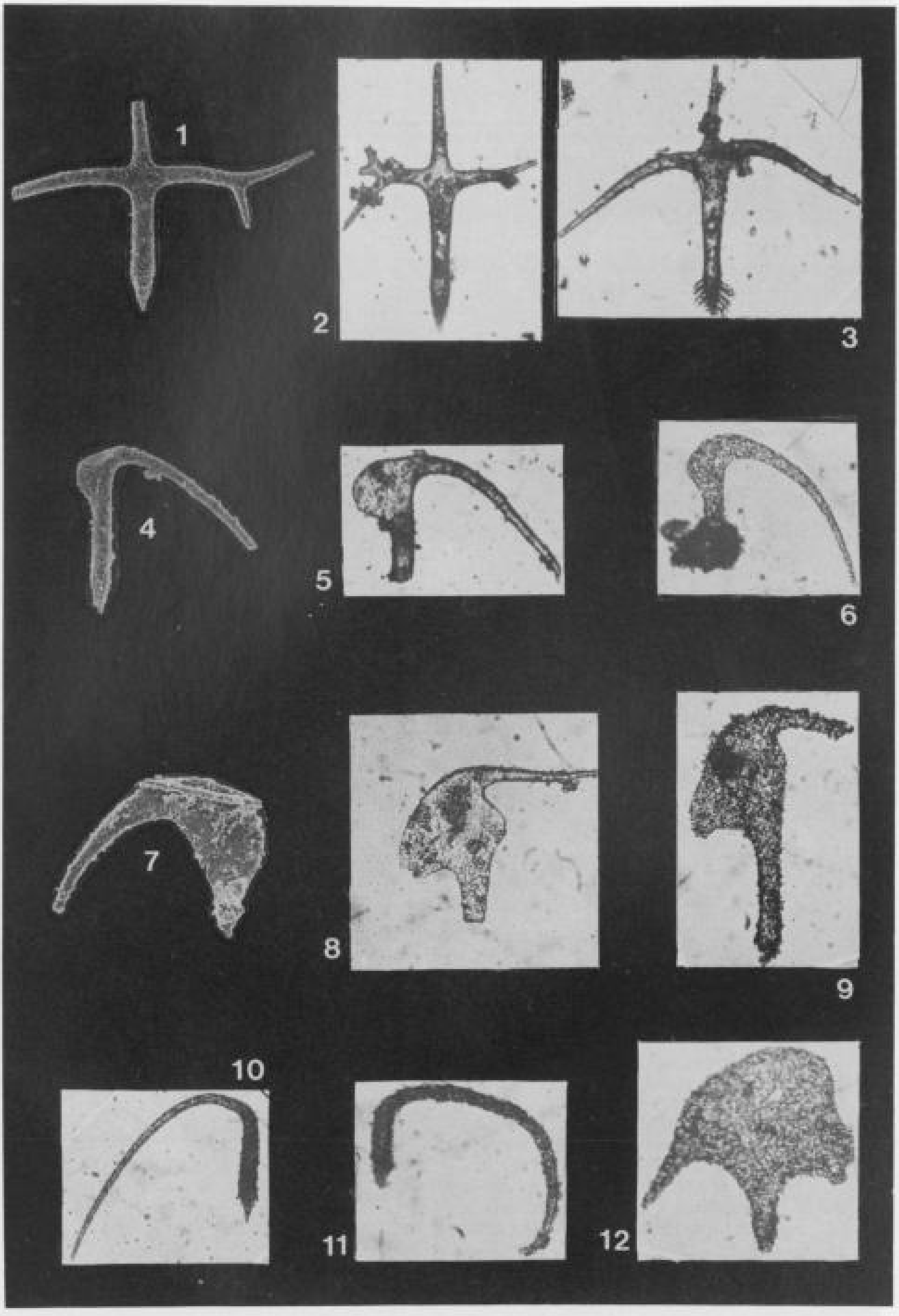
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Plate 4 – Tabla 4

1 *Spongopallium* ? *koppi* (Lahm), 100 ×, 16513/1, 87/175/3
2, 3, 4 *Spongopallium* ? cf. *koppi* (Lahm), 100 ×, *2*: Gr 10, 87/224/2; *3*: 19726/3, 87/229/3; *4*: 19726/3, 87/210/10
5 *Spongopallium* ? sp. A, 100 ×, 19726/3, 87/229/1
6 *Spongopallium* ? sp. B, 150 ×, 19726/5, 87/220/7
7, 8 *Spongopallium contortum* Dumitrica, Kozur & Mostler, 150 ×, *7*: 19726/5, 87/222/4; *8*: Vr 4, 87/183/2
9a, 9b, 10 *Dumitricasphaera* ? *pennata* Goričan n. sp., *9*: holotype, Vr 3, *9a*: 150 ×, 87/179/9; *9b*: polar view of the spine, 200 ×, 88/298/9; *10*: Vr 4, 87/182/7
11, 12, 13 *Dumitricasphaera* ? spp., 150 ×, *11*: Vr 2, 87/185/5; *12*: Vr 3, 87/180/4; *13*: Vr 3, 87/180/3
14 *Dumitricasphaera* ? cf. trispinosa (Kozur & Mostler); 150 ×, Vr 2, 87/185/2

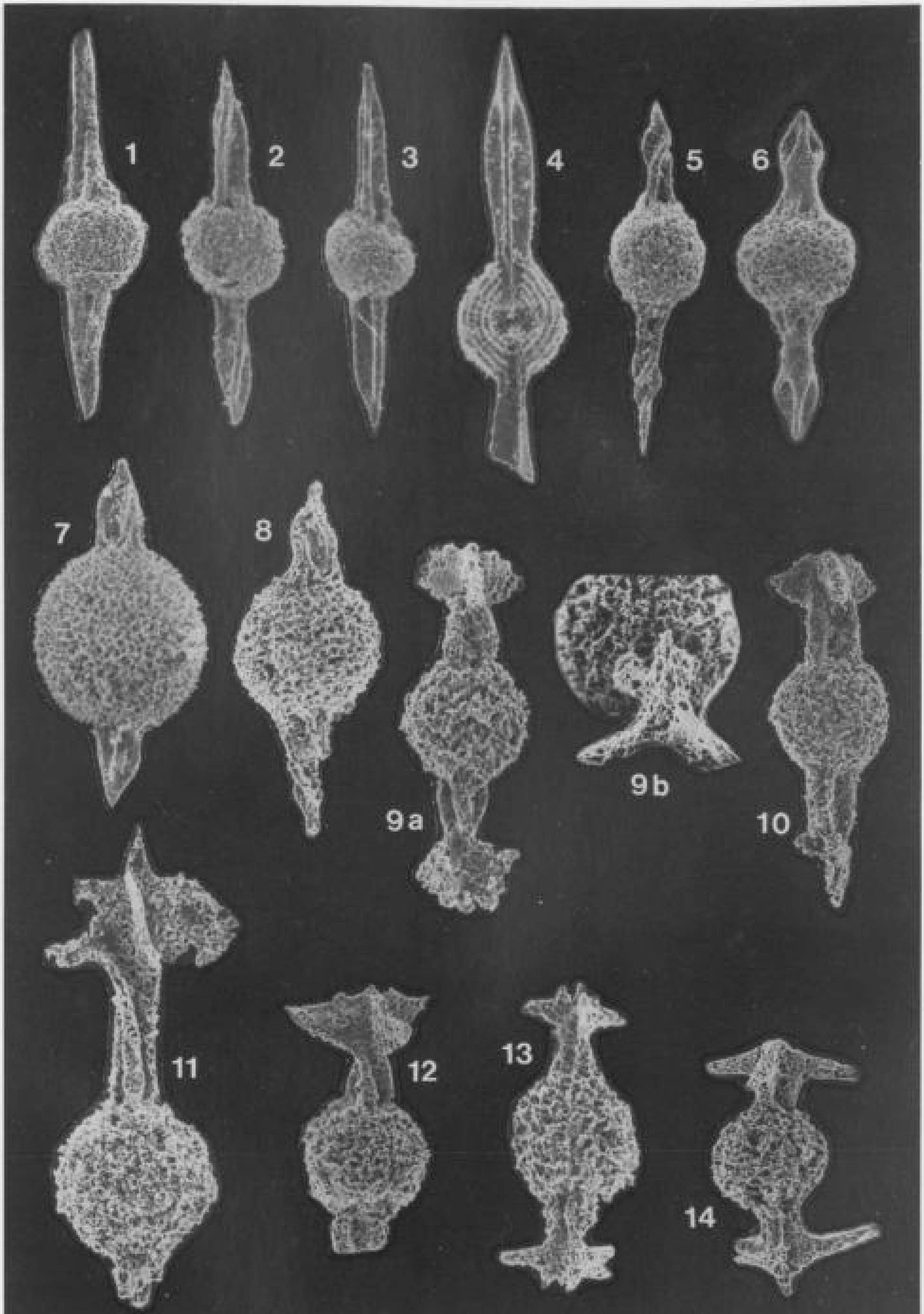
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Plate 5 – Tabla 5

1 *Pseudostylosphaera coccostyla* (Rüst), 100 ×, Gr 11, 87/211/7
2 *Pseudostylosphaera japonica* (Nakaseko & Nishimura), 100 ×, 16513/1, 87/172/5
3, 4, 5 *Pseudostylosphaera longispinosa* Kozur & Mostler, 100 ×, *3*: Gr 11, 87/213/7; *4*: 16513/2, 87/170/8; *5*: Vr 2, 87/184/6
6 *Pseudostylosphaera tenuis* (Nakaseko & Nishimura), 100 ×, 16513/1, 87/176/5
7 *Pseudostylosphaera goestlingensis* (Kozur & Mostler), 100 ×, Vr 4, 87/182/4
8 *Pseudostylosphaera* cf. *hellenica* (De Wever), 100 ×, Mo 19, 87/194/9
9 *Sepsagon longispinosus* (Kozur & Mostler), 150 ×, 19726/3, 87/206/5
10 *Sepsagon* ? *robustus* Lahm, 150 ×, 16513/4, 87/168/4
11, 12 *Sarla* spp., 150 ×, Vr 2, *11*: 87/183/6; *12*: 87/184/5

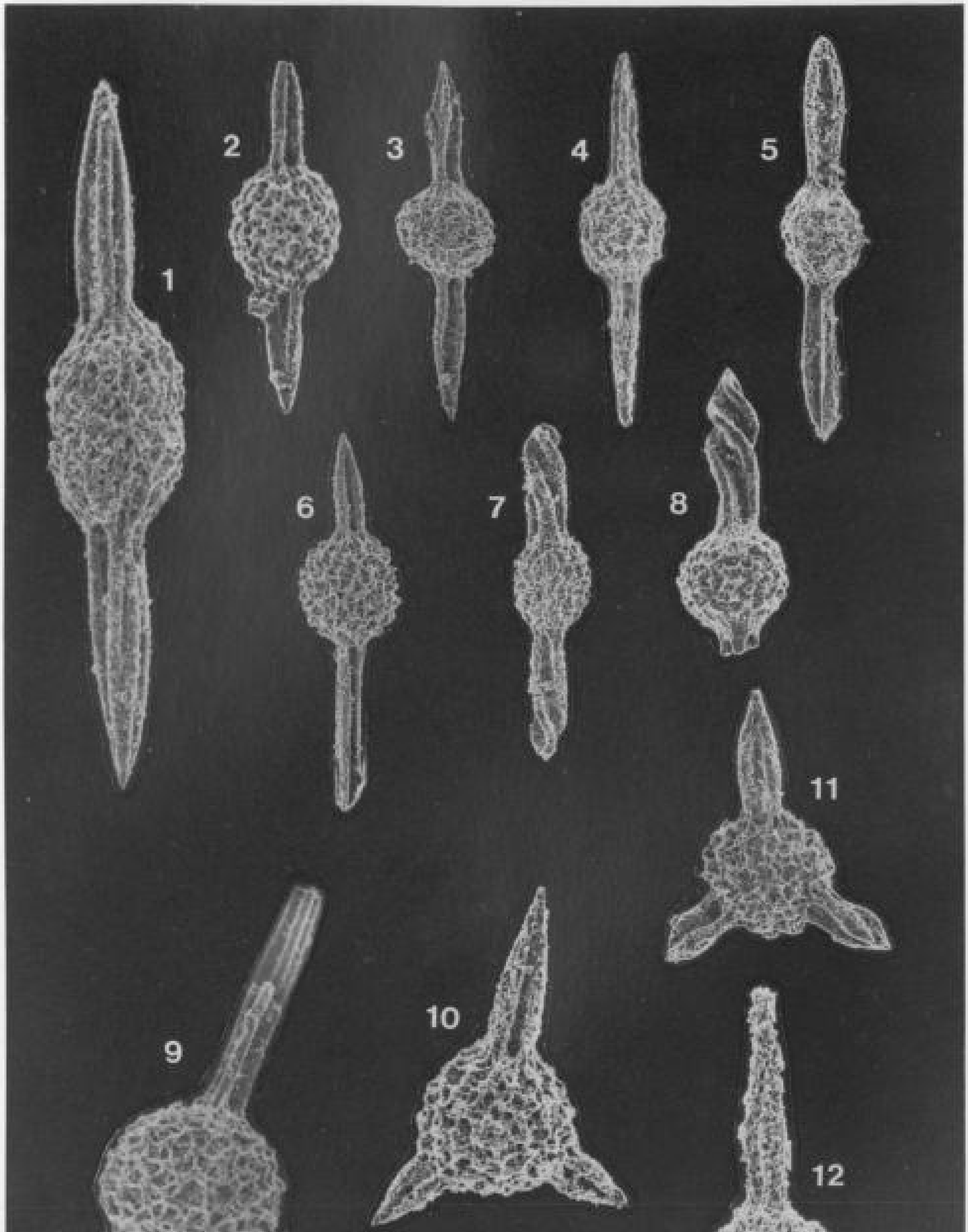
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Plate 6 – Tabla 6

1 *Parasepsagon tetracanthus* Dumitrica, Kozur & Mostler, 100 ×, 19726/3, 88/269/2
2 *Plafkerium* ? cf. *longidentatum* Kozur & Mostler, 100 ×, 19726/3, 87/231/4
3, 4, 5, 6 *Plafkerium* ? *firmum* Goričan n. sp., *3*: holotype, 150 ×, Vr 5, 88/265/9; *4*: 150 ×, Vr 5, 180/9; *5*: 150 ×, Mo 18, 87/195/8; *6*: 100 ×, Vr 5, 88/265/8
7, 8 *Plafkerium abbotti* Pessagno, 150 ×, *7*: Mo 19, 87/201/9; *8*: Mo 18, 87/193/1
9 *Plafkerium* sp., 150 ×, Vr 4, 87/182/1

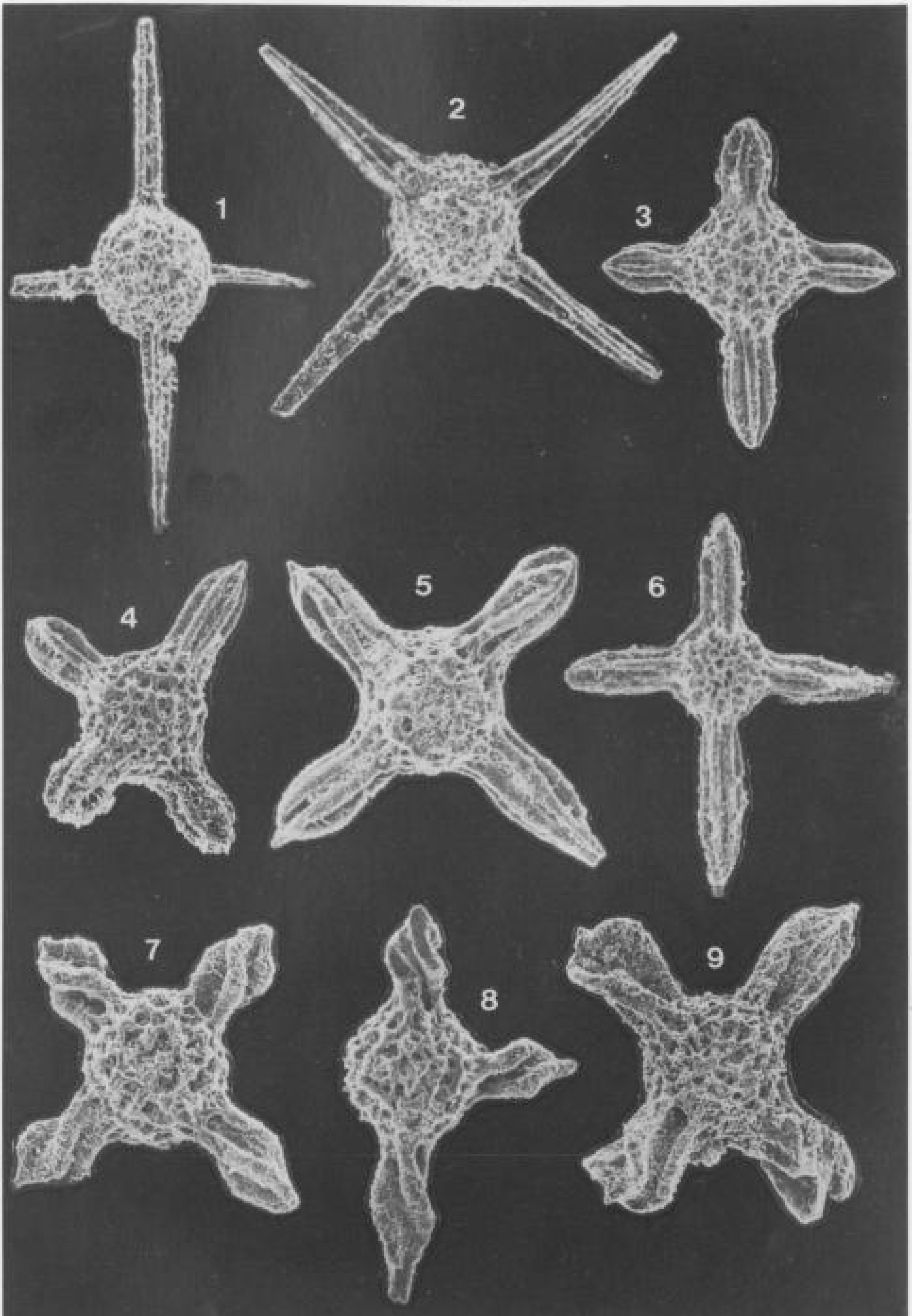
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Plate 7 – Tabla 7

1 *Archaeosemantis cristianensis* Dumitrica, 200 ×, Gr 10, 87/227/6
2 *Archaeosemantis pterostephanus* Dumitrica, 200 ×, 19726/3, 87/229/6
3 *Triassothamnus verticillatus* (Dumitrica), 100 ×, 19726/3, 87/229/9
4 *Tandarnia recoarensis* Dumitrica, 200 ×, 19726/3, 87/229/8
5 *Pentactinocapsa quadripes* Dumitrica, 150 ×, 19726/3, 88/268/9
6 *Parentactinia pugnax* Dumitrica, 200 ×, 19726/3, 87/209/9
7 *Pentactinorbis kozuri* Dumitrica, 150 ×, 16513/1, 87/176/7
8, 9, 10 *Pentactinocarpus tetracanthus* Dumitrica, 150 ×, *8*: 16513/2, 87/170/1; *9*: abnormal specimen, 19726/3, 87/230/6; *10*: abnormal specimen, 19726/3, 87/230/2
11 *Pentactinocarpus fusiformis* Dumitrica, 150 ×, 19726/3, 87/231/5
12 *Pentactinocarpus acanthicus* Dumitrica, 150 ×, Gr 11, 87/212/4

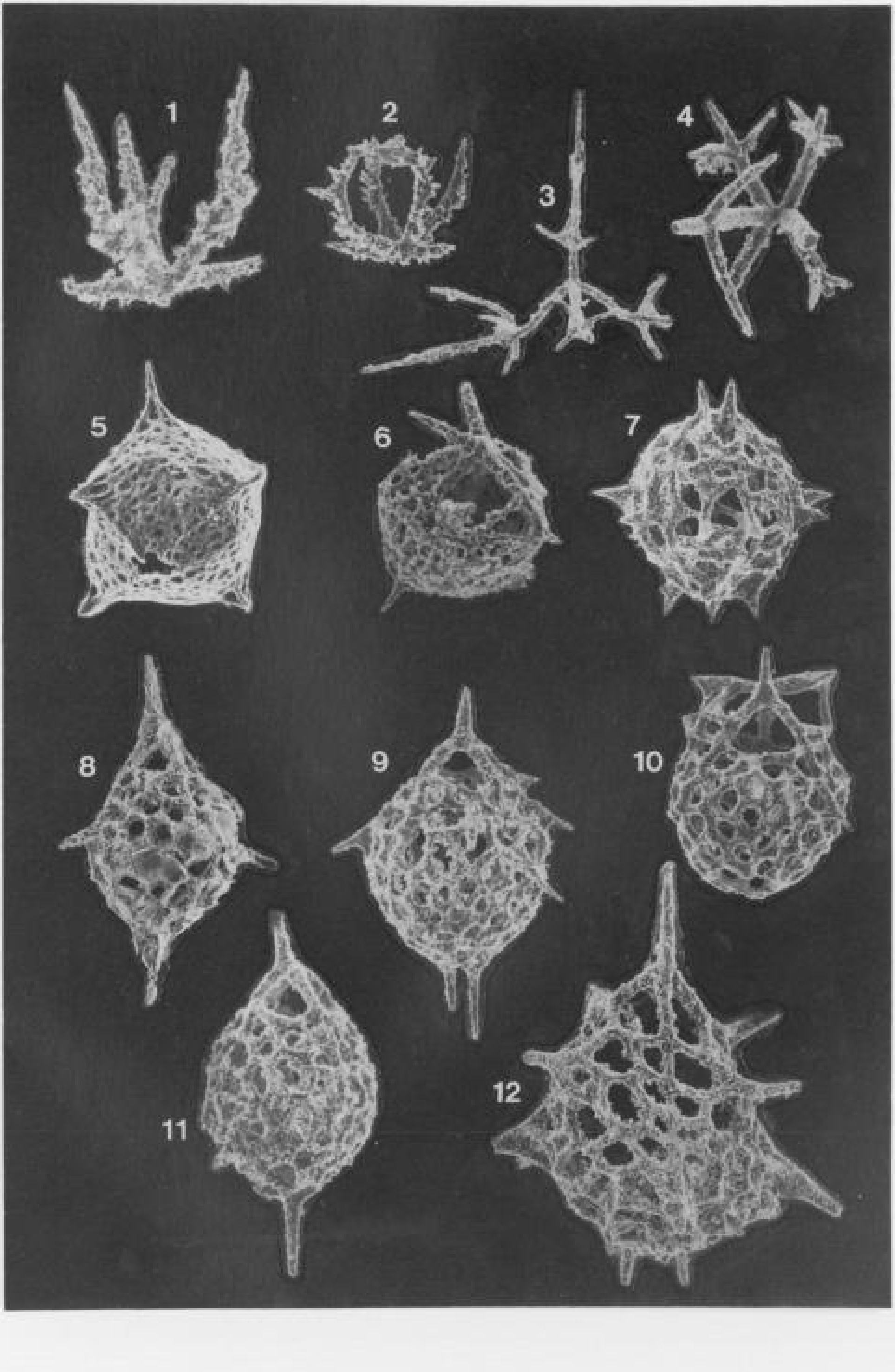
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Plate 8 – Tabla 8

1, 2, 3 *Cryptostephanidium cornigerum* Dumitrica, 200 ×, *1*: Gr 11, 87/212/1; *2*: Vr 3, 87/179/3; 3: abnormal specimen, Gr 10, 87/226/2
4 *Cryptostephanidium verrucosum* Dumitrica, 150 ×, 19726/3, 87/206/9
5 *Cryptostephanidium ? japonicum* (Nakaseko & Nishimura), 150 ×, 19726/3, 87/206/10
6 *Triassistephanidium laticorne* Dumitrica, 150 ×, Gr 11, 87/213/5
7, 8 *Eptingium manfredi* Dumitrica, 100 ×, *7*: Gr 10, 87/225/5; *8*: 19726/3, 88/268/5
9, 10 *Triassobipedis balatonica* Kozur, 200 ×, *9*: 19726/3, 87/209/8; *10*: Gr 9, 87/215/8
11 *Neopylentonema mesotriassica* Kozur, 200 ×, 19726/3, 84/1879

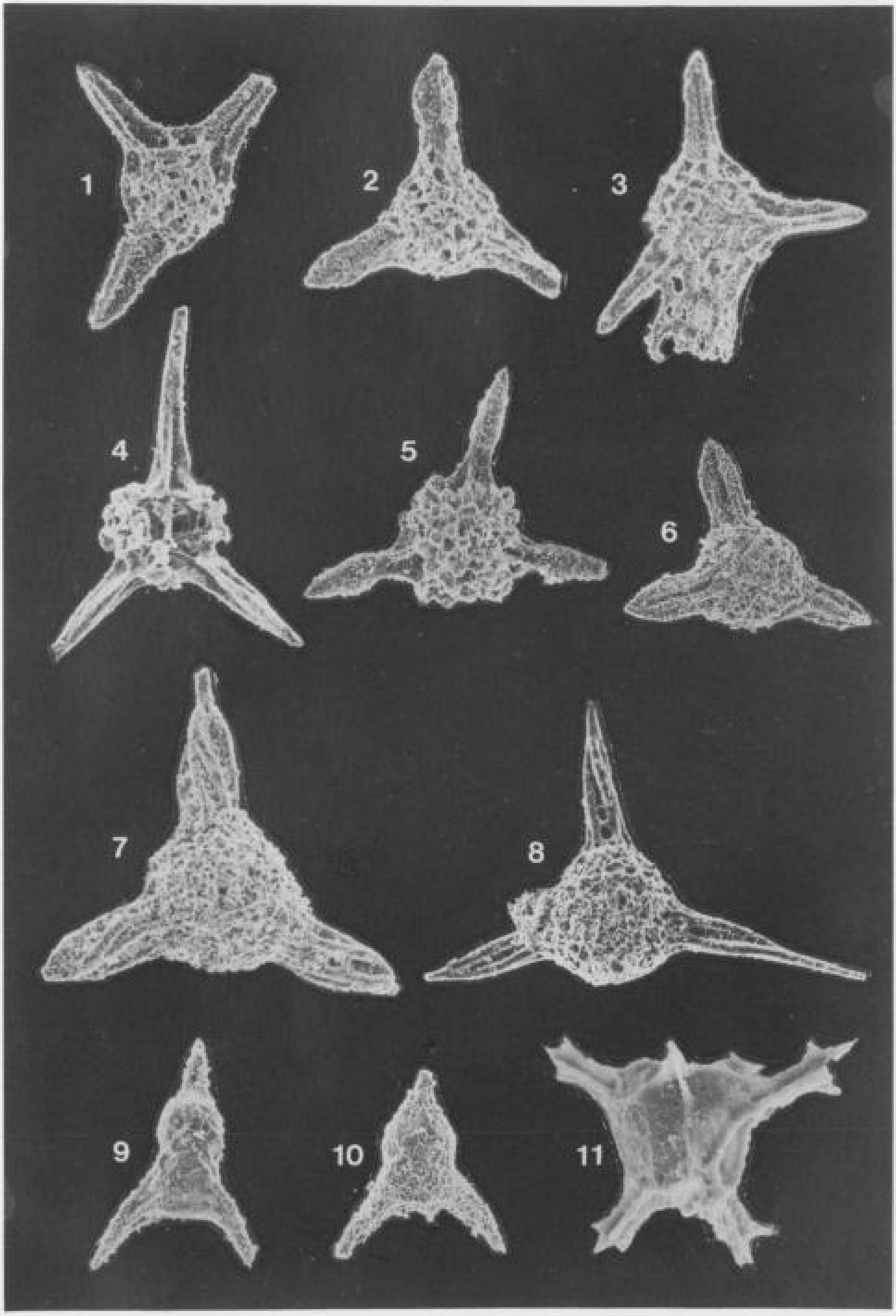
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Plate 9 – Tabla 9

1, 2 *Poulpus curvispinus* Dumitrica, Kozur & Mostler, 200 ×, *1*: 19726/3, 87/230/5; *2*: abnormal specimen, Gr 10, 87/226/1

3 *Poulpus* aff. *curvispinus* Dumitrica, Kozur & Mostler, 150 ×, Vr 2, 87/186/10

4, 5a, 5b, 6, 7a, 7b *Hozmadia pyramidalis* Goričan n. sp., *4*: holotype, 200 ×, 19726/5, 87/221/6; *5a*: 200 ×, 19726/5, 87/269/4; *5b*: apical view, 300 ×, 87/269/5; *6*: 200 ×, Gr 10, 87/236/6; *7a*: 200 ×, 16513/1, 87/173/6; *7b*: antapical view, 300 ×, 87/173/7

8, 9, 10 *Hozmadia reticulata* Dumitrica, Kozur & Mostler, 200 ×, *8*: 19726/3, 88/275/10; *9*: Gr 10, 87/238/5; *10*: 19726/3, 87/230/4

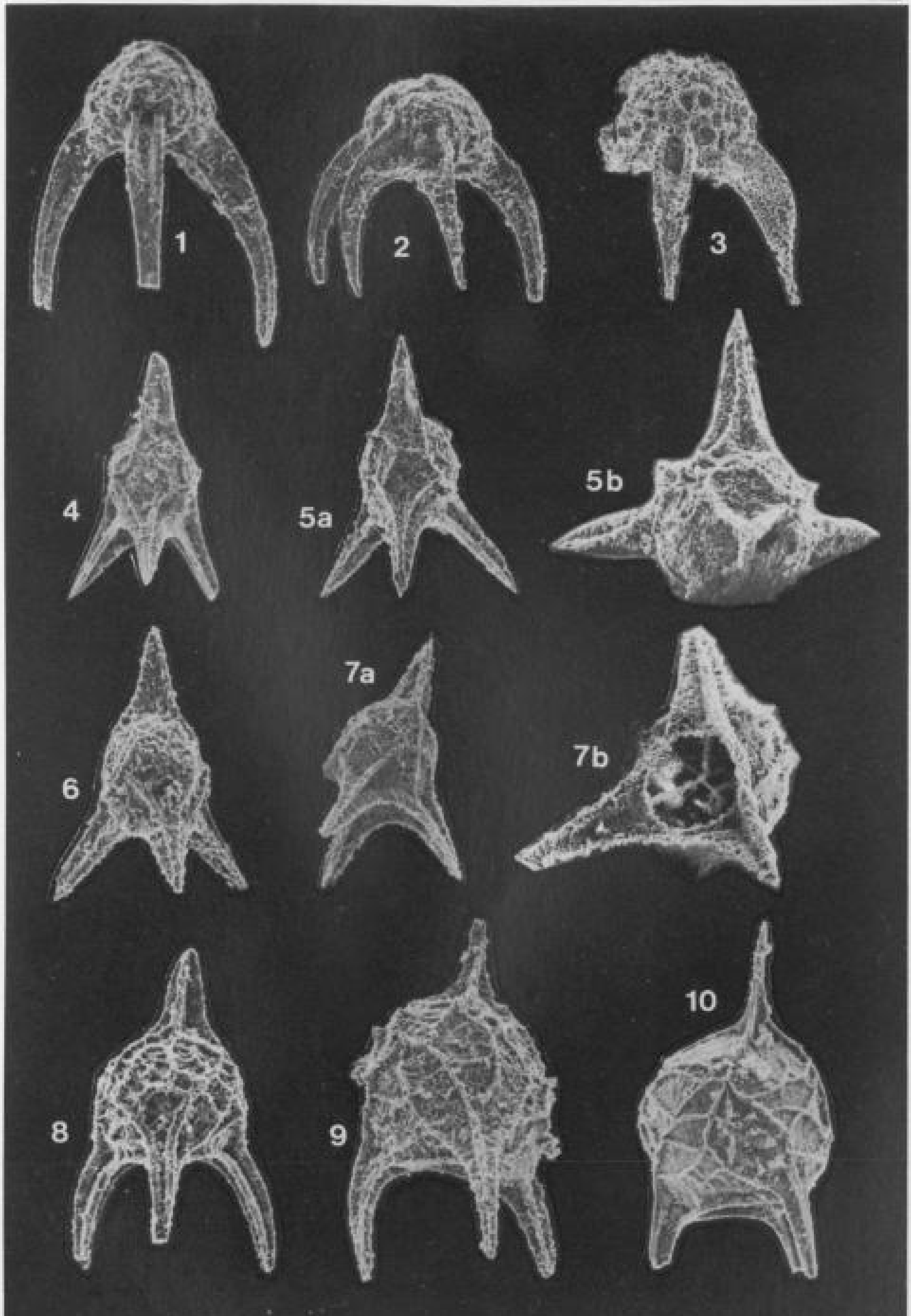
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Plate 10 – Tabla 10

1 *Eonapora mesotriassica* Kozur & Mostler, 150 ×, 19726/3, 87/209/6
2a, 2b *Eonapora* aff. *robusta* Kozur & Mostler, 200 ×, 19726/3, *2a*: 87/209/3; *2b*: antapical view, 87/209/4
3 *Eonapora* sp., 150 ×, Gr 10, 87/237/10
4 *Sanfilippoella recta* Kozur & Mostler, 150 ×, Mo 18, 87/193/8
5 *Hinedorcus alatus* Dumitrica, Kozur & Mostler, 150 ×, 19726/3, 87/207/10
6 *Nofrema trispinosa* Dumitrica, Kozur & Mostler, 150 ×, 16513/1, 87/187/7
7 *Spongosilicarmiger italicus* Kozur, 150 ×, 19726/3, 84/1888
8 *Silicarmiger costatus* Dumitrica, Kozur & Mostler, 150 ×, Gr 11, 87/214/10
9 *Silicarmiger* aff. *costatus* Dumitrica, Kozur & Mostler, 150 ×, Vr 5, 88/266/6

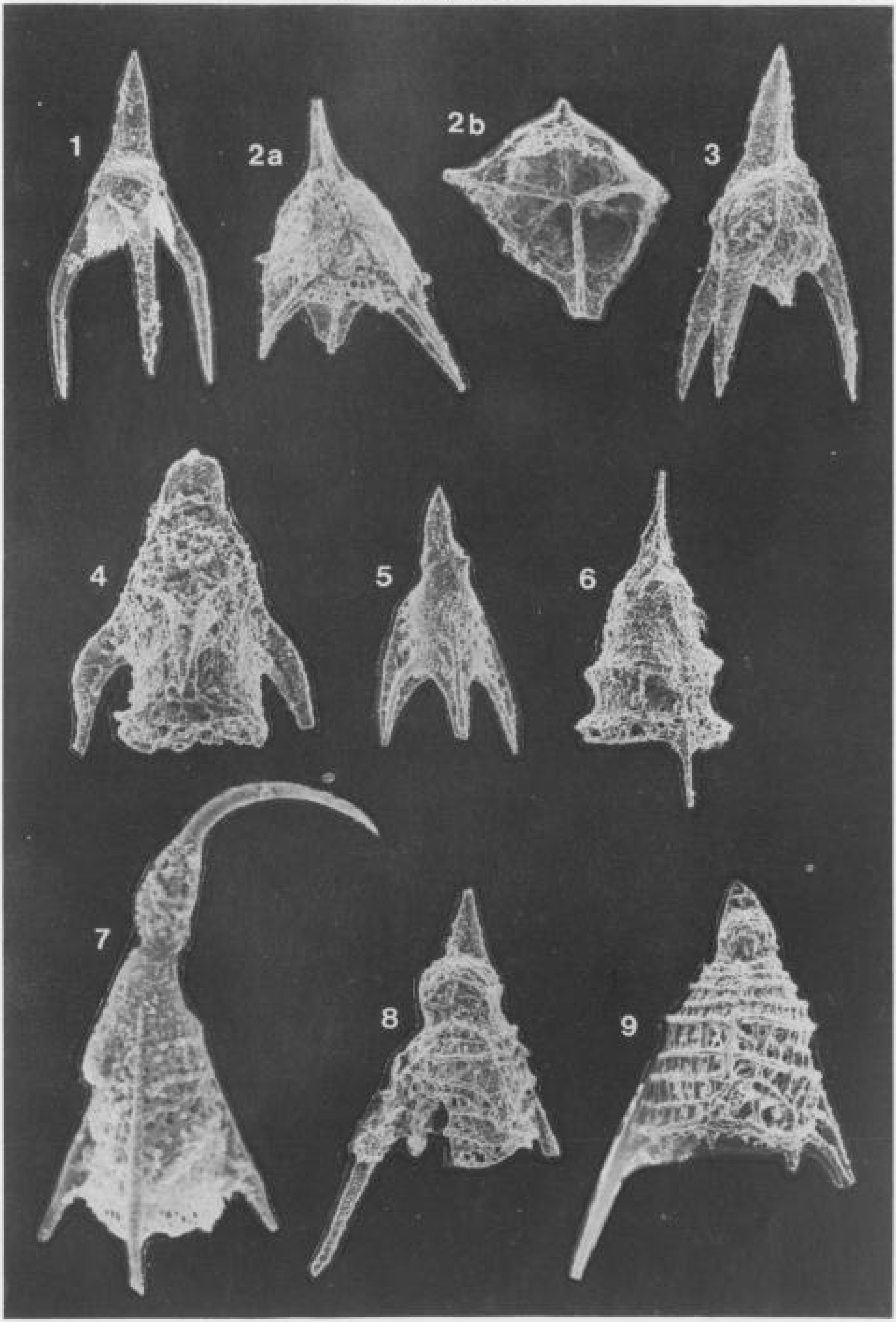
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Plate 11 – Tabla 11

1a, 1b, 2a, 2b, 3a, 3b *Picapora* sp. A, 200 ×, *b*: antapical views, *1a, 1b*: Gr 10, 87/232/6–7; *2a, 2b*: 19726/3, 87/210/1–2; *3a, 3b*: Gr 10, 87/232/4–5

4 *Foremanellina expansolabrum* Dumitrica, 200 ×, Gr 10, 87/227/7

5 *Foremanellina macrocephala* Dumitrica, 200 ×, 19726/5, 87/219/10

6, 7, 8 *Bulbocyrtium* spp., 200 ×, *6*: Mo 19, 87/200/1; *7*: 19726/3, 87/209/2; *8*: 19726/3, 87/208/4

9 *Goestlingella illyrica* Kozur, 200 ×, 19726/3, 87/207/9

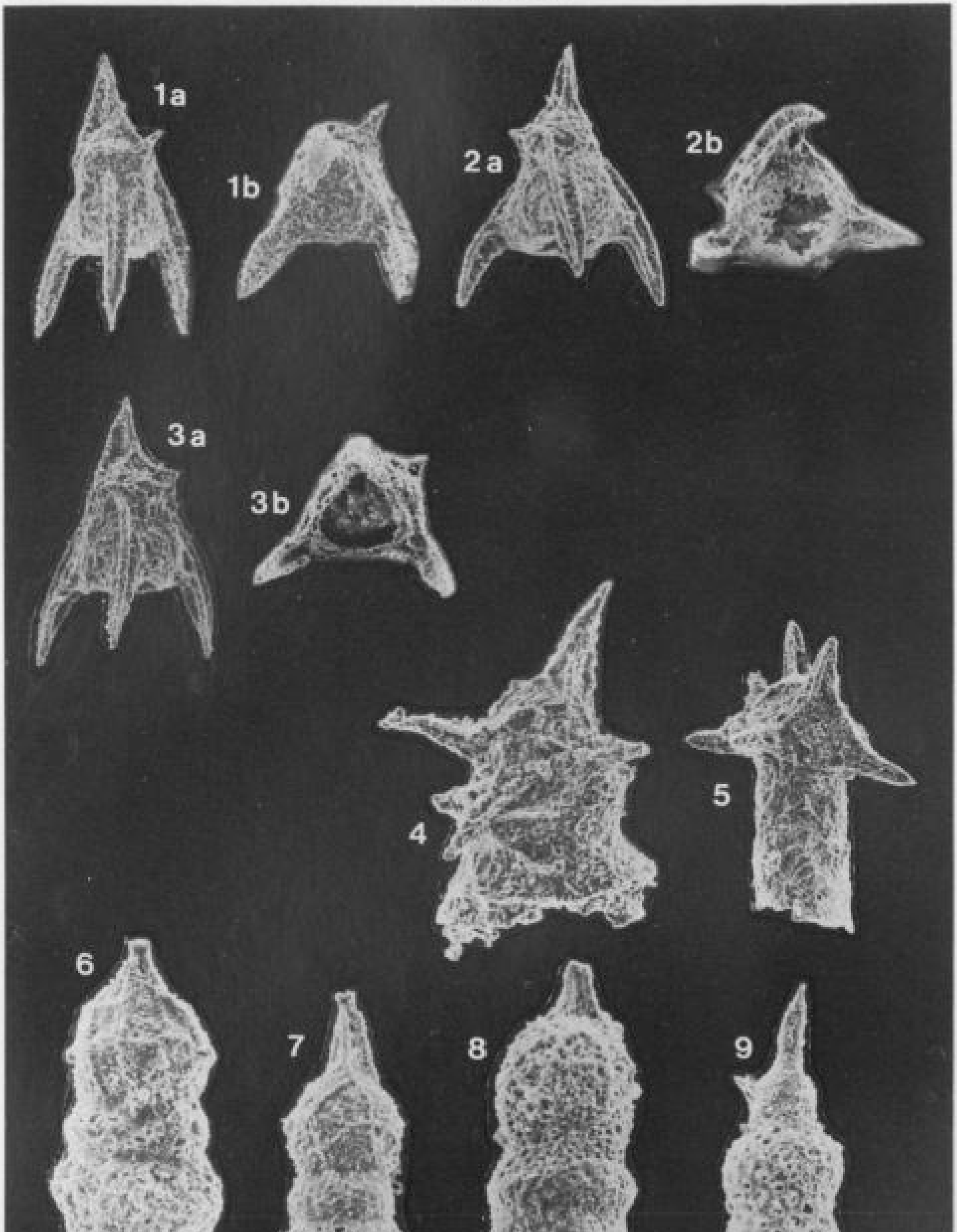
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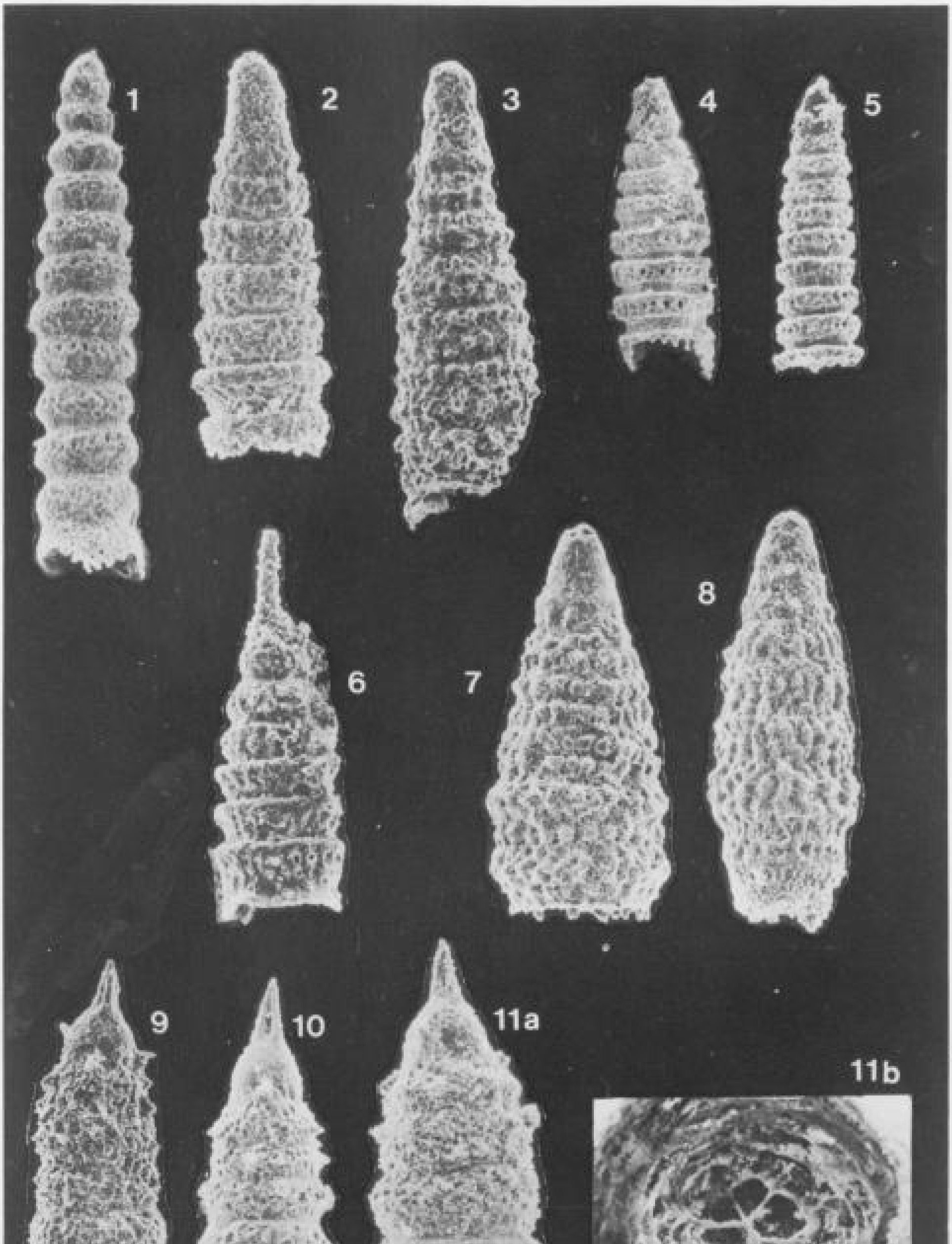
Plate 12 – Tabla 12

1 *Triassocampe* sp. A, 200 ×, Gr 9, 87/218/7
2, 3 *Triassocampe scalaris* Dumitrica, Kozur & Mostler, 200 ×, *2*: Gr 10, 87/233/5; *3*: Vr 5, 87/181/1
4, 5 *Triassocampe sulovensis* Kozur & Mock, 200 ×, *4*: 19726/5, 87/233/8; *5*: Mo 19, 87/198/9
6 *Yeharaia annulata* Nakaseko & Nishimura, 200 ×, 19726/5, 87/222/7
7, 8 *Triassocampe* spp., 200 ×, Mo 19, *7*: 87/198/6; *8*: 87/199/3
9, 10, 11a, 11b *Anisicyrtis* sp. A, 200 ×, *9*: Gr 11, 87/214/1; *10*: 19726/3, 87/207/5; *11a*: 19726/3, 87/207/7; *11b*: antapical view, 300 ×, 87/207/6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