ISSN 0031-0301, Paleontological Journal, 2007, Vol. 41, No. 10, pp. 951–1029. © Pleiades Publishing, Ltd., 2007.

Late Triassic Radiolarians of Southern Cyprus

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Received June 20, 2006

Abstract—Radiolarians from the Upper Triassic of the allochthonous Mamonia Assemblage of southern Cyprus are considered. The Phasoula Formation, composed of basic volcanics, with lenses and interbeds of micritic limestones and cherts, contains (1) a Lower Norian assemblage with *Capnodoce crystallina–Trialatus robustus*, which also includes *Capnodoce anapetes* De Wever, *Capnuchosphaera deweveri* Kozur et Mostler, *C. theloides* De Wever, *Deflandrecyrtium curvatum* Kozur et Mostler, *Icrioma cruciformis* Tekin, *Kahlerosphaera norica* Kozur et Mock, *Kinyrosphaera helicata* Bragin, *Mostlericyrtium sitepesiformis* Tekin, *Palaeosaturnalis latiannulatus* Kozur et Mostler, *Spongostylus tortilis* Kozur et Mostler, *Xiphotheca rugosa* Bragin, and *Zhamojdasphaera proceruspinosa* Lahm; (2) a Middle Norian assemblage with *Capnodoce sarisa* accompanied by *Loffa mulleri* Pessagno, *Nabolella trispinosa* Bragin, and *Praexehasaturnalis tenuispinosus* (Donofrio et Mostler); and (3) an Upper Norian assemblage with *Livarella densiporata–Lysemelas olbia* accompanied by *Pentactinocarpus sevaticus* Kozur et Mostler, *Praemesosaturnalis multidentatus* (Kozur et Mostler), and others. This assemblage also occurs in clastic turbidites of the Vlambouros Formation. In the sections of southern Cyprus, radiolarian zones are recognized that correspond to the zones previously established in the Far East of Russia, which include *Capnodoce crystallina* (Lower and Middle Norian) and *Lysemelas olbia* (lower part of the Upper Norian). Radiolarians belonging to three orders, 24 families, 59 genera, and 101 species are described; of them 2 genera, 9 species, and 1 subspecies were previously described by the author; 14 new species and 1 new subspecies are established. The diagnoses of many genera and species are emended, the stratigraphic and geographical ranges of the majority of taxa are substantially expanded.

DOI: 10.1134/S0031030107100012

CONTENTS

INTRODUCTION

Although it was previously believed that radiolarians are little-suited for stratigraphy, they have recently become an important tool for the development of detailed zonation and correlation of complex dislocated strata of mobile belts. Great progress has been achieved in the stratigraphy of the Mesozoic and Paleozoic siliceous strata, the structure and genesis of which are mysterious and rather complex, the more so as they frequently contain no fossils except radiolarians.

All of the above is true of Triassic deposits. Early works, with detailed data on Triassic radiolarians, appeared in the 1970s (Kozur and Mostler, 1972, 1978, 1979, Donofrio and Mostler, 1978; Dumitrica, 1978a, 1978b; Pessagno et al., 1979; De Wever et al., 1979; Nakaseko and Nishimura, 1979; Dumitrica et al., 1980). In these studies, most attention was paid to the description of new taxa, which were investigated for the first time using of chemical preparation and electron microscopy from the localities where radiolarians were accompanied by other fossils providing independent dating. Based on these studies, at the beginning of the 1980s, it was established that Triassic radiolarians differ substantially from both Jurassic and Late Paleozoic radiolarians. Triassic assemblages differ significantly depending on age; this suggests the possibility of using radiolarians in Triassic stratigraphy. Finally, detailed examination of well-preserved Triassic radiolarians has demonstrated that many taxa have morphological structures similar to those of Paleozoic radiolarians, which indicate the Paleozoic origin of a number of Triassic groups. This predetermined further progress in the study of Lower Mesozoic radiolarians.

Subsequently, rich Middle and Upper Triassic assemblages from many localities of the Mediterranean Region (Dumitrica, 1982a, 1982b, 1982c; Kozur and Mostler, 1981, 1983; Lahm, 1984; Kozur, 1988a, 1988b; Martini et al., 1989), Japan (Kishida and Sugano, 1982; Mizutani and Koike, 1982; Yao, 1982; Yoshida, 1986), China (Kojima and Mizutani, 1987), western areas of the United States and Canada (Pessagno and Blome, 1980; Blome, 1983, 1984; Yeh, 1989), and the Philippines (Cheng, 1989; Yeh, 1990) were described. In the eastern Soviet Union, Triassic radiolarian assemblages were also discovered and described (Bragin, 1986; Tikhomirova, 1986; Kazintsova and Bychkov, 1987). The radiolarian assemblages occurred in various stratigraphic intervals along with other fossil groups; this provided the basis for the development of the first zonation schemes of Triassic beds based on radiolarians (Yao, 1982; Blome, 1984; Yoshida, 1986; Bragin, 1986, 1991a; Tikhomirova, 1986). These schemes were characterized by a small number of units, in some cases, the absence of continuous biostratons, and a relatively small number of taxa involved in stratification.

Subsequently, new radiolarian localities were found in various regions of the world, the study of which substantially expanded our knowledge of the taxonomic composition and geographical and stratigraphic distribution of Triassic radiolarians. Based on this, the systematics of Triassic radiolarians was elaborated in more detail (Carter, 1993; Kozur and Mostler, 1994; Sugiyama, 1997; Tekin, 1999), new detailed stratigraphic charts were proposed (Kozur and Mostler, 1994; Sugiyama, 1997; Bragin, 2000b, 2002), paleobiogeographic realms were recognized (Bragin, 1994a, 2002), Triassic stages in the development of this group were examined, and the history of radiolarians in the time of great biotic crises at the beginning and at the end of the Triassic was analyzed (Bragin, 1994b, 2000a, 2002).

At the same time, Triassic radiolarians remain incompletely understood, mostly with reference to the systematics and geographical and stratigraphic distribution of many species. This indicates the significance of descriptive works, particularly those involving radiolarians from the regions where they have not been studied systematically. It is noteworthy that Triassic radiolarians have been relatively completely described in only a few regions of the world, such as northern Italy (Middle Triassic), Austria (Upper Triassic), Oregon and British Columbia (Upper Triassic), Japan (from the Olenekian Stage to the Upper Triassic inclusive), Far East and northeastern Russia (Middle and Upper Triassic), and southern Turkey (upper part of the Middle and Upper Triassic).

The present study deals with radiolarians from the Upper Triassic of southern Cyprus. This area belongs to the Mediterranean mobile belt, where Triassic radiolarians have been studied for several decades. Good preservation and diverse taxonomic composition of radiolarians from localities of southern Cyprus considerably expand the knowledge of the biodiversity and distribution of radiolarians and provide the basis for detailed comparisons of Cyprian assemblages with associations from other regions of the world and for the recognition of zones based on radiolarians. This study is also of certain regional significance, since radiolarians are unique microfossils that are frequently recorded in Mesozoic allochthons of the Mediterranean belt and allow detailed dating and zonation of the Mesozoic Mamonia Complex of southern and southeastern Cyprus.

CHAPTER 1. UPPER TRIASSIC SECTIONS OF SOUTHERN CYPRUS

Triassic deposits occupy a special place in the geological structure of southern Cyprus. They occur in the allochthonous Mamonia Complex (Lapierre, 1975) located in the southwestern part of this island (Fig. 1) and composed of a complex set of tectonic nappes, including various magmatic and sedimentary formations of the Neotethys and its southern, passive marginal area (Robertson and Woodcock, 1979). The Mamonia Complex is subdivided into two: the Ayios Photios Group, composed of sedimentary rocks from

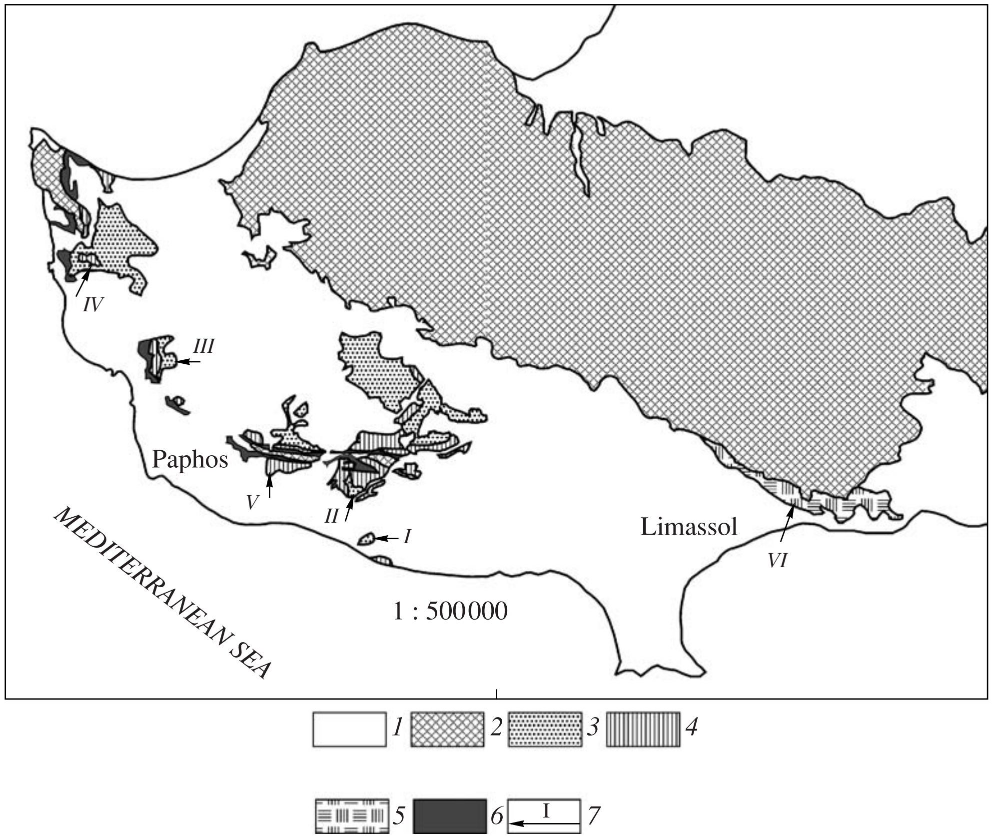


Fig. 1. Scheme of the geological structure of southern and southwestern Cyprus and positions of the major localities of Triassic radiolarians. Designations: (*1*) Campanian, Maastrichtian, and Cenozoic beds; (*2*) ophiolitic complex of Troodos; (*3*) Ayios Photios Group (Upper Triassic–Cretaceous); (*4*) Dhiarizos Group (Upper Triassic–Lower Cretaceous); (*5*) Moni olistostrome (Upper Cretaceous); (*6*) serpentinite melange; and (*7*) positions of sections and localities; (*I*) section on the Khapotami River; (*II*) section on the Dhiarizos River near the village of Souskiou; (*III*) section on the Mavrokolymbos River; (*IV*) section at Lara Bay; (*V*) locality near the village of Ayia Varvara; and (*VI*) locality near the village of Parekklisia.

the Upper Triassic to the Albian–Turonian, and the Dhiarizos Group, composed mostly of Triassic–Lower Cretaceous volcanics, with interbeds and lenses of sedimentary rocks. Radiolarians occur in Triassic beds of either group. The material was collected by the author during field studies in 1990, 1998, and 2003.

AYIOS PHOTIOS GROUP

The earliest (Upper Triassic) beds of the Ayios Photios Group are referred to as the Vlambouros Formation observed in southwestern Cyprus, from the Akamas Peninsula to the Khapotami River Basin (Fig. 1). The Vlambouros Formation is composed of terrigenous turbidites and contourites with limestone interbeds and is interpreted as deposits formed on the southern, passive marginal area of the Tethys and corresponding to the time of rifting (Robertson and Woodcock, 1979; Kaz'min et al., 1987). This formation was initially referred to as the Middle (?) or Upper Triassic (Swarbrick and Robertson, 1980); subsequently, this age was determined more precisely as the Upper Carnian–Upper Norian (Bragin and Krylov, 1996). Rhaetian beds have not been recorded in this formation. The Vlambouros Formation is overlain, with a large stratigraphical gap corresponding to the entire Lower Jurassic and a part of the Middle Jurassic (Bragin and Krylov, 1996, 1999a), by the Episkopi Formation composed of siliceous and terrigenous deposits (Middle Jurassic–Cretaceous to the Albian–Turonian inclusive) (Swarbrick and Robertson, 1980; Bragin et al., 2000).

The most representative radiolarian assemblages occur in the basin of the Khapotami River (Figs. 1, 2, Table 1), where the section of the Vlambouros Formation is characterized by the most distal facies of turbidites and has the following structure (from the base upwards).

Vlambouros Formation

(1) Interbedding reddish gray and gray siltstones, gray limestones, pink, micritic cross-bedded, calcarenites, gray fine-grained sandstones. Radiolarians are represented by *Livarella* sp.; dated Late Norian–Rhaetian (?); 10 m of visible thickness.

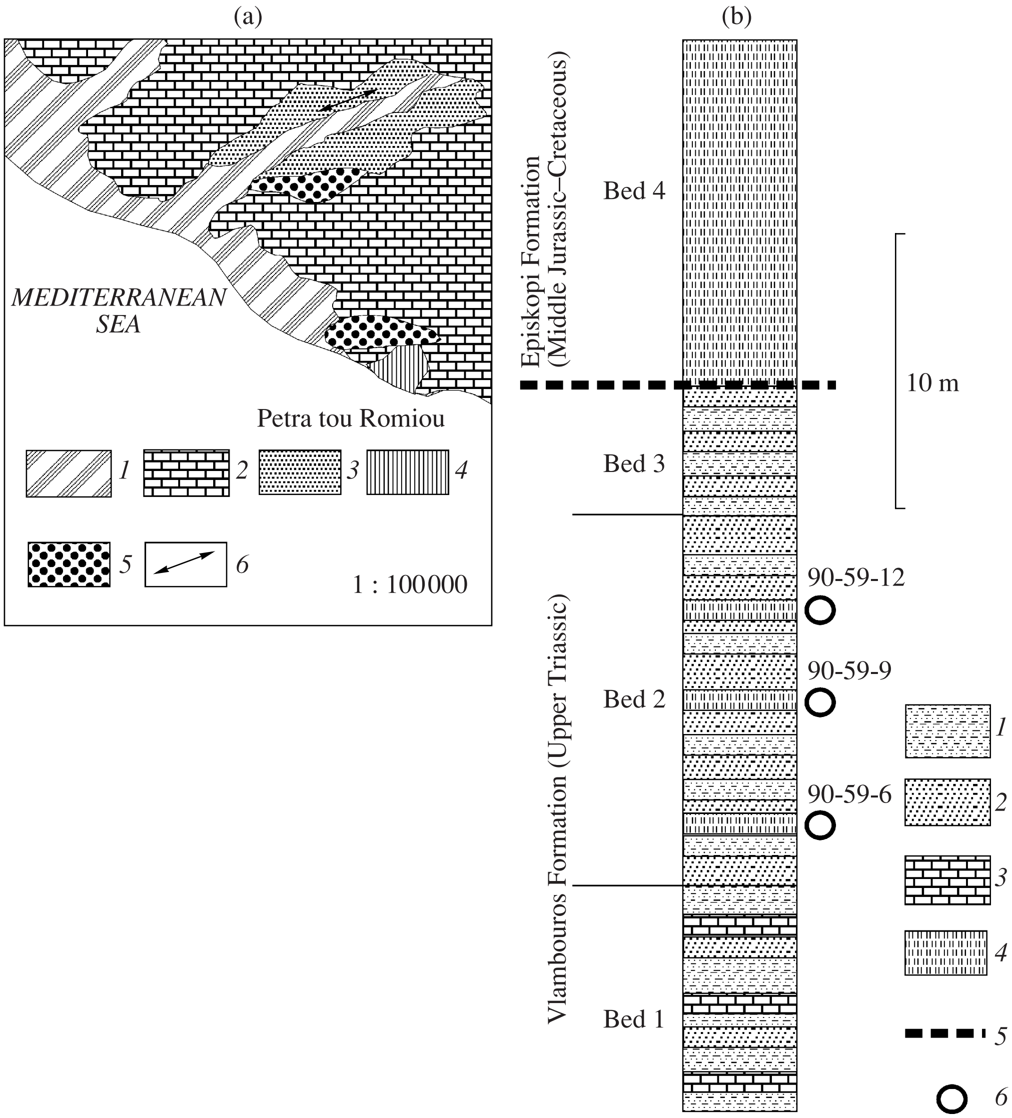


Fig. 2. Position and geological structure of the section of the Vlambouros Formation on the Khapotami River: (a) position of the section and scheme of geological structure. Designations: (*1*) Quaternary beds; (*2*) Neogene beds; (*3*) Ayios Photios Group (Upper Triassic–Cretaceous); (*4*) Dhiarizos Group (Upper Triassic–Lower Cretaceous); (*5*) serpentinites; and (*6*) position of the section; (b) stratigraphic column of the section. Designations: (*1*) siltstones; (*2*) sandstones; (*3*) micritic limestones; (*4*) cherts; (*5*) hiatus at the base of the Episkopi Formation; and (*6*) levels of radiolarian records with the numbers of samples.

(2) Gray and greenish gray, fine-grained, undulating sandstones, with interbeds of light gray siltstones and pink and light red cherts and infrequent interbeds of pink micritic limestones (samples 90-59-6, 90-59-9, and 90-59-12). Radiolarians are represented by *Livarella densiporata* Kozur et Mostler, *L. longa* Yoshida, *Praemesosaturnalis multidentatus* (Kozur et Mostler), *Pentactinocarpus sevaticus* Kozur et Mostler, *Sarla vetusta* Pessagno, *S. viscainoensis* Pessagno, etc.; Late Norian; 15 m thick.

(3) Interbedding gray and light gray, fine-grained, thin-bedded sandstones and reddish gray siltstones; 5 m thick.

Episkopi Formation

(4) Red and brick red, calcareous cherts, with frequent thin interbeds of red siliceous claystones. The radiolarian fauna is dated Callovian–Oxfordian, including *Gueuxella nudata* (Kocher), *Hsuum brevicostatum* (Ozwoldova), *Protunuma ochiensis* Matsuoka, etc.; 20 m thick.

In the central area of the Mamonia Complex, the Vlambouros Formation acquires coarser, more proximal clastic units, while the interbeds of micritic limestones with radiolarians occur less often. There, on the right bank of the Dhiarizos River opposite the village of Souskiou, fragments of a strongly dislocated section

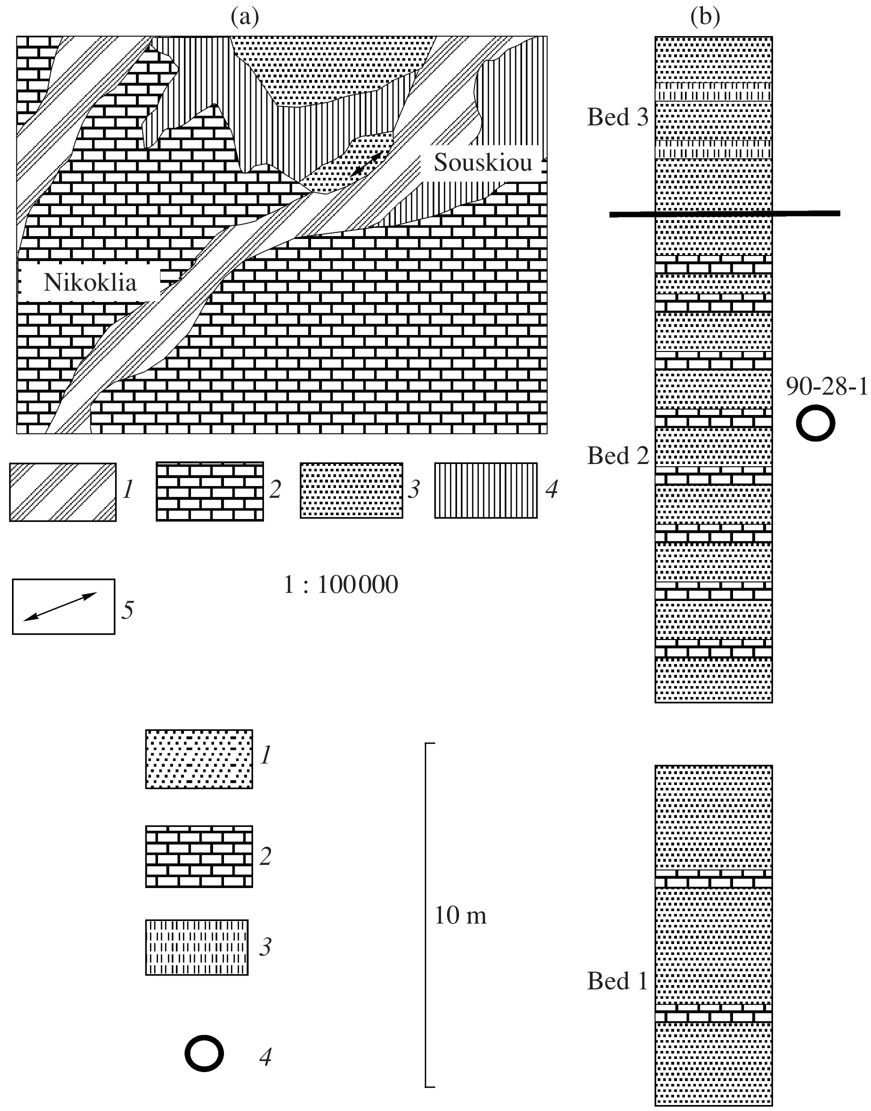


Fig. 3. Position and geological structure of the section of the Vlambouros Formation on the Dhiarizos River: (a) position of the section and scheme of the geological structure. Designations: (*1*) Quaternary beds; (*2*) Neogene and Paleogene beds; (*3*) Ayios Photios Group (Upper Triassic–Cretaceous); (*4*) Dhiarizos Group (Upper Triassic–Lower Cretaceous); and (*5*) position of the section; (b) stratigraphical column of the section. Designations: (*1*) sandstones; (*2*) micritic limestones; (*3*) cherts; (*4*) levels of radiolarian records with the numbers of samples.

outcrop, showing the following structure (Figs. 1, 3, Table 1).

Vlambouros Formation

(1) Gray, medium- and fine-grained, thick-laminated sandstones, with plant detritus, rare interbeds of gray, micritic limestones; 10 m of visible thickness; nonexposed layer is 30–40 m thick.

(2) Gray and greenish gray, fine-grained sandstones, with frequent interbeds of gray micritic limestones and pink calcarenites; limestone interbeds (sample 90-28-1) contain the following Late Norian radiolarians: *Livarella densiporata* Kozur et Mostler, *L. longa* Yoshida, *L. inflata* Yeh, *Lysemelas olbia* Sugiyama, *Neopaurinella sevatica* Kozur et Mostler, *Pentactinocarpus sevaticus* Kozur et Mostler, *Praemesosaturnalis gracilis* (Kozur et Mostler), *P. quadrirariatus* (Kozur et Mostler), *Sarla viscainoensis* Pessagno, etc.; 15 m of visible thickness.

(3) Interbedding reddish gray, fine-grained, obliquely bedded sandstones and reddish gray siltstones, with infrequent interbeds of red cherts; 5 m of visible thickness.

The most complete and paleontologically best understood section of the Vlambouros Formation is known in the northern part of the Mamonia Complex area, on the left bank of the Mavrokolymbos River, at the mouth of the Argakin ton Vatkion Creek. The fol-

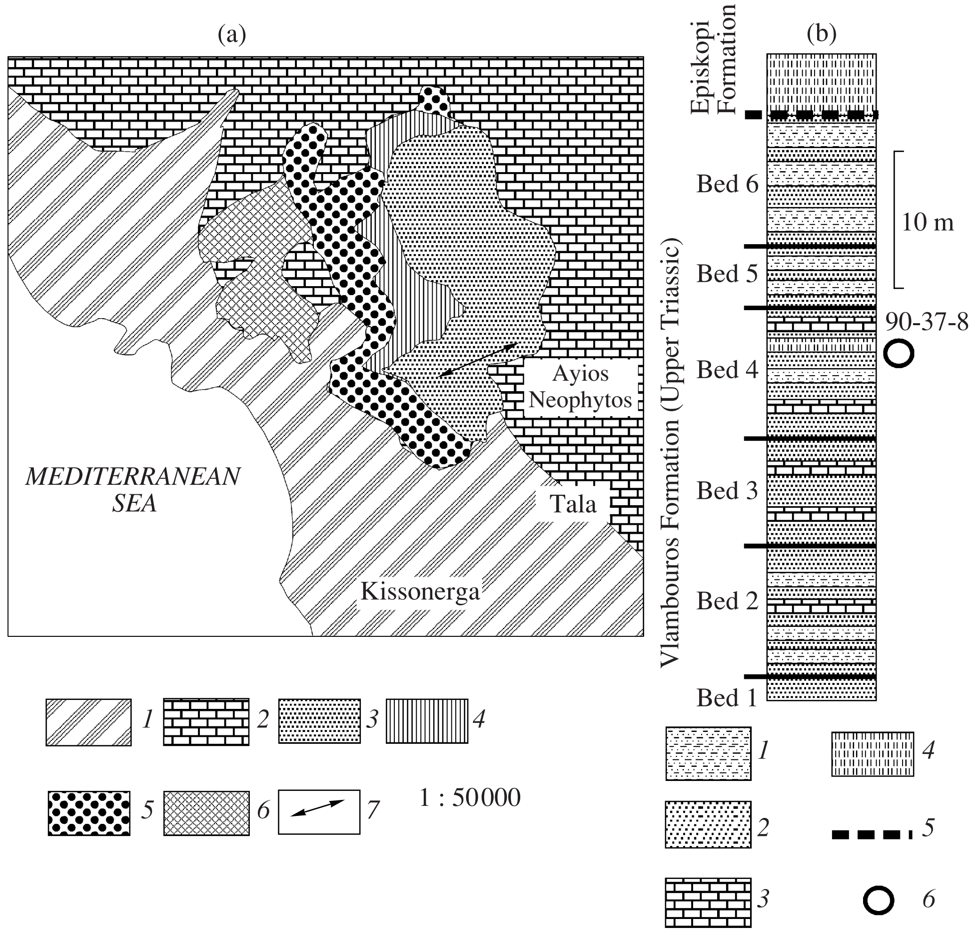


Fig. 4. Position and geological structure of the section of the Vlambouros Formation on the Mavrokolymbos River: (a) position of the section and scheme of geological structure. Designations: (*1*) Quaternary beds; (*2*) Neogene and Paleogene beds; (*3*) Ayios Photios Group (Upper Triassic–Cretaceous); (*4*) Dhiarizos Group (Upper Triassic–Lower Cretaceous); (*5*) serpentinite melange; (*6*) volcanics of the ophiolitic complex of Troodos; and (*7*) position of the section; (b) stratigraphical column of the section. Designations: (*1*) siltstones; (*2*) sandstones; (*3*) micritic limestones; (*4*) cherts; (*5*) hiatus at the base of the Episkopi Formation; and (*6*) levels of radiolarian records with the numbers of samples.

lowing beds are exposed there (from the base upwards) (Figs. 1, 4; Table 1).

Vlambouros Formation

(1) Yellowish gray, coarse- and medium-grained, thick-laminated sandstones, with well pronounced A–C intervals of the Bouma cycle (Bouma, 1962). Particular layers are up to 1 m thick. The sandstones contain abundant plant detritus on the planes of bedding and the bivalve *Halobia* sp.; 2 m of visible thickness.

(2) Light gray, medium- and fine-grained, massive and thick-bedded sandstones, with frequent greenish gray siltstone interbeds and individual layers of light gray, micritic limestones. The sandstones show distinct turbidite structures; in the rhythms, B–C and B–C–D–E intervals are recognized. The limestones contain the Carnian–Early Norian conodont *Neogondolella nodosa* (Hayashi); 10 m of thickness.

(3) Greenish gray fine-grained sandstones, passing into siltstones, with interbeds of gray and pink micritic limestones and pink calcarenites. The limestone interbeds yielded the conodont *Epigondolella* sp. (Late Carnian–Norian); 8 m of thickness.

(4) Interbedding of gray and reddish gray sandstones, greenish gray, or, less often, reddish gray, fine-grained siltstones, red cherts, and pink calcarenites. The cherts (sample 90-37-8) yielded the Late Norian radiolarians *Livarella densiporata* Kozur et Mostler, *L. longa* Yoshida, *L. inflata* Yeh, *Praemesosaturnalis quadriradiatus* (Kozur et Mostler), *P. validus* (Donofrio et Mostler), etc.; 10 m of thickness.

(5) Interbedding red, medium- and fine-grained, calcareous sandstones and brick red siltstones; 5 m of thickness.

(6) Interbedding gray, fine-grained sandstones and brick red siltstones, with infrequent interbeds of red

cherts, containing the Late Norian–Rhaetian (?) radiolarian *Livarella* sp.; 10 m of thickness.

Episkopi Formation

The Vlambouros Formation is overlain without clear unconformity by red siliceous claystones, with thin (up to 3 cm thick) frequent interbeds of red and green cherts, containing the abundant Late Callovian–Early Oxfordian radiolarians *Guexella nudata* (Kocher), *Hsuum brevicostatum* Ozwoldova, *Protunuma ochiensis* Matsuoka, *Zhamoidellum mikamense* Aita, etc.

When comparing the sections examined, the Vlambouros Formation shows a clear tripartite structure.

(1) Medium-grained sandstones, with plant detritus and rare interbeds of micritic limestones, containing Late Carnian–Early Norian conodonts, such as *Epigondolella abneptis* (Huckriede) and *Neogondolella nodosa* (Hayashi). Possibly, these strata also include Middle Norian deposits; 10 m of visible thickness.

(2) Fine-grained sandstones and siltstones, with frequent interbeds of limestones, calcarenites, and (sometimes) cherts, containing Late Norian radiolarians and conodonts, such as *Livarella densiporata* Kozur et Mostler, *Lysemelas olbia* Sugiyama, *Pentactinocarpus sevaticus* (Kozur et Mostler), *Epigondolella bidentata* Mosher, etc.; up to 20 m thick.

(3) Fine-grained sandstones and red siltstones, with infrequent interbeds of cherts containing Late Norian radiolarians; the thickness ranges from 0 to 20 m in different sections. These strata are overlain with unconformity by Middle Jurassic deposits (Episkopi Formation).

DHIARIZOS GROUP

The Dhiarizos Group comprises three formations: Phasoula (Triassic–Lower Cretaceous basic volcanics with interbeds of micritic limestones and radiolarian cherts) (Swarbrick and Robertson, 1980); Loutra tis Afroditis (Lower Jurassic ophiolitic breccia with interbeds of radiolarian cherts) (Swarbrick and Robertson, 1980; Bragin and Krylov, 2000), and Petra tou Romiou (Triassic basic volcanics with lenses of shallow reef-building limestones) (Lapierre, 1975; Swarbrick and Robertson, 1980). Triassic radiolarians occur in sections of the Phasoula Formation, which is treated as intrabasin volcanics, the formation of which began from the time of Neotethyan rifting (Robertson and Woodcock, 1979). This formation includes Upper Carnian and Norian (to the Upper Norian) beds, while the presence of Rhaetian units has not been supported by paleontological data. Limestones and siliceous rocks of the Phasoula Formation have yielded the richest and most diverse assemblages of Triassic radiolarians in Cyprus.

The stratigraphically most complete section of the Phasoula Formation is in the Akamas Peninsula, 3 km east-northeast of Lara Bay (Figs. 1, 5, Table 1). In this area, the following layers are exposed upward in the section:

(1) Fulvous brown, greenish fulvous basalts, occasionally, with a pillow structure, considerably splintered; 50–100 m of visible thickness.

(2) White, laminated, strongly recrystallized limestones, with interbeds of pink micritic limestones (sample 98-2-2) and red radiolarian jaspers (98-2-4), with Early Norian radiolarians *Capnodoce anapetes* De Wever, *C. crystallina* Pessagno, *Capnuchosphaera deweveri* Kozur et Mostler, *C. theloides* De Wever, *C. triassica* De Wever, *C. tricornis* De Wever, *Dreyericyrtium curvatum* Kozur et Mostler, *Icrioma cruciformis* Tekin, *Kahlerosphaera norica* Kozur et Mock, *Kinyrosphaera helicata* Bragin, *Mostlericyrtium sitepesiformis* Tekin, *Palaeosaturnalis latiannulatus* Kozur et Mostler, *P. raridenticulatus* Kozur et Mock, *Spongostylus tortilis* Kozur et Mostler, *Xiphotheca rugosa* Bragin, *Zhamojdasphaera proceruspinosa* Lahm, and others; 8 m of thickness.

(3) Red, thin-laminated, slightly clayey jaspers (sample 98-2-9), with infrequent pink and gray micritic limestone interbeds almost lacking claystone interbeds. Radiolarians are represented by the Late Norian *Livarella densiporata* Kozur et Mostler, *L. longa* Yoshida, *L. inflata* Yeh, *Pentactinocarpus sevaticus* Kozur et Mostler, etc.; 5–7 m of thickness.

(4) Red, thin-laminated, clayey jaspers, with frequent interbeds of red–brown siliceous claystones and rare interbeds of greenish gray cherts. The lower part of this member yielded the Lower Jurassic radiolarians *Bipedis hannai* Whalen et Carter, *Charlottea weedensis* Whalen et Carter, *Crucella* sp., *Katroma inflatio* Whalen et Carter, *K. irwingi* Whalen et Carter, *K. elegans* Tekin, *Parahsuum* sp., *Paronaella jamesi* Whalen et Carter, *Paronaella* sp., and *Trexus* sp. cf. *T. dodgensis* Whalen et Carter. The upper part of the member yielded the Upper Jurassic–Lower Cretaceous radiolarians *Archaeodictyomitra apiara* (Rust), *Podocapsa amphitreptera* Foreman, *Wrangellium puga* (Schaaf), etc.; 7–10 m of visible thickness.

Thus, in this section, thick volcanic strata are covered by relatively thin carbonate–siliceous layers, the lower part of which contains rich Upper Triassic radiolarian assemblages. In the other regions, the Phasoula Formation is much more strongly dislocated; therefore, it is difficult to restore the stratigraphic sequence and reveal the microfauna. Nevertheless, some points have yielded representative radiolarian assemblages, which supplement the stratigraphic pattern.

In the Ezousa River basin, near the village of Ayia Varvara, in terrigenous melange that occupies the lower position in the system of nappes of the Mamonia Complex (Figs. 1, 6), a large micritic limestone block typical for the Phasoula Formation was investigated. It contained a rich Lower Norian assemblage of radiolarians and conodonts (Bragin and Krylov, 1999b). These limestones are relatively pure, do not contain terrige-

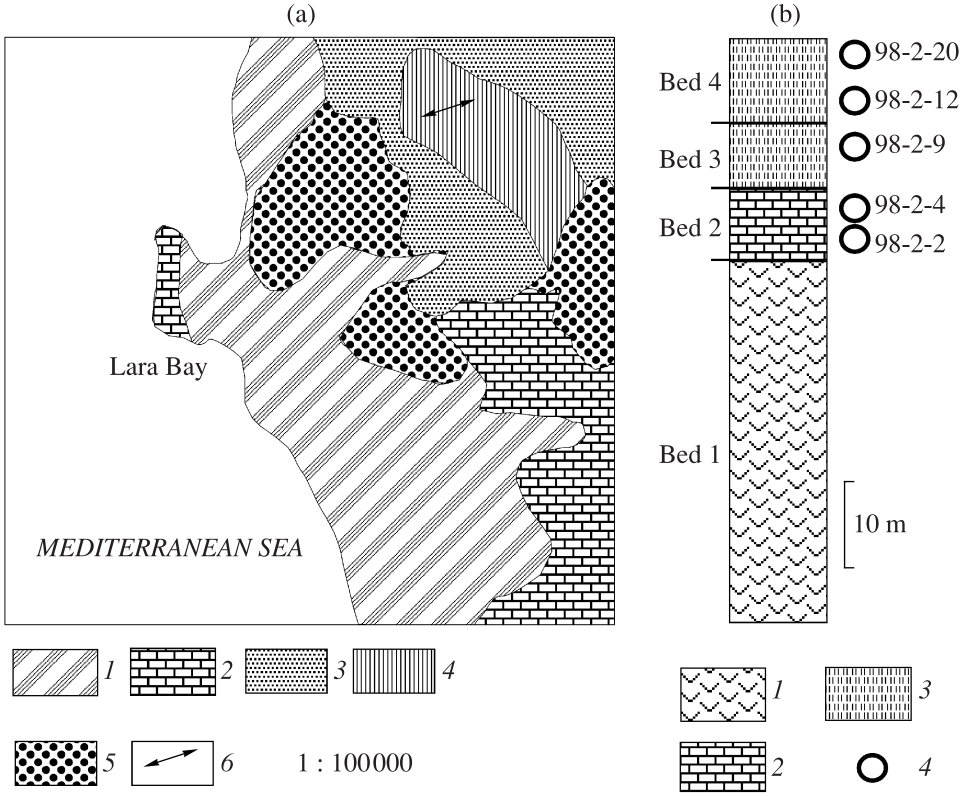


Fig. 5. Position and geological structure of the section of the Phasoula Formation near the Lara Bay: (a) position of the section and scheme of the geological structure. Designations: (*1*) Quaternary beds; (*2*) Neogene, Paleogene, and Upper Cretaceous beds; (*3*) Ayios Photios Group (Upper Triassic–Cretaceous); (*4*) Dhiarizos Group (Upper Triassic–Lower Cretaceous); (*5*) serpentinite melange; and (*6*) position of the section; (b) stratigraphical column of the section. Designations: (*1*) basic volcanics; (*2*) micritic limestones; (*3*) cherts; (*4*) levels of radiolarian records with the numbers of samples.

nous admixture; they are distinguished by both composition and earlier age from Upper Norian limestones, which are enriched by terrigenous micritic matter from the middle strata of the Vlambouros Formation (Bragin and Krylov, 1996). This block includes a small fragment of the section:

(1) White, thickly laminated and massive limestones, with gray cherty interbeds; 1.5 m of visible thickness.

(2) Pink, thickly laminated limestones; 1.5 m thick.

(3) Greenish gray, laminated, siliceous limestones; 1 m thick.

(4) Pink, massive limestones. The roof of this layer (sample 90-39) contains the radiolarians *Annulotriassocampe baldii* Kozur, *Bulbocyrtium latum* Bragin, *Caphtorocyrtium tenerum* Bragin, *Capnodoce ruesti* Kozur et Mock, *Capnuchosphaera deweveri* Kozur et Mostler, *C. theloides minor* Bragin, *C. constricta* (Kozur et Mock), *Carinaheliosoma carinata* (Kozur et Mostler), *Icrioma tetrancistrum* De Wever, *Kahlerosphaera norica* Kozur et Mostler, *Karnospongella bispinosa* Kozur et Mostler, *Kinyrosphaera trispinosa* Bragin, *K. helicata* Bragin, *Liassosaturnalis parvus* Kozur et Mostler, *Loffa mulleri* Pessagno, *Mostlericyrtium striata* Tekin, *Multimonilis pulcher* Yeh, *Nabolella trispinosa* Bragin, *Neopylentonema procera* Sugiyama, *Orbiculiforma goestlingensis* Kozur et Mostler, *Palaeosaturnalis triassicus* (Kozur et Mostler), *P. latiannulatus* Kozur et Mostler, *P. mocki* Kozur et Mostler, *Papiliocampe tokerae* Tekin, *Pentactinocarpus tetracanthus* Dumitrica, *Poulpus piabyx* De Wever, *Pseudosaturniforma carnica* Kozur et Mostler, *Praenanina veghae* Kozur, *Sarla transita* (Kozur et Mock), *Senelella spinellifera* (Bragin), *Sepsagon longispinosus* Dumitrica, Kozur et Mostler, *Spongostylus carnicus* Kozur et Mostler, *S. tortilis* Kozur et Mostler, *Syringocapsa batodes* De Wever, *Trialatus robustus* (Nakaseko et Nishimura), *Triassocrucella triassica* (Kozur et Mostler), *Whalenella robusta* Bragin, *Xiphotheca rugosa* Bragin, *X. longa* Kozur et Mock, *Zhamojdasphaera proceruspinosa* Lahm, and others. Radiolarians are accompanied by the Lower Norian conodont *Epigondolella spatulata* (Hayashi); 2 m thick.

(5) Pink, laminated cherts; 0.5 m thick.

(6) White and pink, massive limestones; 4 m of visible thickness.

In the southern extremity of Cyprus, to the north and northeast of the town of Limassol, large blocks of the Phasoula Formation occur in the Campanian–Maas-

Table 1. Species composition in radiolarian assemblages from the Upper Triassic of southern Cyprus

Locality no.	98-2			90-39	03-1			90-59			90-28	90-37
Sample no. / Radiolarian species	2	4	9	8	1	24	25	6	9	12	1	8
Pentactinocarpus tetracanthus	R	C		C	R							
Pentactinocarpus sevaticus			C					C	R	R	R	R
Sepsagon longispinosus	C	A		A								
Parasepsagon asymmetricus	C	C										
Praenanina veghae				C								
Triarcella sulovensis				R								
Carinaheliosoma carinata	C	C		C								
Kahlerosphaera parvispinosa	R	C		C								
Kahlerosphaera norica		R		A								
Kahlerosphaera kemerensis	A	C										
Capnuchosphaera deweveri	A	A		A								
Capnuchosphaera tricornis	C	R		R								
Capnuchosphaera theloides	C	C		A	R							
Capnuchosphaera triassica	C	C				C	R					
Capnuchosphaera constricta	R	R		C								
Capnuchosphaera crassa	C	R										
Capnuchosphaera concava	R	R			C		R					
Icrioma tetrancistrum	R			C								
Icrioma cruciformis	C	C										
Paricrioma truncatum	R											
Kinyrosphaera trispinosa	R	R		C								
Kinyrosphaera tuzcuae		R										
Kinyrosphaera helicata	R	C		C								
Dicapnuchosphaera quinquespina				R								
Dicapnuchosphaera carterae		R										
Monocapnuchosphaera inflata		R										
Sarla vetusta			R					R	R	R		
Sarla transita				A								
Sarla vizcainoensis			R					R		R	R	R
Braginastrum curvatus	C	R										
Betraccium smithi		R										
Betraccium irregulare	C	C										
Capnodoce anapetes	C	C		R								
Capnodoce ruesti		R		C								
Capnodoce sarisa		R			R	C	C					
Capnodoce crystallina	C	R		R								
Loffa mulleri		R		R		R	R					
Spongostylus carnicus	C	C		R	C							
Spongostylus tortilis	C	C		C								
Dumitricasphaera elegans	R	C										
Zhamojdasphaera proceruspinosa	R	R		R								
Neopaurinella sevatica			R								C	
Palaeosaturnalis triassicus	C	C		C								
Palaeosaturnalis latiannulatus	C	C		C								
Palaeosaturnalis raridenticulatus	C	C										
Palaeosaturnalis mocki	C	C		C								
Praehexasaturnalis tenuispinosus						R	C					
Praemesosaturnalis validus			R						R		C	R
Praemesosaturnalis spiralis								R	R			
Praemesosaturnalis nobleae			C						R		C	R

Table 1. (Contd.)

Locality no.	98-2			90-39	03-1			90-59			90-28	90-37
Radiolarian species / Sample no.	2	4	9	8	1	24	25	6	9	12	1	8
Praemesosaturnalis gracilis			R					R		R	R	
Praemesosaturnalis quadriradiatus			R								C	R
Praemesosaturnalis convertus			R							R	R	R
Praemesosaturnalis acanthicus			C							A	C	C
Praemesosaturnalis zapfei											R	
Mesosaturnalis furcatus						R		R				
Liassosaturnalis parvus	R			R								
Veghicyclia haeckeli	R											
Karnospongella bispinosa	R			R								
Orbiculiforma goestlingensis	R	R		A								
Bistarkum coriniforme	C	C										
Paronaella norica		R		A								
Triassocrucella triassica				C								
Pylostephanidium clavator	R											
Sanfilippoella lengeranlii	R	R		R								
Picapora robusta												
Poulpus piabyx	C	C		C								
Poulpus transitus	C	C		R								
Neopylentonema procera		R		R								
Trialatus robustus	C	C		C								
Pseudosaturniforma carnica				R								
Dreyericyrtium curvatum	R	R										
Dreyericyrtium carterae	R	R		C								
Haeckelicyrtium subcircularis	R	R		R								
Nabolella trispinosa	R	R		R			R					
Caphtorocyrtium tenerum		R		C								
Caphtorocyrtium paenuloides	C	C										
Podobursa yazgani		R		C		R	R					
Podobursa akayi				R								
Podobursa tenuicephala				C								
Syringocapsa batodes	R	R		C								
Syringocapsa circumvoluta				R								
Whalenella robusta		R		C								
Pachus multinodosus	R	R		R								
Lysemelas olbia											R	
Annulotriassocampe baldii	R	R		C								
Papiliocampe tokerae				R								
Bulbocyrtium latum		R		C								
Conospongocyrtis tekini				R								
Mostlericyrtium sitepesiformis	C	C										
Mostlericyrtium striata	C	C		C								
Mostlericyrtium bacilliformis	C	C										
Multimonilis pulcher				C								
Senelella spinellifera		R		R								
Xiphotheca rugosa	C	C		C								
Xiphotheca longa	C	C		C	R	R	R					
Livarella longa			R					R	R	R	C	C
Livarella densiporata			R					C	C	C	R	C
Livarella inflata			R						C		R	R
Ayrtonius elisabethae									R	R		R

Note: Abundance: (A) abundant; (C) common, and (R) rare.

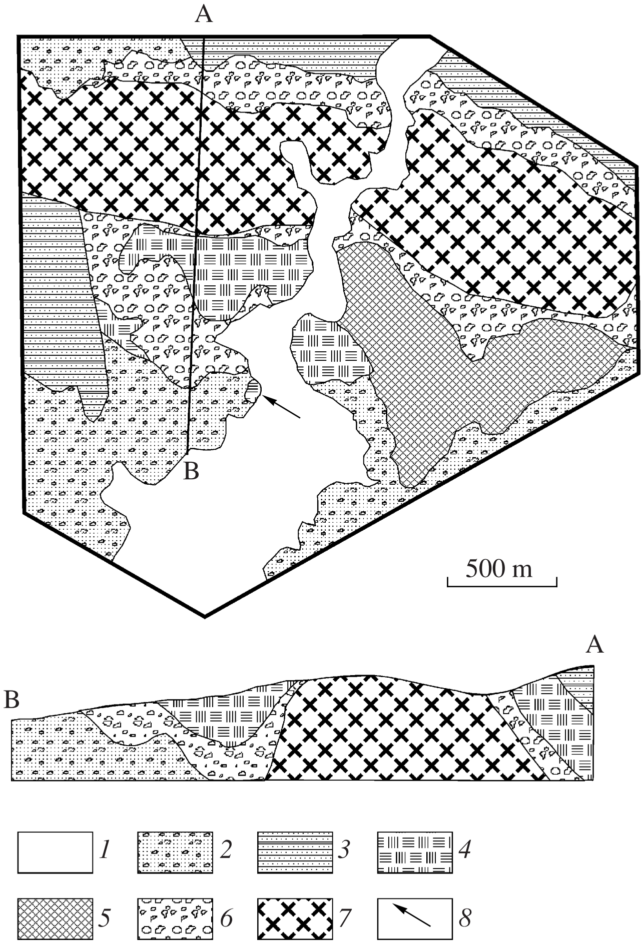


Fig. 6. The scheme of the geological structure in the vicinity of the village of Ayia Varvara and the position of the Lower Norian radiolarian locality (Bragin and Krylov, 1999b). Designations: (*1*) Quaternary beds; (*2*) Late Cretaceous clastic melange; (*3*) Ayios Photios Group, Upper Triassic–Cretaceous; (*4*) Dhiarizos Group, Upper Triassic–Lower Cretaceous; (*5*) metamorphic Ayia Varvara Complex; (*6*) serpentinite melange; (*7*) basalts of the ophiolitic complex of Troodos; (*8*) Lower Norian radiolarian locality.

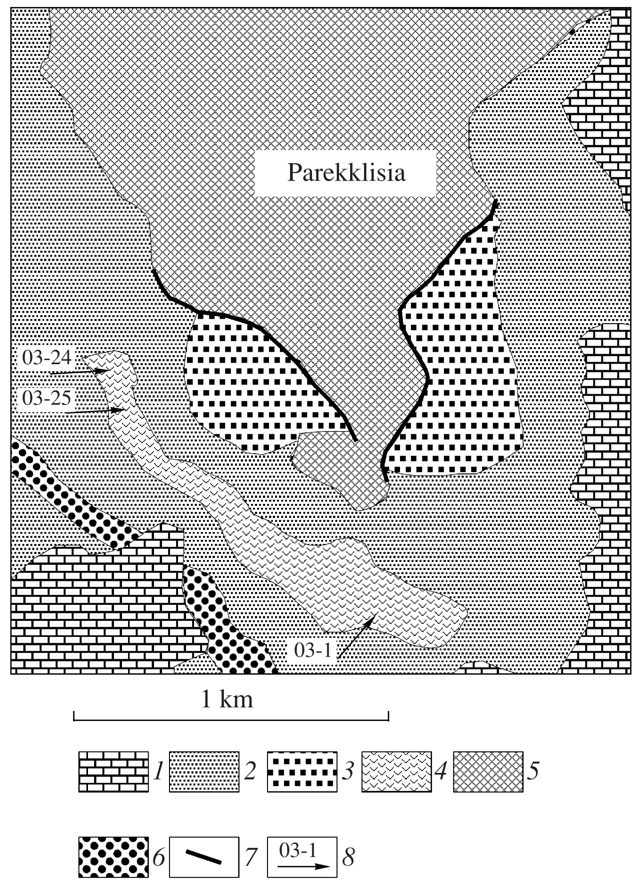


Fig. 7. Scheme of geological structure in the vicinity of the village of Parekklisia and positions of the Upper Triassic radiolarian localities. Designations: (*1*) Miocene beds; (*2*) Moni Formation (olistostrome of the Campanian–Maastrichtian age; (*3*) sandstone blocks of Parekklisia (Lower Cretaceous); (*4*) volcanic and limestone block of the Phasoula Formation (Upper Triassic); (*5*) basic volcanics of the ophiolitic complex of Troodos; (*6*) serpentinites; (*7*) breaks; and (*8*) position of radiolarian records of the Upper Triassic.

trichtian Moni olistostrome (Robertson and Woodcock, 1979; Urquhart and Robertson, 2000). Such a block outcrops south of the village of Parekklisia (Figs. 1, 7; Table 1). It is included in the lower part of the Moni olistostrome and strikes for 1.5 km; it is composed of reddish brown and greenish, strongly transformed volcanics at least 100 m thick, which contain small (1–2 m thick) lenses of white, light gray, and pink micritic limestones, with thin gray and pink cherty interbeds (samples 03-1-1, 03-1-24, 03-1-25). The block yielded the Middle Norian radiolarians *Capnodoce sarisa* De Wever, *Capnuchosphaera concava* De Wever, *C. triassica* De Wever, *Loffa mulleri* Pessagno, *Nabolella trispinosa* Bragin, *Podobursa yazgani* Tekin, *Praexehasaturnalis tenuispinosus* (Donofrio et Mostler), *Spongostylus carnicus* Kozur and Mostler, *Xiphotheca longa* Kozur et Mostler, and others.

The Phasoula Formation covers a stratigraphical interval from the Upper Triassic (Upper Carnian–Lower Norian) to the Lower Cretaceous; this agrees with former assumptions (Robertson and Woodcock, 1979; Swarbrick and Robertson, 1980). Regarding the stratigraphic volume, the Phasoula Formation almost coincides with the Ayios Photios Group; however, the Phasoula Formation contains Lower Jurassic beds, which are absent from the Ayios Photios Group because of a large regional hiatus (Bragin and Krylov, 1996; 1999a). Sedimentary rocks are not everywhere confined to the upper part of the section, as was previously supposed (Swarbrick and Robertson, 1980); on the contrary, they usually occur in different parts of the volcanogenic section. Volcanics belong not only to the Triassic, but also to the Jurassic and Cretaceous. Sedimentary rocks are only represented by two lithotypes, i.e., the micritic limestones without a terrigenous admixture and the radiolarian cherts; they probably accumulated

Stage	Substage	Radiolarian Zone, Far East, Russia (Bragin, 2002)	Late Triassic Radiolarian Assemblage of Cyprus (Mamonia Complex)	
			Phasoula Formation	Vlambouros Formation
Norian	Upper	*Lysemelas olbia*	*Livarella densiporata–Lysemelas olbia*	
	Middle	*Capnodoce crystallina*	*Capnodoce sarisa*	
	Lower		*Capnodoce crystallina–Trialatus robustus*	

Fig. 8. Radiolarian assemblages in the Upper Triassic of the Mamonia Complex of southern Cyprus: stratigraphic position and correlation.

very slowly, during breaks in volcanic activity. The most representative stratigraphic sequence in micrites and cherts of a section near Lara Bay is probably incomplete because of latent gaps, which are difficult to reveal in this considerably condensed section.

CHAPTER 2. RADIOLARIAN ASSEMBLAGES OF THE UPPER TRIASSIC OF SOUTHERN CYPRUS AND THEIR STRATIGRAPHIC SIGNIFICANCE

The earliest radiolarian associations are recorded in a section near Lara Bay (locality 98-2) and in a limestone block obtained near the village of Ayia Varvara (locality 90-39). Each locality has yielded the following species: *Annulotriassocampe baldii, Bulbocyrtium latum, Carinaheliosoma carinata, Caphtorocyrtium tenerum, Capnodoce anapetes, C. ruesti, C. crystallina, Capnuchosphaera constricta, C. deweveri, C. theloides, C. tricornis, Dreyericyrtium carterae, Haeckelicyrtium subcircularis, Icrioma tetrancistrum, Kahlerosphaera norica, K. parvispinosa, Karnospongella bispinosa, Kinyrosphaera trispinosa, K. helicata, Loffa mulleri, Mostlericyrtium striata, Nabolella trispinosa, Neopylentonema procera, Orbiculiforma goestlingensis, Pachus multinodosus, Palaeosaturnalis latiannulatus, P. mocki, P. triassicus, Paronaella norica, Pentactinocarpus tetracanthus, Podobursa yazgani, Poulpus piabyx, P. transitus, Sanfilippoella lengeranlii, Senelella spinellifera, Sepsagon longispinosus, Spongostylus carnicus, S. tortilis, Syringocapsa batodes, Trialatus robustus, Whalenella robusta, Xiphotheca longa, X. rugosa*, and *Zhamojdasphaera proceruspinosa* (Table 1). The majority of these species are widely known, primarily from the Triassic beds of the Mediterranean Region. Almost all of them occur in the Upper Triassic (Upper Carnian–Lower Norian) of southern Turkey (De Wever et al., 1979; Tekin, 1999). Many species from this list also occur in the Upper Carnian–Lower Norian of Greece and Sicily (De Wever et al., 1979) and in the Lower Norian of Slovakia (Kozur and Mostler, 1981).

Some species, for example, *Capnodoce anapetes, C. crystallina, Capnuchosphaera theloides, Loffa mulleri, Syringocapsa batodes, Trialatus robustus, Xiphotheca longa*, and *X. rugosa*, occur in remote regions. They were recorded in the Upper Carnian of Transcaucasia (Knipper et al., 1997), the Upper Carnian–Lower Norian of Oman (Otsuka et al., 1992), the Upper Carnian–Lower Norian of the Far East of Russia (Bragin, 1991a) and Japan (Sugiyama, 1997), and the upper part of the Upper Carnian–Middle Norian of Mexico and Oregon (Pessagno et al., 1979; Blome, 1984). In general, these assemblages correspond in taxonomic composition to the *Capnodoce ruesti* Zone of the Lower Norian of Slovakia (Kozur and Mostler, 1994), TR 6B (*Trialatus robustus–Lysemelas olbia*) Zone of the Lower Norian of Japan (Sugiyama, 1997), the *Capnodoce crystallina* Zone of the Lower–Middle Norian of the Far East of Russia (Bragin, 2000b; 2002). In the Ayia Varvara locality, the assemblage is accompanied by the Early Norian conodont *Epigondolella spatulata* (Hayashi), while, in the Yailakuzdere section in southern Turkey, a very similar assemblage occurs in the conodont zones with *Epigondolella primitia* (upper part of the Upper Carnian–Lower Norian) and *Epigondolella abneptis* (Lower Norian) (Tekin, 1999).

Thus, it is possible to recognize the earliest radiolarian assemblage from the Lower Norian, with *Capnodoce crystallina–Trialatus robustus,* which occurs in micritic limestones of the Phasoula Formation (Fig. 8).

Table 2. Stratigraphic ranges of radiolarians studied

Species	Triassic system								
	Middle		Upper						
	Ladinian		Carnian			Norian			Rhaetian
	L	U	L	M	U	L	M	U	
Pentactinocarpus tetracanthus	—	—	—	—	—	—			
Pentactinocarpus sevaticus								—	—
Sepsagon longispinosus	—	—	—	—	—	—			
Parasepsagon asymmetricus						—			
Praenanina veghae					—	—			
Triarcella sulovensis						—			
Carinaheliosoma carinata				—	—	—			
Kahlerosphaera parvispinosa				—	—	—			
Kahlerosphaera norica						—	—		
Kahlerosphaera kemerensis						—			
Capnuchosphaera deweveri						—			
Capnuchosphaera tricornis					—	—			
Capnuchosphaera theloides					—	—			
Capnuchosphaera triassica					—	—	—		
Capnuchosphaera constricta					—	—			
Capnuchosphaera crassa					—	—			
Capnuchosphaera concava					—	—	—		
Icrioma tetrancistrum					—	—			
Icrioma cruciformis					—	—			
Paricrioma truncatum						—			
Kinyrosphaera trispinosa						—			
Kinyrosphaera tuzcuae						—			
Kinyrosphaera helicata						—			
Dicapnuchosphaera quinquespina						—			
Dicapnuchosphaera carterae						—			
Monocapnuchosphaera inflata						—			
Sarla vetusta						—	—	—	
Sarla transita						—			
Sarla vizcainoensis						—	—	—	
Braginastrum curvatus						—			
Betraccium smithi						—	—		
Betraccium irregulare						—			
Capnodoce anapetes					—	—			
Capnodoce ruesti						—			
Capnodoce sarisa						—	—		
Capnodoce crystallina						—			
Loffa mulleri						—	—		
Spongostylus carnicus			—	—	—	—			
Spongostylus tortilis			—	—	—	—			
Dumitricasphaera elegans						—			
Zhamojdasphaera proceruspinosa				—	—	—			
Neopaurinella sevatica								—	
Palaeosaturnalis triassicus					—	—			
Palaeosaturnalis latiannulatus						—			
Palaeosaturnalis raridenticulatus						—			
Palaeosaturnalis mocki						—			
Praehexasaturnalis tenuispinosus						—	—	—	—
Praemesosaturnalis validus								—	
Praemesosaturnalis spiralis								—	

Table 2. (Contd.)

Species	Triassic system								
	Middle		Upper						
	Ladinian		Carnian			Norian			Rhaetian
	L	U	L	M	U	L	M	U	
Praemesosaturnalis nobleae								—	—
Praemesosaturnalis gracilis								—	—
Praemesosaturnalis quadriradiatus								—	—
Praemesosaturnalis convertus								—	
Praemesosaturnalis acanthicus								—	
Praemesosaturnalis zapfei								—	
Mesosaturnalis furcatus								—	
Liassosaturnalis parvus								—	—
Veghicyclia haeckeli								—	—
Karnospongella bispinosa				—	—	—			
Orbiculiforma goestlingensis				—	—	—			
Bistarkum coriniforme						—			
Paronaella norica						—	—		
Triassocrucella triassica					—	—	—		
Sanfilippoella lengeranlii						—			
Poulpus piabyx					—	—			
Poulpus transitus					—	—			
Neopylentonema procera					—	—			
Trialatus robustus					—	—			
Pseudosaturniforma carnica				—	—	—			
Dreyericyrtium curvatum				—	—	—			
Dreyericyrtium carterae						—			
Haeckelicyrtium subcircularis						—			
Nabolella trispinosa						—			
Caphtorocyrtium tenerum						—			
Caphtorocyrtium paenuloides						—			
Podobursa yazgani						—			
Podobursa akayi						—			
Podobursa tenuicephala						—			
Syringocapsa batodes					—	—	—		
Syringocapsa circumvoluta						—			
Whalenella robusta						—			
Pachus multinodosus						—			
Lysemelas olbia							—	—	
Annulotriassocampe baldii				—	—	—	—		
Papiliocampe tokerae						—			
Bulbocyrtium latum						—			
Eucyrtis (?) magnus						—			
Mostlericyrtium sitepesiformis						—			
Mostlericyrtium striata						—			
Mostlericyrtium bacilliformis						—			
Multimonilis pulcher					—	—	—		
Senelella spinellifera						—			
Xiphotheca rugosa					—	—			
Xiphotheca longa				—	—	—			
Livarella longa								—	—
Livarella densiporata								—	—
Livarella inflata								—	—
Ayrtonius elisabethae								—	—

This assemblage includes many species that are confined stratigraphically to the Lower Norian and species that either appear in the Lower Norian, such as *Sarla vetusta* and *S. viscainoensis*, or do not pass into the Middle Norian, such as *Spongostylus carnicus* and *S. tortilis* (Table 2). This strongly suggests an Early Norian age for this assemblage. The assemblage containing *Capnodoce crystallina–Trialatus robustus* is compared to the association from the lower part of the *Capnodoce crystallina* Zone of the Lower–Middle Norian of eastern Russia (Bragin, 2002) and to associations from the *Capnodoce ruesti* Zone of the Lower Norian of Slovakia (Kozur and Mostler, 1994), TR 6B (*Trialatus robustus–Lysemelas olbia*) Zone of the Lower–Middle Norian of Japan (Sugiyama, 1997) (Fig. 8).

Radiolarians from of limestone and cherty lenses of the large block from the Phasoula Formation of southern Cyprus, from the Moni olistostrome (locality 03-1) are younger (Fig. 7). This sample contains *Capnuchosphaera triassica, C. concava, Capnodoce sarisa, Loffa muelleri, Praehexasaturnalis tenuispinosus*, etc. (Table 1). *Capnodoce sarisa* was described from the Middle Norian of southern Turkey, where it co-occurred with the typical Middle Norian bivalves *Halobia lineata* (Munster) and *Perihalobia subreticulata* (Gemmellaro) (De Wever et al., 1979). *Lysemelas olbia* first appeared in the Middle Norian (Table 2) and was recorded in the Middle and Upper Norian of Japan (Sugiyama, 1997). A number of species (*Capnodoce sarisa, Capnuchosphaera triassica*, and *Loffa muelleri*) appeared for the last time in the Middle Norian.

Therefore, it is possible to recognize a particular Middle Norian assemblage with *Capnodoce sarisa.* It is correlated with the association from the upper part of the *Capnodoce crystallina* Zone of the Lower–Middle Norian of eastern Russia (Bragin, 2002) and with the association from the upper part of the TR 6B (*Trialatus robustus–Lysemelas olbia*) Zone of the Lower–Middle Norian of Japan (Sugiyama, 1997) (Fig. 8). Note that, to date, a separate radiolarian zone corresponding to the Middle Norian has not been established in the world, and zonation of the Lower and Middle Norian based on radiolarians has not been proposed; thus, the establishment of this assemblage is the first step in this direction.

Associations of Late Norian radiolarians are known in siliceous beds of the Phasoula Formation and in clastic turbidites of the Vlambouros Formation. The following radiolarian species are typical for these associations: *Ayrtonius elisabethae, Livarella densiporata, L. inflata, L. longa, Pentactinocarpus sevaticus, Praemesosaturnalis convertus, P. gracilis, P. nobleae, P. validus, Sarla vetusta*, and *S. vizcainoensis* (Table 1). These taxa are recorded in the Upper Norian and Rhaetian of various regions, including Turkey (Tekin, 2002), Austria (Kozur and Mostler, 1981), Japan (Sugiyama, 1997), and the Far East of Russia (Bragin, 2000b, 2002). The Vlambouros Formation on the Dhiarizos River (90-28 locality) yielded the typical Late Norian species *Neopaurinella sevatica* and *Lysemelas olbia.* The second is an index species of the TR 7 (*Lysemelas olbia*) Zone of the lower part of the Upper Norian of Japan (Sugiyama, 1997); it did not pass into the Rhaetian Stage (Table 2). Many species are confined to the Late Norian, i.e., *Neopaurinella sevatica, Praemesosaturnalis validus, P. zapfei*, etc. (Table 2). Some species, including all members of the genus *Livarella* (*L. densiporata, L. longa*, and *L. inflata*) appeared for the first time in the Late Norian (Table 2). In addition, the associations considered lack typical Rhaetian species, such as *Risella tledoensis, Globolaxtorum cristatum*, and *Haeckelicyrtium breviora.*

This suggests a particular Late Norian assemblage should be recognized, that includes *Livarella densiporata–Lysemelas olbia.* This probably corresponds to the association from the *Lysemelas olbia* Zone from the lower part of the Upper Norian of the Far East of Russia (Bragin, 2000b, 2002) and to the TR 7 (*Lysemelas olbia*) Zone from the lower part of the Upper Norian of Japan (Sugiyama, 1997) (Fig. 8). No younger Triassic radiolarian assemblages (corresponding to the period from the upper part of the Upper Norian to the Rhaetian Stage) have been recorded on Cyprus.

Thus, the Upper Triassic beds of the Mamonia Complex of southern Cyprus contain three successive radiolarian assemblages; the Early Norian assemblage with *Capnodoce crystallina–Trialatus robustus*, the Middle Norian assemblage with *Capnodoce sarisa*, and the Late Norian assemblage with *Livarella densiporata–Lysemelas olbia.* The three assemblages occur in the Phasoula Formation, while the Vlambouros Formation contains only the Late Norian assemblage. The three radiolarian assemblages can be compared with radiolarian associations of the same age from other regions, including some remote areas (Fig. 8). The majority of taxa recorded there show relatively short stratigraphic ranges (Table 2).

CHAPTER 3. PALEONTOLOGICAL DESCRIPTIONS

This chapter contains descriptions of all species in the material collected that meet nomenclature requirements (taxa in the open nomenclature are excluded). In addition, the diagnoses of genera and families (subfamilies and superfamilies if necessary) and brief characteristics of orders are given. The taxonomy of Triassic radiolarians follows the generally accepted system. A total of 101 radiolarian species belonging to 3 orders, 24 families, and 59 genera are described; of them 2 genera, 9 species, and 1 subspecies were previously described by the author; 14 new species and 1 new subspecies are established. The diagnoses of many genera and species are emended. The stratigraphic and geographical ranges of the majority of taxa are substantially expanded. Among the species described, six belong to the order Entactinaria, 57 are from the order Spumellaria, and 33 are from the order Nassellaria; four species are polycystine radiolarians of uncertain taxonomic position.

TYPE SARCODINA DUJARDIN, 1838

CLASS RADIOLARIA MÜLLER, 1858

SUBCLASS EURADIOLARIA LAMEERE, 1931

Superorder Polycystina Ehrenberg, 1838

Order Entactinaria Kozur et Mostler, 1982

Diagnosis. Polycystina with primary skeleton with multi-rayed main spicule or its derivatives. Elements of spicule undifferentiated or poorly differentiated (into apical or basal elements), positioned in the same or different planes. Spicule always single, usually located at center of skeleton; sometimes, displaced to or beyond outer shell. Spicule frame-building or restricted to first (smallest) shell. One to three spherical, subspherical, discoid, or prunoid shells usually developed; occasionally, shells reduced. Shells porous, latticed, or reticular. Mode of skeleton growth concentric.

Composition. Paleozoic–Recent. In the Triassic, the order is represented by the families Entactiniidae Riedel, 1967, Polyentactiniidae Nazarov, 1975, Pentactinocarpidae Dumitrica, 1978, Sepsagonidae Kozur et Mostler, 1981, Hexapylomellidae Kozur et Mostler, 1979, Multiarcusellidae Kozur et Mostler, 1979, and Austrisaturnalidae Kozur et Mostler, 1983.

Comparison. The order Entactinaria differs from Spumellaria Ehrenberg, 1875 in the primary skeleton in the shape of a multirayed spicule or its derivatives, and from the order Nassellaria Ehrenberg, 1875 in the concentric mode of skeleton growth.

Remarks. Petrushevskaya (1984, 1986) rejected the placement of all Polycystina with a well-developed spicule in a single order, believing that taxa with poorly developed tangential elements (shells) should be placed in the order Collodaria. At the same time, Triassic radiolarian genera and species with a poorly differentiated (entactinal) spicule show a number of cases with a more or less completely reduced outer shell; sometimes, specimens with well-developed, poorly developed, and almost reduced shells occur within the same species (for example, Early Triassic *Parentactinia nakatsugawaensis* Sugiyama, 1992) from the same assemblage. Consequently, this character is extremely unstable and is even subject to intraspecific variability. Therefore, it is impossible to use it, along with the average size of the shell (Petrushevskaya, 1986, p. 122), as a diagnostic character of the order.

Another objection discussed by Petrushevskaya (1986) concerns distinctions in the structure of the nucleus, nucleoaxopodial apparatus, and central capsule of extant taxa that Kozur and Mostler (1982) placed in the order Entactinaria. This is not improbable; however, if this is the case, the classification of living polycystine radiolarians should be substantiated based on these data on the cellular structure, although Petrushevskaya does not follow this approach. Here, we probably deal with the classical contradiction between biological and paleontological variants of classification of the same group. Since it is impossible to study organelles that are not preserved in fossils, extinct radiolarians are classified based exclusively on skeletal morphological characters.

Family Pentactinocarpidae Dumitrica, 1978

Pentactinocarpidae: Dumitrica, 1978b, p. 41.

Diagnosis. Entactinaria with five-rayed spicule, having one apical and four basal spines and positioned external to outer shell. All spines smooth, circular in cross section, located in different planes. One or two porous or reticular shells, first of which developed from basal spines.

Generic composition. *Pentactinocarpus* Dumitrica, 1978, *Pentactinorbis* Dumitrica, 1978, *Lobactinocapsa* Dumitrica, 1978, *Pentactinocapsa* Dumitrica, 1978, and *Pentactinosphaera* Nakaseko, Nagata et Nishimura, 1983. Middle Triassic to (?) Miocene.

Comparison. The family Pentactinocarpidae differs from Sepsagonidae Kozur et Mostler, 1981 and Multiarcusellidae Kozur et Mostler, 1979 in the five-rayed spicule positioned external to the outer shell.

Remarks. This group of genera was initially included in the bilaterally symmetrical radiolarians of the family Paleoscenidiidae Deflandre, 1953. However, typical Paleozoic and Early Triassic Paleoscenidiidae never form pronounced shells; their primary framework usually has several (two to four) apical spines and many apophyses of basal spines. In addition, they usually have a poorly developed median bar. These distinctions in the primary skeleton suggest rather remote relationships between Pentactinocarpidae and Paleoscenidiidae.

Genus *Pentactinocarpus* Dumitrica, 1978

Pentactinocarpus: Dumitrica, 1978b, p. 43.

Oertlisphaera: Kozur and Mostler, 1979, p. 53

Praedruppatractylis: Kozur and Mostler, 1979, p. 82.

Type species. *P. fusiformis* Dumitrica, 1978b; Lower Ladinian of southern Alps.

Diagnosis. One porous subspheroid or prunoid shell connected to distal parts of basal spines of spicule. Proximal parts of basal spines of spicule bordered by large subtriangular pores in apical part of skeleton, opposite end of which has antapical spine.

Species composition. Five species from the Middle and Upper Triassic of the Mediterranean, the Far East of Russia, Japan, the Philippines, and British Columbia.

Comparison. *Pentactinocarpus* differs from *Lobactinocapsa* Dumitrica, 1978 in the absence of additional lobes of the outer shell in the apical part of the test; it differs from *Pentactinorbis* Dumitrica, 1978 in the presence of one shell and from *Pentactinocapsa* Dumitrica, 1978 in the presence of the antapical spine.

Pentactinocarpus tetracanthus Dumitrica, 1978

Plate 1, fig. 1

Pentactinocarpus tetracanthus: Dumitrica, 1978b, p. 44, pl. 2, fig. 1; Dumitrica et al., 1980, p. 8, pl. 4, figs. 1–4; Lahm, 1984, p. 23, pl. 2, fig. 11; Gorican and Buser, 1990, p. 150, pl. 7, figs. 8–10; Kozur and Mostler, 1994, p. 47, pl. 2, figs. 6–7; Kellici and De Wever, 1995, p. 153, pl. 3, fig. 20; Sugiyama, 1997, p. 184, text-fig. 49.23; Tekin, 1999, p. 134, pl. 27, figs. 9 and 10.

Sethophaena ? sp. *A*: Nakaseko and Nishimura, 1979, p. 79, pl. 8, fig. 7 (non fig. 8).

Pentactinocarpus bispinosus: Lahm, 1984, p. 24, pl. 2, fig. 13.

H o l o t y p e. Northern Italy, Recoaro; Lower Ladinian, Buchenstein Formation (Dumitrica, 1978b, pl. 2, fig. 1). Collection number and depository are not indicated.

D e s c r i p t i o n. The shell is subspherical, extended towards the poles, slightly spindle-shaped, with a latticed shell, with large circular pores varying in size in smoothed polygonal frameworks. The apical spine is short, conical; the antapical spine is longer than the apical spine. The bases of the basal spines are included in the shell, their ends extend freely beyond the shell.

M e a s u r e m e n t s, μm. Shell length without spines, 200–220; apical spine length, 30–40; shell width, 150–180.

C o m p a r i s o n. *P. tetracanthus* differs from *P. sevaticus* Kozur et Mostler, 1981 in the smaller shell size and the smoothed polygonal shape of the framework.

O c c u r r e n c e. Ladinian–Lower Norian of Romania, Italy, Japan, Sikhote Alin, Turkey, and Cyprus.

M a t e r i a l. Fourteen specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Pentactinocarpus sevaticus Kozur et Mostler, 1981

Plate 1, figs. 2 and 3

Pentactinocarpus sevaticus: Kozur and Mostler, 1981, p. 21, pl. 52, fig. 3; pl. 53, fig. 5; pl. 55, fig. 1; Sugiyama, 1997, p. 184, text-fig. 50.7; Tekin, 1999, p. 134, pl. 27, figs. 7 and 8.

Pentactinocarpus sp. cf. *P. sevaticus* Kozur et Mostler: Carter, 1993, p. 40, pl. 1, figs. 11 and 15; pl. 21, figs. 15 and 17; Bragin and Krylov, 1996, pl. 1, fig. 7; Bragin and Tekin, 1996, pl. 3, fig. 1.

H o l o t y p e. KoMo (collection of Kozur and Mostler), no. 1980 I-52; Austria, Pötchenpass; Upper Norian (Kozur and Mostler, 1981, pl. 52, fig. 3); depository not indicated.

D e s c r i p t i o n. The shell is large, subspherical or ellipsoidal. The apical spine is short, smooth; the outer shell has pores varying in size and enclosed in hexagonal frames. The basal spines have free extensions in the middle part of the shell.

M e a s u r e m e n t s, μm. Shell length without apical spine, 330–380; apical spine length, 20–30; apical pore length, 60–70.

C o m p a r i s o n. *P. sevaticus* differs from *P. aspinosus* Kozur et Mostler, 1981 in the longer basal spines, the distal ends of which extend freely beyond the shell.

O c c u r r e n c e. Middle?–Upper Norian–Rhaetian of Austria, British Columbia, Cyprus, Turkey, and Japan.

M a t e r i a l. Twenty-six specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Family Sepsagonidae Kozur et Mostler, 1981

Sepsagonidae: Kozur and Mostler, 1981, p. 35.

D i a g n o s i s. Entactinaria with seven-rayed, poorly differentiated spicule without median bar or with poorly developed median bar, with four basal and three apical spines in external lateral position relative to internal subspherical shell; internal shell partially including basal spines. Rays of spicule located in different planes. Test always having two shells. Outer shell subspherical or subprunoid, with one or several main spines and, occasionally, with several subsidiary spines. Massive radial bars extending from bases of main spines inside shell, connecting external and internal shells, and not connected to spicule; thus, spicule not skeleton-building.

G e n e r i c c o m p o s i t i o n. *Sepsagon* Dumitrica, Kozur et Mostler, 1980 and *Parasepsagon* Dumitrica, Kozur et Mostler, 1980. Upper parts of the Lower–Upper Triassic.

C o m p a r i s o n. The family Sepsagonidae differs from Entactiniidae Riedel and Polyentactiniidae Nazarov, 1975 in the seven-rayed spicule; it differs from Hexapylomellidae Kozur et Mostler in the presence of external spines.

Genus *Sepsagon* Dumitrica, Kozur et Mostler, 1980

Sepsagon: Dumitrica, Kozur and Mostler, 1980, p. 14.

T y p e s p e c i e s. *Triactoma longispinosum* Kozur et Mostler, 1979; Middle Carnian of Austria.

D i a g n o s i s. Test spherical, double-layered, with three main spines located in one plane.

S p e c i e s c o m p o s i t i o n. Up to ten species from the upper part of the Lower Triassic and the Middle and Upper Triassic.

C o m p a r i s o n. *Sepsagon* differs from *Parasepsagon* Dumitrica, Kozur et Mostler, 1980 in the presence of three main spines.

Sepsagon longispinosus (Kozur et Mostler, 1979)

Plate 1, figs. 4 and 5

Triactoma longispinosum: Kozur and Mostler, 1979, p. 59, pl. 1, fig. 6, pl. 11, figs. 3 and 8, pl. 12, fig. 6, pl. 13, fig. 1.

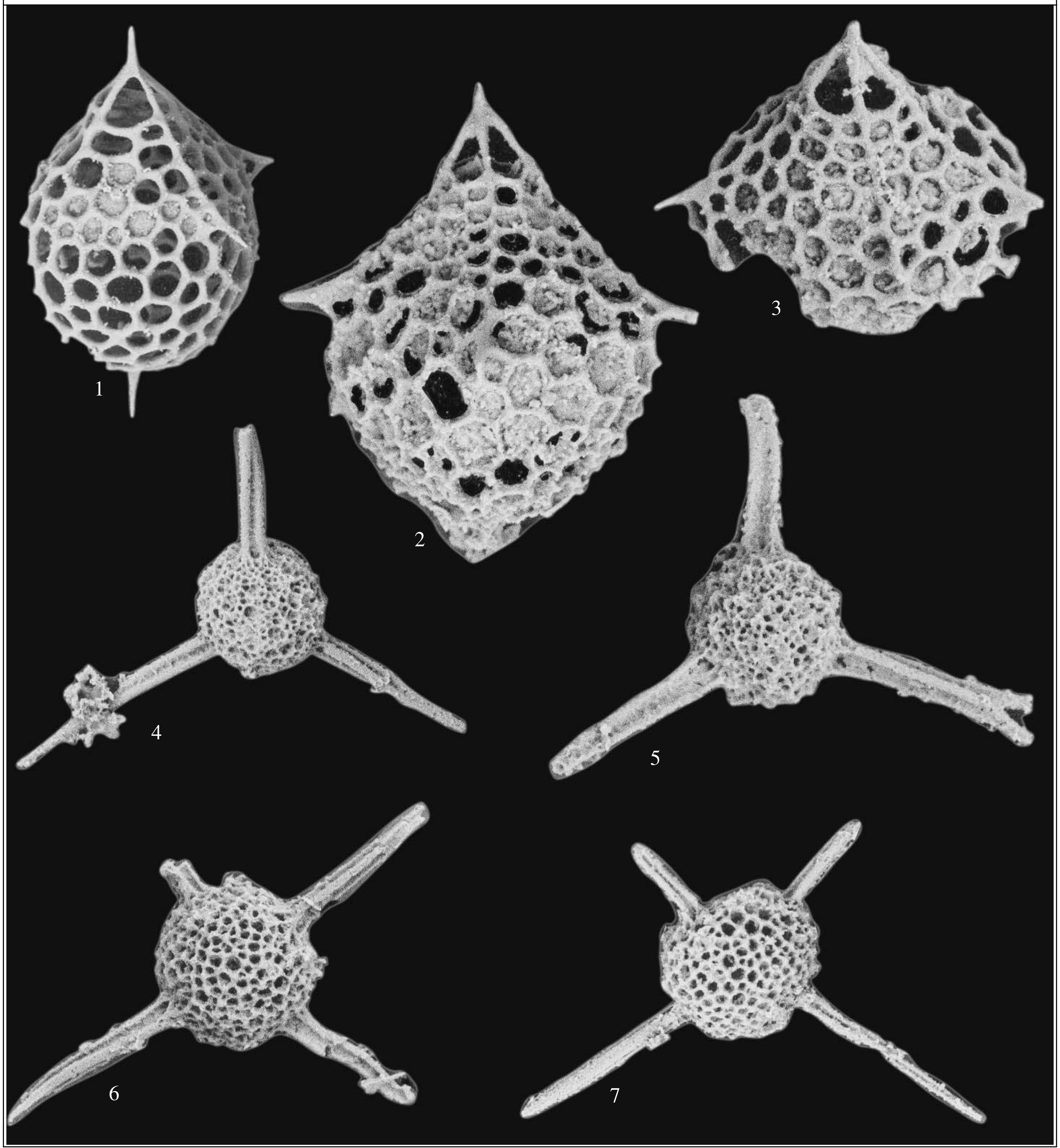
Sepsagon longispinosus: Dumitrica et al., 1980, p. 15, pl. 5, figs. 1, 2, 5, and 6, pl. 15, fig. 1.

Sarla longispinosum: Blome, 1983, p. 19, pl. 3, figs. 5, 7, 10, and 18, pl. 11, fig. 4.

Sarla longispinosa: Blome, 1984, p. 31, pl. 4, fig. 3.

Sepsagon longispinosus longispinosus: Lahm, 1984, p. 39, pl. 6, figs. 3–5.

Plate 1



Explanation of Plate 1

Fig. 1. *Pentactinocarpus tetracanthus* Dumitrica, specimen GIN, no. 4858-203; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×145.

Figs. 2 and 3. *Pentactinocarpus sevaticus* Kozur et Mostler, Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-2, ×200: (2) GIN, no. 4858-204 and (3) GIN, no. 4858-205.

Figs. 4 and 5. *Sepsagon longispinosus* (Kozur et Mostler), Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (4) GIN, no. 4858-206 and (5) GIN, no. 4858-207.

Figs. 6 and 7. *Parasepsagon asymmetricus* sp. nov., Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, paratypes, ×170: (6) GIN, no. 4858-201 and (7) GIN, no. 4858-202.

Holotype. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 13, fig. 1); collection number and depository are not indicated.

Description. The outer shell is spherical, double-layered. The external layer has oval angular pores in polygonal frames, with well-pronounced tubercles at the vertices. The internal layer is fine-porous. The surface of the outer shell is tuberculate. Three main spines are long, narrow, three-bladed at the base and in the middle part, tapering, smooth, sometimes, with slight dextral coiling.

Measurements, µm. Outer shell diameter, 110–120; length of the main spines, up to 280.

Comparison. *S. longispinosus* differs from *S. robustus* Lahm, 1984 in the long, narrow spines.

Occurrence. Ladinian–Norian of Austria, Italy, Oregon, and Cyprus.

Material. Thirty-two specimens from the Lara locality (samples 98-2-2, 98-2-4) and the Ayia Varvara locality (sample 90-39).

Genus *Parasepsagon* Dumitrica, Kozur et Mostler, 1980

Type species. *Parasepsagon tetracanthus* Dumitrica, Kozur et Mostler, 1980; Lower Ladinian of Italy.

Diagnosis. Shell spherical double-layered, with four main spines unequal in size and located in one plane. Axes of two shorter spines not coinciding.

Species composition. About five species from the Middle and Upper Triassic.

Comparison. *Parasepsagon* differs from *Sepsagon* in the presence of four main spines of unequal size.

Parasepsagon asymmetricus sp. nov.

Plate 1, figs. 6 and 7; Plate 2, fig. 1

Etymology. From the Latin *asymmetricus* (asymmetrical).

Holotype. GIN (Geological Institute of the Russian Academy of Sciences), no. 4858-114; Cyprus, Akamas Peninsula, Lara section; Lower Norian, Phasoula Formation (Pl. 2, fig. 1).

Description. The outer shell is spherical, slightly flattened, double-layered. The external layer has rounded polygonal pores varying in size, enclosed in polygonal (mostly tetra–hexagonal) pore frames, frequently with well-pronounced massive tubercles at the vertices; in some cases, the external layer resembles the pseudoaulophacoid layer. The internal layer is fine-porous. Four main spines differ in length and thickness and are located in one plane. The thickest and most massive spine is the shortest; it is opposed to the longest spine, which is somewhat narrower than the first. The other two spines are slightly shorter than the longest spine, positioned perpendicular to the first pair, their axes do not coincide.

Measurements, µm. Outer shell diameter, 180–220; the shortest spine is 250 long and 35–40 thick; the longest spine is 350–400 long and 30–35 thick.

Comparison. The new species differs from congeners in the absence of division of spines into two pairs and in the different length of all spines.

Occurrence. Lower Norian of Cyprus.

Material. Forty-one specimens from the Lara locality.

Family Hexapylomellidae Kozur et Mostler, 1979

Hexapylomellidae: Kozur and Mostler, 1979, p. 70.

Diagnosis. Spicule seven-rayed. Outer shell spherical, single or double-layered, without external spines.

Generic composition. *Hexapylomella* Kozur et Mostler, 1981, *Praenanina* Kozur, 1994, *Nanina* Kozur et Mostler, 1981, *Blomella* Sugiyama, 1997, and *Braginella* Sugiyama, 1997 from the Upper Triassic.

Comparison. The family Hexapylomellidae differs from Sepsagonidae Kozur et Mostler, 1981 in the absence of external spines.

Genus *Praenanina* Kozur, 1994

Type species. *P. veghae* Kozur, 1994; Carnian Stage of Hungary, Balaton Highland, borehole Inke-1.

Diagnosis. Hexapylomellidae having double-layered outer shell without pylomes.

Species composition. Type species.

Comparison. *Praenanina* differs from *Nanina* in the double-layered shell and from *Praenanina* in the absence of pylomes.

Praenanina veghae Kozur, 1994

Plate 2, fig. 2

Praenanina veghae: Kozur and Mostler, 1994, p. 247, pl. 2A, fig. 2; pl. 4A, figs. 1 and 3; Bragin and Krylov, 1999b, p. 543, text-figs. 2B, 2C, and 2E.

Holotype. Hungary, borehole Inke-1; Carnian (Kozur and Mostler, 1994, pl. 4A, fig. 1); collection number and depository are not specified.

Description. The shell is spherical, double-layered. The internal layer has small, oval or circular pores; the external layer is latticed, with massive nodes at the vertices. Spines and pylome are absent.

Measurements, µm. Outer shell diameter, 230–260.

Occurrence. Middle?–Upper Carnian of Hungary; Lower Norian of Cyprus.

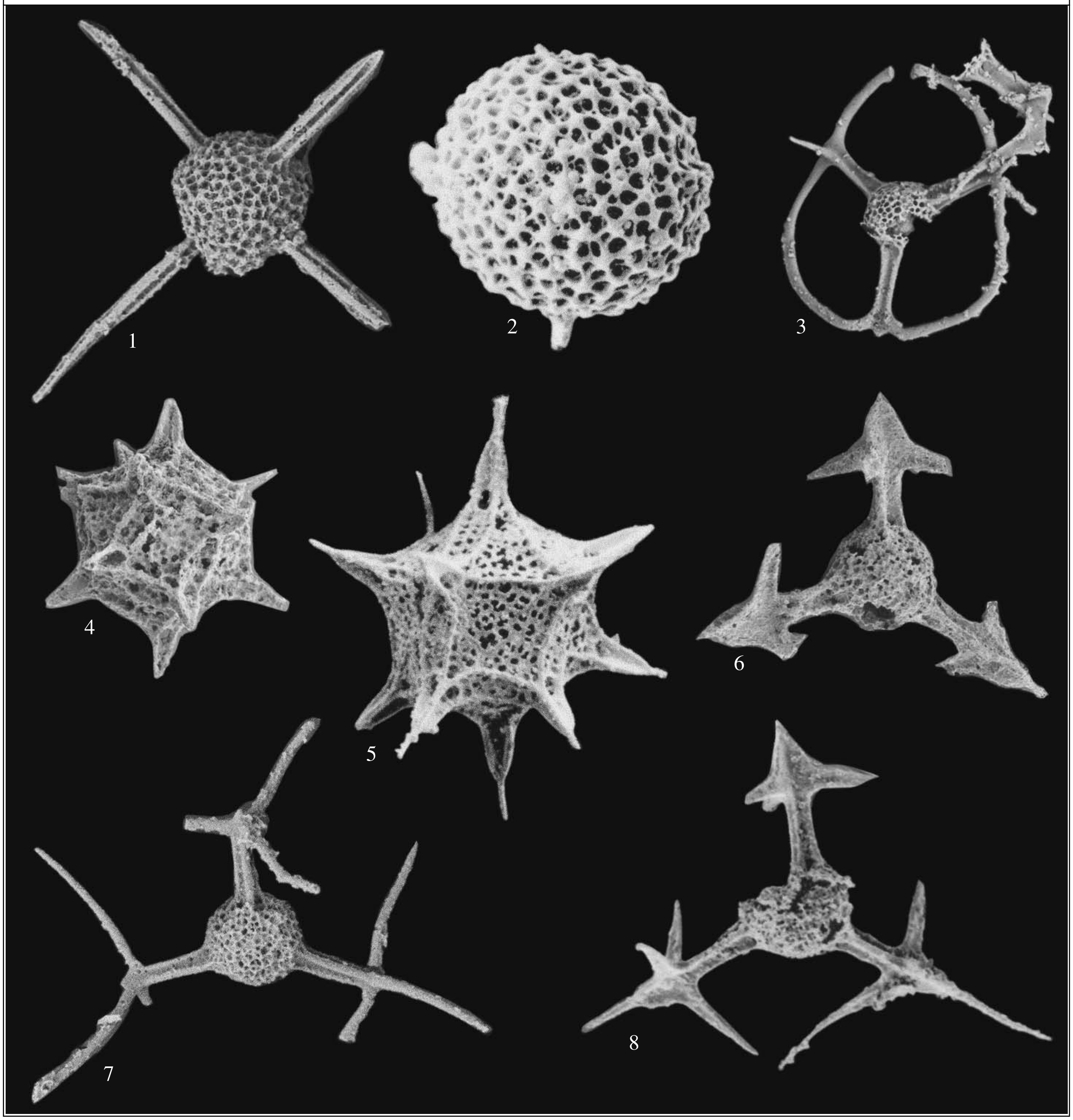
Material. Eighteen specimens from the Ayia Varvara locality.

Family Multiarcusellidae Kozur et Mostler, 1979

Multiarcusellidae: Kozur and Mostler, 1979, p. 85.

Diagnosis. Entactinaria with six-rayed spicule located in central part of test, with one shell and varying

Plate 2



Explanation of Plate 2

Fig. 1. *Parasepsagon asymmetricus* sp. nov., holotype GIN, no. 4858-114; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

Fig. 2. *Praenanina veghae* Kozur, specimen GIN, no. 4858-116; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×250.

Fig. 3. *Triarcella sulovensis* Kozur et Mock, specimen GIN, no. 4858-117; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.

Figs. 4 and 5. *Carinaheliosoma carinata* (Kozur et Mostler); Phasoula Formation, Lower Norian: (4) GIN, no. 4858-118, Lara section, sample 98-2-4, ×170; (5) GIN, no. 4858-119, Ayia Varvara locality, sample 90-39, ×250.

Figs. 6 and 8. *Kahlerosphaera parvispinosa* Kozur et Mostler; Phasoula Formation, Lower Norian: (6) GIN, no. 4858-120, Lara section, sample 98-2-2, ×170; (8) GIN, no. 4858-121, Ayia Varvara locality, sample 90-39, ×200.

Fig. 7. *Kahlerosphaera norica* Kozur et Mock, specimen GIN, no. 4858-122; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

number of main spines connected to each other by arches.

Composition. Subfamilies Multiarcusellinae Kozur et Mostler, 1979 and Triarcellinae Kozur et Mock, 1981 from the Upper Triassic.

Comparison. The family Multiarcusellidae is distinguished from Eptingiidae Riedel, 1967 by the main spines connected to each other by arches.

Subfamily Triarcellinae Kozur et Mock, 1981

Triarcellinae: Kozur and Mostler, 1981, p. 26.

Diagnosis. Multiarcusellidae with three main spines connected by arches located in one plane.

Generic composition. *Triarcella* Kozur et Mock, 1981.

Comparison. The subfamily Triarcellinae is distinguished from Multiarcusellinae by the presence of three main spines and by the position of arches in the same plane.

Genus *Triarcella* Kozur et Mock, 1981

Triarcella: Kozur and Mostler, 1981, p. 26.

Type species. *Triarcella sulovensis* Kozur et Mock, 1981; Lower Norian of Slovakia.

Diagnosis. The only genus in the subfamily.

Species composition. Two species, *Triarcella sulovensis* and *T. arcuata*, from the Lower Norian of Slovakia, Turkey, and Cyprus.

***Triarcella sulovensis* Kozur et Mock, 1981**

Plate 2, fig. 3

Triarcella sulovensis: Kozur and Mostler, 1981, p. 26, pl. 62, figs. 1–4; Tekin, 1999, p. 127, pl. 25, figs. 3 and 4.

Holotype. KoMo, no. 1980 I-12, Slovakia, village of Sulov; Lower Norian (Kozur et Mostler, 1981, pl. 62, fig. 1); depository not specified.

Description. The outer shell is subspherical, slightly flattened in the plane of the main spines, with irregularly hexagonal pore frameworks. The three main spines are moderately long, three-bladed; their ends are connected in a ring by smooth semicircular arches.

Measurements, μm. Ring diameter, 255; length of spines, 70–75.

Comparison. *T. sulovensis* differs from *T. arcuata* Kozur et Mock, 1981 in a single ring without additional arches.

Occurrence. Lower Norian of Slovakia, Turkey, and Cyprus.

Material. One specimen from the Ayia Varvara locality.

Order Spumellaria Ehrenberg, 1875

Diagnosis. Polycystina with primary framework represented by pierced initial shell varying in outlines and structure, with varying number of shells varying in shape and structure, with concentric mode of skeleton growth.

Composition. Silurian?–Recent. In the Triassic, the order is represented by the superfamilies Actinommoidea Haeckel, 1862 and Spongodiscoidea Haeckel, 1862.

Comparison. The order Spumellaria differs from Entactinaria Kozur et Mostler, 1982 in the primary framework represented by the initial shell without a spicule.

Superfamily Actinommoidea Haeckel, 1862

Actinommatida: Haeckel, 1862, p. 440.

Actinommida: Haeckel, 1887, p. 251.

Diagnosis. Spumellaria with primary framework represented by spherical or subspherical, porous initial shell in center of skeleton, with one or several spherical or subspherical shells, with a varying number of external spines or without spines.

Composition. Silurian?–Recent. In the Triassic, the superfamily is represented by the families Actinommidae Haeckel, 1881, Capnuchosphaeridae De Wever, 1979, Pantanelliidae Pessagno, 1977, Ferresiidae Carter, 1993, and Stylosphaeridae Haeckel, 1882.

Comparison. The superfamily Actinommoidea differs from Spongodiscoidae Haeckel, 1962 in the primary framework of spherical or subspherical porous shell in the center of the skeleton.

Family Actinommidae Haeckel, 1862

Actinommatida: Haeckel, 1862, p. 440.

Actinommida: Haeckel, 1887, p. 251.

Diagnosis. Actinommoidea with spherical microsphere, with several porous single-layered, or, less often, spongy single-layered shells and varying numbers of simple radial main spines never occupying polar positions.

Generic composition. Triassic–Recent. In the Triassic, the family is represented by the genera *Archaeocenosphaera* Pessagno et Yang, 1989, *Carinaheliosoma* Kozur et Mostler, 1981, *Kahlerosphaera* Kozur et Mostler, 1979, and *Triassospongosphaera* Kozur et Mostler, 1979.

Comparison. The family Actinommidae is distinguished from Capnuchosphaeridae by the single-layered outer shells and from Stylosphaeridae by the main spines which do not occupy a polar position.

Genus *Carinaheliosoma* Kozur et Mostler, 1981

Carinaheliosoma: Kozur and Mostler, 1981, p. 68.

Type species. *Carinaheliosoma densiporata* Kozur et Mock, 1981; Carnian Stage of Slovakia.

Diagnosis. One subspherical porous shell with 14–18 three-bladed spines. Bases of spines connected by ridges extending on surface of shell.

Species composition. Three species from the Carnian–Lower Norian of Slovakia, Austria, Cyprus, Turkey, and the Koryak Upland.

Comparison. *Carinaheliosoma* differs from *Heliosoma* Haeckel, 1881 in the presence of ridges connecting the bases of spines on the surface of the shell.

Carinaheliosoma carinata (Kozur et Mostler, 1979)

Plate 2, figs. 4 and 5

Heliosoma carinata: Kozur et Mostler, 1979, p. 52, pl. 9, figs. 1–3.

Carinaheliosoma carinata: Lahm, 1984, p. 65, pl. 11, fig. 8; Bragin and Krylov, 1999b, p. 545, text-figs. 2A and 2D; Tekin, 1999, p. 63, pl. 1, figs. 1 and 2.

Holotype. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 9, fig. 1); collection number and depository are not indicated.

Description. The shell is a regular spherical polyhedron with 14 apices which terminate in moderately long narrow spines, with three-bladed bases and smooth distal parts. The apices of the polyhedron are connected by straight narrow ridges; the shell wall between the ridges is pierced by small, circular, irregularly arranged pores.

Measurements, μm. Shell diameter, 150–170; length of spines, 40–60.

Comparison. *C. carinata* differs from *C. ehrenbergi* (Kozur et Mostler, 1979) in the polyhedral shell and in the greater number of spines.

Occurrence. Carnian–Lower Norian of Austria, Turkey, and Cyprus.

Material. More than 50 specimens from the Lara and Ayia Varvara localities.

Genus *Kahlerosphaera* Kozur et Mostler, 1979

Kahlerosphaera: Kozur and Mostler, 1979, p. 66.

Fontinella: Carter, 1993, p. 43.

Type species. *Kahlerosphaera parvispinosa* Kozur et Mostler, 1979; Middle Carnian of Austria, Göstling.

Diagnosis. Outer shell subspherical, latticed. Each of three main spines Y-shaped in cross section, with three distal branches connected to ridges of proximal parts of spines.

Species composition. About ten species from the Carnian–Rhaetian of the Mediterranean and Pacific regions.

Comparison. *Kahlerosphaera* differs from *Triactoma* Rust, 1885 in the presence of branches of ridges in the distal parts of spines.

Remarks. Species usually combined under the name *Fontinella* (Carter, 1993) are only distinguished from typical *Kahlerosphaera* Kozur et Mostler, 1979 by the short branches of the main spines. Thus, they hardly deserve to be placed in a separate genus.

Kahlerosphaera parvispinosa Kozur et Mostler, 1979

Plate 2, figs. 6 and 8

Kahlerosphaera parvispinosa: Kozur and Mostler, 1979, p. 66, pl. 11, figs. 4 and 5; pl. 13, fig. 4; Bragin and Krylov, 1999b, p. 545, text-fig. 7A; Tekin, 1999, p. 64, pl. 1, figs. 3 and 4.

Holotype. Austria, Göstling, Middle Carnian (Kozur and Mostler, 1979, pl. 13, fig. 4); collection number and depository are not indicated.

Description. The outer shell is subspherical or subtriangular, spongy, with small pores. Three spines are Y-shaped in cross section, located in the same plane. Three straight, relatively short, proximally inclined apophyses with Y-shaped cross section extend from the distal parts of the main spines.

Measurements, μm. Outer shell diameter, 180–200; length of spines, 160–180; length of apophyses of distal parts of spines, 120–140.

Comparison. *K. parvispinosa* differs from *K. norica* Kozur et Mock, 1981 in the spongy shell structure and Y-shaped cross section of the distal apophyses of the spines.

Occurrence. Lower Norian of Slovakia, Cyprus, and Turkey.

Material. Thirty-seven specimens from the Lara and Ayia Varvara localities.

Kahlerosphaera norica Kozur et Mock, 1981

Plate 2, fig. 7; Plate 3, fig. 1

Kahlerosphaera norica: Kozur and Mostler, 1981, p. 36, pl. 15, fig. 4; Sugiyama, 1997, p. 181; Bragin and Krylov, 1999b, p. 545, text-figs. 6G and 6H; Tekin, 1999, p. 65, pl. 1, figs. 11 and 12; Tekin and Yurtsever, 2003, p. 151, pl. 1, fig. 1.

Holotype. KoMo, no. 1980 I-71. Slovakia, western Carpathians, village of Sulov, Lower Norian (Kozur and Mostler, 1981, pl. 15, fig. 4); depository not indicated.

Description. The outer shell is subspherical, sometimes, subtriangular, latticed, with small irregularly polygonal frames having small tubercles at the vertices. Three spines with the Y-shaped cross section are positioned in the same plane. Three long, slightly distally curved, smooth, rod-shaped apophyses extend from the distal part of each spine.

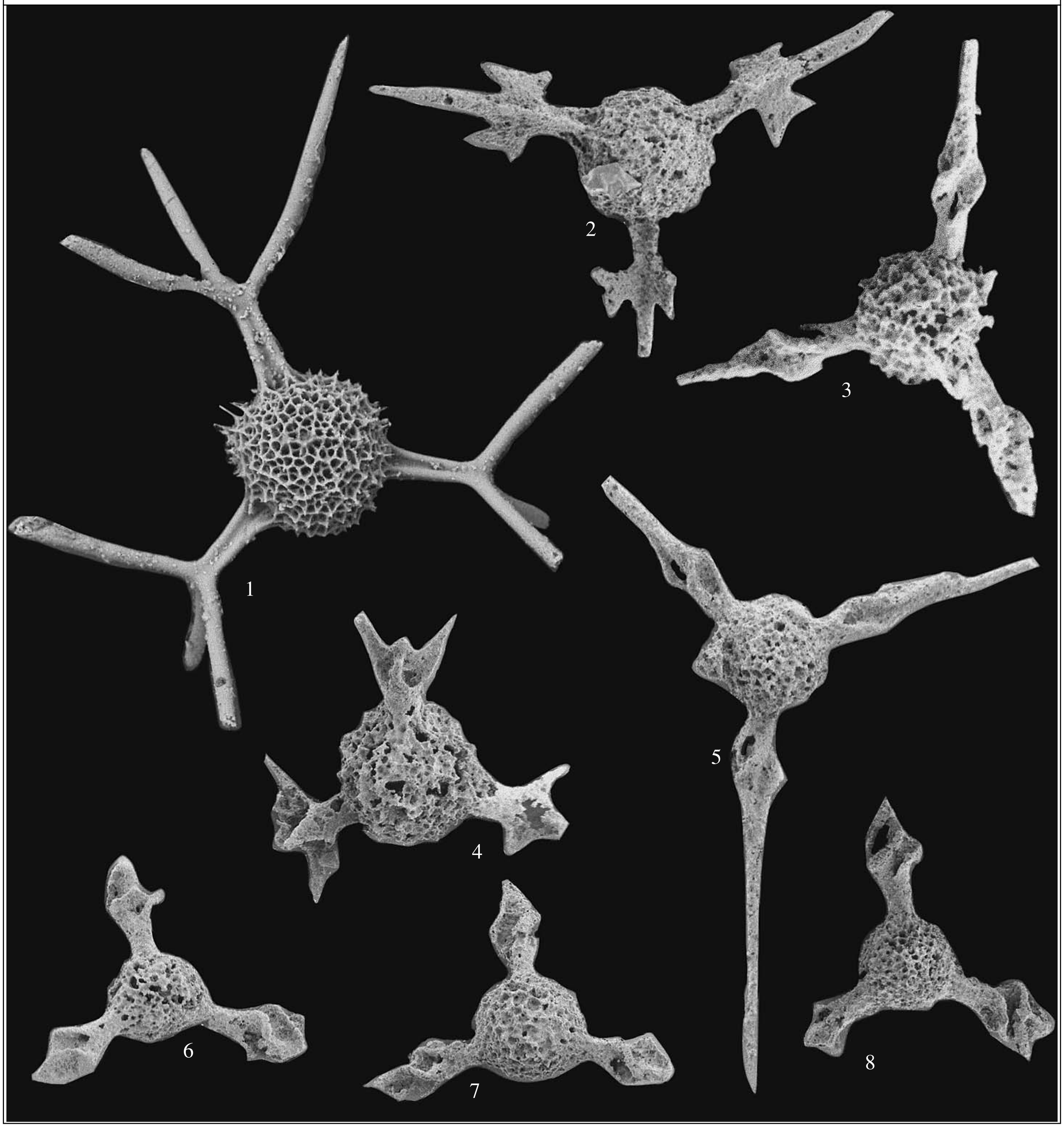
Measurements, μm. Outer shell diameter, 120–140; length of spines, 140–160; length of apophyses of distal part of spines, 150–200.

Comparison. *K. norica* differs from *K. aspinosa* Kozur et Mock, 1981 in the longer and rod-shaped apophyses of its spines.

Occurrence. Lower Norian of Slovakia, Japan, Cyprus, and Turkey.

Material. Twenty-two specimens from the Lara and Ayia Varvara localities.

Plate 3



Explanation of Plate 3

Fig. 1. *Kahlerosphaera norica* Kozur et Mock, specimen GIN, no. 4858-123; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-38, ×200.

Fig. 2. *Kahlerosphaera kemerensis adentatus* Tekin, specimen GIN, no. 4858-124; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×200.

Figs. 3 and 5. *Capnuchosphaera deweveri* Kozur et Mostler; Phasoula Formation, Lower Norian: (3) GIN, no. 4858-125, Ayia Varvara locality, sample 90-38, ×200; (5) GIN, no. 4858-126, Lara section, sample 98-2-4, ×170.

Fig. 4. *Capnuchosphaera tricornis* De Wever, specimen GIN, no. 4858-127; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

Figs. 6–8. *Capnuchosphaera triassica* De Wever, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×140: (6) GIN, no. 4858-136, (7) GIN, no. 4858-137, and (8) GIN, no. 4858-138.

***Kahlerosphaera kemerensis* Tekin, 1999**

Kahlerosphaera kemerensis: Tekin, 1999, p. 64, pl. 1, figs. 5–9.

H o l o t y p e. Turkey, Yailakuzdere section, Upper Carnian–Lower Norian (Tekin, 1999, pl. 1, fig. 7), collection number not indicated, housed in MTA (General Directorate of Geology and Mineral Resources), Ankara.

D e s c r i p t i o n. The outer shell is subspherical or subtriangular, double-layered. The external layer has polygonal, pore frames varying in size; the internal layer is fine-porous. Three main spines are located symmetrically in the same plane. The spines are straight, three-bladed, gradually narrowing to smooth pointed ends. In the middle part of the spines, their ridges expand into three flat wing-shaped projections with, or without teeth.

C o m p a r i s o n. *K. kemerensis* differs from other species in the presence of wing-shaped projections rather than apophyses on the main spines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Thirty-eight specimens from the Lara locality.

***Kahlerosphaera kemerensis adentatus* Tekin, 1999**

Plate 3, fig. 2

Kahlerosphaera kemerensis adentatus: Tekin, 1999, p. 64, pl. 1, figs. 5 and 6.

H o l o t y p e. Turkey, Yailakuzdere section, Upper Carnian–Lower Norian (Tekin, 1999, pl. 1, fig. 5); collection number is not indicated, housed in MTA, Ankara.

D i a g n o s i s. Wing-shaped projections of main spines lacking additional teeth.

M e a s u r e m e n t s, µm. Outer shell diameter, 150–170; length of the three-bladed part of the main spine, 130–140; total length of the spine, 280–300; width of wing-shaped projections, up to 100.

C o m p a r i s o n. *K. k. adentatus* differs from the type subspecies in the absence of teeth on the wing-shaped projections of the main spines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Thirty-eight specimens from the Lara locality.

Family Capnuchosphaeridae De Wever, 1979

Capnuchosphaeridae: De Wever et al., 1979, p. 81.

D i a g n o s i s. Actinommoidea with spherical or flattened double-layered porous outer shell, with several radial main spines, including tumidaspines, i.e., spines clearly divided into three regions. Proximal region of tumidaspines (spinal channel) often hollow. Middle region (spinal tumor) usually with spiral sculpturing, with three pores, if spinal channel hollow. Distal region (spinal shaft) relatively narrow. Number of tumidaspines ranging from one to four; in addition, ordinary spines may present. Spines connected to initial shell by radial bars.

C o m p o s i t i o n. Two subfamilies, Capnuchosphaerinae De Wever, 1982 and Sarlinae De Wever, 1982, from the Upper Triassic.

C o m p a r i s o n. Capnuchosphaeridae differs from other families of Actinommoidea in the presence of tumidaspines.

Subfamily Capnuchosphaerinae De Wever, 1982

Capnuchosphaerinae: De Wever, 1982, p. 149.

D i a g n o s i s. Capnuchosphaeridae with hollow tumidaspines.

G e n e r i c c o m p o s i t i o n. *Capnuchosphaera* De Wever, 1979, *Sarla* Pessagno, 1979, *Plafkerium* Pessagno, 1979, *Icrioma* De Wever, 1979, *Catoma* Blome, 1983, *Weverella* Kozur et Mostler, 1981, *Kinyrosphaera* Bragin, 1999, *Dicapnuchosphaera* Tekin, 1999, *Monocapnuchosphaera* Tekin, 1999, *Paricrioma* Tekin, 1999, and *Braginastrum* Tekin, 1999 from the Ladinian–Norian.

C o m p a r i s o n. The subfamily Capnuchosphaerinae differs from Sarlinae De Wever in the presence of cavities in the tumidaspines.

Genus *Capnuchosphaera* De Wever, 1979

Capnuchosphaera: De Wever et al., 1979, p. 82.

Divatella: Kozur and Mostler, 1981, p. 75.

T y p e s p e c i e s. *Capnuchosphaera triassica* De Wever, 1979; Upper Carnian of Sicily.

D i a g n o s i s. Outer shell subspherical or discoidal–spherical, with three tumidaspines located in one plane. Spinal channel thick, hollow. Spinal tumor massive, with three pores, often with spiral surface sculpturing. Spinal shaft narrow, varying in length.

S p e c i e s c o m p o s i t i o n. About 20 species from the Middle Carnian–Middle Norian of Mediterranean, Japan, Mexico, Oregon, British Columbia, the Far East of Russia, and the Philippines.

C o m p a r i s o n. *Capnuchosphaera* differs from *Dicapnuchosphaera* Tekin, 1999 in the presence of three tumidaspines, from *Kinyrosphaera* Bragin, 1999 in the porous shell in the proximal region of the tumidaspines.

***Capnuchosphaera deweveri* Kozur et Mostler, 1979**

Plate 3, figs. 3 and 5

Capnuchosphaera triassica var. *a*: De Wever et al., 1979, p. 84, pl. 4, figs. 3–5; Nakaseko and Nishimura, 1979, p. 76, pl. 7, fig. 4.

Capnuchosphaera deweveri: Kozur et Mostler, 1979, p. 77, pl. 10, figs. 2, 4–8; pl. 12, fig. 1; De Wever, 1982, p. 152, pl. 3, figs. 10 and 11; pl. 4, figs. 1 and 2; Blome, 1983, p. 16, pl. 1, figs. 3, 8, 9, 16, and 18; pl. 11, figs. 1, 2, and 16; Blome, 1984, p. 28, pl. 3, fig. 9; Lahm, 1984, p. 81, pl. 14, fig. 7; Yeh, 1990, p. 8, pl. 2, fig. 5; pl. 10, fig. 8; Otsuka et al., 1992, pl. 3, fig. 3; Aita and Sporli, 1994, pl. 6, fig. 3; Bragin and Krylov, 1999b, p. 547, text-fig. 4A.

Non *Capnuchosphaera deweveri*: Tekin, 1999, p. 71, pl. 3, figs. 12 and 13 (= *Kinyrosphaera helicata* Bragin, 1999).

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 12, fig. 1); collection number and depository are not specified.

D e s c r i p t i o n. The outer shell is spherical, double-layered; the external layer has large rounded triangular pores, the internal layer has small circular pores. The tumidaspines are long, narrow; the spinal tumor shows well-pronounced dextral coiling and has large pores. The spinal shaft is narrow.

M e a s u r e m e n t s, μm. Outer shell diameter, 160–180; length of tumidaspines, 180–210.

C o m p a r i s o n. *C. deweveri* differs from *C. triassica* Kozur et Mostler, 1979 in the long and narrow tumidaspines, which are longer than the diameter of the outer shell.

O c c u r r e n c e. Carnian–Lower Norian of Sicily, Greece, Turkey, Austria, Japan, Slovakia, Oregon, New Zealand, the Philippines, and Cyprus.

M a t e r i a l. More than 50 specimens from the Lara and Ayia Varvara localities.

Capnuchosphaera tricornis De Wever, 1979

Plate 3, fig. 4

Capnuchosphaera tricornis: De Wever et al., 1979, p. 85, pl. 4, figs. 6–10; De Wever, 1982, p. 161, pl. 6, figs. 5 and 7, pl. 7, figs. 5 and 6, pl. 8, figs. 1–4; Yoshida, 1986, pl. 12, fig. 3; Bragin, 1991b, pl. 1, fig. 7; pl. 2, fig. 2; Halamic and Gorican, 1995, pl. 2, fig. 16; Tekin, 1999, pl. 4, figs. 6 and 7.

Capnuchosphaera: Yeh, 1992, pl. 9, fig. 10.

Non *Capnuchosphaera tricornis*: Yeh, 1992, pl. 9, fig. 12 (= *Capnuchosphaera triassica* De Wever, 1979).

H o l o t y p e. Sicily, Monte Cammarata; Upper Carnian (De Wever et al., 1979, pl. 4, figs. 6–8); collection number is not indicated, housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The outer shell is spherical, latticed, double-layered; the external layer has large rounded triangular pores; the internal layer has small circular pores. The tumidaspines are thick; the spinal tumor is massive, triangular in projection, lacks a spiral sculpturing, and has large pores. The spinal shaft is narrow, smooth. Three short rod-shaped subsidiary spines deviate from the apices of triangular spinal tumor.

M e a s u r e m e n t s, μm. Outer shell diameter, 120–150; length of tumidaspines, 120–160.

C o m p a r i s o n. *C. tricornis* differs from *C. theloides* De Wever, 1979 in the presence of subsidiary spines on the spinal tumors of the tumidaspines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Sicily, Turkey, Japan, the Koryak Upland, the Philippines, Croatia, and Cyprus.

M a t e r i a l. Seventeen specimens from the Lara and Ayia Varvara localities.

Capnuchosphaera theloides De Wever, 1979

Capnuchosphaera theloides: De Wever et al., 1979, p. 83, pl. 3, figs. 10–13, pl. 4, fig. 1; Nakaseko and Nishimura, 1979, p. 75, pl. 7, fig. 7; De Wever, 1982, p. 158, pl. 6, fig. 8; Yao et al., 1982, pl. 1, fig. 23; Yao, 1982, pl. 1, fig. 23; ?Yoshida, 1986, pl. 12, fig. 4; Yeh, 1990, p. 9, pl. 2, fig. 13; pl. 3, fig. 12; Bragin, 1991a, p. 77, pl. 5, figs. 14 and 15; Bragin and Krylov, 1999b, p. 548, text-figs. 4D and 4E; Tekin, 1999, pl. 4, fig. 3; Wang et al., 2002, p. 326, pl. 1, figs. 11–14.

H o l o t y p e. Sicily, Monte Cammarata; Upper Carnian (De Wever et al., 1979, pl. 3, figs. 11–13); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The shell is spherical; the external layer of the shell is fine-porous, almost spongy. The pores vary in shape and size, enclosed in irregular, sometimes hexagonal or pentagonal frames. The tumidaspines have smooth, thick spinal channels; the spinal tumors are massive, triangular in projection, lack spiral sculpturing and have large pores. The spinal shafts are long, gradually tapering.

M e a s u r e m e n t s, μm. Outer shell diameter, 130–140; length of tumidaspines, 110–120; length of their spinal channels, ca. 50.

C o m p a r i s o n. *C. theloides* differs from *C. tricornis* De Wever, 1979 in the absence of three apophyses on the spinal tumors of tumidaspines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Greece, Turkey, Cyprus, Japan, the Philippines, Sikhote Alin, the Koryak Upland, and Tibet.

M a t e r i a l. Forty-seven specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Capnuchosphaera theloides theloides De Wever, 1979

Capnuchosphaera theloides: De Wever et al., 1979, p. 83, pl. 3, figs. 10–13; Yeh, 1990, p. 9, pl. 2, fig. 13; pl. 3, fig. 12; Tekin, 1999, pl. 4, fig. 3; Wang et al., 2002, p. 326, pl. 1, figs. 11–14.

H o l o t y p e. Sicily, Monte Cammarata; Upper Carnian (De Wever et al., 1979, pl. 3, figs. 11–13); collection number is not indicated, housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The shell is small, spherical, with three massive, moderately long tumidaspines. The spinal channels are smooth, moderately thick; the spinal tumors are three-bladed, tetrahedral, without coiling; the spinal shafts are very long and narrow, without a distinct boundary with the spinal tumors. Pores of the outer shell are small, rounded, enclosed in irregular frameworks with small, short secondary spines.

C o m p a r i s o n. *C. t. theloides* differs from *C. t. minor* in the thick, massive, moderately long tumidaspines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Sicily, the Philippines, Turkey, and Tibet.

Capnuchosphaera theloides minor Bragin, 1999

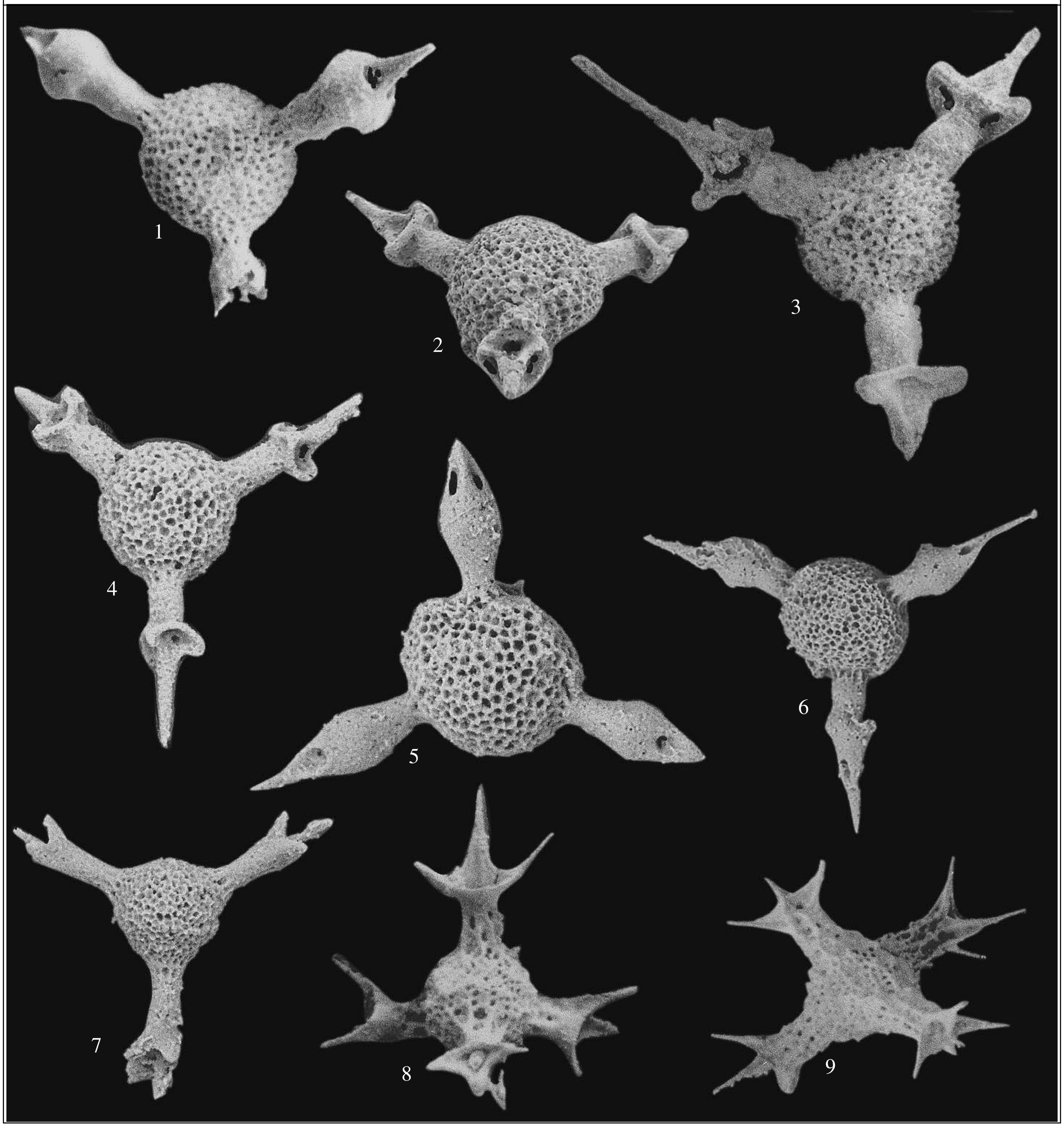
Plate 4, figs. 2–4

Capnuchosphaera theloides De Wever, var. *a*: De Wever et al., 1979, p. 84, pl. 4, fig. 1; Nakaseko and Nishimura, 1979, p. 75, pl. 7, fig. 7; De Wever, 1982, p. 158, pl. 6, fig. 8.

Capnuchosphaera theloides De Wever: Yao, 1982, pl. 1, fig. 23; Yoshida, 1986, pl. 12, fig. 4; Bragin, 1991a, p. 77, pl. 5, figs. 14 and 15.

Capnuchosphaera theloides minor: Bragin and Krylov, 1999b, p. 548, text-figs. 4D and 4E.

Plate 4



Explanation of Plate 4

Fig. 1. *Capnuchosphaera constricta* (Kozur et Mock), specimen GIN, no. 4858-128; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.

Figs. 2–4. *Capnuchosphaera theloides minor* Bragin; Phasoula Formation, Lower Norian: (2, 4) Lara section, sample 98-2-2, ×170, paratypes: (2) GIN, no. 4858-129 and (4) GIN, no. 4858-130; (3) holotype GIN, no. 4858-42, Ayia Varvara locality, sample 90-39, ×170.

Figs. 5 and 6. *Capnuchosphaera crassa* Yeh, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2: (5) GIN, no. 4858-130, ×200; (6) GIN, no. 4858-131, ×170.

Fig. 7. *Capnuchosphaera concava* De Wever, specimen GIN, no. 4858-131; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×140.

Figs. 8 and 9. *Icrioma tetrancistrum* De Wever; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170: (8) GIN, no. 4858-132 and (9) GIN, no. 4858-133.

H o l o t y p e. GIN, no. 4858-42, Cyprus, village of Ayia Varvara, Mamonia Complex; Upper Triassic, Lower Norian (Bragin and Krylov, 1999b, p. 548, text-fig. 4D).

D e s c r i p t i o n. The shell is relatively small, spherical, with three long and narrow tumidaspines. The spinal channels are smooth, moderately thick; the spinal tumors are three-bladed, tetrahedral, without coiling; the spinal shafts are very long and narrow, without a clear boundary with the spinal tumors. Pores of the outer shell are small, rounded, enclosed in irregular frames with small, short secondary spines.

M e a s u r e m e n t s, μm. Shell diameter, 130–135; total length of tumidaspines, 220–260; length of spinal shafts, 145–160; greatest width of tumidaspines, 80–90.

C o m p a r i s o n. *C. t. minor* differs from *C. t. theloides* (De Wever, 1979, p. 83, pl. 3, figs. 10–13) in the narrower and longer tumidaspines, in which the spinal tumors and spinal shafts are not separated by a clear boundary.

O c c u r r e n c e. Upper Carnian–Middle Norian of Sicily, Turkey, Japan, Sikhote Alin, and Cyprus.

M a t e r i a l. Forty-seven specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Capnuchosphaera triassica De Wever, 1979

Plate 3, figs. 6–8

Capnuchosphaera triassica: De Wever et al., 1979, p. 84, pl. 3, figs. 14–19; Nakaseko and Nishimura, 1979, p. 76, pl. 7, figs. 5 and 6; De Wever, 1982, p. 159, pl. 6, figs. 5 and 6, pl. 7, figs. 1 and 4; Nishizono et al., 1982, pl. 1, fig. 17; Lahm, 1984, p. 82, pl. 14, figs. 8 and 9; Sato et al., 1986, pl. 16, fig. 13; Yeh, 1990, p. 9, pl. 2, figs. 9, 10, and 16, pl. 3, figs. 5, 10, 14, and 15; Yeh, 1992, pl. 9, fig. 11; Fujii et al., 1993, pl. 3, fig. 14; Halamic and Gorican, 1995, pl. 2, fig. 9; Tekin, 1999, p. 72, pl. 4, figs. 4 and 5; Wang et al., 2002, p. 326, pl. 1, figs. 15–17.

Capnuchosphaera n. sp. aff. *triassica*: Kozur and Mostler, 1979, p. 75, pl. 10, fig. 3.

Capnuchosphaera tricornis: Yeh, 1992, pl. 9, fig. 12.

H o l o t y p e. Sicily, Monte Cammarata; Upper Carnian (De Wever et al., 1979, pl. 3, figs. 14 and 17); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The shell is spherical; the outer shell is double-layered, resembling the pseudoaulophacoid structure, i.e., the small, oval, circular, or rounded triangular pores are enclosed in irregular polygonal frames. The pores and frames of the internal layer of the shell are smaller than those of the external layer. The tumidaspines are massive, short; the spinal shafts are thick, short, cylindrical; the spinal tumors are very thick, with considerable dextral coiling. The spinal shafts are short, blunt.

M e a s u r e m e n t s, μm. Outer shell diameter, 160–180; length of tumidaspines, 120–130.

C o m p a r i s o n. *C. triassica* differs from *C. deweveri* Kozur et Mostler, 1979 in the thicker and shorter tumidaspines with the blunted spinal shafts.

O c c u r r e n c e. Middle Carnian–Middle Norian of Greece, Sicily, Turkey, Austria, the Philippines, Japan, Croatia, Tibet, and Cyprus.

M a t e r i a l. Thirty-three specimens from the Lara and Parekklisia localities.

Capnuchosphaera constricta (Kozur et Mock, 1981)

Plate 4, fig. 1

Sulovella constricta: Kozur and Mostler, 1981, p. 77, pl. 64, fig. 2; Bragin and Krylov, 1999b, p. 549, text-figs. 5A and 5B.

Capnuchosphaera cf. *constricta*: Halamic and Gorican, 1995, pl. 2, fig. 11.

Capnuchosphaera constricta: Tekin, 1999, pl. 3, figs. 8 and 9.

H o l o t y p e. KoMo, no. 1980 I-2, Slovakia, western Carpathians, Sulov; Lower Norian (Kozur and Mostler, 1981, pl. 64, fig. 2); depository not indicated.

D e s c r i p t i o n. The outer shell is spherical, with rounded pores in hexagonal and pentagonal frames. The tumidaspines are moderately long; their spinal channels are subcylindrical, with a distinct middle expansion; the spinal tumors are thick, subspherical, separated from the spinal shafts by distinct constrictions. The spinal shafts are narrow, straight, three-bladed.

M e a s u r e m e n t s, μm. Outer shell diameter, 160–180; length of tumidaspines, 160–190.

C o m p a r i s o n. *C. constricta* differs from *C. crassa* Yeh, 1990 in the subcylindrical spinal channels with the middle swelling.

O c c u r r e n c e. Lower Norian of Slovakia, Croatia, Turkey, and Cyprus.

M a t e r i a l. Fourteen specimens from the Lara and Ayia Varvara localities.

Capnuchosphaera crassa Yeh, 1990

Plate 4, figs. 5 and 6

Capnuchosphaera crassa: Yeh, 1990, p. 8, pl. 1, figs. 8, 11–13, 18, and 19; Halamic and Gorican, 1995, pl. 2, fig. 12; Tekin, 1999, p. 70, pl. 3, figs. 10 and 11.

H o l o t y p e. NMNS (National Museum of Natural History of Taiwan), no. 010098, Philippines, Busuanga; Upper Carnian–Lower Norian (Yeh, 1990, pl. 1, fig. 8); housed in the National Museum of Natural History of Taiwan.

D e s c r i p t i o n. The outer shell is subspherical, with rounded pores in pentagonal and hexagonal frames. The tumidaspines are moderately long, spindle-shaped, located in the same plane; the spinal channels are smooth, gradually expanding and passing without a constriction into the spinal tumors, with three distinct elongated pores. The spinal shafts are short, three-bladed.

M e a s u r e m e n t s, μm. Outer shell diameter, 160–180; length of tumidaspines, 160–190.

C o m p a r i s o n. *C. crassa* differs from *C. constricta* (Kozur et Mock, 1981) in the spindle-shaped tumidaspines without constrictions.

Occurrence. Lower Norian of the Philippines, Croatia, Turkey, and Cyprus.

Material. Twenty-two specimens from the Lara locality.

***Capnuchosphaera concava* De Wever, 1979**

Plate 4, fig. 7

Capnuchosphaera concava: De Wever et al., 1979, p. 82, pl. 6, figs. 13–15; De Wever, 1982, p. 151, pl. 3, figs. 8 and 9; pl. 6, fig. 1; Tekin, 1999, p. 70, pl. 3, figs. 6 and 7.

Holotype. Sicily, Monte Cammarata; Upper Carnian (De Wever et al., 1979, pl. 2, fig. 14); collection number is not indicated; housed in the Museum of Natural History, Paris.

Description. The outer shell is subspherical, with small rounded pores in irregular, mostly hexahedral frames. The tumidaspines are moderately long, their spinal channels are subcylindrical, gently expanding and passing without a constriction into the rounded triangular spinal tumors, with slight dextral coiling. The corners of triangular spinal tumors are clearly elongated distally. The spinal shafts are narrow, smooth.

Measurements, µm. Outer shell diameter, 100–120; length of tumidaspines, 110–130.

Comparison. *C. concava* differs from *C. theloides* De Wever, 1979 in the slight dextral coiling of spinal tumors with the distally elongated corners.

Occurrence. Upper Carnian–Middle Norian of Sicily, Turkey, and Cyprus.

Material. Fourteen specimens from the Lara and Parekklisia localities.

Genus *Icrioma* De Wever, 1979

Icrioma: De Wever et al., 1979, p. 85, De Wever, 1982, p. 261.

Pseudohagiastrum: Pessagno et al., 1979, p. 165.

Type species. *Icrioma tetrancistrum* De Wever, 1979; Upper Carnian–Lower Norian of Sicily.

Diagnosis. Outer shell latticed, double-layered, with four tumidaspines positioned radially on axes of tetrahedron and having from three to five terminal pores.

Species composition. Three species from the Upper Carnian–Middle Norian of Sicily, Japan, the Far East of Russia, Turkey, and Cyprus.

Comparison. *Icrioma* differs from *Paricrioma* Tekin, 1999 in the tetrahedral arrangement of tumidaspines.

***Icrioma tetrancistrum* De Wever, 1979**

Plate 4, figs. 8 and 9

Icrioma tetrancistrum: De Wever et al., 1979, p. 86, pl. 4, figs. 13–15; 1982, p. 262, pl. 22, figs. 1–6; Kishida and Sugano, 1982, pl. 2, fig. 17; Bragin and Krylov, 1999b, p. 549, text-fig. 5G; Tekin, 1999, p. 82, pl. 7, figs. 5 and 6.

Holotype. Sicily, Monte Cammarata; Lower Norian (De Wever et al., 1979, pl. 4, figs. 13–15); collection number is not indicated; housed in the Museum of Natural History, Paris.

Description. The outer shell is tetragonal, double-layered, with four tumidaspines, the distal ends of which are triangular in cross section have three triangular terminal pores. The end of the main spines has a well-pronounced axial rod and three subsidiary spines.

Measurements, µm. Outer shell diameter without tumidaspines, 95–100; length of tumidaspines, 80–110.

Comparison. *I. tetrancistrum* differs from *I. cruciformis* Tekin, 1999 in the presence of only three terminal pores in the tumidaspines.

Occurrence. Upper Carnian–Lower Norian of Sicily, Turkey, Japan, and Cyprus.

Material. Fourteen specimens from the Lara and Ayia Varvara localities.

***Icrioma cruciformis* Tekin, 1999**

Plate 5, fig. 1

Icrioma cruciformis: Tekin, 1999, p. 82, pl. 7, figs. 4 and 7.

Holotype. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 7, fig. 4); collection number is not indicated; housed in MTA, Ankara, Turkey.

Description. The outer shell is tetragonal, double-layered, with four tumidaspines, the ends of which are square in cross section and have four triangular terminal pores. The ends of the tumidaspines have a well-pronounced axial rod and four subsidiary spines.

Measurements, µm. Outer shell diameter without main spines, 90–100; length of the main spines, 90–120.

Comparison. *I. cruciformis* differs from *I. tetrancistrum* De Wever, 1979 in the presence of four terminal pores of tumidaspines.

Occurrence. Upper Carnian–Lower Norian of Turkey and Lower–Middle Norian of Cyprus.

Material. Twenty-eight specimens from the Lara locality.

Genus *Paricrioma* Tekin, 1999

Paricrioma: Tekin, 1999, p. 83.

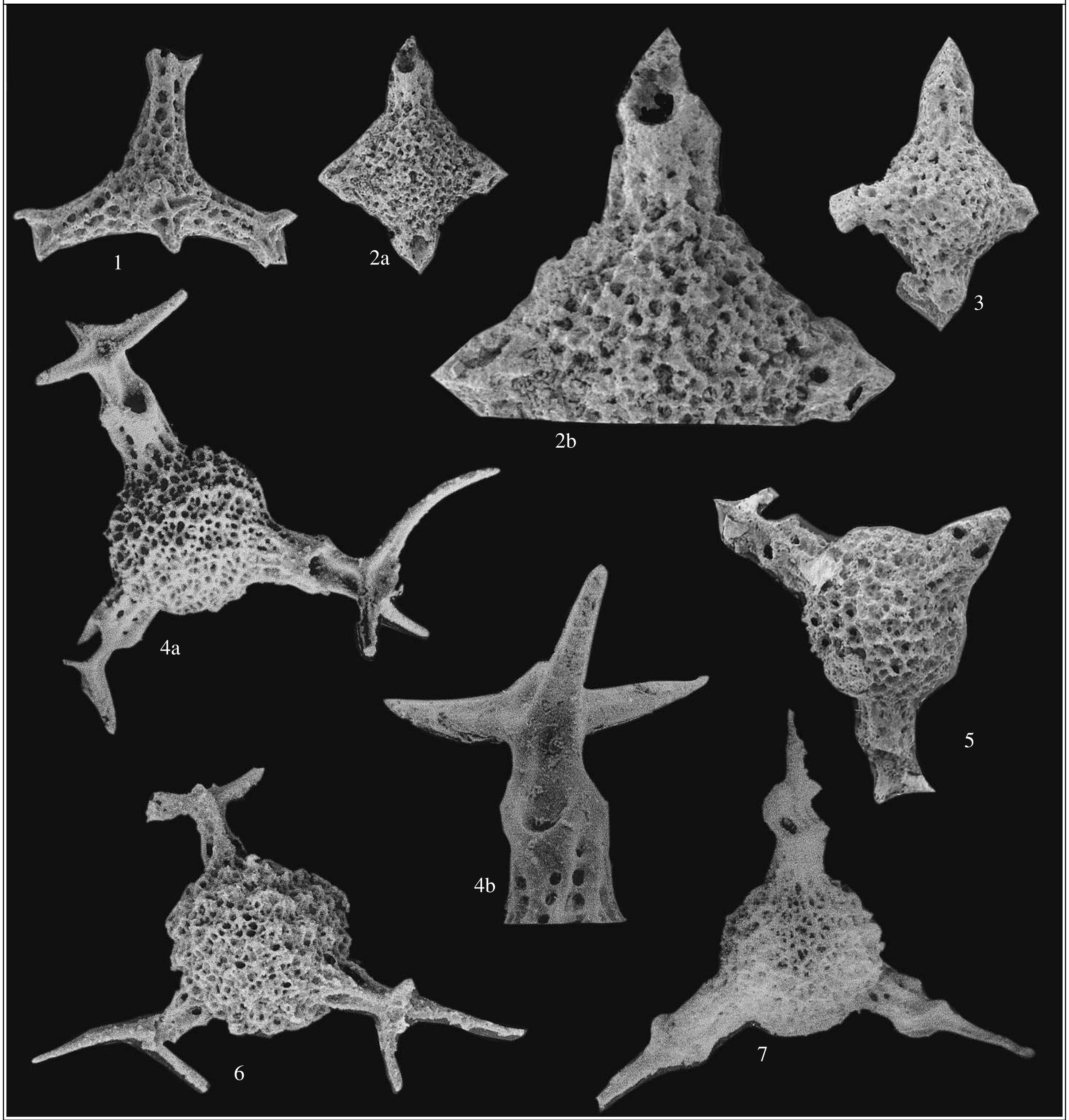
Type species. *Paricrioma deweveri* Tekin, 1999; Lower Norian of Turkey.

Diagnosis. Capnuchosphaerinae with four porous tumidaspines located crosswise in one plane and terminating in terminal pores.

Species composition. Seven species from the Norian and Rhaetian of Oregon, British Columbia, Turkey, and Cyprus.

Comparison. *Paricrioma* differs from *Weverella* Kozur et Mostler, 1981 in the tumidaspines with porous surface.

Plate 5



Explanation of Plate 5

Fig. 1. *Icrioma cruciformis* Tekin, specimen GIN, no. 4858-134; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

Figs. 2 and 3. *Paricrioma truncatum* sp. nov., Phasoula Formation, Lower Norian; Lara section, sample 98-2-2: (2) holotype GIN, no. 4858-102: (2a) general appearance, ×150; (2b) details, ×500; (3) paratype GIN, no. 4858-135, ×150.

Figs. 4 and 5. *Kinyrosphaera trispinosa* Bragin; Phasoula Formation, Lower Norian: (4) holotype GIN, no. 4858-49, Ayia Varvara locality, sample 90-39; (4a) general appearance, ×250; (4b) details, ×500; (5) paratype GIN, no. 4858-149, Lara section, sample 98-2-4, ×220.

Fig. 6. *Kinyrosphaera tuzcuae* (Tekin), specimen GIN, no. 4858-139; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×220.

Fig. 7. *Kinyrosphaera helicata* Bragin, holotype GIN, no. 4858-51, Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.

***Paricrioma truncatum* sp. nov.**

Plate 5, figs. 2 and 3

E t y m o l o g y. From the Latin *truncatus* (truncated).

H o l o t y p e. GIN, no. 4858-102; Cyprus, Akamas Peninsula, Lara section; Lower Norian, Phasoula Formation (Pl. 5, fig. 2).

D e s c r i p t i o n. The outer shell is flattened discoidal, square in outline, double-layered; the external layer has massive, irregular rounded polygonal pore frames; the internal layer is fine-porous, almost spongy. The tumidaspines are short, positioned at the corners of the square shell; one tumidaspine is twice as long as others. The spinal channels have small circular pores; in the longer tumidaspine, they are arranged in a longitudinal row. The distal part of the tumidaspines is wedge-shaped, with three circular terminal pores. Apophyses are absent.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–120; length of the longest tumidaspine, 50–60; length of other tumidaspines, 25–35.

C o m p a r i s o n. The new species differs from *P. deweveri* Tekin, 1999 in the short tumidaspines without apophyses.

O c c u r r e n c e. Lower–Middle Norian of Cyprus.

M a t e r i a l. Seven specimens from the Lara locality.

Genus *Kinyrosphaera* Bragin, 1999

Kinyrosphaera: Bragin and Krylov, 1999b, p. 550.

Nodocapnuchosphaera: Tekin, 1999, p. 80.

T y p e s p e c i e s. *Kinyrosphaera trispinosa* Bragin, 1999; Mamonia Complex, Lower Norian; Cyprus, village of Ayia Varvara.

D i a g n o s i s. Capnuchosphaeridae with three tumidaspines located in one plane, with their spinal channels covered by porous expansion of outer shell. Outer shell spherical or subspherical, wall structure typical for family. Spinal tumors with three large pores, spinal shafts narrow.

S p e c i e s c o m p o s i t i o n. Three species from the Lower Norian of Croatia, Cyprus, and Turkey.

C o m p a r i s o n. *Kinyrosphaera* differs from *Icrioma* De Wever, 1979 in the presence of three tumidaspines, from *Capnuchosphaera* De Wever, 1979 in the porous expansion of the outer shell which covers the spinal channels.

***Kinyrosphaera trispinosa* Bragin, 1999**

Plate 5, figs. 4 and 5

Kinyrosphaera trispinosa: Bragin and Krylov, 1999b, p. 550, text-figs. 5C–5E.

H o l o t y p e. GIN, no. 4858-49; Cyprus, village of Ayia Varvara; Lower Norian; Mamonia Complex (Bragin and Krylov, 1999b, text-fig. 5C).

D e s c r i p t i o n. The outer shell is spherical, with a slightly thorny surface, small circular or rounded angular pores enclosed in loosely arranged frameworks. The tumidaspines are moderately long. The spinal channels are short, cylindrical, with small circular pores arranged in longitudinal rows, sometimes, with poorly pronounced dextral coiling. The spinal tumors are Y-shaped in cross section, with three large pores. The spinal shafts are divided into three rod-shaped, slightly curved apophyses. A small tubercle is at the point of contact between the apophyses.

M e a s u r e m e n t s, μm. Outer shell diameter, 155–180; length of tumidaspines without apophyses, 140–155.

C o m p a r i s o n. *K. trispinosa* differs from *K. helicata* Bragin, 1999 in the absence of coiling in the spinal tumors and in the presence of distal apophyses; it differs from *K. tuzcuae* (Tekin, 1999) in the smaller size of the outer shell which has thorny rather than tuberculate surface.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Twelve specimens from the Lara and Ayia Varvara localities.

***Kinyrosphaera tuzcuae* (Tekin, 1999)**

Plate 5, fig. 6

Nodocapnuchosphaera tuzcuae: Tekin, 1999, p. 81, pl. 6, figs. 10–14; Tekin and Yurtsever, 2003, p. 152, pl. 1, fig. 8.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 6, fig. 10); collection number is not specified; housed in MTA, Ankara.

D e s c r i p t i o n. The outer shell is large, spherical, double-layered, with many hemispherical tubercles. The external layer has large irregular polygonal pore frames. The internal layer has small triangular and hexagonal pore frames. The spinal channels are short, cylindrical, with small circular pores arranged in longitudinal rows, sometimes, with poorly pronounced dextral coiling. The spinal tumors are Y-shaped in cross section, with three large pores. The spinal shafts are divided into three rod-shaped, slightly curved apophyses. A small tubercle is at the point of contact between apophyses.

M e a s u r e m e n t s, μm. Outer shell diameter, 200–240; length of the main spines, 120–140.

C o m p a r i s o n. *K. tuzcuae* differs from *K. trispinosa* Bragin, 1999 in the presence of tubercles on the outer shell, which is larger in size.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and the Lower Norian of Cyprus.

M a t e r i a l. Five specimens from the Lara locality.

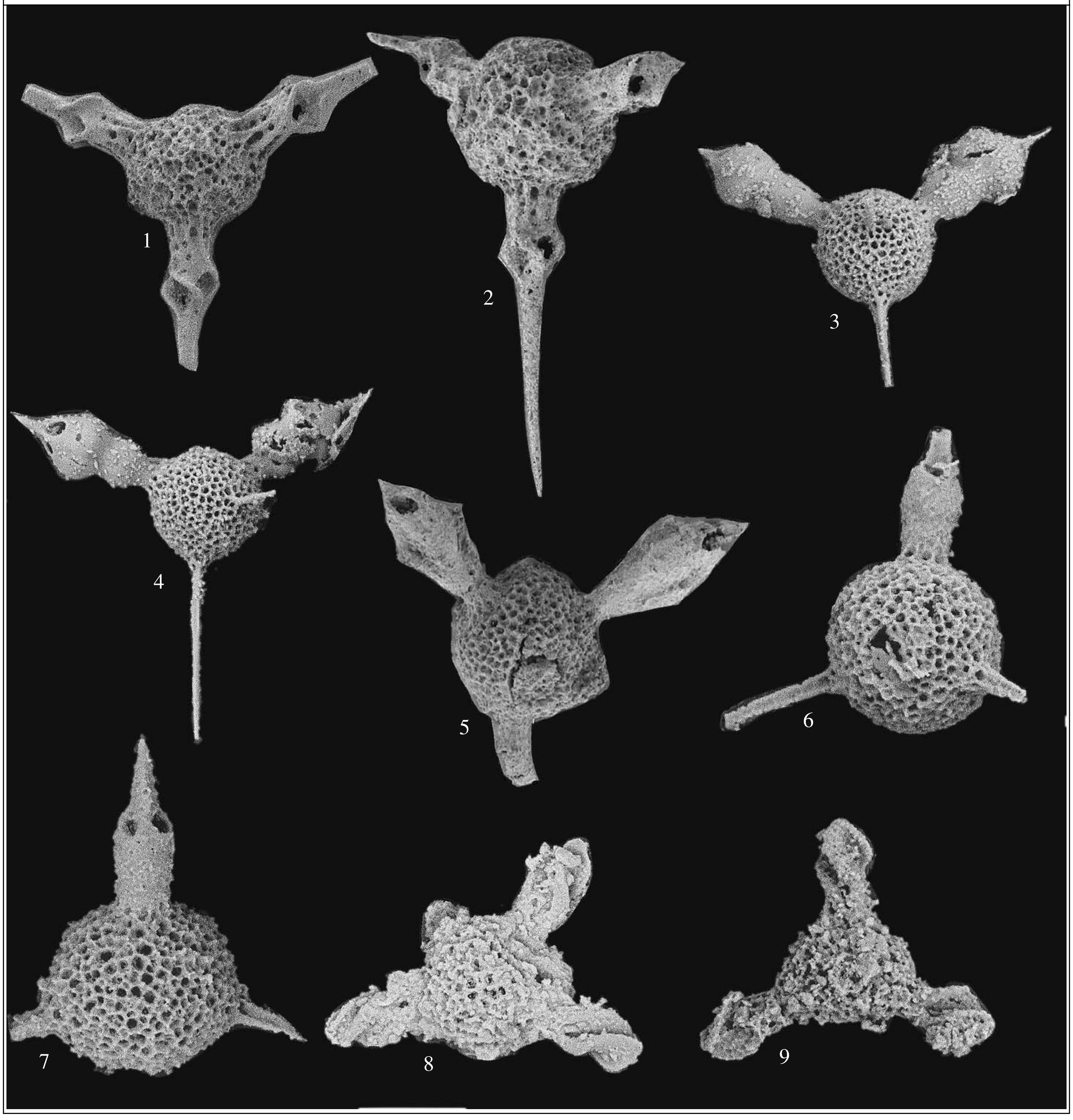
***Kinyrosphaera helicata* Bragin, 1999**

Plate 5, fig. 7; Plate 6, figs. 1 and 2

Capnuchosphaera ? sp.: Halamic and Gorican, 1995, pl. 2, fig. 10.

Kinyrosphaera helicata: Bragin and Krylov, 1999b, p. 551, text-figs. 5F, 5H, and 6A.

Plate 6



Explanation of Plate 6

Figs. 1 and 2. *Kinyrosphaera helicata* Bragin, Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170, paratypes: (1) GIN, no. 4858-140 and (2) GIN, no. 4858-141.

Figs. 3 and 4. *Dicapnuchosphaera quinquespina* sp. nov.; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170: (3) holotype GIN, no. 4858-101 and (4) paratype GIN, no. 4858-142.

Fig. 5. *Dicapnuchosphaera carterae* Tekin, specimen GIN, no. 4858-143; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.

Figs. 6 and 7. *Monocapnuchosphaera inflata* Tekin, Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170: (6) GIN, no. 4858-144 and (7) GIN, no. 4858-145.

Fig. 8. *Sarla vetusta* Pessagno, specimen GIN, no. 4858-146; Vlambouros Formation, Upper Norian, section Khapotami, sample 90-59-9, ×170.

Fig. 9. *Sarla vizcainoensis* Pessagno, specimen GIN, no. 4858-147; Vlambouros Formation, Upper Norian, Lara section, sample 98-2-9, ×170.

Capnuchosphaera deweveri: Tekin, 1999, p. 70, pl. 3, figs. 12 and 13.

Kinyrosphaera helicata helicata: Tekin and Yurtsever, 2003, p. 152.

Kinyrosphaera helicata goekcamensis: Tekin and Yurtsever, 2003, p. 151, pl. 1, figs. 2–4.

H o l o t y p e. GIN, no. 4858-51, Cyprus, village of Ayia Varvara; Lower Norian, Mamonia Complex (Bragin and Krylov, 1999b, text-figs. 5F, 5H).

D e s c r i p t i o n. The outer shell is spherical, with the surface covered with nodes. Pores are small, circular or rounded angular, enclosed in loosely arranged frames. The tumidaspines are long, located in the same plane. The spinal channels are cylindrical, with small circular pores arranged in longitudinal rows, between which longitudinal ridges extend. The spinal tumors show considerable sinistral coiling, Y-shaped in cross section, with three large pores. The spinal shafts are long, narrow.

M e a s u r e m e n t s, μm. Outer shell diameter, 160–200; length of tumidaspines, 220–270; greatest thickness of tumidaspines, 60–80.

C o m p a r i s o n. *K. helicata* differs from *K. trispinosa* Bragin, 1999 in the well-developed coiling of spinal tumors and in the long, narrow spinal shafts.

O c c u r r e n c e. Lower Norian of Croatia, Cyprus, and Turkey.

M a t e r i a l. Thirty-five specimens from the Lara and Ayia Varvara localities.

Genus *Dicapnuchosphaera* Tekin, 1999

Dicapnuchosphaera: Tekin, 1999, p. 73.

T y p e s p e c i e s. *Dicapnuchosphaera elegans* Tekin, 1999; Lower Norian of Turkey.

D i a g n o s i s. Capnuchosphaeridae with three main spines, two of which tumidaspines and one simple spine without division into parts, without internal cavities. Main spines positioned in one plane. External shell spherical.

S p e c i e s c o m p o s i t i o n. Five species from the Upper Carnian–Lower Norian of Turkey and Cyprus.

C o m p a r i s o n. *Dicapnuchosphaera* differs from *Monocapnuchosphaera* Tekin, 1999 in the presence of two tumidaspines.

Dicapnuchosphaera quinquespina sp. nov.

Plate 6, figs. 3 and 4

E t y m o l o g y. From the Latin *quinque* (five) and *spina* (spine).

H o l o t y p e. GIN, no. 4858-101; Cyprus, Ayia Varvara section; Lower Norian, Phasoula Formation (Pl. 6, fig. 3).

D e s c r i p t i o n. The outer shell is spherical; the external layer has relatively large hexagonal and pentagonal pore frames, with small thorns at the vertices; the internal layer has small irregular frames. The tumidaspines are moderately long, expanding abruptly distally, with a thickened central part of the spinal channels, distinct spinal tumor, small ovate–triangular terminal pores, and a well-pronounced pointed spinal shaft. The tumidaspine surface lacks spiral structures. The simple main spine is long, narrow, three-bladed at the base and smooth distally. One smooth subsidiary spine is positioned perpendicular to the plane of the main spines on either side of the outer shell.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–110; length of the main spines, 170–180; greatest width of tumidaspines, 70–80; length of subsidiary spines, 190–200.

C o m p a r i s o n. The new species differs from *D. carterae* Tekin, 1999 in the expanded central part of the spinal channels and in the presence of two subsidiary spines positioned perpendicular to the plane of the main spines.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Five specimens from the Ayia Varvara locality.

Dicapnuchosphaera carterae Tekin, 1999

Plate 6, fig. 5

Dicapnuchosphaera carterae: Tekin, 1999, p. 74, pl. 4, figs. 10–13.

H o l o t y p e. Turkey, Yailakuzdere section; Lower Norian (Tekin, 1999, pl. 4, fig. 10); collection number is not specified; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The outer shell is subspherical, large, double-layered. The external layer has large irregular pore frames, the internal layer has small triangular and hexagonal pore frames. The tumidaspines are inflated, smooth, gently expanding to considerably inflated ends, with three ovate–triangular terminal pores. The simple main spine is short, narrow, and smooth.

M e a s u r e m e n t s, μm. Outer shell diameter, 170–180; length of tumidaspines, 160–170; greatest width of tumidaspines, 70–80; length of the simple main spine, 60–100.

C o m p a r i s o n. *D. carterae* differs from *D. elegans* Tekin in the well-pronounced spinal tumor of tumidaspines, from *D. quinquespina* sp. nov. in the absence of thickening of the central part of the spinal channels and the absence of subsidiary spines.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and the Lower Norian of Cyprus.

M a t e r i a l. Seven specimens from the Lara locality.

Genus *Monocapnuchosphaera* Tekin, 1999

Monocapnuchosphaera: Tekin, 1999, p. 76.

T y p e s p e c i e s. *Monocapnuchosphaera longispina* Tekin, 1999; upper part of the Upper Carnian–Lower Norian of Turkey.

D i a g n o s i s. Capnuchosphaerinae with three main spines, having only one tumidaspine. Two simple main spines narrow, without internal cavities.

S p e c i e s c o m p o s i t i o n. Seven species from the Upper Carnian–Lower Norian of Turkey and the Lower Norian of Cyprus.

C o m p a r i s o n. *Monocapnuchosphaera* differs from *Dicapnuchosphaera* Tekin in the presence of only one tumidaspine.

Monocapnuchosphaera inflata Tekin, 1999

Plate 6, figs. 6 and 7

Monocapnuchosphaera inflata: Tekin, 1999, p. 77, pl. 5, figs. 10–11.

H o l o t y p e. Turkey, Yailakuzdere section; Lower Norian (Tekin, 1999, pl. 5, fig. 9); collection number is not indicated; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The outer shell is large, spherical; the external layer has large, irregular polygonal frames; the internal layer has small hexahedral, or, less often, tetrahedral frames. The tumidaspine is moderately long, smooth, cylindrical, with a small spinal tumor, without spiral structures at the distal end, with distinct triangular terminal pores. The simple main spines are short, three-bladed.

M e a s u r e m e n t s, μm. Outer shell diameter, 170–200; length of tumidaspines, 190–220; length of simple main spines, 100–110.

C o m p a r i s o n. *M. inflata* differs from *M. longispina* Tekin, 1999 in the short tumidaspine with a small spinal tumor, from *M. tornata* Tekin, 1999 in the absence of spiral structures at the distal end of the spine.

O c c u r r e n c e. Lower Norian of Turkey and Cyprus.

M a t e r i a l. Eight specimens from the Lara locality.

Subfamily Sarlinae De Wever, 1982

Sarlinae: De Wever, 1982, p. 165.

D i a g n o s i s. Capnuchosphaeridae with tumidaspines lacking internal cavities.

G e n e r i c c o m p o s i t i o n. Two genera, *Sarla* Pessagno, 1979 and *Braginastrum* Tekin, 1999, from the Upper Triassic.

C o m p a r i s o n. Sarlinae differs from Capnuchosphaerinae De Wever, 1982 in the absence of internal cavities in the tumidaspines.

Genus *Sarla* Pessagno, 1979

Sarla: Pessagno et al., 1979, p. 174.

T y p e s p e c i e s. *Sarla prietoensis* Pessagno; Norian of Mexico.

D i a g n o s i s. Outer shell subspherical, with three straight radial tumidaspines located in one plane, lacking internal cavities, and having spiral spinal tumors and smooth, straight spinal shafts.

S p e c i e s c o m p o s i t i o n. Up to 15 species from the Upper Carnian–Norian of Mexico, Oregon, British Columbia, Mediterranean, Japan, and the Far East of Russia.

C o m p a r i s o n. *Sarla* differs from *Braginastrum* Tekin, 1999 in the straight main spines.

Sarla vetusta Pessagno, 1979

Plate 6, fig. 8

Sarla vetusta: Pessagno et al., 1979, p. 174, pl. 7, figs. 4, 6, 7, 13, and 14; Blome, 1984, p. 32; Donofrio, 1991, p. 209, pl. 3, fig. 3; Sugiyama, 1997, p. 187, fig. 50-10; Tekin, 1999, p. 87, pl. 8, fig. 13; Tekin et al., 2002, p. 131, text-figs. 4 and 5.

Sarla sp. aff. *S. vetusta*: Blome, 1983, p. 19, pl. 3, figs. 4, 13, and 17; Blome, 1984, p. 32, pl. 4, fig. 4.

H o l o t y p e. USNM (American Museum of Natural History), no. 251836; Mexico, California Peninsula, San Hipolito; Lower–Middle Norian (Pessagno et al., 1979, pl. 7, fig. 6); housed in American Museum of Natural History.

D e s c r i p t i o n. The shell is subspherical, flattened up to discoid; the external layer of the shell has large pores in the tetra–hexagonal pore frames. Three tumidaspines are moderately long, three-bladed, with moderate sinistral coiling.

M e a s u r e m e n t s, μm. Outer shell diameter, 90–110; length of tumidaspines, 60–80.

C o m p a r i s o n. *S. vetusta* differs from *S. vizcainoensis* Pessagno, 1979 in the moderate sinistral coiling of the tumidaspines.

O c c u r r e n c e. Upper Carnian–Norian of Mexico, Oregon, Iran, Japan, Turkey, and Cyprus.

M a t e r i a l. Nineteen specimens from the Lara and Khapotami localities.

Sarla transita (Kozur et Mock, 1981)

Plate 7, fig. 1

Vinassaspongus transitus: Kozur and Mostler, 1981, p. 69, pl. 64, fig. 1; Bragin and Krylov, 1999b, p. 546, text-figs. 6D and 6F.

Sarla transita: Sugiyama, 1997, p. 186; Tekin, 1999, p. 87, pl. 8, figs. 11 and 12.

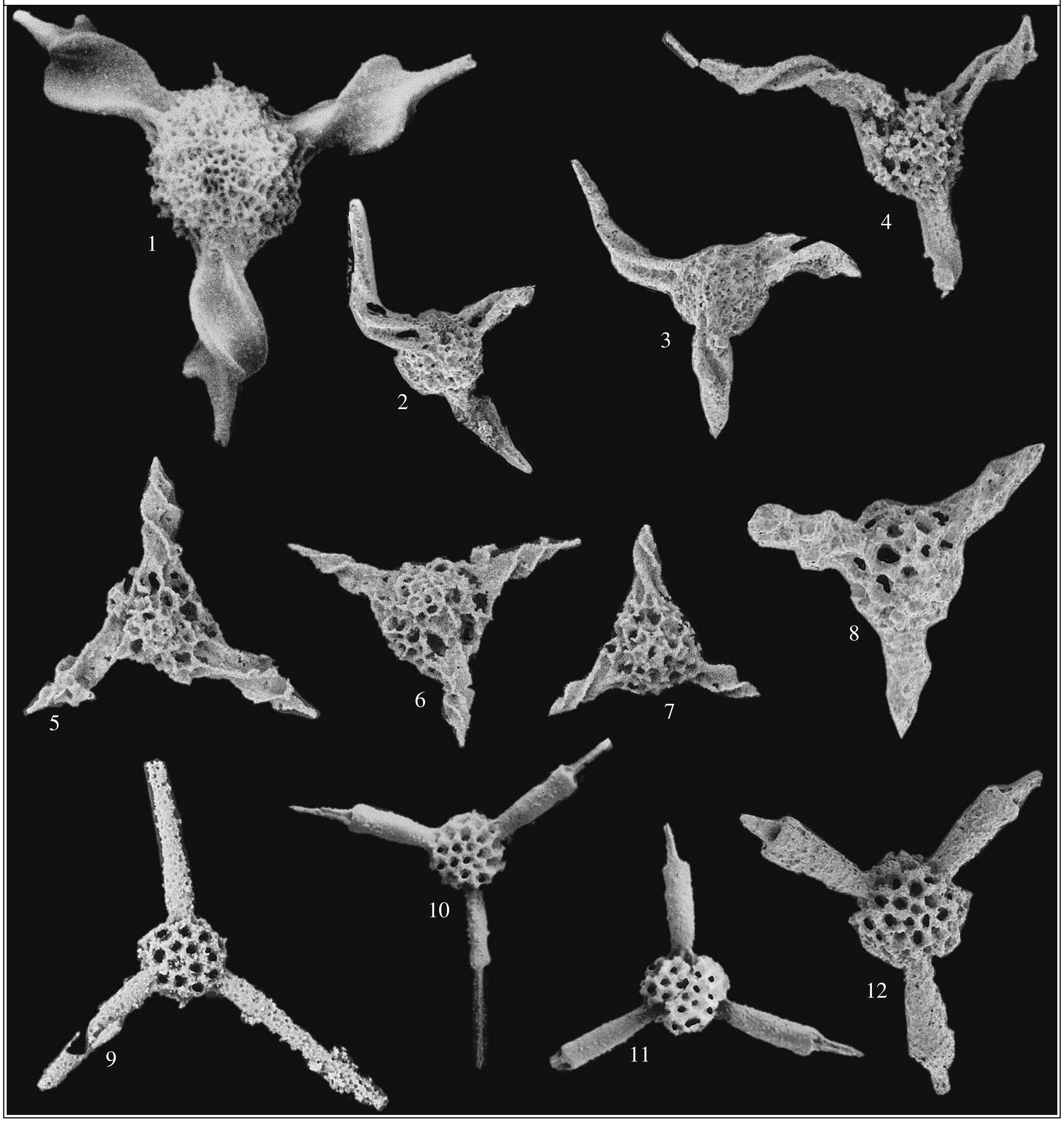
H o l o t y p e. KoMo, no. 1980, I-6; Slovakia, western Carpathians, Sulov; Lower Norian (Kozur and Mostler, 1981, pl. 64, fig. 1); depository not indicated.

D e s c r i p t i o n. The outer shell is spherical, spongy, with many small tubercles. Three tumidaspines are located in the same plane, Y-shaped in cross section, have well-pronounced left spiral sculpturing with narrow ridges and wide grooves. The spinal shafts are narrow, short, smooth.

M e a s u r e m e n t s, μm. Outer shell diameter, 125–135; total length of tumidaspines, 190–220.

C o m p a r i s o n. *S. transita* differs from other species in the wide tumidaspines with Y-shaped section and narrow ridges.

Plate 7



Explanation of Plate 7

Fig. 1. *Sarla transita* (Kozur et Mock), specimen GIN, no. 4858-148; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×250.

Figs. 2–4. *Braginastrum curvatus* Tekin, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (2) GIN, no. 4858-150, (3) GIN, no. 4858-151, and (4) GIN, no. 4858-153.

Figs. 5–7. *Betraccium irregulare* sp. nov.; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (5) holotype GIN, no. 4858-113, (6) paratype GIN, no. 4858-154, and (7) paratype GIN, no. 4858-155.

Fig. 8. *Betraccium smithi* Pessagno, specimen GIN, no. 4858-156; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.

Fig. 9. *Capnodoce sarisa* De Wever, specimen GIN, no. 4858-157; Phasoula Formation, Middle Norian, Parekklisia locality, sample 03-1-24, ×150.

Figs. 10 and 11. *Capnodoce ruesti* Kozur et Mock, Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×150: (10) GIN, no. 4858-158 and (11) GIN, no. 4858-159.

Fig. 12. *Capnodoce anapetes* De Wever, specimen GIN, no. 4858-160; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

O c c u r r e n c e. Lower Norian of Slovakia, Japan, Cyprus, and Turkey.

M a t e r i a l. Thirty-eight specimens from the Ayia Varvara locality.

Sarla vizcainoensis Pessagno, 1979

Plate 6, fig. 9

Sarla vizcainoensis: Pessagno et al., 1979, p. 175, pl. 7, figs. 8 and 12; Kishida and Sugano, 1982, pl. 2, figs. 13 and 14; Blome, 1984, p. 32; Tekin, 1999, p. 87, pl. 8, fig. 14.

Sarla cf. *vizcainoensis*: Bragin, 1991a, p. 79, pl. 6, fig. 12.

H o l o t y p e. USNM, no. 251838, Mexico, California Peninsula, San Hipolito; Lower–Middle Norian (Pessagno et al., 1979, pl. 7, fig. 12); housed in American Museum of Natural History.

D e s c r i p t i o n. The shell is subspherical, slightly flattened up to discoid; the external layer of the shell has large pores in tetra–hexagonal pore frames; the internal layer is fine-porous. Three tumidaspines are moderately long, three-bladed, with considerable sinistral coiling.

M e a s u r e m e n t s, μm. Outer shell diameter, 90–110; length of tumidaspines, 60–80.

C o m p a r i s o n. *S. vizcainoensis* differs from *S. vetusta* Pessagno, 1979 in the extremely expressed sinistral coiling of the tumidaspines.

O c c u r r e n c e. Norian of Mexico, Japan, Oregon, the Far East of Russia, Turkey, and Cyprus.

M a t e r i a l. Twelve specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Genus *Braginastrum* Tekin, 1999

Braginastrum: Tekin, 1999, p. 85.

T y p e s p e c i e s. *Braginastrum curvatus* Tekin, 1999; Lower Norian of Turkey.

D i a g n o s i s. Outer shell flattened, hemispherical or lenticular, double-layered, with three radial spines curved in various directions.

S p e c i e s c o m p o s i t i o n. Type species from the Upper Carnian–Lower Norian of Turkey and Cyprus.

C o m p a r i s o n. *Braginastrum* differs from *Sarla* Pessagno, 1979 in the curved main spines.

Braginastrum curvatus Tekin, 1999

Plate 7, figs. 2–4

Braginastrum curvatus: Tekin, 1999, p. 85, pl. 8, figs. 1–5, and 7.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 5, fig. 9); collection number is not indicated; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The outer shell is flattened, hemispherical or lenticular, double-layered. The external layer has large irregular (triangular to hexagonal) pore frames; the internal layer has small pentagonal and hexagonal pore frames. Three main spines are positioned radially, their proximal parts are straight, three-bladed, with wide smooth ridges and narrow grooves, with sinistral spiral coiling. In the middle part, the spines sharply curve in various directions. The distal part of the spines are smooth, pointed.

M e a s u r e m e n t s, μm. Outer shell diameter, 95–110; length of spines, 170–240; greatest thickness of spines, 30–45.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and the Lower Norian of Cyprus.

M a t e r i a l. Fourteen specimens from the Lara locality.

Family Pantanelliidae Pessagno, 1977

Pantanelliidae: Pessagno, 1977b, p. 32.

D i a g n o s i s. Actinommoidea with spherical microsphere connected by bars to 2–4 main spines, showing polar or plane arrangement. Outer shell spherical or subdiscoidal, large-porous, single-layered, always with well-pronounced hexagonal and pentagonal pore frames, with distinct nodes at vertices.

C o m p o s i t i o n. Upper Triassic–Lower Cretaceous. In the Triassic, the family is represented by two subfamilies, Pantanelliinae Pessagno, 1979 and Capnodocinae Pessagno, 1979.

C o m p a r i s o n. The family Pantanelliidae is very similar to Stylosphaeridae Haeckel, 1882 in the pattern of the primary skeleton, its connection with the main spines, and arrangement of the main spines and differs in the outer shell structure, with large pores enclosed in well-pronounced pore frames. This difference is possibly insufficient to rank these taxa as different families; thus, they may be synonyms. Pantanelliidae differs from other families in the polar arrangement of spines.

Subfamily Pantanelliinae Pessagno, 1979

Pantanelliinae: Pessagno et al., 1979, p. 177.

D i a g n o s i s. Pantanelliidae with spherical outer shell, with two to four three-bladed or Y-shaped in cross section main spines lacking internal cavities.

G e n e r i c c o m p o s i t i o n. Upper Triassic–Lower Cretaceous. In the Triassic, the subfamily is represented by *Betraccium* Pessagno, 1979, *Cantalum* Pessagno, 1979, *Gorgansium* Pessagno et Blome, 1980, and *Pantanellium* Pessagno, 1977.

C o m p a r i s o n. Pantanelliinae differs from Capnodocinae Pessagno, 1979 in the three-bladed spines without internal cavities.

Genus *Betraccium* Pessagno, 1979

Betraccium: Pessagno et al., 1979, p. 177.

T y p e s p e c i e s. *Betraccium smithi* Pessagno, 1979; Middle–Upper Norian of Mexico, California Peninsula.

D i a g n o s i s. Outer shell subspherical, with three equal, usually spiral spines Y-shaped in cross section, positioned radially symmetrically.

S p e c i e s c o m p o s i t i o n. Five species from the Upper Norian–Rhaetian of Mexico, Oregon, British Columbia, Alaska, the Far East of Russia, Japan, the Philippines, New Zealand, Turkey, and Cyprus. Three species occur in the Hettangian of Bavaria.

C o m p a r i s o n. *Betraccium* differs from *Pantanellium* Pessagno, 1977 in the presence of three spines, from *Gorgansium* Pessagno et Blome, 1980 in the symmetrical arrangement and equal size of spines.

Betraccium smithi **Pessagno, 1979**

Plate 7, fig. 8

Betraccium smithi: Pessagno et al., 1979, p. 178, pl. 2, figs. 7, 11–12, and 16.

H o l o t y p e. USNM, no. 251850; Mexico, California Peninsula, San Hipolito; Lower–Middle Norian (Pessagno et al., 1979, pl. 2, figs. 7, 11–12, 16); housed in American Museum of Natural History.

D e s c r i p t i o n. The outer shell is relatively small, subspherical, with large circular pores in massive hexagonal or pentagonal frames. Five to six pore frames are observed on the extension of the axial lines of the main spines. Three spines are long, three-bladed, with well-pronounced sinistral coiling.

M e a s u r e m e n t s, μm. Outer shell diameter, 80–90; length of spines, 75–90.

C o m p a r i s o n. *B. smithi* differs from *B. deweveri* Pessagno et Blome, 1980 in the smaller diameter of the outer shell combined with many pores and pore frames and in the less massive spines.

O c c u r r e n c e. Lower–Middle Norian of Mexico and Cyprus.

M a t e r i a l. Nine specimens from the Lara locality.

Betraccium irregulare **sp. nov.**

Plate 7, figs. 5–7

E t y m o l o g y. From the Latin *irregularis* (irregular, disordered).

H o l o t y p e. GIN, no. 4858-113, Cyprus, Akamas Peninsula; Lower Norian, Mamonia Complex, Phasoula Formation (Pl. 7, fig. 5).

D e s c r i p t i o n. The outer shell is relatively small, subspherical, slightly flattened, with circular pores varying in size in pentagonal and hexagonal pore frames widely varying in size. Large frames occur mostly at the base of spines, while small frames are accumulated in the middle part of the shell. Up to 8–10 frames are observed on the extension of the axial lines of spines. Three spines are moderately long, three-bladed, with well-pronounced sinistral coiling, tapering towards the pointed end.

M e a s u r e m e n t s, μm. Shell diameter, 100–110; length of spines, 110–125.

C o m p a r i s o n. The new species differs from *B. smithi* Pessagno, 1979 in the irregular arrangement of pore frames, which vary widely in size.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Thirty-two specimens from the Lara locality.

Subfamily Capnodocinae Pessagno, 1979

Capnodocinae: Pessagno et al., 1979, p. 175.

D i a g n o s i s. Pantanelliidae having from two to four tubular spines, each with three cavities open in terminal pores. Outer shell subdiscoid, or, less often, spherical.

G e n e r i c c o m p o s i t i o n. *Capnodoce* De Wever, 1979, *Loffa* Pessagno, 1979, *Renzium* Blome, 1983, and *Justium* Blome, 1983. Upper Carnian–Middle Norian.

C o m p a r i s o n. The subfamily Capnodocinae differs from Pantanelliinae Pessagno, 1979 in the spines with internal cavities.

Genus *Capnodoce* De Wever, 1979

Capnodoce: De Wever et al., 1979, p. 81.

T y p e s p e c i e s. *Capnodoce anapetes* De Wever, 1979; Lower Norian, Isparta Çay Formation; Turkey, western Taurus Mountains, Isparta.

D i a g n o s i s. Outer shell subspherical or discoidal–spherical, with three large radial spines located in one plane. Spines hollow, with medial rod and three canals open in three terminal pores at ends of spines.

S p e c i e s c o m p o s i t i o n. Up to 20 species from the Upper Carnian–Middle Norian of Mediterranean, Japan, Mexico, Oregon, British Columbia, Alaska, the Far East of Russia, northeastern China, and the Philippines.

C o m p a r i s o n. *Capnodoce* is distinguished by the presence of three main spines.

Capnodoce anapetes **De Wever, 1979**

Plate 7, fig. 12

Capnodoce anapetes: De Wever et al., 1979, p. 81, pl. 2, figs. 5–7; Nakaseko and Nishimura, 1979, p. 75, pl. 6, figs. 3–5; Baumgartner, 1980, pl. 1, figs. 5 and 6; De Wever, 1982, p. 141, pl. 2, figs. 10–13; Kishida and Sugano, 1982, pl. 2, fig. 7; Nishizono et al., 1982, pl. 1, fig. 11; Nishizono and Murata, 1983, pl. 2, fig. 10; Yoshida, 1986, pl. 10, figs. 9 and 10; Sato et al., 1986, text-fig. 16.9; Bragin, 1986, pl. 1, fig. 2; Bragin, 1991a, p. 83, pl. 6, figs. 8 and 9; Halamic and Gorican, 1995, pl. 2, figs. 6 and 7; Sugiyama, 1997, text-fig. 27.15.

Capnodoce sp. aff. *C. anapetes*: Blome, 1983, p. 23, pl. 8, figs. 3, 10, 11, and 18, pl. 11, figs. 8 and 15; Yeh, 1990, p. 14, pl. 14, fig. 3.

Capnodoce anapates: Tekin, 1999, p. 92, pl. 11, fig. 1.

H o l o t y p e. Turkey, Isparta, Lower Norian (De Wever et al., 1979, pl. 2, figs. 5–7); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The test is subspherical. The outer shell has large circular pores enclosed in massive hexagonal frames with well-pronounced nodes at the vertices. Up to five or six pores are discernible on the extension of the axial lines of spines. The spines are tubular, massive, thickened towards the distal end, almost twice as long as the diameter of the outer shell. The distal part of spines is particularly strongly thickened, the distal ends of the axial rods of spines are short. The pores at the distal end of spines are large, rounded triangular.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–120; length of spines, 180–200; greatest thickness of spines, 50–55.

C o m p a r i s o n. *C. anapetes* is distinguished from other species by the thick spines clearly expanding towards the distal ends.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey, Japan, Sakhalin, Sikhote Alin, the Koryak Upland, Oregon, the Philippines, Croatia, and Cyprus.

M a t e r i a l. Eighteen specimens from the Lara and Ayia Varvara localities.

Capnodoce ruesti Kozur et Mock, 1981

Plate 7, figs. 10 and 11

Capnodoce ruesti: Kozur and Mostler, 1981, p. 74, pl. 65, fig. 2; Bragin and Krylov, 1999b, p. 551, text-figs. 7B and 7C.

Capnodoce sarisa: Kozur and Mostler, 1981, pl. 63, fig. 2.

Capnodoce longibrachium: Tekin, 1999, p. 93, pl. 11, figs. 6–9.

H o l o t y p e. KoMo, no. 1980, I-4; Slovakia, western Carpathians, Sulov; Lower Norian (Kozur and Mostler, 1981, p. 74, pl. 65, fig. 2); depository not indicated.

D e s c r i p t i o n. The outer shell is subspherical, slightly flattened, with large circular pores in regular hexahedral frames; up to six pores are discernible on the extension of the axial lines of spines. The spines are long, and even over the entire extent, with a weak swelling at spine pores, terminating in long, narrow rod-shaped ends.

M e a s u r e m e n t s, μm. Outer shell diameter, 75–90; total length of spines, 200–220; greatest thickness of spines, 30–40.

C o m p a r i s o n. *C. ruesti* differs from *C. crystallina* Pessagno, 1979 in the longer spines lacking constrictions and terminating in long, narrow rod-shaped ends.

O c c u r r e n c e. Lower Norian of Slovakia, Sicily, Cyprus, and Turkey.

M a t e r i a l. Thirty-two specimens from the Lara and Ayia Varvara localities.

Capnodoce sarisa De Wever, 1979

Plate 7, fig. 9

Capnodoce sarisa: De Wever et al., 1979, p. 82, pl. 2, figs. 9–12, non pl. 2, fig. 8 (= *Loffa* sp.); Nakaseko and Nishimura, 1979, p. 75, pl. 6, figs. 1 and 2; De Wever, 1982, p. 143, pl. 3, figs. 1–3; Yao, 1982, pl. 2, fig. 24; Yao et al., 1982, pl. 1, fig. 22; Kishida and Sugano, 1982, pl. 2, fig. 6; Sato et al., 1982, pl. 2, fig. 6; Nishizono and Murata, 1983, pl. 2, fig. 9; Sato et al., 1986, text-fig. 16.10; Sugiyama, 1997, text-fig. 49.16; Tekin, 1999, p. 94, pl. 11, figs. 11 and 12; Wang et al., 2002, p. 328, pl. 2, fig. 41.

Capnodoce fragilis: Blome, 1983, p. 24, pl. 5, figs. 4, 12, and 17; Blome, 1984, p. 34, pl. 4, fig. 11; Yoshida, 1986, pl. 10, fig. 6; Carter, 1990, pl. 1, fig. 10; Carter, 1991, p. 199, pl. 1, figs. 1 and 6; Yeh and Cheng, 1996, pl. 10, figs. 1 and 5.

Capnodoce serisa: Tekin and Yurtsever, 2003, p. 153, pl. 1, figs. 10 and 11.

H o l o t y p e. Turkey, Isparta; Middle Norian (De Wever et al., 1979, pl. 2, fig. 9); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The test is subspherical; the outer shell has large circular pores enclosed in massive hexagonal skeletons with well-pronounced nodes at the vertices. Up to four or five pores are discernible on the extension of the axial lines of spines. The spines are very long, narrow, smooth, twice or more times as long as the outer shell diameter, gently tapering to the distal end.

M e a s u r e m e n t s, μm. Outer shell diameter, 90–100; length of spines, 250–330; greatest thickness of spines, 30–40.

C o m p a r i s o n. *C. sarisa* is distinguished from other species by the very long and narrow spines lacking swellings or constrictions.

O c c u r r e n c e. Lower–Middle Norian of Sicily, Turkey, Japan, Oregon, British Columbia, the Philippines, Sikhote Alin, Tibet, and Cyprus.

M a t e r i a l. Seventeen specimens from the Lara and Parekklisia localities.

Capnodoce crystallina Pessagno, 1979

Plate 8, fig. 1

Capnodoce crystallina: Pessagno et al., 1979, p. 176, pl. 1, figs. 1–3; Blome, 1984, p. 34; Sato et al., 1986, pl. 16, figs. 11 and 12; Sugiyama, 1997, p. 175, text-fig. 49-17; Tekin, 1999, p. 93, pl. 11, figs. 2 and 3; Tekin and Yurtsever, 2003, p. 153, pl. 1, fig. 6.

Capnodoce antiqua: Blome, 1983, p. 24, pl. 5, figs. 4, 12, and 17; Blome, 1984, p. 33, pl. 4, fig. 6; Yoshida, 1986, pl. 10, figs. 4 and 5; Bragin, 1986, pl. 2, fig. 1; Bragin, 1991a, p. 83, pl. 6, fig. 10.

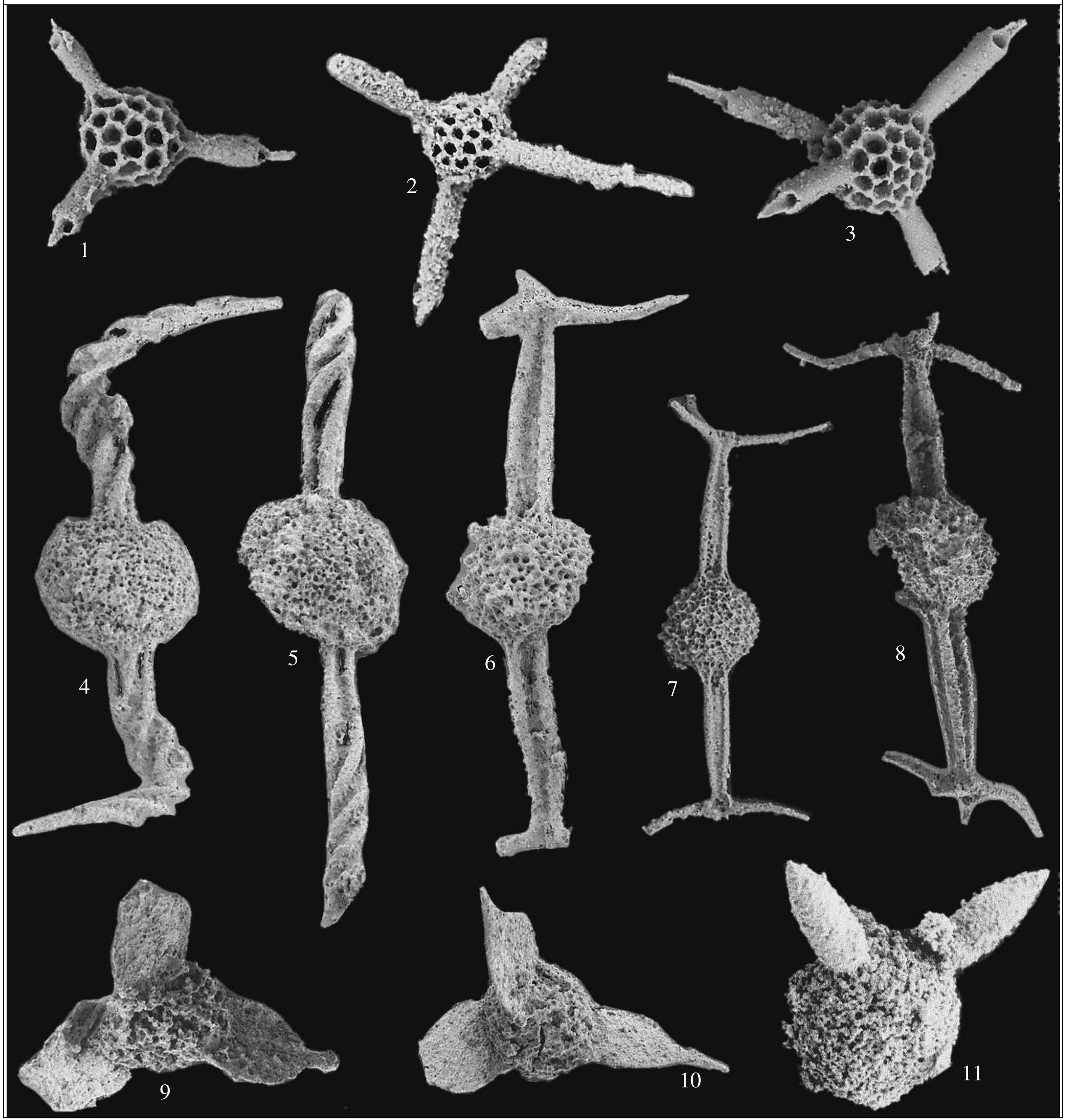
Capnodoce cf. *antiqua*: Knipper et al., 1997, pl. 1, fig. 2.

H o l o t y p e. USNM, no. 251842; Mexico, California Peninsula, San Hipolito; Lower–Middle Norian (Pessagno et al., 1979, p. 176, pl. 1, fig. 2); housed in American Museum of Natural History.

D e s c r i p t i o n. The outer shell is subspherical, slightly flattened up to subdiscoid, with large circular pores in regular hexahedral frames. Five or six pores are discernible on the extension of the axial lines of spines. The spines are moderately long, gradually expanding to the middle part and, then, gradually narrowing to the distal end, or with a slight expansion at the distal end.

M e a s u r e m e n t s, μm. Outer shell diameter, 80–90; length of spines, 120–130; greatest thickness of spines, 35–40.

Plate 8



Explanation of Plate 8

Fig. 1. *Capnodoce crystallina* Pessagno, specimen GIN, no. 4858-161; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.

Figs. 2 and 3. *Loffa mulleri* Pessagno; Phasoula Formation: (2) GIN, no. 4858-162, Middle Norian, Parekklisia locality, sample 03-1-24, ×150; (3) GIN, no. 4858-163, Lower Norian, Ayia Varvara locality, sample 90-39, ×170.

Fig. 4. *Spongostylus carnicus* Kozur et Mostler, specimen GIN, no. 4858-164; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×180.

Fig. 5. *Spongostylus tortilis* Kozur et Mostler, specimen GIN, no. 4858-165; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.

Figs. 6–8. *Dumitricasphaera elegans* sp. nov.; Phasoula Formation, Lower Norian: (6, 8) Lara section, sample 98-2-4, ×170, paratype: (6) GIN, no. 4858-166 and (8) GIN, no. 4858-167; (7) holotype GIN, no. 4858-100, Ayia Varvara locality, sample 90-39, ×140.

Figs. 9 and 10. *Zhamojdasphaera proceruspinosa* Lahm, Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170: (9) GIN, no. 4858-168 and (10) GIN, no. 4858-169.

Fig. 11. *Neopaurinella sevatica* Kozur et Mostler, specimen GIN, no. 4858-170; Vlambouros Formation, Dhiarizos section, sample 90-28-1, ×170.

Comparison. *C. crystallina* differs from *C. anapetes* De Wever, 1979 in the spines with the slightly narrowing distal part.

Occurrence. Upper Carnian–Middle Norian of Mexico, Oregon, Japan, the Far East of Russia, Transcaucasia, Turkey, and Cyprus.

Material. Thirteen specimens from the Lara and Ayia Varvara localities.

Genus *Loffa* Pessagno, 1979

Loffa: Pessagno et al., 1979, p. 177.

Type species. *Loffa mulleri* Pessagno, 1979; Lower–Middle Norian of Mexico.

Diagnosis. Outer shell subspherical or discoidal–spherical, with four large radial spines located on axes of tetrahedron. Spines hollow, with medial rod and three canals open in three pores at distal end of spines.

Species composition. Three species from the Upper Carnian–Middle Norian of Mexico, Oregon, Turkey, and Cyprus.

Comparison. *Loffa* differs from *Renzium* Blome, 1983 and *Capnodoce* De Wever, 1979 in the large number of spines and their arrangement on the axes of the tetrahedron.

Loffa mulleri Pessagno, 1979

Plate 8, figs. 2 and 3

Loffa mulleri: Pessagno et al., 1979, p. 177, pl. 2, figs. 1–6, 8, 14, and 15; De Wever, 1982, p. 147, pl. 3, figs. 4 and 5; Tekin, 1999, p. 95, pl. 12, fig. 1.

Holotype. USNM, no. 251840; Mexico, California Peninsula, San Hipolito; Lower–Middle Norian (Pessagno et al., 1979, pl. 2, fig. 4); housed in American Museum of Natural History.

Description. The outer shell is small, spherical, with large circular pores in regular hexagonal frames. The spines are long, narrow, smooth, with almost constant thickness throughout the spine.

Measurements, μm. Outer shell diameter, 60–70; length of spines, 180–200.

Comparison. *L. mulleri* differs from *L. vesterensis* Blome, 1983 in the long spines lacking thickened ends.

Occurrence. Upper Carnian–Middle Norian of Mexico, Turkey, and Cyprus.

Material. Seven specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Family Stylosphaeridae Haeckel, 1881

Stylosphaerida: Haeckel, 1881, p. 449; 1887, p. 121.

Stylosphaeridae: Kozur and Mostler, 1979, p. 56.

Diagnosis. Actinommoidea with microsphere connected to two polar main spines. Outer shell spherical or prunoid, fine-porous or spongy.

Composition. Two subfamilies, Stylosphaerinae Haeckel, 1881 and Spongopalliinae Kozur, Krainer et Mostler, 1996; Middle Triassic–Recent.

Comparison. The family Stylosphaeridae differs from Pantanelliidae Pessagno in the spongy or fine-porous structure of the outer shell.

Subfamily Stylosphaerinae Haeckel, 1881

Stylosphaerida: Haeckel, 1881, p. 449; 1887, p. 121.

Stylosphaerinae: Kozur and Mostler, 1979, p. 56.

Diagnosis. Stylosphaeridae with fine-porous single-layered outer shell, without pronounced pore frames. Two main polar spines occasionally accompanied by several subsidiary spines.

Generic composition. Middle Triassic–Recent. Triassic genera are *Spongostylus* Haeckel, 1881, *Staurolonche* Haeckel, 1881, *Dumitricasphaera* Kozur et Mostler, 1979, and *Zhamojdasphaera* Kozur et Mostler, 1979.

Comparison. The subfamily Stylosphaerinae differs from Spongopalliinae in the porous single-layered outer shell.

Genus *Spongostylus* Haeckel, 1881

Spongostylus: Haeckel, 1881, p. 455.

Type species. *Spongostylus hastatus* Haeckel, 1881, Recent, world ocean.

Diagnosis. Outer shell spherical or subspherical, spongy, with two polar spines. Internal cavity with small porous shell present. Main spines uniform in thickness, lacking apophyses or blades.

Species composition. About 20 species. Middle Triassic–Recent. Triassic representatives are known in the Mediterranean Region, Japan, Sikhote Alin, and British Columbia.

Comparison. *Spongostylus* differs from *Dumitricasphaera* and *Zhamojdasphaera* in the spines uniform in thickness, without apophyses or blades.

Spongostylus carnicus Kozur et Mostler, 1979

Plate 8, fig. 4

Spongostylus carnicus: Kozur and Mostler, 1979, p. 58, pl. 9, figs. 5, 6, 8, and 9; 1981, pl. 38, fig. 3; Lahm, 1984, p. 69, pl. 12, fig. 4; Carter et al., 1989, pl. 1, fig. 5; Yeh, 1989, p. 67, pl. 13, fig. 8; Grapes et al., 1990, text-fig. 8O; Halamic and Gorican, 1995, pl. 2, figs. 18 and 19; Knipper et al., 1997, pl. II, fig. 1; Bragin and Krylov, 1999b, p. 552, text-fig. 7F; Tekin, 1999, p. 67, pl. 2, figs. 5 and 6; Danelian et al., 2000, fig. 3b; Wang et al., 2002, p. 330, pl. 2, figs. 27 and 28.

Spongostylus aequicurvistylus: Lahm, 1984, p. 69, pl. 12, fig. 5.

Holotype. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 9, fig. 8); collection number and depository are not specified.

Description. The outer shell is subspherical, small, spongy. The two main polar spines are long, three-bladed, with well-pronounced dextral coiling.

Both spines are curved in the middle part almost at a right angle in the same or opposite directions.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–120; length of proximal part of spines (up to the curvature), 120–130; length of distal part of spines, 130–160.

C o m p a r i s o n. *S. carnicus* differs from *S. tortilis* Kozur et Mostler, 1979 in the curved spines.

O c c u r r e n c e. Carnian–Lower Norian of Austria, British Columbia, Oregon, New Zealand, Croatia, Transcaucasia, Cyprus, Turkey, and Tibet.

M a t e r i a l. Thirty-four specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Spongostylus tortilis Kozur et Mostler, 1979

Plate 8, fig. 5

Spongostylus tortilis: Kozur and Mostler, 1979, p. 58, pl. 4, fig. 2; pl. 11, fig. 6; pl. 18, fig. 2; 1981, pl. 40, fig. 2; pl. 56, fig. 3; Lahm, 1984, p. 68, pl. 12, fig. 3; Bragin and Krylov, 1999b, p. 553, text-fig. 8A; Tekin, 1999, p. 67, pl. 2, figs. 7 and 8; Wang et al., 2002, p. 330, pl. 2, figs. 24–26.

Spongostylus sp.: Knipper et al., 1997, pl. I, figs. 5 and 6.

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 11, fig. 6); collection number and depository are not specified.

D e s c r i p t i o n. The outer shell is relatively small, subspherical, spongy. The two main polar spines are long, three-bladed, straight, with well-pronounced dextral coiling, one spine is often longer than the other.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–120; length of spines, 160–250.

C o m p a r i s o n. *S. tortilis* differs from *S. carnicus* Kozur et Mostler, 1979 in the straight spines.

O c c u r r e n c e. Carnian–Lower Norian of Austria, Transcaucasia, Cyprus, Turkey, and Tibet.

M a t e r i a l. Thirty-two specimens from the Lara and Ayia Varvara localities.

Genus *Dumitricasphaera* Kozur et Mostler, 1979

Dumitricasphaera: Kozur et Mostler, 1979, p. 60; Lahm, 1984, p. 70.

T y p e s p e c i e s. *Dumitricasphaera goestlingensis* Kozur et Mostler, 1979; Middle Norian of Austria.

D i a g n o s i s. Outer shell spherical, spongy, with two main polar spines. Main spines straight, with three symmetrically positioned apophyses at ends.

S p e c i e s c o m p o s i t i o n. Four species from the Upper Triassic of Austria, Turkey, and Cyprus.

C o m p a r i s o n. *Dumitricasphaera* differs from *Spongostylus* in the presence of three apophyses at the distal ends of the main spines.

Dumitricasphaera elegans sp. nov.

Plate 8, figs. 6–8

E t y m o l o g y. From the Latin *elegans* (graceful).

H o l o t y p e. GIN, no. 4858-100; Cyprus, Lara section; Lower–Middle Norian, Phasoula Formation (Pl. 8, fig. 7).

D e s c r i p t i o n. The outer shell is relatively small, spherical. Small rounded pores are enclosed in irregular, tetra–hexagonal frames with small sharp thorns at the vertices, forming the rough, thorny surface of the shell. The two main spines are long, straight, three-bladed, with narrow rounded ridges and wide grooves. In the distal third, the spines gradually narrow. Three smooth, slightly curved apophyses deviate symmetrically from the end of each spine; they are somewhat shorter than the spines. The apophyses usually curve distally; however, in some cases, one or two curve towards the shell.

M e a s u r e m e n t s, μm. Outer shell diameter, 100–115; length of spines without apophyses, 190–210; width of spines, 40–50; length of apophyses, 150–170.

C o m p a r i s o n. The new species differs from *D. simplex* Tekin, 1999 in the longer and narrower spines, the longer apophyses, predominantly distal curvature of apophyses, and in the thorny surface of the outer shell.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Seven specimens from the Lara locality.

Genus *Zhamojdasphaera* Kozur et Mostler, 1979

Zhamojdasphaera: Kozur and Mostler, 1979, p. 68.

T y p e s p e c i e s. *Zhamojdasphaera latispinosa* Kozur et Mostler, 1979; Upper Carnian of Austria.

D i a g n o s i s. Outer shell spherical, spongy, with three symmetrically positioned, flat and wide main spines forming blades.

S p e c i e s c o m p o s i t i o n. Two species from the Upper Carnian of the Mediterranean Region.

C o m p a r i s o n. *Zhamojdasphaera* differs from *Spongostylus* Haeckel, 1881 in the presence of three main spines and their flat shape.

Zhamojdasphaera proceruspinosa Lahm, 1984

Plate 8, figs. 9 and 10

Zhamojdasphaera proceruspinosa: Lahm, 1984, p. 75, pl. 13, fig. 6; Bragin and Krylov, 1999b, p. 547, text-fig. 8E.

H o l o t y p e. Slg. München Prot. (Institute of Paleontology and Historical Geology, München), no. 3663, Austria, Großreifling; Middle Carnian (Lahm, 1984, pl. 13, fig. 6); housed in the Institute of Paleontology and Historical Geology, Munich.

D e s c r i p t i o n. The outer shell is small, subspherical, spongy, with three main spines positioned symmetrically. The spines are flat, wide, straight, with narrow and pointed ends.

M e a s u r e m e n t s, μm. Outer shell diameter, 90–110; length of spines, 130–150.

C o m p a r i s o n. *Z. proceruspinosa* differs from *Z. latispinosa* Kozur et Mostler, 1979 in the straight spines.

O c c u r r e n c e. Carnian of Austria, Lower Norian of Cyprus.

M a t e r i a l. Four specimens from the Lara and Ayia Varvara localities.

S u p e r f a m i l y Spongodiscoidea Haeckel, 1862

Spongodiscida: Haeckel, 1862, p. 460.

Spongodiscoidea: Petrushevskaya, 1979, p. 110.

D i a g n o s i s. Spumellaria with primary skeleton in shape of very small polyhedron, with spongy, or, less often, with porous discoidal, stauraxonic, prunoid, or spherical shell, with varying number of spines.

C o m p o s i t i o n. Triassic–Recent. In the Triassic, the superfamily is represented by the families Oertlispongidae Kozur et Mostler, 1980, Saturnalidae Deflandre, 1953, Sponguridae Haeckel, 1862, Orbiculiformidae Pessagno, 1973, and Patulibracchiidae Pessagno, 1971.

C o m p a r i s o n. The superfamily Spongodiscoidea differs from Actinommoidea in the primary skeleton in the shape of a polyhedron.

Family Oertlispongidae Kozur et Mostler, 1980

Oertlispongidae: Dumitrica et al., 1980, p. 4.

D i a g n o s i s. Spongodiscoidea with ellipsoidal, spherical, or flattened spongy multilayered outer shell and 1–4 radial spines, circular in cross section or flat, bladelike, with varying number of subsidiary spines.

C o m p o s i t i o n. Two subfamilies, Oertlisponginae Kozur et Mostler, 1980 and Intermediellinae Lahm, 1984 from the Olenekian–Upper Norian.

C o m p a r i s o n. The family Oertlispongidae differs from Saturnalidae Deflandre, 1953 in the radial spines, which do not form a ring.

Subfamily Intermediellinae Lahm, 1984

Intermediellinae: Lahm, 1984, p. 53.

D i a g n o s i s. Oertlispongidae with two, three, or four main spines circular in cross section, not occupying polar positions, often with pylome replacing one main spine.

G e n e r i c c o m p o s i t i o n. *Paurinella* Kozur et Mostler, 1981, *Katorella* Kozur et Mostler, 1981, *Neopaurinella* Kozur et Mostler, 1981, *Discokatorella* Kozur et Mostler, 1994, *Tetrapaurinella* Kozur et Mostler, 1994, *Kulacella* Kozur et Mostler, 1981, *Norispongus* Kozur et Mostler, 1981, and presumably *Tamonella* Dumitrica, Kozur et Mostler, 1980. Middle and Upper Triassic.

C o m p a r i s o n. The subfamily Intermediellinae differs from Oertlisponginae in the spines, which do not occupy polar positions.

Genus *Neopaurinella* Kozur et Mostler, 1981

Neopaurinella: Kozur and Mostler, 1981, p. 45.

T y p e s p e c i e s. *Neopaurinella sevatica* Kozur et Mostler, 1981; Upper Norian of Austria.

D i a g n o s i s. Shell subspherical or subellipsoidal, spongy, multilayered, with three main spines, two of which massive, slightly inflated, straight, smooth, circular in cross section. Third spine narrow, straight, with pylome at base. All main spines located in one plane. Subsidiary spines occasionally present.

S p e c i e s c o m p o s i t i o n. Four species from Ladinian–Norian of the Mediterranean Region and Japan.

C o m p a r i s o n. *Neopaurinella* differs from *Paurinella* Kozur et Mostler, 1981 in the narrow, noninflated spine at the pylome.

***Neopaurinella sevatica* Kozur et Mostler, 1981**

Plate 8, fig. 11; Plate 9, fig. 1

Neopaurinella sevatica: Kozur and Mostler, 1981, p. 45, pl. 48, fig. 6, pl. 49, figs. 1 and 4.

Neopaurinella sp. cf. *N. sevatica*: Bragin and Krylov, 1996, pl. I, fig. 9.

H o l o t y p e. KoMo, no. 1980 I-26; Austria, Pötchenpass; Upper Norian (Kozur and Mostler, 1981, pl. 48, fig. 6); depository not indicated.

D e s c r i p t i o n. The outer shell is large, subspherical, spongy. The two main spines are massive, circular in cross section, gradually thickening to the midlength and, then, smoothly tapering to the pointed end. The third spine is short, narrow, with a pylome at the base.

M e a s u r e m e n t s, μm. Outer shell diameter, 200–220; length of massive spines, 150–170; length of narrow spine, 70.

C o m p a r i s o n. *N. sevatica* differs from *N. lahmi* Kozur et Mostler, 1994 in the well-pronounced swelling of two main spines which are not connected with the pylome.

O c c u r r e n c e. Middle and Upper Norian of Austria, Cyprus, and Japan.

M a t e r i a l. Twelve specimens from the Lara and Dhiarizos localities.

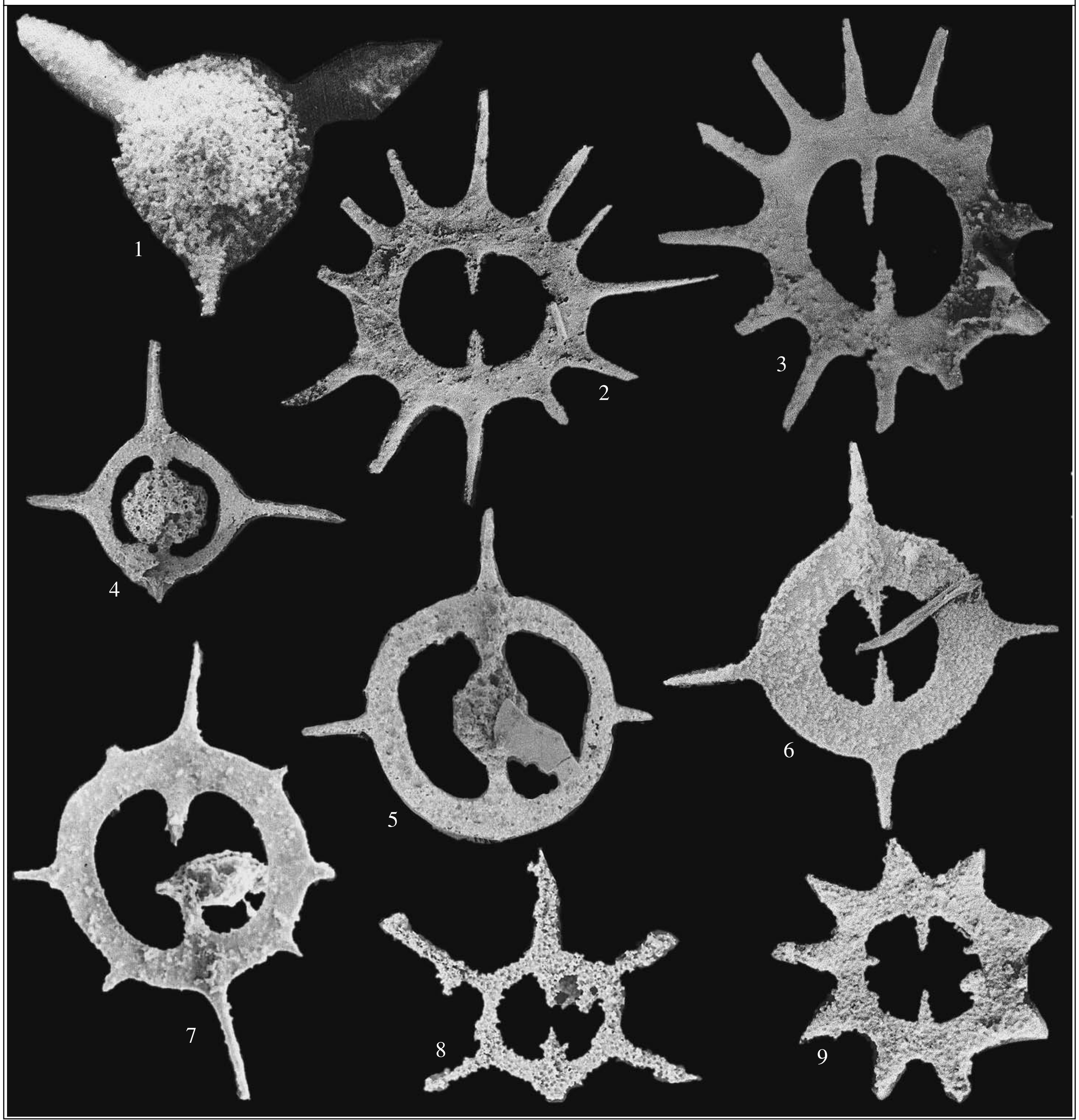
Family Saturnalidae Deflandre, 1953

Saturnalidae: Deflandre, 1953, p. 419.

D i a g n o s i s. Spongodiscoidea with spongy, multilayered discoid outer shell, with porous polyhedral microsphere in center. Sometimes (in Late Mesozoic and Cenozoic taxa) microsphere enclosed in another porous shell; in this case, external spongy shell may be reduced. Two (less often three, four, or more) main spines present, with their distal parts forming lateral projections connected into saturnian ring. Varying numbers of subsidiary spines and external rays occasionally formed.

C o m p o s i t i o n. Subfamilies Parasaturnalinae Kozur et Mostler, 1972, Pseudacanthocircinae Kozur et Mostler, 1990, Saturnalinae Deflandre, 1953, and Veghicycliinae Kozur et Mostler, 1972; Carnian–Recent.

Plate 9



Explanation of Plate 9

Fig. 1. *Neopaurinella sevatica* Kozur et Mostler, specimen GIN, no. 4858-171; Vlambouros Formation, Dhiarizos section, sample 90-28-1, ×200.

Figs. 2 and 3. *Palaeosaturnalis triassicus* (Kozur et Mostler), Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170: (2) GIN, no. 4858-172 and (3) GIN, no. 4858-173.

Figs. 4 and 5. *Palaeosaturnalis raridenticulatus* Kozur et Mock, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2: (4) GIN, no. 4858-174, ×100, and (5) GIN, no. 4858-175, ×170.

Fig. 6. *Palaeosaturnalis latiannulatus* Kozur et Mostler, specimen GIN, no. 4858-176; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.

Fig. 7. *Palaeosaturnalis mocki* Kozur et Mostler, specimen GIN, no. 4858-177; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.

Fig. 8. *Praehexasaturnalis tenuispinosus* (Donofrio et Mostler), specimen GIN, no. 4858-179; Phasoula Formation, Middle Norian, Parekklisia locality, sample 03-1-25, ×170.

Fig. 9. *Praemesosaturnalis quadriradiatus* (Kozur et Mostler), specimen GIN, no. 4858-178; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×150.

C o m p a r i s o n. The family Saturnalidae differs from Oertlispongidae in the ring formed by projections of the main spines.

Subfamily Parasaturnalinae Kozur et Mostler, 1972

Parasaturnalinae: Kozur and Mostler, 1972, p. 42.

Parasaturnalidae: Kozur and Mostler, 1983, p. 13.

D i a g n o s i s. Saturnalidae with flat, wide, rounded or polygonal ring, with two main spines, or, less often, with greater number of spines, with or without subsidiary spines. External margin of saturnian ring usually with many external rays; infrequently with two rays or without rays. Outer shell subspherical, spongy, multilayered.

G e n e r i c c o m p o s i t i o n. Carnian–Recent. In the Upper Triassic, this subfamily is represented by *Palaeosaturnalis* Donofrio et Mostler, 1978, *Pseudoheliodiscus* Kozur et Mostler, 1981, *Heliosaturnalis* Kozur et Mostler, 1983, *Praemesosaturnalis* Kozur et Mostler, 1983, *Mesosaturnalis* Kozur et Mostler, 1983, *Praehexasaturnalis* Kozur et Mostler, 1983, *Stauracanthocircus* Kozur et Mostler, 1983, and *Liassosaturnalis* Kozur et Mostler, 1990.

C o m p a r i s o n. The subfamily Parasaturnalinae differs from Veghicyclinae in the compact ring without pores.

Genus *Palaeosaturnalis* Donofrio et Mostler, 1978

Palaeosaturnalis: Donofrio and Mostler, 1978, p. 33.

T y p e s p e c i e s. *Spongosaturnalis triassicus* Kozur et Mostler, 1972; Middle Carnian of Austria, Göstling.

D i a g n o s i s. Saturnian ring single, with two main spines in polar positions, with many external rays. Subsidiary spines absent.

S p e c i e s c o m p o s i t i o n. About 20 species from the Upper Triassic and Lower Jurassic of Mediterranean, Japan, and the Far East of Russia.

C o m p a r i s o n. *Palaeosaturnalis* differs from *Praehexasaturnalis* in the absence of subsidiary spines.

Palaeosaturnalis triassicus (Kozur et Mostler, 1972)

Plate 9, figs. 2 and 3

Spongosaturnalis triassicus: Kozur and Mostler, 1972, p. 40, pl. 1, fig. 10; pl. 4, figs. 1 and 2.

Non *Spongosaturnalis triassicus*: De Wever et al., 1979, p. 81, pl. 2, fig. 2.

Non *Acanthocircus triassicus*: De Wever, 1982, p. 207, pl. 13, fig. 10.

Palaeosaturnalis triassicus: Kozur and Mostler, 1981, p. 55; Kozur and Mostler, 1983, pl. 6, fig. 2; Lahm, 1984, p. 97, pl. 17, fig. 11; Dozstaly, 1993, pl. 4, fig. 1; Bragin and Krylov, 1999b, p. 555, text-figs. 9A, 9B, and 9E; Tekin, 1999, pl. 17, figs. 6 and 7; Wang et al., 2002, p. 329, pl. 1, figs. 1–3.

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1972, pl. 4, fig. 2); collection number and depository are not indicated.

D e s c r i p t i o n. The saturnian ring is wide, circular or slightly ovate, with 14–16 moderately long rays, widened at the base and gently narrowing to the slightly pointed ends, which are positioned symmetrically relative to the main spines. Sometimes, the rays located on the axis of the main spines are longer than the others.

M e a s u r e m e n t s, μm. Diameter of the ring without external rays, 150–190; length of the main spines, 40–50; length of external rays, 60–90.

C o m p a r i s o n. *P. triassicus* differs from *P. dumitricai* Tekin, 1999 in the large number of the longer external rays; it differs from *P. hugluensis* Tekin, 1999 in the narrower ring and the narrower bases of external rays.

O c c u r r e n c e. Carnian–Lower Norian of Austria, Sicily, Hungary, Cyprus, Turkey, and Tibet.

M a t e r i a l. Twenty-five specimens from the Lara and Ayia Varvara localities.

Palaeosaturnalis latiannulatus Kozur et Mostler, 1983

Plate 9, fig. 6

Palaeosaturnalis latiannulatus: Kozur and Mostler, 1983, p. 20, pl. 5, fig. 1; Bragin and Krylov, 1999b, p. 556, text-fig. 9D; Tekin, 1999, p. 110, pl. 17, figs. 1 and 2; Tekin and Yurtsever, 2003, p. 154, pl. 1, fig. 18.

H o l o t y p e. T 5842; Slovakia, village of Sulov; Lower Norian (Kozur and Mostler, 1983, pl. 5, fig. 1); depository not indicated.

D e s c r i p t i o n. The saturnian ring is wide, regularly circular, with moderately wide main spines, with four moderately long, narrow, transversely positioned external rays.

M e a s u r e m e n t s, μm. Ring diameter, 200–220; length of the main spines, 40–50; length of external rays, 40–50.

C o m p a r i s o n. *P. latiannulatus* differs from *P. raridenticulatus* Kozur et Mock, 1981 in the wider ring with short external rays.

O c c u r r e n c e. Lower Norian of Slovakia, Cyprus, and Turkey.

M a t e r i a l. Twenty-two specimens from the Lara and Ayia Varvara localities.

Palaeosaturnalis raridenticulatus Kozur et Mock, 1981

Plate 9, figs. 4 and 5

Palaeosaturnalis raridenticulatus: Kozur et Mock, 1981, in Kozur et Mostler, 1981, p. 56, pl. 61, fig. 5; Tekin, 1999, p. 111, pl. 17, figs. 4 and 5.

H o l o t y p e. KoMo, no. 1980 I-10; Slovakia, village of Sulov; Lower Norian (Kozur et Mostler, 1981, pl. 61, fig. 5); depository not indicated.

D e s c r i p t i o n. The saturnian ring is narrow, circular or slightly ovate, with narrow main spines and four transversely positioned, very long, narrow external rays.

M e a s u r e m e n t s, μm. Ring diameter, 200–220; length of the main spines, 40–50; length of external rays, 170–200.

Comparison. *P. raridenticulatus* differs from *P. latiannulatus* Kozur et Mostler, 1983 in the narrow ring with longer and narrower external rays.

Occurrence. Lower Norian of Slovakia, Turkey, and Cyprus.

Material. Nineteen specimens from the Lara locality.

Palaeosaturnalis mocki **Kozur et Mostler, 1983**

Plate 9, fig. 7

Palaeosaturnalis mocki: Kozur and Mostler, 1983, p. 21, pl. 5, fig. 2; Bragin and Krylov, 1999b, p. 556, text-figs. 9G and 9H; Tekin, 1999, p. 110, pl. 17, fig. 3.

Holotype. T 5843; Slovakia, village of Sulov; Lower Norian (Kozur and Mostler, 1983, pl. 5, fig. 2); depository not indicated.

Description. The saturnian ring is wide, regularly circular, with narrow main spines and 6–8 narrow, moderately long, symmetrically positioned external rays.

Measurements, μm. Saturnian ring diameter, 190–215; length of the main spines, 40–50; length of external rays, 50–80.

Comparison. *P. mocki* differs from *P. latiannulatus* Kozur et Mostler, 1983 in the greater number of external rays.

Occurrence. Lower Norian of Slovakia, Cyprus, and Turkey.

Material. Twenty-seven specimens from the Lara and Ayia Varvara localities.

Genus *Praehexasaturnalis* Kozur et Mostler, 1983

Praehexasaturnalis: Kozur and Mostler, 1983, p. 30.

Type species. *Palaeosaturnalis tenuispinosus* Donofrio et Mostler, 1978; Upper Norian of Austria.

Diagnosis. The saturnian ring is simple, single, polygonal (octagonal or hexagonal), with two main polar spines and varying number of subsidiary spines or without them, with six or eight external rays.

Species composition. About ten species from Norian–Hettangian.

Comparison. *Praehexasaturnalis* differs from *Palaeosaturnalis* in the polygonal outlines of the ring.

Praehexasaturnalis tenuispinosus **(Donofrio et Mostler, 1978)**

Plate 9, fig. 8

Palaeosaturnalis tenuispinosus: Donofrio et Mostler, 1978, p. 37, pl. 7, figs. 1–3 and 8.

Spongosaturnalis sp. cf. *S. elegans*: De Wever et al., 1979, p. 81, pl. 2, figs. 3 and 4.

Palaeosaturnalis aff. *tenuispinosus*: Yao, 1982, pl. 3, fig. 17.

Acanthocircus tenuispinosus: De Wever, 1982, p. 206, pl. 13, figs. 3–5.

Praehexasaturnalis tenuispinosus: Kozur and Mostler, 1983, p. 30; Kozur and Mostler, 1990, p. 194; Sugiyama, 1997, p. 185, text-figs. 51.9 and 51.10; Tekin and Yurtsever, 2003, p. 154, pl. 2, fig. 1.

Acanthocircus cf. *A. elegance*: Yoshida, 1986, pl. 15, figs. 8 and 9.

Holotype. Austria, Pötschenpass; Upper Norian (Donofrio and Mostler, 1978, pl. 7, fig. 2); collection number and depository are not specified.

Description. The saturnian ring is hexagonal in outline, with two moderately long main polar spines, without subsidiary spines. Six long, narrow external rays, with pointed ends extending from the corners of the hexagonal ring.

Measurements, μm. Ring diameter without external rays, 110–120; length of the main spines, 50–60; length of external rays, 140–160.

Comparison. *P. tenuispinosus* differs from *P. burnensis* (Blome, 1984) in the presence of only six (instead of eight) external rays.

Occurrence. Lower Norian–Hettangian of Austria, Turkey, Oregon, Japan, the Philippines, and Cyprus.

Material. Fourteen specimens from the Parekklisia locality.

Genus *Praemesosaturnalis* Kozur et Mostler, 1983

Praemesosaturnalis: Kozur and Mostler, 1983, p. 58.

Kozurastrum: De Wever, 1984, p. 16.

Type species. *Spongosaturnalis bifidus* Kozur et Mostler, 1972; Upper Norian, Pötschen Formation; Pötschenpass, Austria.

Diagnosis. Saturnian ring single, with two main peripolar spines, many external rays, and varying number of subsidiary spines.

Species composition. Up to 30 species from the Upper Triassic and Lower Jurassic (Norian–Toarcian) of the Mediterranean, Japan, the Far East of Russia, the Philippines, and British Columbia.

Comparison. *Praemesosaturnalis* differs from *Mesosaturnalis* Kozur et Mostler, 1981 in the presence of subsidiary spines.

Praemesosaturnalis validus **(Donofrio et Mostler, 1978)**

Plate 10, fig. 1

Palaeosaturnalis validus: Donofrio and Mostler, 1978, p. 38, pl. 7, figs. 4–6 and 10.

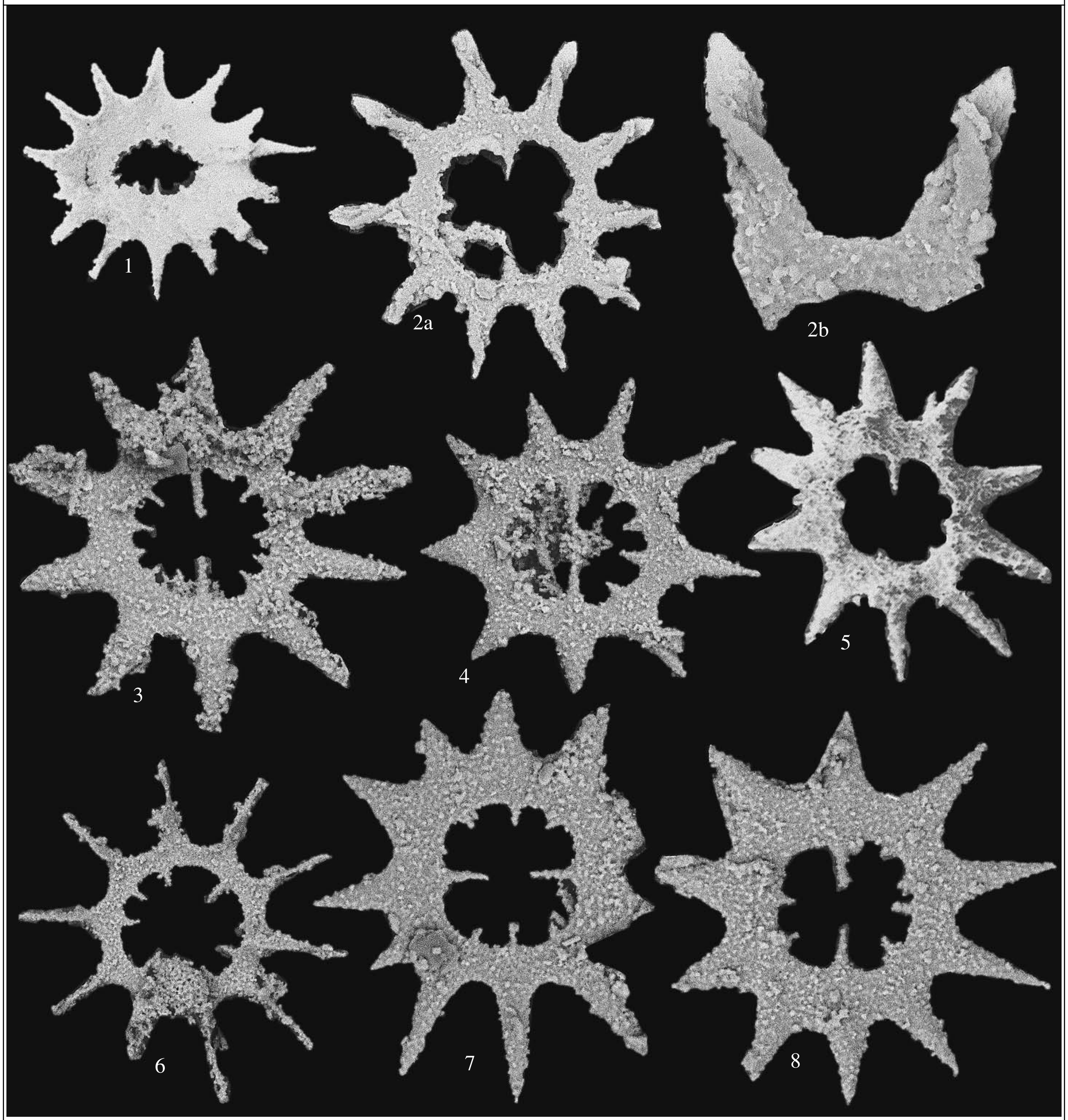
Holotype. Austria, Pötschenpass; Upper Norian (Donofrio and Mostler, 1978, pl. 7, fig. 6); collection number and depository are not specified.

Description. The saturnian ring is wide, with moderately long main spines and 10–12 short subsidiary spines; 14 moderately long external rays, with pointed distal ends and wide, fused bases are present.

Measurements, μm. Ring diameter, 230–270; length of the main spines, 25–30; length of external rays, 60–80.

Comparison. *P. validus* differs from *P. multidentatus* (Kozur et Mostler, 1972) in the wide ring with relatively small spines and rays.

Plate 10



Explanation of Plate 10

Fig. 1. *Praemesosaturnalis validus* (Donofrio et Mostler), specimen GIN, no. 4858-180; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×120.

Fig. 2. *Praemesosaturnalis spiralis* sp. nov., holotype GIN, no. 4858-108; Vlambouros Formation, Upper Norian, section Khapotami, sample 90-59-9: (2a) general appearance, ×170, and (2b) detail, ×500.

Figs. 3 and 4. *Praemesosaturnalis nobleae* Tekin, Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170: (3) GIN, no. 4858-181 and (4) GIN, no. 4858-182.

Fig. 5. *Praemesosaturnalis gracilis* (Kozur et Mostler), specimen GIN, no. 4858-183; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170.

Fig. 6. *Praemesosaturnalis convertus* (Kozur et Mostler), specimen GIN, no. 4858-184; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170.

Figs. 7 and 8. *Praemesosaturnalis acanthicus* sp. nov., Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170: (7) paratype GIN, no. 4858-185 and (8) holotype GIN, no. 4858-109.

O c c u r r e n c e. Upper Norian of Austria and Cyprus.

M a t e r i a l. Nineteen specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Praemesosaturnalis spiralis sp. nov.

Plate 10, fig. 2

E t y m o l o g y. From the Latin *spiralis* (spiral).

H o l o t y p e. GIN, no. 4858-108, Cyprus, Khapotami River; Upper Norian, Mamonia Complex, Vlambouros Formation (Pl. 10, fig. 2).

D e s c r i p t i o n. The saturnian ring has moderately long main spines and two short subsidiary spines positioned perpendicular to the main spines. The ring is narrow, with 10–12 moderately long external rays. The rays are massive, with well-pronounced sinistral coiling, up to one complete coil along the ray. The distal ends of rays are pointed.

M e a s u r e m e n t s, μm. Ring diameter without external rays, 160–180; length of the main spines, 30–35; length of subsidiary spines, 15–20; length of external rays, 60–70.

C o m p a r i s o n. The new species differs from its congeners in the well-pronounced spiral coiling of external rays of the saturnian ring.

O c c u r r e n c e. Upper Norian of Cyprus.

M a t e r i a l. Four complete and three fragmentary specimens from the Khapotami locality.

Praemesosaturnalis nobleae Tekin, 2002

Plate 10, figs. 3 and 4

Pseudoheliodiscus sp. aff. *multidentatus* (pars.): Yeh, 1990, p. 18, pl. 12, fig. 13, non pl. 15, figs. 7, 9–11.

Praemesosaturnalis multidentatus (pars.): Sugiyama, 1997, p. 185, text-fig. 28-2, non fig. 51-1.

Praemesosaturnalis nobleae: Tekin, 2002, p. 426, pl. 2, figs. 10–12.

H o l o t y p e. Turkey, Hocakoy section; Upper Norian, Gökdere Formation (Tekin, 2002, pl. 2, fig. 10); collection number is not indicated; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The saturnian ring is wide, with moderately long main spines, many (8–10) short subsidiary spines throughout the ring perimeter, ten moderately long external rays, which are wide at the base and wedge-shaped tapering towards the distal end.

M e a s u r e m e n t s, μm. Saturnian ring diameter without external rays, 190–210; length of the main spines, 45–50; length of external rays, 70–90.

C o m p a r i s o n. *P. nobleae* differs from *P. multidentatus* (Kozur et Mostler, 1972) in the longer external rays and half as many subsidiary spines.

O c c u r r e n c e. Upper Norian–Rhaetian of the Philippines, Japan, Turkey, and Cyprus.

M a t e r i a l. Twenty-four specimens from the Khapotami, Dhiarizos, and Mavrokolymbos localities.

Praemesosaturnalis gracilis (Kozur et Mostler, 1972)

Plate 10, fig. 5

Spongosaturnalis gracilis: Kozur and Mostler, 1972, p. 35, pl. 1, fig. 17.

Pseudoheliodiscus gracilis: Kido, 1982, pl. 3, fig. 2.

Kozurastrum gracilis: De Wever, 1984, p. 18; Bragin, 1991a, p. 93, pl. 10, fig. 11; Bragin, 1991b, p. 58, pl. 2, figs. 3–6; Carter, 1993, p. 53, pl. 4, figs. 10 and 11;

Praemesosaturnalis gracilis: Sugiyama, 1997, text-fig. 51.15.

H o l o t y p e. Austria, Pötschenpass; Middle–Upper Norian (Kozur and Mostler, 1972, pl. 1, fig. 17); collection number and depository are not indicated.

D e s c r i p t i o n. The saturnian ring is narrow, with moderately long main spines, six subsidiary spines, which are slightly shorter than the main spines, and ten long, narrow external rays.

M e a s u r e m e n t s, μm. Ring diameter without external rays, 150–170; length of the main spines, 30–35; length of subsidiary spines, 25–30; length of external rays, 60–75.

C o m p a r i s o n. *P. gracilis* differs from *P. quadriradiatus* (Kozur et Mostler, 1972) in the greater number of subsidiary spines, from *P. acanthicus* sp. nov. in the narrower and longer external rays and the narrow ring.

O c c u r r e n c e. Upper Norian–Rhaetian of Austria, Sikhote Alin, British Columbia, and Japan.

M a t e r i a l. Thirteen specimens from the Lara, Khapotami, and Dhiarizos localities.

Praemesosaturnalis quadriradiatus (Kozur et Mostler, 1972)

Plate 9, fig. 9

Spongosaturnalis quadriradiatus: Kozur and Mostler, 1972, p. 39, pl. 1, fig. 8.

Pseudoheliodiscus quadriradiatus: De Wever, 1981, p. 143, pl. 4, fig. 1; De Wever, 1982, p. 221, pl. 19, figs. 5 and 7.

Kozurastrum quadriradiatus: Bragin, 1991a, p. 92, pl. 8, fig. 8; Bragin, 1991b, p. 60, pl. 3, fig. 6.

Praemesosaturnalis quadriradiatus: Bragin and Krylov, 1996, pl. 2, fig. 2.

H o l o t y p e. Austria, Pötschenpass; Middle–Upper Norian (Kozur and Mostler, 1972, pl. 1, fig. 8); collection number and depository are not indicated.

D e s c r i p t i o n. The saturnian ring is narrow, with moderately long main spines, two short subsidiary spines positioned perpendicular to the main spines, and nine or ten moderately long external rays.

M e a s u r e m e n t s, μm. Ring diameter without external rays, 150–170; length of the main spines, 30–35; length of subsidiary spines, 15–20; length of external rays, 40–60.

C o m p a r i s o n. *P. quadriradiatus* differs from *P. gracilis* in the presence of only two subsidiary spines.

O c c u r r e n c e. Upper Norian–Pliensbachian of Austria, Turkey, Sikhote Alin, the Koryak Upland, and Cyprus.

M a t e r i a l. Nine specimens from the Lara, Dhiarizos, and Mavrokolymbos localities.

Praemesosaturnalis convertus **(Kozur et Mostler, 1972)**

Plate 10, fig. 6

Spongosaturnalis convertus: Kozur et Mostler, 1972, p. 34, pl. 2, figs. 16 and 19.

Holotype. Austria, Pötschenpass; Upper Norian, (Kozur and Mostler, 1972, pl. 1, fig. 16); collection number and depository are not indicated.

Description. The saturnian ring has moderately long main spines, six subsidiary spines, which are slightly shorter than the main spines, and ten long flat external rays. The planes of rays are perpendicular to the plane of the ring, so that the rays are turned to the observer by their narrow lateral edges.

Measurements, μm. Ring diameter without external rays, 210–220; length of the main spines, 40–45; length of subsidiary spines, 35–40; length of external rays, 120–140.

Comparison. *P. convertus* is distinguished by the fact that the planes of the external rays are perpendicular to the plane of the saturnian ring.

Occurrence. Upper Norian of Austria and Cyprus.

Material. Eleven specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Praemesosaturnalis acanthicus **sp. nov.**

Plate 10, figs. 7 and 8; Plate 11, fig. 1

Etymology. From the Greek *acanthus* (acanthus, a plant with pointed leaves).

Holotype. GIN, no. 4858-109; Cyprus, Dhiarizos River; Upper Norian, Mamonia Complex, Vlambouros Formation (Pl. 10, fig. 8).

Description. The saturnian ring is wide, with moderately long main spines, six short subsidiary spines, 10–12 moderately long external rays, widened at the base and gently narrowing and pointed at the distal end.

Measurements, μm. Ring diameter without external rays, 170–190; length of the main spines, 40–50; length of external rays, 90–110.

Comparison. The new species differs from *P. nobleae* Tekin, 2002 in the fewer subsidiary spines (6 versus 8–10).

Occurrence. Upper Norian of Cyprus.

Material. Thirty-two specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Praemesosaturnalis zapfei **(Kozur et Mostler, 1972)**

Plate 11, fig. 2

Spongosaturnalis zapfei: Kozur and Mostler, 1972, p. 41, pl. 1, fig. 2.

Praemesosaturnalis zapfei: Bragin and Krylov, 1996, pl. II, fig. 1.

Holotype. Austria, Pötschenpass; Upper Norian, (Kozur and Mostler, 1972, pl. 1, fig. 2); collection number and depository are not indicated.

Description. The saturnian ring is simple, single, narrow, with two moderately long peripolar main spines, a few (2–4) short, irregularly positioned subsidiary spines, 11 or 12 relatively short, narrow, and flat external rays.

Measurements, μm. Ring diameter without external rays, 200–230; length of the main spines, 30–35; length of external rays, 50–55.

Comparison. *P. zapfei* differs from congeners in the narrow ring with a few, irregularly arranged subsidiary spines.

Occurrence. Upper Norian of Austria and Cyprus.

Material. Seven specimens from the Dhiarizos locality.

Genus *Mesosaturnalis* Kozur et Mostler, 1981

Mesosaturnalis: Kozur and Mostler, 1981, p. 57.

Type species. *Palaeosaturnalis levis* Donofrio et Mostler, 1978; Cenomanian of Austria.

Diagnosis. The saturnian ring is single, with two peripolar main spines, with varying number of external rays and without subsidiary spines.

Species composition. Up to 20 species from the Upper Triassic, Jurassic, and Cretaceous.

Comparison. *Mesosaturnalis* differs from *Praemesosaturnalis* Kozur et Mostler, 1981 in the absence of subsidiary spines, from *Palaeosaturnalis* Donofrio et Mostler, 1978 in the peripolar position of the main spines.

Mesosaturnalis furcatus **sp. nov.**

Plate 11, fig. 3

Etymology. From the Latin *furcatus* (branching).

Holotype. GIN, no. 4858-110; Cyprus, Khapotami River; Upper Norian, Mamonia Complex, Vlambouros Formation (Pl. 11, fig. 3).

Description. The saturnian ring is narrow, with ten short, narrow external rays, which slightly expand towards the distal end and are divided into two or three apophyses.

Measurements, μm. Ring diameter, 200–210; length of the main spines, 65–70; length of external rays, 65–75.

Comparison. The new species differs from all congeners in the external rays divided into two or three apophyses.

Occurrence. Middle–Upper Norian of Cyprus.

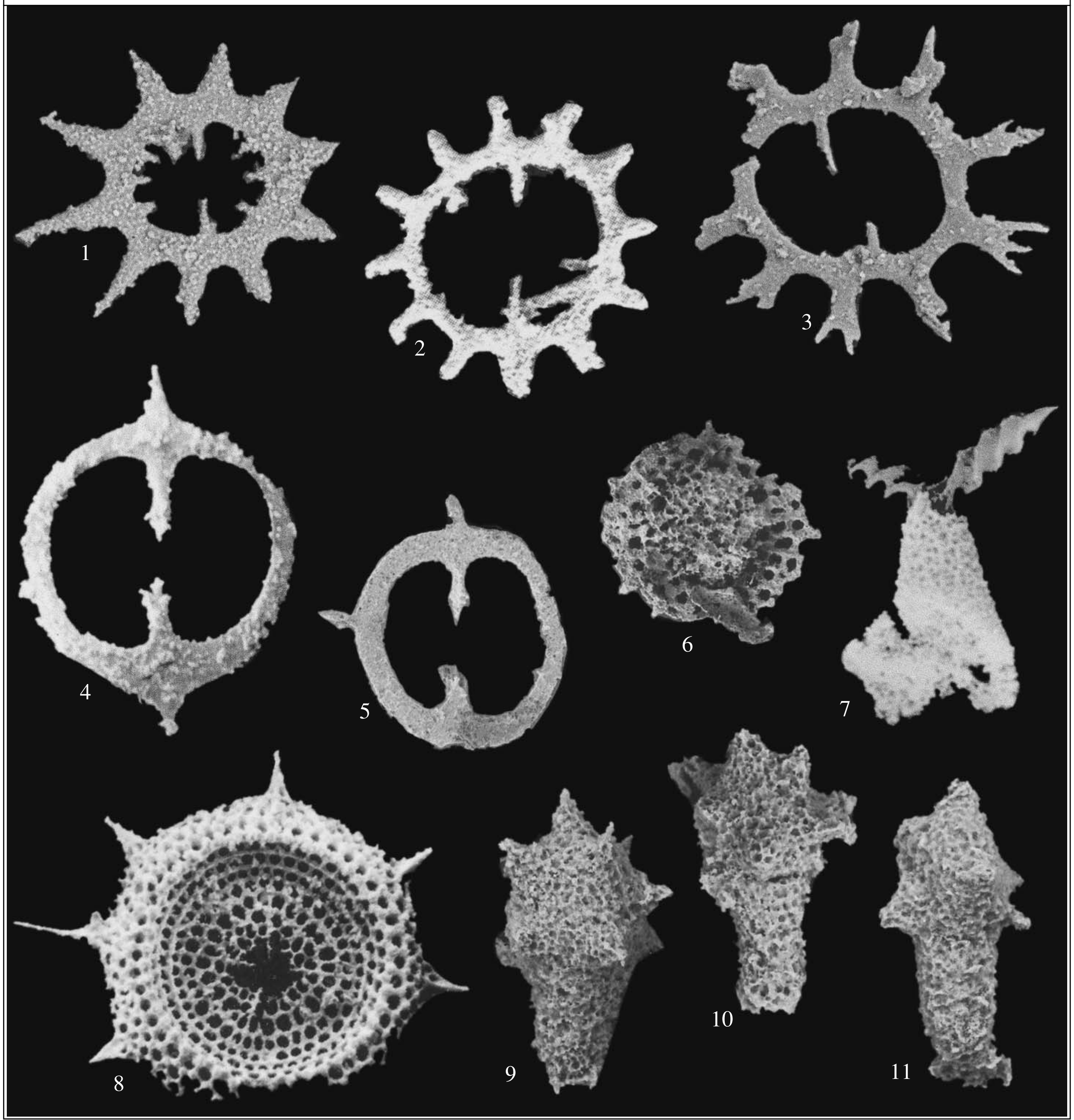
Material. Three specimens from the Parekklisia and Khapotami localities.

Genus *Liassosaturnalis* Kozur et Mostler, 1990

Liassosaturnalis: Kozur and Mostler, 1990, p. 202.

Type species. *Liassosaturnalis parvus* Kozur et Mostler, 1990; Hettangian, Kirchstein Formation; Bavaria, Germany.

Plate 11



Explanation of Plate 11

Fig. 1. *Praemesosaturnalis acanthicus* sp. nov., paratype GIN, no. 4858-185; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×150.

Fig. 2. *Praemesosaturnalis zapfei* (Kozur et Mostler), specimen GIN, no. 4858-186; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×200.

Fig. 3. *Mesosaturnalis furcatus* sp. nov., holotype GIN, no. 4858-110; Vlambouros Formation, Upper Norian, section Khapotami, sample 90-59-6, ×200.

Figs. 4 and 5. *Liassosaturnalis parvus* Kozur et Mostler, Phasoula Formation, Lower Norian; (4) GIN, no. 4858-187, Ayia Varvara locality, sample 90-39, ×250, and (5) GIN, no. 4858-188, Lara section, sample 98-2-2, ×180.

Fig. 6. *Veghicyclia haeckeli* Kozur et Mostler, specimen GIN, no. 4858-189; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×140.

Fig. 7. *Karnospongella bispinosa* Kozur et Mostler, specimen GIN, no. 4858-190; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.

Fig. 8. *Orbiculiforma goestlingensis* (Kozur et Mostler), specimen GIN, no. 4858-191; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.

Figs. 9–11. *Bistarkum coriniforme* sp. nov., Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170; (9) holotype GIN, no. 4858-111, (10) paratype GIN, no. 4858-192, and (11) paratype GIN, no. 4858-193.

D i a g n o s i s. Saturnian ring single, with two polar main spines and two external rays. Subsidiary spines either absent or 1–4 very narrow spines present.

S p e c i e s c o m p o s i t i o n. Four species from the Norian–Hettangian of the Mediterranean Region.

C o m p a r i s o n. *Liassosaturnalis* differs from *Palaeosaturnalis* in the presence of only two external rays.

Liassosaturnalis parvus Kozur et Mostler, 1990

Plate 11, figs. 4 and 5

Liassosaturnalis parvus: Kozur and Mostler, 1990, p. 203, pl. 4, figs. 3, 7, and 12; pl. 6, fig. 6; Bragin and Krylov, 1999b, p. 556, text-fig. 9C.

H o l o t y p e. KoMo no. 1990 I-62; Germany, Bavaria, Kirchstein; Hettangian (Kozur and Mostler, 1990, pl. 4, fig. 3); depository not indicated.

D e s c r i p t i o n. The ring is small, simple, flat, regularly spherical, with two polar main spines and two external rays on the extension of the spines.

M e a s u r e m e n t s, μm. Ring diameter, 130–140; length of external rays, 20–30.

C o m p a r i s o n. *L. parvus* differs from *L. undulatus* Kozur et Mostler, 1990 in the smooth, regularly spherical ring.

O c c u r r e n c e. Norian–Hettangian of Bavaria and Cyprus.

M a t e r i a l. Eight specimens from the Lara and Ayia Varvara localities.

Subfamily Veghicycliinae Kozur et Mostler, 1972

Veghicyclidae: Kozur and Mostler, 1972, p. 9.

D i a g n o s i s. Saturnalidae with single, very wide ring pierced by many circular, irregularly arranged pores. Outer shell subspherical, multilayered, spongy, with microsphere in center; four main spines deviating from microsphere located crosswise in one plane.

C o m p a r i s o n. The Veghicycliinae are distinguished by the ring with many irregularly arranged pores.

G e n e r i c c o m p o s i t i o n. Two genera, *Veghicyclia* Kozur et Mostler, 1972 and *Carinacyclia* Kozur et Mostler, 1972, from the Upper Triassic.

Genus *Veghicyclia* Kozur et Mostler, 1972

Veghicyclia: Kozur and Mostler, 1972, p. 10.

T y p e s p e c i e s. *Veghicyclia pulchra* Kozur et Mostler, 1972; Middle Carnian of Austria.

D i a g n o s i s. Central part of skeleton enclosed in variously developed, sometimes incomplete, flattened ellipsoidal spongy shell. Internal position occupied by microsphere, with four spines positioned crosswise in one plane. Wide saturnian ring located in this plane in shape of disk with many holes arranged in concentric rows or randomly.

S p e c i e s c o m p o s i t i o n. Four species from the Carnian of Austria and Lower Norian of Cyprus.

C o m p a r i s o n. *Veghicyclia* differs from *Carinacyclia* Kozur et Mostler, 1972 in the flattened ellipsoidal shells lacking a peripheral ridge.

Veghicyclia haeckeli Kozur et Mostler, 1972

Plate 11, fig. 6

Veghicyclia haeckeli: Kozur et Mostler, 1972, p. 13, pl. 4, fig. 13, non pl. 3, fig. 2 (= *V. goestlingensis* Kozur et Mostler, 1972); Tekin, 1999, p. 117, pl. 20, fig. 3.

Veghicyclia austriaca: Kozur et Mostler, 1972, only pl. 3, fig. 3.

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1972, pl. 4, fig. 13); collection number and depository are not indicated.

D e s c r i p t i o n. The shell is discoid, flattened, spongy. The saturnian ring is wide, flat, with three exposed concentric rows of holes, with many short external rays.

M e a s u r e m e n t s, μm. Shell diameter, including ring, 220–240; diameter of spongy shell, 110–130.

C o m p a r i s o n. *V. haeckeli* differs from *V. austriaca* Kozur et Mostler, 1972 in the arrangement of holes in the saturnian ring in concentric rows.

O c c u r r e n c e. Carnian–Lower Norian of Austria, Turkey, and Cyprus.

M a t e r i a l. Three specimens from the Lara locality.

Family Sponguridae Haeckel, 1862

Spongurida: Haeckel, 1862, p. 447.

Sponguridae: Petrushevskaya, 1979, p. 114.

D i a g n o s i s. Spongodiscoidea with spongy shell, with ellipsoidal or cylindrical test having two poles bearing three-bladed or Y-shaped in section main spines or two apophyses.

G e n e r i c c o m p o s i t i o n. Middle Triassic–Recent. In the Triassic, the family is represented by the genera *Archaeospongoprunum* Pessagno, 1973, *Gomberellus* Dumitrica, Kozur et Mostler, 1980, *Praegomberellus* Kozur et Mostler, 1994, and *Karnospongella* Kozur et Mostler, 1981.

C o m p a r i s o n. The family Sponguridae differs from Orbiculiformidae Pessagno, 1973 in the ellipsoidal or cylindrical shape of the shell.

Genus *Karnospongella* Kozur et Mostler, 1981

Karnospongella: Kozur and Mostler, 1981, p. 42.

T y p e s p e c i e s. *Karnospongella bispinosa* Kozur et Mostler, 1981; Lower Carnian of Austria.

D i a g n o s i s. Outer shell with two main spines located on one pole. Subsidiary spines absent.

S p e c i e s c o m p o s i t i o n. One species from the Ladinian–Lower Norian of the Mediterranean and Pacific regions.

C o m p a r i s o n. *Karnospongella* differs from *Gomberellus* in the absence of subsidiary spines

Karnospongella bispinosa Kozur et Mostler, 1981

Plate 11, fig. 7

Spumellaria gen. et sp. indet.: Kozur and Mostler, 1979, pl. 21, fig. 2.

Karnospongella bispinosa: Kozur and Mostler, 1981, p. 42, pl. 50, figs. 1 and 2; Bragin and Krylov, 1999b, p. 554, text-fig. 7G; Tekin, 1999, p. 103, pl. 14, figs. 6 and 7.

Karnospongella trispinosa: Lahm, 1984, p. 42, pl. 7, fig. 2.

Karnospongella sp. *B*: Yeh, 1989, pl. 14, fig. 16.

Gomberellus bispinosus: Gorican and Buser, 1990, p. 146, pl. 1, fig. 10; Halamic and Gorican, 1995, pl. 1, fig. 6.

Bernoullius? capricornus: Bragin, 1991b, p. 83, pl. 1, figs. 1–5.

H o l o t y p e. KoMo, no. 1980 I-18; Austria, Göstling; Middle Carnian (Kozur and Mostler, 1981, pl. 50, fig. 1); depository not indicated.

D e s c r i p t i o n. The outer shell is ellipsoidal or rounded conical, egg-shaped, spongy. One pole has two moderately long, three-bladed, inclined spines with well-pronounced sinistral coiling. The angle between the spines is 90°.

M e a s u r e m e n t s, μm. Length of the outer shell, 180–220; length of spines, 90–100.

O c c u r r e n c e. Ladinian–Lower Norian of Austria, Oregon, Slovenia, the Koryak Upland, Croatia, and Cyprus.

M a t e r i a l. Four specimens from the Lara and Ayia Varvara localities.

Family Orbiculiformidae Pessagno, 1973

Orbiculiformidae: Pessagno, 1973, p. 71.

D i a g n o s i s. Spongodiscoidea with primary skeleton in shape of microsphere of three connected rings, positioned perpendicular to each other, forming in projection crosswise structure, giving rise to four equatorial rays extending inside shell and inside its projections. Shell latticed–spongy, discoid, with or without stauraxonic projections, with or without main spines.

C o m p o s i t i o n. Middle? Triassic–Upper Cretaceous. In the Triassic, the family is represented by two subfamilies, Orbiculiforminae Pessagno, 1973 and Relindellinae Kozur et Mostler, 1980.

C o m p a r i s o n. The family Orbiculiformidae differs from Sponguridae in the discoid type of the outer shell.

Subfamily Orbiculiforminae Pessagno, 1973

Orbiculiformidae: Pessagno, 1973, p. 71.

Orbiculiforminae: Baumgartner et al., 1995, p. 24.

D i a g n o s i s. Orbiculiformidae with rounded discoid shell without main spines.

G e n e r i c c o m p o s i t i o n. Upper Triassic–Upper Cretaceous. In the Triassic, the subfamily is represented by the genus *Orbiculiforma* Pessagno.

C o m p a r i s o n. The subfamily Orbiculiforminae differs from Relindellinae in the absence of main spines on the margin of the shell.

Genus *Orbiculiforma* Pessagno, 1973

Orbiculiforma: Pessagno, 1973, p. 71.

Praeorbiculiformella: Kozur et Mostler, 1978, p. 163.

T y p e s p e c i e s. *Orbiculiforma quadrata* Pessagno, 1973; Upper Cretaceous of California.

D i a g n o s i s. Primary skeleton represented by small polygonal microsphere connected with discoid, concentric outer shell by four short bars, located in one plane. External margin of shell thickened, forming marginal rim without projections, with small peripheral spines.

S p e c i e s c o m p o s i t i o n. Seven species from the Carnian–Rhaetian of the Mediterranean and Pacific regions. Many species from the Jurassic and Cretaceous throughout the world.

C o m p a r i s o n. *Orbiculiforma* differs from *Higumastra* Baumgartner, 1980 in the rounded shell without projections.

Orbiculiforma goestlingensis (Kozur et Mostler, 1978)

Plate 11, fig. 8

Praeorbiculiformella goestlingensis: Kozur and Mostler, 1978, p. 164, pl. 1, figs. 10 and 13; pl. 4, fig. 3; Lahm, 1984, p. 93, pl. 17, fig. 2; Bragin and Krylov, 1999b, p. 554, text-fig. 8D.

Orbiculiforma goestlingensis: Tekin, 1999, p. 118, pl. 20, figs. 8 and 9.

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1978, pl. 1, fig. 13); collection number and depository are not indicated.

D e s c r i p t i o n. The shell is large, discoid, rounded; its external margin is substantially thickened, with short, narrow spines positioned radially in the plane of the shell. The entire shell surface, including the external margin, is pierced by circular pores, which are arranged in regular concentric rows. The microsphere is usually dissolved; however, some specimens have four crosswise positioned bars, which connect the microsphere to the outer shell.

M e a s u r e m e n t s, μm. Outer shell diameter, 250–320; length of spines, 70–100; width of thickened external margin, 60–70.

C o m p a r i s o n. *O. goestlingensis* differs from *O. plana* (Kozur et Mostler, 1978) in the thickened external border and from *O. vulgaris* (Kozur et Mostler, 1978) in the narrow spines of the external border.

O c c u r r e n c e. Carnian–Lower Norian of Austria, Cyprus, and Turkey.

M a t e r i a l. Thirty-six specimens from the Lara and Ayia Varvara localities.

Family Patulibracchiidae Pessagno, 1971

Patulibracchiinae: Pessagno, 1971, p. 22.

Patulibracchiidae: Baumgartner et al., 1995, p. 26.

D i a g n o s i s. Spongodiscoidea with spongy discoid shell, with stauraxonic projections formed of spongy tissue and lacking internal rays or main spines. Bracchiopyle occasionally present.

G e n e r i c c o m p o s i t i o n. Upper Triassic–Upper Cretaceous. In the Triassic, the family is represented by the genera *Bistarkum* Yeh, 1987, *Paronaella* Pessagno, 1971, *Triassocrucella* Kozur, 1984, and *Paratriassoastrum* Kozur et Mostler, 1981.

C o m p a r i s o n. The family Patulibracchiidae differs from Orbiculiformidae in the absence of rays inside the stauraxonic projections.

Genus *Bistarkum* Yeh, 1987

Bistarkum: Yeh, 1987, p. 42.

T y p e s p e c i e s. *Bistarkum rigidum* Yeh, 1987; Lower Jurassic of Oregon, USA.

D i a g n o s i s. Shell spongy, with two stauraxonic projections, distal end of which varying in shape.

S p e c i e s c o m p o s i t i o n. Up to ten species from the Upper Triassic–Lower Cretaceous.

C o m p a r i s o n. *Bistarkum* differs from *Paronaella* Pessagno, 1971 in the presence of only two stauraxonic projections.

Bistarkum coriniforme sp. nov.

Plate 11, figs. 9–11

E t y m o l o g y. From the Greek *corina* (club).

H o l o t y p e. GIN, no. 4858-111; Cyprus, Akamas Peninsula; Lower Norian, Mamonia Complex, Phasoula Formation (Pl. 11, fig. 9).

D e s c r i p t i o n. The shell is extended, almost cylindrical, without spines. One end of the shell is slightly narrowed, the opposite end is considerably inflated, with many (more than ten) high, massive conical tubercles with slightly pointed distal ends. The shell is spongy, its surface is entirely covered with many small, irregularly arranged pores.

M e a s u r e m e n t s, μm. Shell length, 240–260; width of the middle part of shell, 70–80; width of the inflated end of the shell, 150–180.

C o m p a r i s o n. The new species differs from *B. cylindratum* Carter, 1993 in the considerable inflation of only one end of the shell.

R e m a r k s. The species is referred to the genus *Bistarkum* Yeh, 1987 with some reservation (the same is true of the other Triassic species *B. cylindratum* Carter, 1993), because it differs from typical Jurassic and Cretaceous species in the cylindrical shape of the shell and in the irregular arrangement of the spongy shell.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Forty-seven specimens from the Lara locality.

Genus *Paronaella* Pessagno, 1971

Paronaella: Pessagno, 1971, p. 46.

T y p e s p e c i e s. *Paronaella solanoensis* Pessagno, 1971; Upper Cretaceous of California.

D i a g n o s i s. Shell spongy, with three stauraxonic projections. Ends of rays either tapering or inflated.

S p e c i e s c o m p o s i t i o n a n d o c c u r r e n c e. Several tens species from the Upper Triassic–Upper Cretaceous throughout the world.

C o m p a r i s o n. *Paronaella* differs from *Bistarkum* in the presence of three stauraxonic projections of the shell.

Paronaella norica Kozur et Mock, 1981

Plate 12, fig. 1

Paronaella norica: Kozur and Mostler, 1981, p. 61, pl. 46, fig. 2; Bragin and Krylov, 1999b, p. 554, text-figs. 8G and 8H; Tekin, 1999, p. 89, pl. 9, fig. 11.

H o l o t y p e. KoMo, no. 1980 I-67; Slovakia, village of Sulov; Lower Norian (Kozur and Mostler, 1981, pl. 46, fig. 2); depository not indicated.

D e s c r i p t i o n. The shell is large, with long even rays having moderately thickened ends. The rays are pierced by rounded elliptical pores grouped in longitudinal rows (up to six row on the exposed surface of a ray); on the thickened ends of rays, the pores are arranged irregularly. In some rays, the rows of pores show poorly pronounced sinistral coiling.

M e a s u r e m e n t s, μm. Length of rays, 200–250; width of the proximal part of rays, 60–70; width of the distal part of rays, 80–90.

C o m p a r i s o n. *P. norica* differs from *P. trammeri* (Kozur et Mostler, 1978) in the thickened ends of the rays.

O c c u r r e n c e. Lower Norian of Slovakia, Cyprus, and Turkey.

M a t e r i a l. More than 50 specimens from the Lara and Ayia Varvara localities.

Genus *Triassocrucella* Kozur, 1984

Triassocrucella: Kozur, 1984, p. 33.

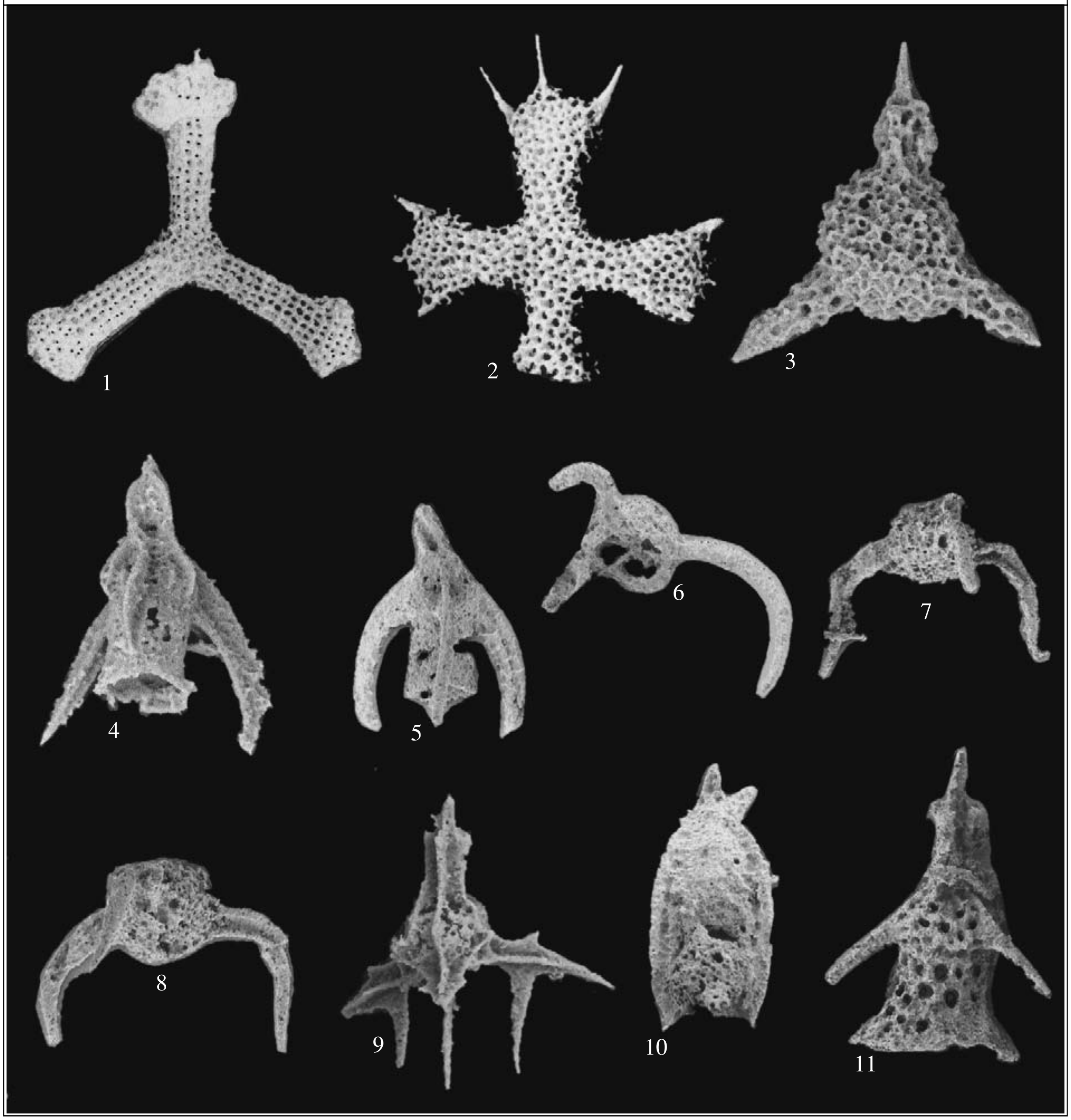
T y p e s p e c i e s. *Hagiastrum baloghi* Kozur et Mostler, 1978; Upper Triassic, Lower Carnian; Göstling, Austria.

D i a g n o s i s. Stauraxonic shell with four projections, each terminating in three short spines.

S p e c i e s c o m p o s i t i o n. Three species from the Carnian–Rhaetian of the Mediterranean and eastern Pacific regions.

C o m p a r i s o n. *Triassocrucella* differs from *Paronaella* in the presence of four stauraxonic projections.

Plate 12



Explanation of Plate 12

Fig. 1. *Paronaella norica* Kozur et Mock, specimen GIN, no. 4858-194; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.
Fig. 2. *Triassocrucella triassica* (Kozur et Mostler), specimen GIN, no. 4858-195; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×200.
Fig. 3. *Pylostephanidium clavator* Dumitrica, specimen GIN, no. 4858-196; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.
Figs. 4 and 5. *Sanfilippoella lengeranlii* Tekin, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (4) GIN, no. 4858-197 and (5) GIN, no. 4858-198.
Fig. 6. *Poulpus piabyx* De Wever, specimen GIN, no. 4858-199; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.
Figs. 7 and 8. *Poulpus transitus* Kozur et Mostler, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (7) GIN, no. 4858-209 and (8) GIN, no. 4858-210.
Fig. 9. *Neopylentonema procera* Sugiyama, specimen GIN, no. 4858-200; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.
Fig. 10. *Picapora robusta* Kozur et Mostler, specimen GIN, no. 4858-208; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.
Fig. 11. *Trialatus robustus levantinensis* subsp. nov., holotype GIN, no. 4858-107; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.

***Triassocrucella triassica* (Kozur et Mostler, 1978)**

Plate 12, fig. 2

Hagiastrum triassicum: Kozur and Mostler, 1978, p. 146, pl. 1, fig. 4, pl. 2, figs. 11 and 12.

Crucella triassica: Lahm, 1984, p. 91, pl. 16, fig. 9.

Triassocrucella triassica: Kozur, 1984, p. 33; Bragin and Krylov, 1999b, p. 554, text-fig. 8J; Tekin, 1999, p. 88, pl. 9, fig. 6.

H o l o t y p e. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1978, pl. 1, fig. 4); collection number and depository are not indicated.

D e s c r i p t i o n. The shell is large; the rays are straight, massive, moderately long, gently expanding to the distal ends; the terminal spines are narrow and short. The rays are spongy, pierced by small randomly arranged pores.

M e a s u r e m e n t s, μm. Length of rays, 150–170; length of terminal spines, 60–70; greatest width of rays, 90–100.

C o m p a r i s o n. *T. triassica* differs from *T. baloghi* (Kozur et Mostler, 1978) in the wider and more massive rays with the narrow terminal spines.

O c c u r r e n c e. Carnian–Lower Norian of Austria, Cyprus, Slovakia, and Turkey.

M a t e r i a l. Thirty-two specimens from the Ayia Varvara locality.

Order Nassellaria Ehrenberg, 1875

D i a g n o s i s. Polycystina with primary skeleton in shape of considerably differentiated spicule, with elements MB (median bar), A (apical spine), Vert (vertical spine), D (dorsal spine), L (large lateral spines), and l (small lateral spines). Elements of spicule located in different planes. Spicule always confined to first chamber of skeleton (cephalis). One, two, three, several, or many chambers present on axis of skeleton according to linear mode of growth, with formation of true metamerism.

C o m p o s i t i o n. Triassic–Recent. In the Triassic, the order is represented by the families Eptingiidae Dumitrica, 1978, Tripedurnulidae Dumitrica, 1991, Sanfilippoellidae Kozur et Mostler, 1979, Hinedorcidae Kozur et Mostler, 1981, Ultranaporidae Pessagno, 1977, Pseudosaturniformidae Kozur et Mostler, 1979, Spongolophophaenidae Kozur et Mostler, 1994, Deflandrecyrtiidae Kozur et Mostler, 1979, Monicastericidae Kozur et Mostler, 1994, Syringocapsidae Foreman, 1973, Parvicingulidae Pessagno, 1977, Tetraspinocyrtiidae Kozur et Mostler, 1994, Triassocampidae Kozur et Mostler, 1981, Planispinocyrtidae Kozur et Mostler, 1981, and Bulbocyrtidae Kozur et Mostler, 1981.

C o m p a r i s o n. Nassellaria differs from Entactinaria in the differentiated elements of the spicule and in the linear mode of growth of the shell.

R e m a r k s. In the system of Recent and Cenozoic Nassellaria, a number of superfamilies were established. It is rather difficult to recognize relationships between them and Triassic nassellarians because the cephalic structures are insufficiently understood. Therefore, this review only considers the families of Triassic nassellarians, some of which are obviously artificial taxa.

Family Eptingiidae Dumitrica, 1978

Eptingiidae: Dumitrica, 1978a, p. 29.

D i a g n o s i s. Nassellaria with skeleton composed of cephalis with internal spicule having sagittal ring and well-developed spines A, Lr, and Ll, giving rise to three large external spines positioned in one plane. Spine D sometimes reduced. Outer shell discoid–stauraxonic.

G e n e r i c c o m p o s i t i o n. *Eptingium* Dumitrica, 1978, *Cryptostephanidium* Dumitrica, 1978, *Triassistephanidium* Dumitrica, 1978, *Spongostephanidium* Dumitrica, 1978, *Pylostephanidium* Dumitrica, 1978, *Busuanga* Yeh, 1990, and *Tetrarhopalus* Sugiyama, 1992 from the Olenekian–Rhaetian.

C o m p a r i s o n. The family Eptingiidae differs from Sanfilippoellidae in the presence of the sagittal ring of the spicule and in the discoid–stauraxonic shape of the shell.

Genus *Pylostephanidium* Dumitrica, 1978

Pylostephanidium: Dumitrica, 1978a, p. 34.

T y p e s p e c i e s. *Pylostephanidium clavator* Dumitrica, 1978a; Lower Ladinian, Buchenstein Formation, of the southern Alps.

D i a g n o s i s. Cephalis porous, with pylome, wall of which containing apical horn. Sagittal ring freely located in cephalic cavity, other arches included in cephalic wall; dorsal spine very short.

S p e c i e s c o m p o s i t i o n. Two species from the Middle and Upper Triassic of Mediterranean, the Far East of Russia, and Japan.

C o m p a r i s o n. *Pylostephanidium* differs from *Eptingium* in the presence of the pylome.

***Pylostephanidium clavator* Dumitrica, 1978**

Plate 12, fig. 3

Pylostephanidium clavator: Dumitrica, 1978a, p. 34, pl. 2, figs. 6 and 7; Bragin, 1986, pl. II, fig. 13; Bragin, 1991a, p. 110, pl. III, fig. 14; Kozur and Mostler, 1994, pl. 1, fig. 6; Sugiyama, 1997, p. 186.

H o l o t y p e. Italy, Recoaro; Lower Ladinian, Formation Buchenstein (Dumitrica, 1978a, p. 34, pl. 2, fig. 6); collection number and depository are not indicated.

D e s c r i p t i o n. The cephalis is porous, subspherical, with three tracery spongy projections approximately equal in length. One projection has a pylome, the wall of which includes an apical horn extending beyond the pylome.

M e a s u r e m e n t s, μm. Cephalic diameter, 120–130; length of projections, 100–120; length of the apical horn, 120–130.

C o m p a r i s o n. *P. clavator* differs from *P. ankaraense* (Bragin et Tekin, 1996) in the spongy tracery wall of the pylome and in the extension of the apical horn beyond the pylome.

R e m a r k s. This species is typical of the Middle Triassic (Ladinian Stage). Early Norian Cyprian specimens are possibly the latest representatives of the species; this is indirectly corroborated by the extremely scarce finds of this radiolarian.

O c c u r r e n c e. Ladinian of Romania, Italy, Sakhalin, Sikhote Alin, and Japan and the Lower Norian of Cyprus.

M a t e r i a l. Two specimens from the Lara locality.

Family Sanfilippoellidae Kozur et Mostler, 1979

Sanfilippoellidae: Kozur and Mostler, 1979, p. 92.

D i a g n o s i s. Nassellaria with monocyrtid shell with spicule, elements of which connected by arches AV, AL, VL, Ll, and lD. Three basal feet formed by extensions of L and D present, sometimes accompanied by velum. Some specimens with apical horn.

G e n e r i c c o m p o s i t i o n. *Sanfilippoella* Kozur et Mostler, 1979, *Eonapora* Kozur et Mostler, 1979, *Hozmadia* Dumitrica, Kozur et Mostler, 1980, *Poulpus* De Wever, 1979, *Parapoulpus* Kozur et Mostler, 1981, and *Neopylentonema* Kozur, 1984 from the Lower Triassic–Lower Cretaceous.

C o m p a r i s o n. The family Sanfilippoellidae differs from Eptingiidae in the absence of a sagittal ring of the spicule and in the presence of basal feet.

Genus *Sanfilippoella* Kozur et Mostler, 1979

Sanfilippoella: Kozur and Mostler, 1979, p. 93.

T y p e s p e c i e s. *Sanfilippoella tortilis* Kozur et Mostler, 1979; Upper Triassic of Austria.

D i a g n o s i s. Monocyrtid shell with velum and massive apical horn, with three basal feet.

S p e c i e s c o m p o s i t i o n. Several species from the Upper Triassic of the Mediterranean Region.

C o m p a r i s o n. *Sanfilippoella* differs from *Poulpus* De Wever, 1979 in the presence of the apical horn and velum.

Sanfilippoella lengeranlii Tekin, 1999

Plate 12, figs. 4 and 5

Sanfilippoella lengeranlii: Tekin, 1999, p. 160, pl. 38, figs. 6–8.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 38, fig. 6); collection number is not indicated; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The cephalis is large, hemispherical, without pores, with a massive three-bladed apical horn with sinistral coiling. A relatively small vertical horn is present. The thorax is wide, truncated conical, with small pores, frequently with a long subcylindrical velum. Spines D and 2l form three long, gently curved, three-bladed basal feet; the aperture is wide, open.

M e a s u r e m e n t s, μm. Length of the apical horn, 55–65; length of the cephalothorax, 80–85; greatest width of the thorax, 80–85; length of the velum, 70–75; length of basal feet, 150–170.

C o m p a r i s o n. *S. lengeranlii* differs from *S. tortilis* Kozur et Mostler, 1979 in the less pronounced spiral coiling of the apical horn and in the weaker curvature of the basal feet.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and the Lower Norian of Cyprus.

M a t e r i a l. Seven specimens from the Lara and Ayia Varvara localities.

Genus *Poulpus* De Wever, 1979

Poulpus: De Wever et al., 1979, p. 94.

Annulopoulpus: Kozur and Mostler, 1981, p. 83.

Spinopoulpus: Kozur and Mostler, 1981, p. 85.

Veghia: Kozur and Mostler, 1981, p. 86.

T y p e s p e c i e s. *Poulpus piabyx* De Wever, 1979; Upper Triassic of Turkey.

D i a g n o s i s. Monocyrtid shell without velum or apical horn, with wide, open aperture.

S p e c i e s c o m p o s i t i o n. About 15 species from the Lower Triassic–Jurassic of the Mediterranean Region, Japan, and western areas of the USA, and Canada, the Far East of Russia, the Philippines, and New Zealand.

C o m p a r i s o n. *Poulpus* differs from *Neopylentonema* Kozur, 1984 in the absence of an apical horn or other external spines, except for three basal feet; it differs from *Sanfilippoella* Kozur et Mostler, 1979 in the absence of both apical horn and velum.

Poulpus piabyx De Wever, 1979

Plate 12, fig. 6

Poulpus piabyx: De Wever et al., 1979, p. 98, pl. 7, figs. 12 and 13; Kozur and Mostler, 1979, p. 89, pl. 4, fig. 3; Kozur and Mostler, 1981, p. 80, pl. 30, fig. 5; De Wever, 1982, p. 328, pl. 48, figs. 5 and 6; De Wever, 1984, pl. 3, figs. 3 and 4; Yeh, 1990, pl. 8, figs. 3, 7, and 9; Sugiyama, 1997, text-fig. 49.15; Bragin and Krylov, 1999b, p. 558, text-figs. 10A–10C; Tekin, 1999, p. 160, pl. 38, figs. 3 and 4; Wang et al., 2002, p. 331, pl. 2, figs. 30–34.

H o l o t y p e. Greece, Karpenission; Upper Carnian–Lower Norian (De Wever et al., 1979, pl. 7, figs. 12, 13); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The cephalis is hemispherical, smooth, with an open aperture without blades. Basal feet are smooth, long, curved distally.

M e a s u r e m e n t s, μm. Apertural diameter, 75–90; cephalic height, 55–70; length of basal feet, 200–250.

C o m p a r i s o n. *P. piabyx* differs from *P. transitus* Kozur et Mostler, 1981 in the smooth basal feet.

Occurrence. Upper Carnian–Lower Norian of Sicily, Turkey, Austria, Slovakia, the Philippines, Japan, Cyprus, and Tibet.

Material. Thirty-six specimens from the Lara and Ayia Varvara localities.

***Poulpus transitus* Kozur et Mostler, 1981**

Plate 12, figs. 7 and 8

Poulpus transitus: Kozur et Mostler, 1981, p. 81, pl. 29, fig. 2; pl. 31, fig. 3; Tekin, 1999, p. 160, pl. 38, fig. 5.

Holotype. KoMo, no. 1980 I-83; Austria, Großreifling; Middle Carnian (Kozur and Mostler, 1981, pl. 29, fig. 2); depository not indicated.

Description. The cephalis is hemispherical, smooth, with an open aperture, without blades. The basal feet are three-bladed, long, curved distally.

Measurements, µm. Cephalic height, 50–60; cephalic diameter, 70–80; length of basal feet, 150–180.

Comparison. *P. transitus* differs from *P. piabyx* De Wever, 1979 in the three-bladed basal feet.

Occurrence. Upper Carnian–Lower Norian of Austria, Turkey, and Cyprus.

Material. Twenty-three specimens from the Lara and Ayia Varvara localities.

Genus *Neopylentonema* Kozur, 1984

Neopylentonema: Kozur, 1984, p. 70.

Type species. *Neopylentonema mesotriassica* Kozur, 1984; Lower Ladinian of Italy.

Diagnosis. Single-chambered shell. Cephalis large, dome-shaped or hemispherical, with wide open aperture. Apical horn, vertical horn, two lateral horns, and three basal feet (extensions of elements V and l) present. External spines massive, three-bladed.

Species composition. Three species from the Middle and Upper Triassic of Italy, the Philippines, Japan, and Cyprus.

Comparison. *Neopylentonema* differs from *Poulpus* De Wever, 1979 in the presence of the apical horn, vertical and two lateral horns.

***Neopylentonema procera* Sugiyama, 1997**

Plate 12, fig. 9

Poulpus? sp. *C*: Yeh, 1989, p. 74, pl. 6, figs. 5 and 10.

Neopylentonema procera: Sugiyama, 1997, p. 161, text-figs. 46.3a and 46.3b; Tekin, 1999, p. 159, pl. 37, figs. 7–9.

Holotype. ESN (Nagoya University), no. 148033; Japan, Inuyama; Triassic, Carnian (Sugiyama, 1997, text-figs. 46.3a, 46.3b); housed in Nagoya University.

Description. The cephalis is hemispherical, with small rounded pores and a massive apical horn, which is three-bladed at the base and in the middle part, becoming smooth and narrow in the distal part. The basal feet are massive, three-bladed; three apophyses deviate from edges in the middle part of each spine; the largest apophyses are turned downwards from the aperture. The edges of the apical horn are connected to the edges of the basal feet by narrow ribs. The aperture is wide, open.

Measurements, µm. Cephalic diameter, 55–65; shell length, including the apical horn and apophyses, 230–250; length of basal feet, 90–100.

Comparison. *N. procera* differs from *N. nakasekoi* (Sugiyama, 1992) in the massive three-bladed apical horn.

Occurrence. Upper Carnian–Lower Norian of Japan, Turkey, and Cyprus.

Material. Three specimens from the Lara and Ayia Varvara localities.

Family Hinedorcidae Kozur et Mostler, 1981

Hinedorcidae: Kozur and Mostler, 1981, p. 109.

Diagnosis. Double-chambered nassellarians with well-developed apical horn and vertical horn. The apical horn is positioned asymmetrically relative to the longitudinal axis of the shell. The vertical horn is positioned at approximately 70°–120° to the apical horn. Three basal feet are present; the aperture is wide, open.

Generic composition. *Hinedorcus* Dumitrica, Kozur et Mostler, 1980, *Picapora* Kozur et Mostler, 1981, and *Alatipicapora* Tekin, 1999 from the Upper Triassic.

Comparison. The family Hinedorcidae differs from Ultranaporidae Pessagno, 1977 in the presence of a vertical horn and in the asymmetrical position of the apical horn.

Genus *Picapora* Kozur et Mostler, 1981

Picapora: Kozur and Mostler, 1981, p. 109.

Type species. *Picapora robusta* Kozur et Mostler, 1981; Middle Carnian of Austria.

Diagnosis. Cephalis small, hemispherical; apical horn and vertical horn massive, three-bladed, almost equal in length. Thorax truncated pyramidal, with three long, three-bladed basal feet slightly curved towards aperture.

Species composition. Two species from the Middle Carnian–Lower Norian of Austria, Turkey, and Cyprus.

Comparison. *Picapora* differs from *Hinedorcus* Kozur et Mostler in the almost equal length of the apical horn and vertical horn. It differs from *Alatipicapora* Tekin in the absence of wing-shaped projections on the basal feet.

***Picapora robusta* Kozur et Mostler, 1981**

Plate 12, fig. 10

Picapora robusta: Kozur and Mostler, 1981, p. 110, pl. 7, figs. 1 and 2; Tekin, 1999, p. 147, pl. 32, figs. 8 and 9.

Holotype. KoMo, no. 1980 I-99; Austria, Göstling; Middle Carnian (Kozur and Mostler, 1981, pl. 7, fig. 1); depository not indicated.

D e s c r i p t i o n. The cephalis is small, hemispherical, with small, round, randomly scattered pores. The apical horn and vertical horns are large, massive, three-bladed, almost equal in size. The angle between the horns is up to 70°. The thorax is truncated pyramidal, with three massive basal feet slightly curved towards the aperture. Massive ridges pass lengthwise the entire thorax, connecting the bases of horns and basal feet. Between the ridges, the surface of the thorax is tuberculate, with small randomly scattered pores.

M e a s u r e m e n t s, μm. Shell length, 190–210; greatest shell width, 100–110; length of the apical horn, 50; length of the vertical horn, 40–45.

C o m p a r i s o n. *P. robusta* differs from *P. elegantissima* Tekin, 1999 in the shorter apical horn and vertical horns and in the smaller angle between the apical horn and the vertical horn.

O c c u r r e n c e. Middle Carnian–Lower Norian of Austria, Turkey, and Cyprus.

M a t e r i a l. Three specimens from the Lara locality.

Family Ultranaporidae Pessagno, 1977

Ultranaporidae: Pessagno, 1977b, p. 38.

D i a g n o s i s. Double-chambered Nassellaria with small hemispherical cephalis and large open thorax, having three feet continuing elements D and L. Apical horn developed from spine A.

G e n e r i c c o m p o s i t i o n. Middle Triassic–Upper Cretaceous. In the Triassic, the family is represented by the genera *Silicarmiger* Dumitrica, Kozur et Mostler, 1980, *Spongosilicarmiger* Kozur, 1984, and *Trialatus* Yeh, 1990.

C o m p a r i s o n. The family Ultranaporidae differs from Hinedorcidae Kozur et Mostler in the absence of a vertical horn.

Genus *Trialatus* Yeh, 1990

Trialatus: Yeh, 1990, p. 27.

T y p e s p e c i e s. *Trialatus megacornutus* Yeh, 1990; Upper Triassic of the Philippines.

D i a g n o s i s. Shell composed of two chambers. Cephalis small, dome-shaped, without pores, with large three-bladed apical horn. Thorax hemispherical, much larger than cephalis, with rounded pores in hexagonal frames, and with three curved spines. The thoracic skirt is present; it is bell-shaped, truncated conical, or cylindrical.

S p e c i e s c o m p o s i t i o n. Three species from the Carnian–Lower Norian of Japan, the Philippines, Sikhote Alin, Cyprus, and Turkey.

C o m p a r i s o n. *Trialatus* differs from *Silicarmiger* Dumitrica, Kozur et Mostler, 1980 in the presence of thoracic skirt.

Trialatus robustus (Nakaseko et Nishimura, 1979)

Napora robusta: Nakaseko and Nishimura, 1979, p. 78, pl. 8, figs. 4–6; Yoshida, 1986, pl. 7, figs. 1, 6, and 8; Bragin, 1991a, p. 97, pl. VI, figs. 2 and 3.

Trialatus robustus: Sugiyama, 1997, text-fig. 27.16; Bragin and Krylov, 1999b, p. 558, text-figs. 11A and 11B.

Trialatus praerobustus: Tekin, 1999, p. 184, pl. 45, figs. 9–12.

H o l o t y p e. MTMN (Osaka City University), no. 2301-1, Japan, Shimoaso; Upper Carnian (Nakaseko and Nishimura, 1979, pl. 8, fig. 4); housed in Osaka City University.

D e s c r i p t i o n. The cephalis is small, subconical, with a long massive apical horn, which is three-bladed at the base and in the middle part; distally, it abruptly becomes narrower and smooth. The thorax is hemispherical, inflated, with large circular pores and three basal feet. The thoracic skirt is cylindrical and short, or bell-shaped and long.

C o m p a r i s o n. *T. robustus* differs from *T. praerobustus* Sugiyama, 1997 in the apical horn which is three-bladed at the base and in the middle part.

O c c u r r e n c e. Carnian–Lower Norian of Japan, Sakhalin, the Koryak Upland, Sikhote Alin, Cyprus, and Turkey.

M a t e r i a l. Thirty specimens from the Lara and Ayia Varvara localities.

Trialatus robustus robustus (Nakaseko et Nishimura, 1979)

Napora robusta: Nakaseko and Nishimura, 1979, p. 78, pl. 8, figs. 4–6; Yoshida, 1986, pl. 7, figs. 1, 6, and 8; Bragin, 1991a, p. 97, pl. VI, figs. 2 and 3.

Trialatus robustus: Sugiyama, 1997, text-fig. 27.16.

D i a g n o s i s. *Trialatus robustus* with short, cylindrical thoracic skirt.

C o m p a r i s o n. *T. r. robustus* differs from *T. r. levantinensis* subsp. nov. in its short cylindrical thoracic skirt.

O c c u r r e n c e. Carnian–Lower Norian of Japan, Sakhalin, the Koryak Upland, and Sikhote Alin.

Trialatus robustus levantinensis subsp. nov.

Plate 12, fig. 11

Trialatus robustus: Bragin and Krylov, 1999b, p. 558, text-figs. 11A and 11B.

Trialatus praerobustus: Tekin, 1999, p. 184, pl. 45, figs. 9–12.

E t y m o l o g y. From Levant (lands bordering the eastern shores of the Mediterranean Sea).

H o l o t y p e. GIN, no. 4858-107; Cyprus, Lara section; Lower Norian (Pl. 12, fig. 11).

D e s c r i p t i o n. *Trialatus robustus* that has a bell-shaped thoracic skirt, with slightly curved margins, smooth ring-shaped termination pierced by hardly discernible transverse rows of rounded pores. The basal feet are long, their ends are narrow and smooth.

M e a s u r e m e n t s, μm. Shell length with the apical horn, 280–300; length of the apical horn, 100–110; greatest width of the abdomen, 130–140.

Comparison. The new subspecies differs from the type subspecies in the bell-shaped thoracic skirt and the longer basal feet.

Occurrence. Upper Carnian–Lower Norian of Cyprus and Turkey.

Material. Thirty specimens from the Lara and Ayia Varvara localities.

Family Pseudosaturniformidae Kozur et Mostler, 1979

Pseudosaturniformidae: Kozur and Mostler, 1979, p. 91.

Diagnosis. Double-chambered Nassellaria with hemispherical cephalis without apical horn; spicule without element D. Thorax in shape of ring connected by bars to cephalis.

Generic composition. *Pseudosaturniforma* Kozur et Mostler, 1979 from the Upper Carnian–Norian.

Comparison. Pseudosaturniformidae differs from other families in the characteristic ring-shaped thorax.

Genus *Pseudosaturniforma* Kozur et Mostler, 1979

Pseudosaturniforma: Kozur and Mostler, 1979, p. 91.

Type species. *Pseudosaturniforma latimarginata* Kozur et Mostler, 1979; Middle Carnian of Austria.

Diagnosis. The only genus in the family.

Species composition. Four species from the Upper Carnian–Middle Norian of the Mediterranean Region and western areas of North America.

Pseudosaturniforma carnica Kozur et Mostler, 1979

Plate 13, fig. 1

Pseudosaturniforma carnica: Kozur and Mostler, 1979, p. 94, pl. 17, fig. 3; 1981, pl. 22, fig. 3; Blome, 1984, p. 52, pl. 13, figs. 5, 9, 11, and 18; Bragin and Krylov, 1999b, p. 558, text-figs. 10I, 10K, and 10L; Tekin, 1999, p. 156, pl. 34, figs. 7–10.

Holotype. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 17, fig. 3); collection number and depository are not indicated.

Description. The shell is relatively small, with a smooth hemispherical cephalis, a narrow thoracic ring having a rim and connected to the cephalis by six narrow bars, with six large rounded triangular pores between the bars.

Measurements, μm. Diameter of the thoracic ring, 200–220; cephalic diameter, 80–90.

Comparison. *P. carnica* differs from *P. latimarginata* Kozur et Mostler, 1979 in the narrow thoracic ring, the narrow bars, and in the rounded triangular pores between the bars.

Occurrence. Carnian–Lower Norian of Austria, Oregon, Cyprus, and Turkey.

Material. Six specimens from the Ayia Varvara locality.

Family Deflandrecyrtiidae Kozur et Mostler, 1979

Deflandrecyrtiidae: Kozur and Mostler, 1979, p. 95.

Diagnosis. Nassellaria with two, three, or four-chambered shell; cephalis with or without large apical horn. Last chamber considerably widened, so that shell bell-shaped, with widely open aperture.

Generic composition. *Deflandrecyrtium* Kozur et Mostler, 1979, *Dreyericyrtium* Kozur et Mostler, 1979, *Haeckelicyrtium* Kozur et Mostler, 1979, *Nabolella* Petrushevskaya, 1981, *Caphthorocyrtium* Bragin, 1999, *Citriduma* De Wever, 1979, *Praecitriduma* Kozur, 1984, and *Goestlingella* Kozur et Mostler, 1979 from the Upper Triassic.

Comparison. The family Deflandrecyrtiidae differs from Ultranaporidae Pessagno in the wide, bell-shaped last chamber.

Remarks. These nassellarians are similar in structure to the Late Mesozoic family Neosciadiocapsidae Pessagno, 1969; however, they are not ancestral to the latter, showing only homeomorphic similarity (Sugiyama, 1997).

Genus *Dreyericyrtium* Kozur et Mostler, 1979

Dreyericyrtium: Kozur et Mostler, 1979, p. 97.

Type species. *Dreyericyrtium curvatum* Kozur et Mostler, 1979; Middle Carnian of Austria.

Diagnosis. Shell double-chambered. Cephalis small, hemispherical or conical, with large apical horn. Thorax large, hemispherical, with bell-shaped skirt.

Species composition. About ten species from Carnian–Rhaetian of Austria, Japan, the Far East of Russia, the Philippines, Turkey, and Cyprus.

Comparison. *Dreyericyrtium* differs from *Haeckelicyrtium* Kozur et Mostler, 1979 in the presence of an apical horn; it differs from *Deflandrecyrtium* Kozur et Mostler, 1979 in the double-chambered shell.

Remarks. Sugiyama (1997) believed that only forms with inflated thorax should be assigned to this genus.

Dreyericyrtium curvatum Kozur et Mostler, 1979

Plate 13, figs. 5 and 6

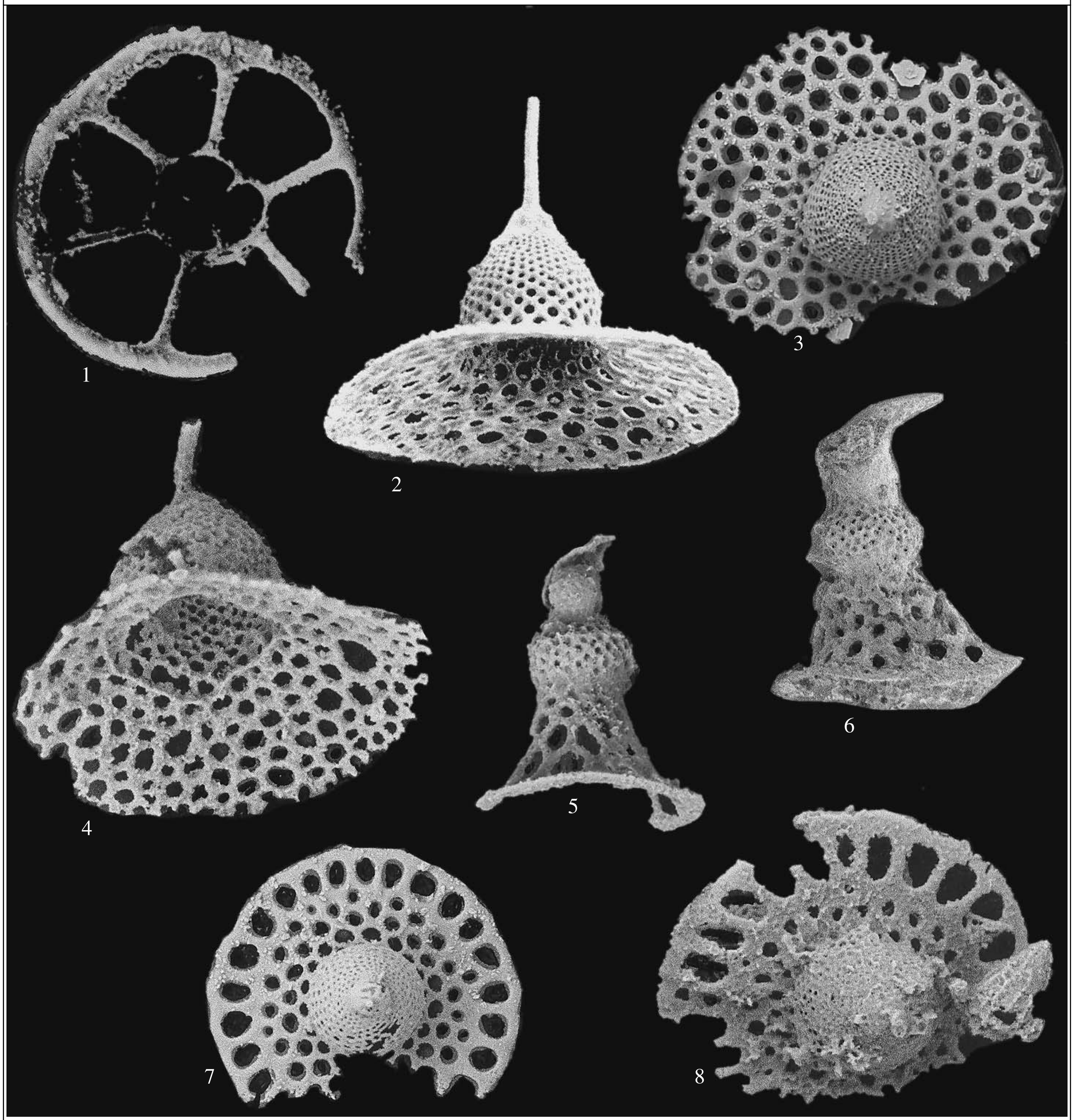
Dreyericyrtium curvatum: Kozur and Mostler, 1979, p. 99, pl. 13, fig. 3.

Deflandrecyrtium curvatum: Kozur and Mostler, 1981, p. 89, pl. 34, fig. 2; pl. 35, fig. 1; Tekin, 1999, p. 140, pl. 30, fig. 3.

Holotype. Austria, Göstling; Middle Carnian (Kozur and Mostler, 1979, pl. 13, fig. 3); collection number and depository are not indicated.

Description. The cephalis is subspherical, without pores. The apical horn is large, three-bladed; at the base, it is as wide as the cephalis; distally, it gently narrows to the pointed end. The horn is gently curved, resembling in shape the upper half of a crescent. The thorax is inflated, with small rounded pores in hexahedral pore frames; the skirt is wide, bell-shaped, with a

Plate 13



Explanation of Plate 13

Fig. 1. *Pseudosaturniforma carnica* Kozur et Mostler, specimen GIN, no. 4858-211; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×250.

Figs. 2–4. *Dreyericyrtium carterae* (Bragin); Phasoula Formation, Lower Norian: (2, 3); Ayia Varvara locality, sample 90-39, ×170: (2) holotype GIN, no. 4858-79 and (3) paratype GIN, no. 4858-212; (4) paratype GIN, no. 4858-213, Lara section, sample 98-2-4, ×230.

Figs. 5 and 6. *Dreyericyrtium curvatum* Kozur et Mostler, Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (5) GIN, no. 4858-214 and (6) GIN, no. 4858-215.

Figs. 7 and 8. *Haeckelicyrtium subcircularis* Tekin, 1999; Phasoula Formation, Lower Norian: (7) GIN, no. 4858-216, Ayia Varvara locality, sample 90-39, ×150; (8) GIN, no. 4858-217, Lara section, sample 98-2-4, ×170.

large open aperture and large pores arranged in staggered rows.

M e a s u r e m e n t s, μm. Shell length, including the apical horn, 270–300; cephalic width, 60; thoracic width, 80–90; skirt width, 200–220.

C o m p a r i s o n. *D. curvatum* differs from congeners in the curved apical horn.

O c c u r r e n c e. Middle Carnian–Lower Norian of Austria, Turkey, and Cyprus.

M a t e r i a l. Five specimens from the Lara locality.

Dreyericyrtium carterae (Bragin, 1999)

Plate 13, figs. 2–4

Haeckelicyrtium carterae: Bragin and Krylov, 1999b, p. 562, text-figs. 12A–12C, 12E, and 12F.

H o l o t y p e. GIN, no. 4858-79; Cyprus, village of Ayia Varvara; Lower Norian, Mamonia Complex (Bragin and Krylov, 1999b, p. 562, text-fig. 12A).

D e s c r i p t i o n. The cephalis is small, subconical, without pores; it has a long, narrow, rod-shaped apical horn and a small thorn formed by the spine V. The thorax is large, bell-shaped, with a hemispherical inflated proximal part, a constriction in the middle part, and a wide, open thoracic skirt turned at 90° to the lateral wall of the thorax. The thoracic wall is single-layered, with rounded pores; the pores increase in size towards the aperture. The pores show regular hexagonal arrangement; the thoracic skirt has five or six rows of pores. The velum is undeveloped.

M e a s u r e m e n t s, μm. Shell length without the apical horn, 190–235; greatest length of the apical horn, 400; greatest shell width, 265–490.

C o m p a r i s o n. *D. carterae* differs from *D. teren* (Sugiyama, 1997) in the inflated proximal part of the thorax and the presence of a constriction in the middle part of the thorax and in the long and narrow apical horn. It differs from *D. tegumentiformis* (Tekin, 1999) in the widely turned thoracic skirt with larger pores.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Sixteen specimens from the Lara and Ayia Varvara localities.

Genus *Haeckelicyrtium* Kozur et Mostler, 1979

Haeckelicyrtium: Kozur and Mostler, 1979, p. 98.

T y p e s p e c i e s. *Haeckelicyrtium austriacum* Kozur et Mostler, 1979; Middle Carnian of Austria.

D i a g n o s i s. Shell double-chambered. Cephalis without pores; in well-preserved specimens, external spines A and V well developed; apical horn undeveloped. Thorax hemispherical, with thoracic skirt; thoracic shell porous or latticed (on skirt).

S p e c i e s c o m p o s i t i o n. Up to ten species from the Carnian–Rhaetian of the Mediterranean and western Pacific regions.

C o m p a r i s o n. *Haeckelicyrtium* differs from *Dreyericyrtium* Kozur et Mostler, 1979 in the absence of an apical horn.

R e m a r k s. According to the original diagnosis, the shell of *Haeckelicyrtium* consists of three chambers (Kozur and Mostler, 1979). However, no partitions are observed between the thorax and its skirt in the species assigned to this genus; therefore, the shell should be regarded as double-chambered (Sugiyama, 1997).

Haeckelicyrtium subcircularis Tekin, 1999

Plate 13, figs. 7 and 8

Haeckelicyrtium subcircularis: Tekin, 1999, p. 144, pl. 31, figs. 5 and 6.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 31, fig. 5); collection number is not indicated, housed in MTA, Ankara.

D e s c r i p t i o n. The cephalis is small, conical, smooth, without pores; it has a narrow short horns A and V. The thorax is dome-shaped, with many rounded pores; the thoracic skirt is wide, turned at 90° to the lateral surface of the thorax. The thoracic skirt has four or five rows of rounded pores; the pores of the external row are twice as large as others and ovate in shape; the axes of these ovals are oriented radially. The external margin of the skirt is smooth, slightly wavy, without subsidiary spines or rays.

M e a s u r e m e n t s, μm. Cephalic diameter, 45–50; thoracic diameter without skirt, 110–115; skirt diameter, 310–320.

C o m p a r i s o n. *H. subcircularis* differs from *H. austriacum* Kozur et Mostler, 1979 in the wide thoracic skirt turned at 90° to the lateral surface of the thorax.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Eight specimens from the Lara and Ayia Varvara localities.

Genus *Nabolella* Petrushevskaya, 1981

Squinabolella: Kozur and Mostler, 1979, p. 94 (junior homonym of *Squinabolella* Pessagno, 1969).

Nabolella: Petrushevskaya, 1981, p. 76.

T y p e s p e c i e s. *Squinabolella longispinosa* Kozur et Mostler, 1979; Carnian of Austria.

D i a g n o s i s. Shell double-chambered. Cephalis dome-shaped, with apical horn. Thorax umbrella-shaped, wide, with basal feet formed by elements D, L, l, and their branches.

S p e c i e s c o m p o s i t i o n. Three species from the Carnian–Middle Norian of Austria and Cyprus.

C o m p a r i s o n. *Nabolella* differs from *Dreyericyrtium* Kozur et Mostler, 1979 in the development of basal feet.

***Nabolella trispinosa* Bragin, 1999**

Plate 14, figs. 1 and 2

Nabolella trispinosa: Bragin and Krylov, 1999b, p. 562, text-figs. 12D, 12G–12I.

H o l o t y p e. GIN, no. 4858-82; Cyprus, village of Ayia Varvara; Lower Norian, Mamonia Complex (Bragin and Krylov, 1999b, text-fig. 12D).

D e s c r i p t i o n. The cephalis is dome-shaped, with long, narrow, rod-shaped, slightly inclined apical horn and small hardly discernible pores. A distinct constriction is located between the cephalis and thorax. The thorax is bell-shaped, with an inflated proximal part and a wide, open distal part. The thoracic wall is single-layered, pierced by rounded pores, which increase in size towards the distal margin of the shell. Three long, rod-shaped spines deviate from the cephalis; they are partially included in the thoracic wall. The distal parts of these spines form three basal feet. These spines are presumably extensions of the elements D and L of the cephalic spicule. The velum is undeveloped.

M e a s u r e m e n t s, μm. Shell length without apical horn and basal feet, 180–200; greatest shell width, 290–300; length of the apical horn, 100.

C o m p a r i s o n. *N. trispinosa* differs from *N. longispinosa* (Kozur et Mostler, 1979) in the presence of only three basal feet.

O c c u r r e n c e. Lower–Middle Norian of Cyprus.

M a t e r i a l. Eighteen specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Genus *Caphtorocyrtium* Bragin, 1999

Caphtorocyrtium: Bragin and Krylov, 1999b, p. 560.

T y p e s p e c i e s. *Caphtorocyrtium tenerum* Bragin, 1999; Lower Norian of Cyprus.

D i a g n o s i s. Shell double-chambered. Cephalis conical, with well-developed apical horn and small horn formed by spine V included in wall of short truncated tube. Thorax truncated conical, with bell-shaped expanded thoracic skirt. Lateral horns occasionally present.

S p e c i e s c o m p o s i t i o n. Two species from the Upper Triassic, Lower Norian, of Cyprus and Turkey.

C o m p a r i s o n. *Caphtorocyrtium* differs from *Dreyericyrtium* Kozur et Mostler, 1979 in the presence of the horn V and tube.

***Caphtorocyrtium tenerum* Bragin, 1999**

Plate 14, figs. 3 and 4

Caphtorocyrtium tenerum (pars.): Bragin and Krylov, 1999b, p. 560, text-figs. 11E–11H, non text-figs. 11C–11D (= *Caphtorocyrtium paenuloides* sp. nov.).

Trialatus procerus: Tekin, 1999, p. 184, pl. 46, figs. 1–4.

H o l o t y p e. GIN, no. 4858-71; Cyprus, village of Ayia Varvara, Lower Norian, Mamonia Complex (Bragin and Krylov, 1999b, text-fig. 11E).

D e s c r i p t i o n. The shell consists of the cephalis and thorax. The cephalis is small, conical, lacking pores; it has a long, narrow, rod-shaped apical horn, which is three-bladed in the middle part and abruptly narrows and becomes smooth distally. A short horn V, included in a smooth wall of short truncated tube is present at the base of the cephalis. Three lateral horns (extensions of the elements D and L) are located at the joint of the thorax and thoracic skirt; they are three-bladed at the base, becoming smooth, narrow, long, rod-shaped, and slightly curved distally. The thorax is short, slightly inflated, with small randomly arranged pores. The thoracic skirt is bell-shaped, concave conical, with five or six transverse rows of circular or rounded angular pores varying in size. The skirt abruptly increases in width towards the wide open aperture.

M e a s u r e m e n t s, μm. Shell length, including the apical horn, 290–335; greatest shell width, 235–290.

C o m p a r i s o n. *C. tenerum* differs from *C. paenuloides* sp. nov. in the presence of three lateral horns.

R e m a r k s. The species shows distinct homeomorphic similarity to some representatives of *Trialatus robustus* (Nakaseko et Nishimura, 1979), which is manifested in the apical horn with the three-bladed cross section in the middle part, in the oral part, and lateral horns (or basal feet). However, *C. tenerum* is distinguished by the presence of the V horn and tube.

O c c u r r e n c e. Lower Norian of Cyprus and Turkey.

M a t e r i a l. Thirty-seven specimens from the Lara and Ayia Varvara localities.

***Caphtorocyrtium paenuloides* sp. nov.**

Plate 14, figs. 5–8

Caphtorocyrtium tenerum (pars.): Bragin and Krylov, 1999b, p. 560, text-figs. 11C and 11D, non figs. 11E–11H.

E t y m o l o g y. From the Greek *paenula* (raincoat with a hood) and *eidos* (shape).

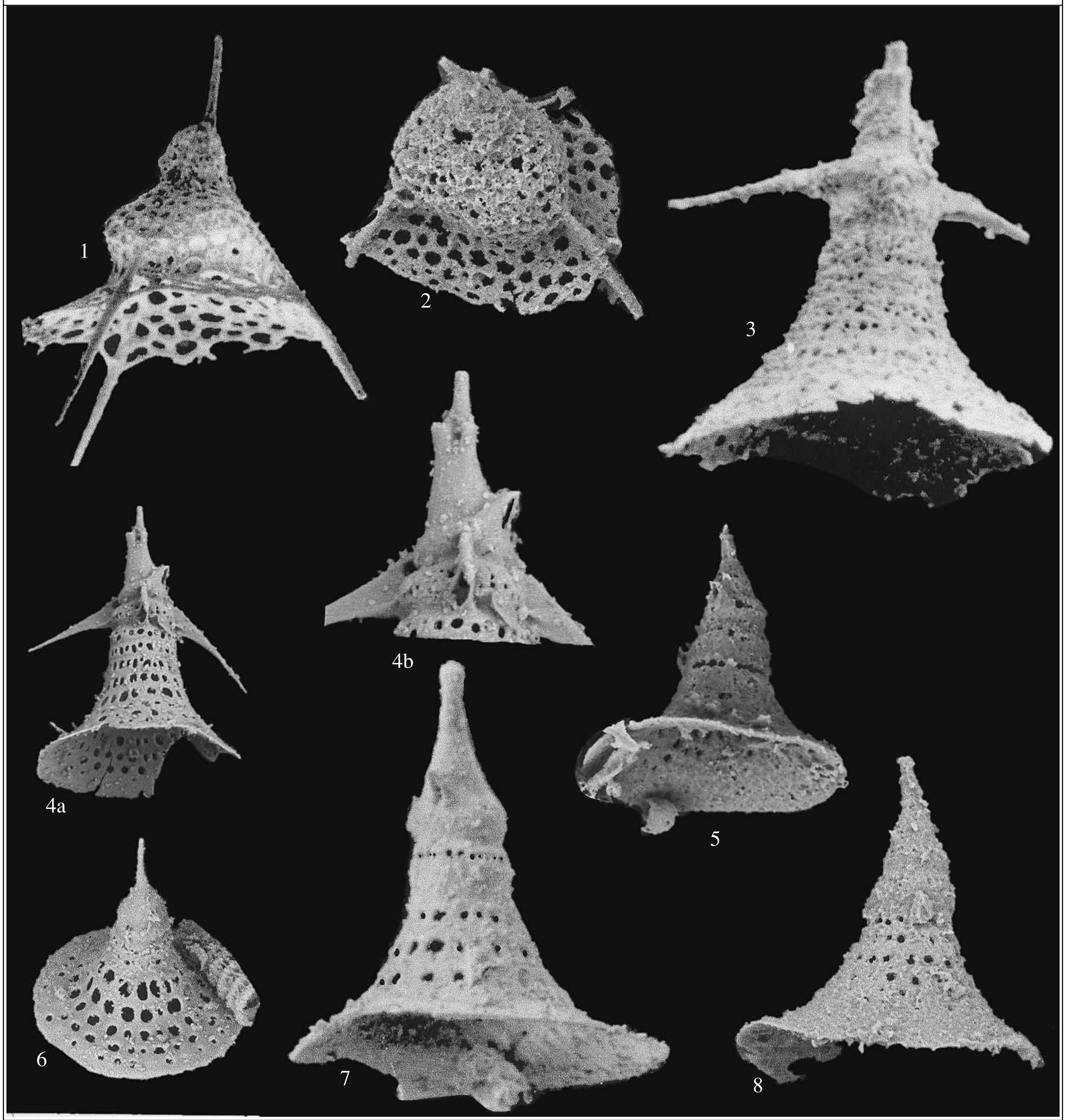
H o l o t y p e. GIN, no. 4858-112; Cyprus, Lara locality; Lower Norian, Mamonia Complex, Phasoula Formation (Pl. 14, fig. 5).

D e s c r i p t i o n. The shell consists of the cephalis and thorax. The cephalis is small, conical, lacking pores, with a long, narrow, rod-shaped apical horn circular in cross section over the entire extent. A short horn V, included in the smooth wall of the short truncated tube, is located at the base of the cephalis. Lateral horns are absent. The thorax is short, slightly inflated, with small, widely spaced, irregularly arranged pores. The thoracic skirt is bell-shaped, concave conical, with five or six transverse rows of circular or rounded angular pores varying in size. The skirt abruptly increases in width towards the wide open aperture.

M e a s u r e m e n t s, μm. Shell length, including the apical horn, 280–310; greatest shell width, 240–260.

C o m p a r i s o n. The new species differs from *C. tenerum* in the apical horn which is smooth throughout its length and in the absence of lateral horns.

Plate 14



Explanation of Plate 14

Figs. 1 and 2. *Nabolella trispinosa* Bragin; Phasoula Formation, Lower Norian: (1) holotype GIN, no. 4858-82, Ayia Varvara locality, sample 90-39, ×180; (2) paratype GIN, no. 4858-218, Lara section, sample 98-2-4, ×170.

Figs. 3 and 4. *Caphtorocyrtium tenerum* Bragin, 1999; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39: (3) holotype GIN, no. 4858-71, ×250 and (4) paratype GIN, no. 4858-219: (4a) ×170 and (4b) details, apical part with the apical horn, vertical horn and tube, ×250.

Figs. 5–8. *Caphtorocyrtium paenuloides* sp. nov.; Phasoula Formation, Lower Norian: (5, 6, 8) Lara section, sample 98-2-2, ×170: (5) holotype GIN, no. 4858-112, (6) paratype GIN, no. 4858-220, and (8) GIN, no. 4858-221; (7) Ayia Varvara locality, sample 90-39, ×250.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Twenty-three specimens from the Lara locality.

Family Syringocapsidae Foreman, 1973

Syringocapsinae: Foreman, 1973, p. 265.

Syringocapsidae: Baumgartner et al., 1995, p. 31.

D i a g n o s i s. Multicyrtoid Nassellaria, with inflated subspherical middle part of shell. Segments of proximal part very small and numerous, distal part formed of one segment considerably extended to form tube.

G e n e r i c c o m p o s i t i o n. Upper Triassic–Cretaceous. In the Triassic, the family is represented by the genera *Syringocapsa* Neviani, 1900, *Katroma* Pessagno et Poisson, 1981, *Globolaxtorum* Carter, 1993, and *Podobursa* Wisniowski, 1889.

C o m p a r i s o n. Syringocapsidae differs from other multicyrtoid families in the inflated subspherical middle part of the shell.

R e m a r k s. The structure of the primary skeleton in this family is poorly understood. Therefore, they possibly include homeomorphic genera and species that are not related to each other.

Genus *Podobursa* Wisniowski, 1889

Podobursa: Wisniowski, 1889, p. 686.

T y p e s p e c i e s. *Podobursa dunikowskii* Wisniowski, 1898; Upper Jurassic of Poland.

D i a g n o s i s. Inflated middle part of shell with various number of spines (two or more) positioned equatorial or differently. Apical horn present in some species.

S p e c i e s c o m p o s i t i o n. Up to 20 species from the Upper Triassic–Lower Cretaceous throughout the world.

C o m p a r i s o n. *Podobursa* differs from *Syringocapsa* Neviani, 1900 in the presence of spines on the inflated middle part of the shell.

***Podobursa yazgani* Tekin, 1999**

Plate 15, fig. 1

Podobursa yazgani: Tekin, 1999, p. 166, pl. 40, figs. 1 and 2.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 40, fig. 1); collection number is not indicated; housed in MTA, Ankara.

D e s c r i p t i o n. The shell consists of four chambers. The cephalis is small, hemispherical, with a small narrow apical horn. The thorax is twice as wide as the cephalis, slightly inflated; the abdomen is subcylindrical, more than 1.5 times as wide as the thorax. The cephalis, thorax, and abdomen lack pores, are equal in length to the postabdominal chamber without the tube. The constriction between the abdomen and postabdominal chamber has a row of small circular pores. The postabdominal chamber is large, inflated, with circular pores in hexagonal frames few smooth radial spines. The terminal tube is moderately long, subcylindrical, with circular and elliptical pores forming somewhat irregular longitudinal rows. The end of the tube is bordered by small triangular blades.

M e a s u r e m e n t s, μm. Total shell length, 330–370; width of the postabdominal chamber, 125–140; length of terminal tube, 100–120.

C o m p a r i s o n. *P. yazgani* differs from *P. turriformis* Tekin, 1999 in the fewer spines (up to five) on the postabdominal chamber and in the presence of triangular blades at the end of the terminal tube; it differs from *P. akayi* Tekin, 1999 in the large size of the first three chambers and in the distinctly developed apical horn.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Twelve specimens from the Lara and Ayia Varvara localities.

***Podobursa akayi* Tekin, 1999**

Plate 15, fig. 2

Podobursa akayi: Tekin, 1999, p. 163, pl. 39, figs. 1–3.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 39, fig. 1); collection number is not indicated; housed in MTA, Ankara, Turkey.

D e s c r i p t i o n. The shell consists of four chambers. The cephalis is hemispherical, sometimes with very small and narrow, infrequently preserved apical horn, without pores. The thorax and abdomen are relatively small, truncated conical, without pores; the constriction between them is hardly discernible. The total length of the cephalis, thorax, and abdomen is about half the length of the postabdominal chamber without the tube. The postabdominal chamber is large, almost spherical, separated from the abdomen by a well-pronounced constriction with a row of circular pores. The surface of the postabdominal chamber is covered with circular pores varying in size and enclosed in tetra–hexagonal frames with small thorns at the vertices. In the equatorial plane of this chamber, there is a row of smooth spines; four or five spines are observed on the exposed side of the shell. The terminal tube is long, cylindrical, pierced by circular and elliptical pores varying in size and arranged randomly; the end of the tube has triangular blades.

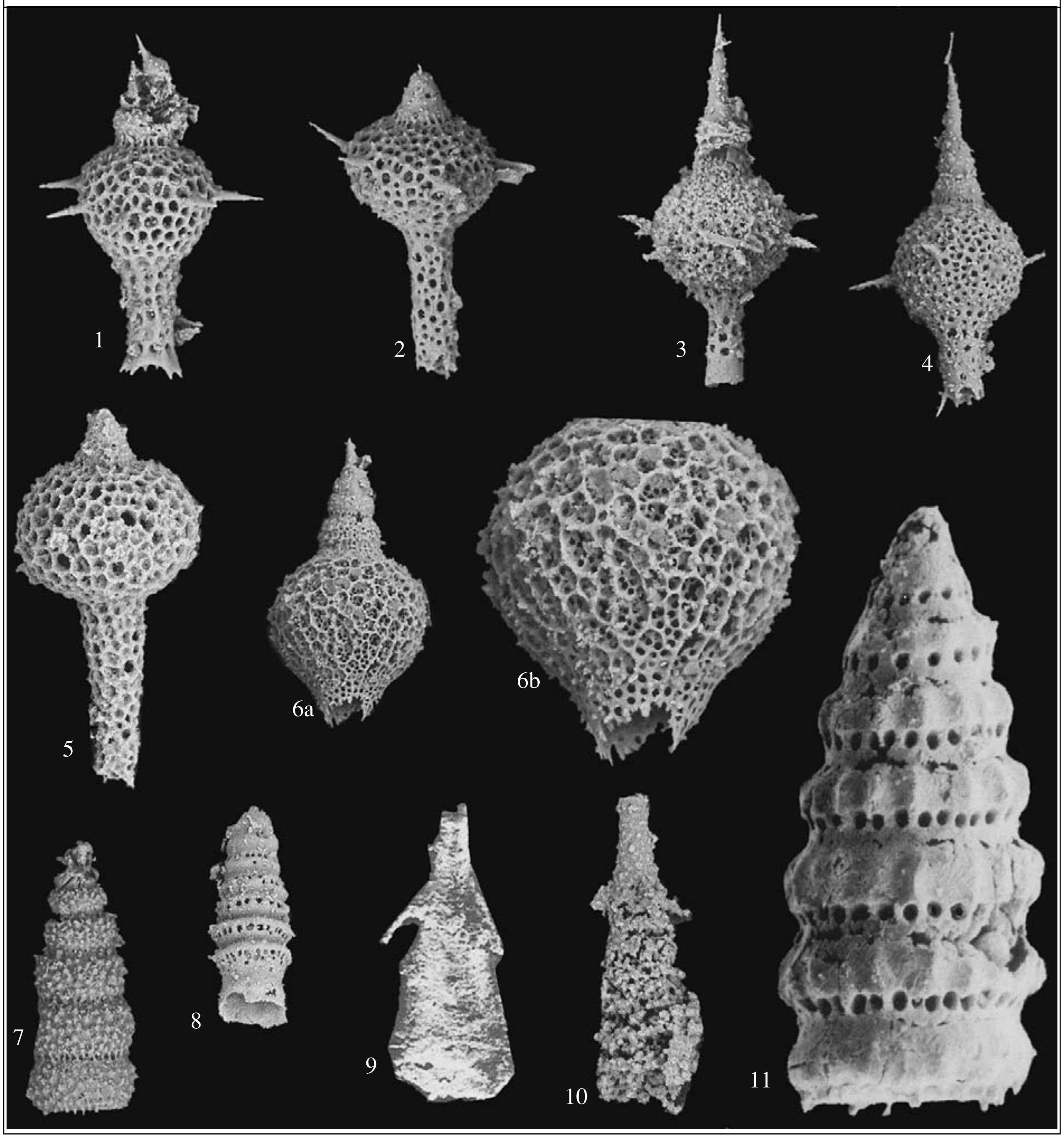
M e a s u r e m e n t s, μm. Shell length, 260–300; width of the postabdominal chamber, 150–160; length of the terminal tube, 150–180.

C o m p a r i s o n. *P. akayi* differs from *P. yazgani* Tekin, 1999 in the equatorial position of spines of the postabdominal chamber, the smaller size of the first three chambers, and in the poorly developed apical horn.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Four specimens from the Ayia Varvara locality.

Plate 15



Explanation of Plate 15

Fig. 1. *Podobursa yazgani* Tekin, specimen GIN, no. 4858-222; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.
Fig. 2. *Podobursa akayi* Tekin, specimen GIN, no. 4858-222; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.
Figs. 3 and 4. *Podobursa tenuicephala* sp. nov., Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170: (3) paratype GIN, no. 4858-223 and (4) holotype GIN, no. 4858-104.
Fig. 5. *Syringocapsa batodes* De Wever, specimen GIN, no. 4858-224; Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170.
Fig. 6. *Syringocapsa circumvoluta* sp. nov., holotype GIN, no. 4858-105; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39; (6a) general appearance, ×140; (6b) inflated segment and apertural tube, ×350.
Fig. 7. *Pachus multinodosus* Tekin, specimen GIN, no. 4858-225; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×150.
Fig. 8. *Annulotriassocampe baldii* Kozur, specimen GIN, no. 4858-226; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×150.
Figs. 9 and 10. *Lysemelas olbia* Sugiyama, Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×180: (9) GIN, no. 4858-227 and (10) GIN, no. 4858-228.
Fig. 11. *Whalenella robusta* Bragin, holotype GIN, no. 4858-12, Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×350.

Podobursa tenuicephala **sp. nov.**

Plate 15, figs. 3 and 4

E t y m o l o g y. From the Latin *tenuis* (thin) and the Latinized Greek *cephalis* (head).

H o l o t y p e. GIN, no. 4858-104; Cyprus, village of Ayia Varvara; Lower Norian (Pl. 15, fig. 4).

D e s c r i p t i o n. The shell is four-chambered. The cephalis is small, conical, without pores, with a long, smooth apical horn, which is thick at the base and gradually narrows towards the distal end. The constriction between the cephalis and thorax is poorly pronounced. The thorax is subcylindrical, smooth, slightly wider than the cephalis, lacks pores. The constriction between the thorax and abdomen is distinct. The abdomen is subcylindrical, smooth, slightly wider than the thorax. A distinct constriction with one row of small circular pores is seen between the abdomen and postabdominal chamber. The postabdominal chamber is large, subspherical, with short smooth spines located in the equatorial plane. Up to five spines are on the exposed side of the shell. The wall of the postabdominal chamber is pierced by circular pores varying in size, enclosed in tetra–hexagonal frames, with small tubercles at the vertices. The terminal tube is relatively short, slightly expand towards the distal end, which is bordered by small triangular blades; its wall is pierced by circular, irregularly arranged pores.

M e a s u r e m e n t s, μm. Shell length, 330–350; width of the postabdominal chamber, 150–170; length of the terminal tube, 65–75.

C o m p a r i s o n. The new species differs from *P. yazgani* Tekin, 1999 in the short terminal tube, the long and basally thickened apical horn, and in the poorly pronounced constriction between the cephalis and thorax; it differs from *P. turriformis* Tekin, 1999 in the longer apical horn and the presence of blades at the distal end of the terminal tube.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Six specimens from the Ayia Varvara locality.

Genus *Syringocapsa* Neviani, 1900

Syringocapsa: Neviani, 1900, p. 662.

T y p e s p e c i e s. *Theosyringium robustum* Vinassa de Regny, 1901; Lower Cretaceous of Greece.

D i a g n o s i s. Apical horn absent, surface of inflated part of shell smooth, without spines.

S p e c i e s c o m p o s i t i o n a n d o c c u r r e n c e. More than 15 species are known from the Upper Triassic–Cretaceous throughout the world, except for boreal and notal regions. In the Triassic, the genus is represented by five known species.

C o m p a r i s o n. *Syringocapsa* differs from *Podobursa* Wisniowski in the absence of the apical horn.

Syringocapsa batodes **De Wever, 1979**

Plate 15, fig. 5

Syringocapsa batodes: De Wever et al., 1979, p. 91, pl. 6, figs. 10 and 12; Nakaseko and Nishimura, 1979, p. 81, pl. 8, figs. 9 and 10; De Wever, 1982, p. 292, pl. 41, figs. 13 and 14; pl. 42, fig. 6; Yao et al., 1982, pl. 1, fig. 18; Bragin, 1991a, p. 106, pl. VI, figs. 4 and 5; Bragin and Krylov, 1999b, p. 563, text-figs. 13L and 13M.

Syringocapsa cf. *batodes:* Yoshida, 1986, pl. 6, figs. 9 and 10.

? unnamed *Podobursa*-like nassellarian: Pessagno et al., 1979, pl. 4, fig. 7.

H o l o t y p e. Greece, Karpenission; Upper Carnian–Lower Norian (De Wever et al., 1979, pl. 6, figs. 11, 12); collection number is not indicated; housed in the Museum of Natural History, Paris.

D e s c r i p t i o n. The shell consists of four segments. The cephalis is small, dome-shaped, without pores. The thorax and abdomen are truncated conical, smooth, separated from each other by a poorly pronounced constriction; they have small, isolated, widely spaced pores. The postabdominal segment is large, strongly inflated, porous, single-layered. The pores are small, rounded, enclosed in irregularly polygonal pore frames, with small nodes at the vertices. The segment extends to form a long porous terminal tube; the aperture is open. Narrow, moderately long radial spines are observed on the equator of the inflated part of the segment.

M e a s u r e m e n t s, μm. Shell length, 220–250; greatest width, 110–120; length of the terminal tube, 120–140.

C o m p a r i s o n. *S. batodes* differs from *S. turgida* Blome, 1984 in the smooth thorax without tubercles and in the presence of spines on the equator of the fourth segment.

O c c u r r e n c e. Upper Carnian–Lower Norian of Sicily, Turkey, Japan, Mexico, and Cyprus.

M a t e r i a l. Twelve specimens from the Lara and Ayia Varvara localities.

Syringocapsa circumvoluta **sp. nov.**

Plate 15, fig. 6

E t y m o l o g y. From the Latin *circumvoluta* (wrapped, enveloped).

H o l o t y p e. GIN, no. 4858-105; Cyprus, village of Ayia Varvara; Lower Norian (Pl. 15, fig. 6).

D e s c r i p t i o n. The shell is four-chambered. The cephalis is relatively large, conical, smooth, without pores. The constriction between the cephalis and thorax is distinct, narrow. The thorax is subcylindrical, slightly inflated, without pores. The constriction between the thorax and abdomen is distinct, has a row of small pores. The abdomen is truncated conical, inflated, with numerous small pores in pentagonal and hexagonal frames. The constriction between the abdomen and postabdominal chamber is well-pronounced, with two rows of small pores. The postabdominal chamber is large, spherical, with a double-layered wall. The external layer of the wall is coarsely cellular; the cells are circular in the proximal part of the chamber, becoming longitudinally extended in the distal part. The internal layer has many small, irregularly arranged pores. The terminal tube is short, single-layered, pierced by small, circular, irregularly arranged pores.

M e a s u r e m e n t s, μm. Shell length, 260–300; width of the postabdominal chamber, 130–150; length of the terminal tube, 40–70.

C o m p a r i s o n. *S. circumvoluta* differs from *S. extansa* Tekin, 1999 in the presence of the cellular external layer of the postabdominal chamber.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Four specimens from the Ayia Varvara locality.

Family Parvicingulidae Pessagno, 1977

Parvicingulidae: Pessagno, 1977a, p. 83.

D i a g n o s i s. Multicyrtoid Nassellaria with very small cephalis; apical horn occasionally present. Postthoracic segments separated by transverse external ridges, which or spaced between which containing transverse rows of pores enclosed in polygonal pore frames. Transverse rows of pores separated from each other by additional transverse ridges. Shell wall double- or multilayered.

C o m p o s i t i o n. Two subfamilies: Parvicingulinae Pessagno, 1977 and Canoptinae Pessagno, 1979 from the Middle Triassic (Ladinian)–Lower Cretaceous.

C o m p a r i s o n. Parvicingulidae differs from other families with a multicyrtoid shell in the wall structure, i.e., transverse rows of pores alternating with transverse ridges.

R e m a r k s. This is undoubtedly an artificial family that possibly comprises unrelated taxa. The cephalic structure of many taxa remains an open question.

Subfamily Canoptinae Pessagno, 1979

Canoptidae: Pessagno et al., 1979, p. 180.

D i a g n o s i s. Parvicingulidae with porous external layer of shell and latticed internal layer.

G e n e r i c c o m p o s i t i o n. Upper Triassic–Lower Cretaceous. In the Triassic, the subfamily is represented by the genus *Canoptum* Pessagno, 1979. The genera *Japonocampe* Kozur, 1984, *Pachus* Blome, 1984, and *Whalenella* Kozur, 1984 are tentatively referred to this subfamily.

C o m p a r i s o n. The subfamily Canoptinae differs from Parvicingulinae in the porous external layer of the shell.

Genus *Whalenella* Kozur, 1984

Whalenella: Kozur, 1984, p. 71.

Corum: Blome, 1984, p. 50.

T y p e s p e c i e s. *Dictyomitra arrecta* Hinde, 1908; Jurassic? of Indonesia.

D i a g n o s i s. Shell multicyrtoid, with double-layered wall. Internal layer coarse-pored, external layer pierced by transverse rows of pores only on constrictions between chambers. Postthoracic segments with longitudinal ridges interrupted at interchamber constrictions.

S p e c i e s c o m p o s i t i o n. About ten species from the Upper Carnian–Norian of Japan, Oregon, Sikhote Alin, Cyprus, and Turkey.

C o m p a r i s o n. *Whalenella* differs from *Japonocampe* Kozur, 1984 and *Canoptum* Pessagno, 1979 in the presence of longitudinal ridges.

Whalenella robusta Bragin, 1999

Plate 15, fig. 11

Whalenella robusta: Bragin and Krylov, 1999b, p. 565, text-figs. 14A and 14B.

H o l o t y p e. GIN, no. 4858-12; Cyprus, village of Ayia Varvara, Lower Norian (Bragin and Krylov, 1999b, p. 565, text-fig. 14A).

D e s c r i p t i o n. The shell consists of eight or nine chambers. The cephalis is dome-shaped, without pores or apical horn. The thorax is subtrapezoid, smooth. The abdomen and postabdominal chambers have well-pronounced smooth longitudinal ridges interrupted at the vertices of chambers. In the middle part of the shell, each segment has 16–18 ridges (8 or 9 are exposed). Each segment has one transverse row of large, deep, circular or slightly elliptical pores. The segments gradually increase in height towards the aperture. The segments increase in width up to the fourth postabdominal segment; then, the width remains constant or decreases slightly.

M e a s u r e m e n t s, μm. Shell length, 180–205; greatest shell width, 85–90.

C o m p a r i s o n. *W. robusta* differs from *W. speciosa* (Blome) in the smoother ridges, which do not bifurcate on the last segments of the shell and in the larger pores.

O c c u r r e n c e. Upper Carnian–Middle Norian of Japan and Lower Norian of Cyprus.

M a t e r i a l. Thirteen specimens from the Lara and Ayia Varvara localities.

Genus *Pachus* Blome, 1984

Pachus: Blome, 1984, p. 48.

T y p e s p e c i e s. *Pachus firmus* Blome, 1984; Lower–Middle Norian of Oregon.

D i a g n o s i s. Shell multicyrtoid, with double-layered wall. Internal layer coarse-pored, external layer pierced by transverse rows of pores only on constrictions between chambers. Postthoracic segments with transverse rows of tubercles.

S p e c i e s c o m p o s i t i o n. Three species from the Upper Carnian–Middle Norian of North America and the Mediterranean Region.

C o m p a r i s o n. *Pachus* differs from *Whalenella* Kozur, 1984 in the abundant tubercles on chambers, which are grouped in transverse rows.

***Pachus multinodosus* Tekin, 1999**

Plate 15, fig. 7

?Canesium sp.: Otsuka et al., 1992, pl. 3, fig. 13.

Pachus multinodosus: Tekin, 1999, p. 139, pl. 29, figs. 9–12.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 29, fig. 9); collection number is not indicated; housed in MTA, Ankara.

D e s c r i p t i o n. The shell consists of 6–8 chambers. The cephalis is small, dome-shaped, smooth, without an apical horn or tubercles. The constriction between the cephalis and thorax is poorly pronounced, lacks pores. The thorax is subcylindrical, slightly inflated, with small tubercles. The constriction between the thorax and abdomen is well-pronounced, smooth, lacks pores. The abdomen and subsequent chambers are subcylindrical, slightly inflated, gradually expanding, separated from each other by distinct constrictions with one row of small pores covered with many small tubercles, which form indistinct transverse rows; the last chambers have up to six rows.

M e a s u r e m e n t s, μm. Shell length, 230–240; greatest shell width, 95–100.

C o m p a r i s o n. *P. multinodosus* differs from *P. firmus* Blome, 1984 in the greater number of rows of tubercles (up to six) on the chambers.

O c c u r r e n c e. Upper Carnian–Lower Norian of Turkey and Cyprus.

M a t e r i a l. Thirteen specimens from the Lara and Ayia Varvara localities.

Family Tetraspinocyrtiidae Kozur et Mostler, 1994

Tetraspinocyrtiidae: Kozur and Mostler, 1994, p. 129.

D i a g n o s i s. Multicyrtoid Nassellaria, element V of cephalic spicule sometimes reduced. Large apical horn present. Thorax or cephalothorax having three subhorizontal horns formed by elements D and 2L.

G e n e r i c c o m p o s i t i o n. *Tetraspinocyrtis* Kozur et Mostler, 1994 from the Triassic (Olenekian–Norian). In addition, the Upper Triassic genus *Lysemelas* Sugiyama, 1997 is tentatively assigned to this family.

C o m p a r i s o n. The family Tetraspinocyrtiidae differs from Ultranaporidae Pessagno in the multicyrtoid shell.

Genus *Lysemelas* Sugiyama, 1997

Lysemelas: Sugiyama, 1997, p. 160.

T y p e s p e c i e s. *Lysemelas olbia* Sugiyama, 1997; Upper Norian of Japan.

D i a g n o s i s. Shell polychambered, conical. Cephalis with apical horn, without pores. Thorax with small pores and three basal spines. Abdomen and postabdominal segments short, wide, with small pores grouped in longitudinal rows.

S p e c i e s c o m p o s i t i o n. Type species from the Norian of Japan, northeastern China, Cyprus, and Sikhote Alin.

C o m p a r i s o n. *Lysemelas* differs from *Tetraspinocyrtis* Kozur et Mostler, 1994 in the presence of only three basal spines and in the the longitudinal rows of pores on the abdomen and postabdominal segments.

***Lysemelas olbia* Sugiyama, 1997**

Plate 15, figs. 9 and 10

Parahsuum (?) sp. *A*: Kojima and Mizutani, 1987, figs. 3–10.

Tetraspinocyrtis (?) sp.: Bragin and Krylov, 1996, pl. II, figs. 8 and 11.

Parahsuum (?) sp.: Zhang et al., 1997, pl. 2, figs. 4a and 4b.

Lysemelas olbia: Sugiyama, 1997, p. 160, text-figs. 28.1, 43.6–43.10.

H o l o t y p e. ESN, no. 148029; Japan, Inuyama; Upper Norian (Sugiyama, 1997, text-fig. 28.1); housed in Nagoya University.

D e s c r i p t i o n. The shell is polychambered, conical. The apical horn is massive, long, smooth, circular in cross section. The basal spines are long, smooth, circular in cross section, slightly curved. The pores of the thorax are small, arranged irregularly. The pores of the abdomen and postabdominal part of the shell are larger, circular, enclosed in uncertain polygonal pore frames and are grouped in longitudinal rows. The aperture is wide, circular.

M e a s u r e m e n t s, μm. Shell length without apical horn, 150–200; length of the apical horn, up to 180; shell width, 90–130.

O c c u r r e n c e. Upper Norian of Japan, Cyprus, northeastern China, and Sikhote Alin.

R e m a r k s. *L. olbia* differs from members of the genus *Trialatus* (*T. robustus* (Nakaseko et Nishimura, 1979)) in the smooth apical horn, circular in cross section and in the smooth basal spines of the thorax; it differs from *Caphthorocyrtium tenerum* Bragin, 1999 in the polychambered structure of the shell.

M a t e r i a l. Eleven specimens from the Dhiarizos locality.

Family Triassocampidae Kozur et Mostler, 1981

Triassocampidae: Kozur et Mostler, 1981, p. 97.

D i a g n o s i s. Multicyrtoid Nassellaria with or without apical horn. Shell wall single-layered, with transverse ridges at boundaries between segments and with transverse rows of pores.

G e n e r i c c o m p o s i t i o n. *Triassocampe* Dumitrica, Kozur et Mostler, 1980, *Paratriassocampe* Kozur et Mostler, 1994, *Pseudotriassocampe* Kozur et Mostler, 1994, *Striatotriassocampe* Kozur et Mostler, 1994, *Yeharaia* Nakaseko et Nishimura, 1979, *Annulotriassocampe* Kozur, 1994, and *Papiliocampe* Tekin, 1999 from the Anisian–Norian.

C o m p a r i s o n. The family Triassocampidae differs from Parvicingulidae Pessagno in the single-layered wall of the shell.

Genus *Annulotriassocampe* Kozur, 1994

Annulotriassocampe: Kozur and Mostler, 1994, p. 249.

T y p e s p e c i e s. *Annulotriassocampe baldii* Kozur, 1994; Carnian of Hungary.

D i a g n o s i s. Shell multicyrtoid, narrow conical, without apical horn. Postabdominal chambers with one central row of pores bordered by two smooth transverse ridges. In primitive forms, lower transverse ridge undeveloped.

S p e c i e s c o m p o s i t i o n. Eight species from the Middle Anisian–Lower Norian of the Mediterranean and Pacific regions.

C o m p a r i s o n. *Annulotriassocampe* differs from *Triassocampe* Dumitrica, Kozur et Mostler, 1980 in the presence of only one row of pores on the postabdominal chambers.

Annulotriassocampe baldii Kozur, 1994

Plate 15, fig. 8

Annulotriassocampe baldii: Kozur and Mostler, 1994, p. 249, pl. 1A, fig. 13; Tekin, 1999, p. 169, pl. 41, figs. 1 and 2; Wang et al., 2002, p. 331, pl. 2, figs. 11–13.

Triassocampe baldii: Sugiyama, 1997, text-fig. 49.6.

H o l o t y p e. Hungary, Balaton Highland, borehole Inke-1; Middle–Upper Carnian (Kozur and Mostler, 1994, pl. 1A, fig. 13); collection number and depository are not indicated.

D e s c r i p t i o n. The shell is multicyrtoid, consisting of 7–10 segments. The cephalothorax is dome-shaped, smooth, almost lacking pores. The abdomen is subcylindrical, smooth, without pores, separated from the cephalothorax by a narrow constriction. The postabdominal segments are subcylindrical, each has a smooth transverse ridge and, under it, a transverse row of small pores. The first two postabdominal segments have an additional smooth transverse ridge below the row of pores; in other segments, it is absent. The last segment has two transverse rows of pores and a short smooth terminal tube.

M e a s u r e m e n t s, μm. Shell length, 200–220; greatest shell width, 80.

C o m p a r i s o n. *A. baldii* differs from *A. sulovensis* (Kozur et Mock, 1981) in the reduction of the second ridge in the last postabdominal segments.

O c c u r r e n c e. Carnian–Lower Norian of Hungary, Japan, Turkey, Sikhote Alin, Tibet, and Cyprus.

M a t e r i a l. Twenty-six specimens from the Lara and Ayia Varvara localities.

Genus *Papiliocampe* Tekin, 1999

Papiliocampe: Tekin, 1999, p. 182.

T y p e s p e c i e s. *Papiliocampe tokerae* Tekin, 1999; Lower Norian of Turkey.

D i a g n o s i s. Triassocampidae with apical horn and flat longitudinal ring, beginning from apical horn, entirely covering shell, and terminating in apertural region.

S p e c i e s c o m p o s i t i o n. Two species from the Lower Norian of Turkey and Cyprus.

C o m p a r i s o n. *Papiliocampe* differs from other genera of the family in the development of a longitudinal ring entirely covering the shell.

R e m a r k s. In *Papiliocampe* Tekin, 1999, the ring is formed by the development of flat lateral spines originating from the apical part of the shell. In the Middle Triassic genus *Draculocampe* Kozur (in press), which is ancestral to *Papiliocampe* Tekin, 1999, these lateral spines form something like two flat wings. The ring of *Papiliocampe* Tekin, 1999 provides an example of homeomorphic development of a similar element (such as the ring of the Saturnalidae Deflandre, 1953 and Austrisaturnalidae Kozur et Mostler, 1983).

Papiliocampe tokerae Tekin, 1999

Plate 16, figs. 1 and 2

Triassocampidae gen. et sp. indet.: Bragin and Krylov, 1999b, p. 566, text-figs. 14E and 14G.

Papiliocampe tokerae: Tekin, 1999, p. 183, pl. 45, figs. 6–8.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, p. 45, fig. 6); collection number is not indicated; housed in MTA, Ankara.

D e s c r i p t i o n. The shell is small, subcylindrical, consists of 6–8 segments, and has a narrow, relatively short apical horn. The cephalis is dome-shaped, lacks pores. Succeeding segments are subcylindrical, separated from each other by narrow superficial constrictions; each constriction has a row of small pores. Isolated randomly scattered pores are also present on the segments. The aperture is wide circular. The ring is wide, covers the shell entirely from the apical horn to the aperture; two sides of the ring are positioned at an angle of 135°.

M e a s u r e m e n t s, μm. Shell length, 135–140; shell width without ring, 65–70; greatest width of the ring, 200–220.

C o m p a r i s o n. *P. tokerae* differs from *P. ovalis* Tekin, 1999 in the considerably wider ring.

O c c u r r e n c e. Upper Carnian–Lower Norian of Cyprus and Turkey.

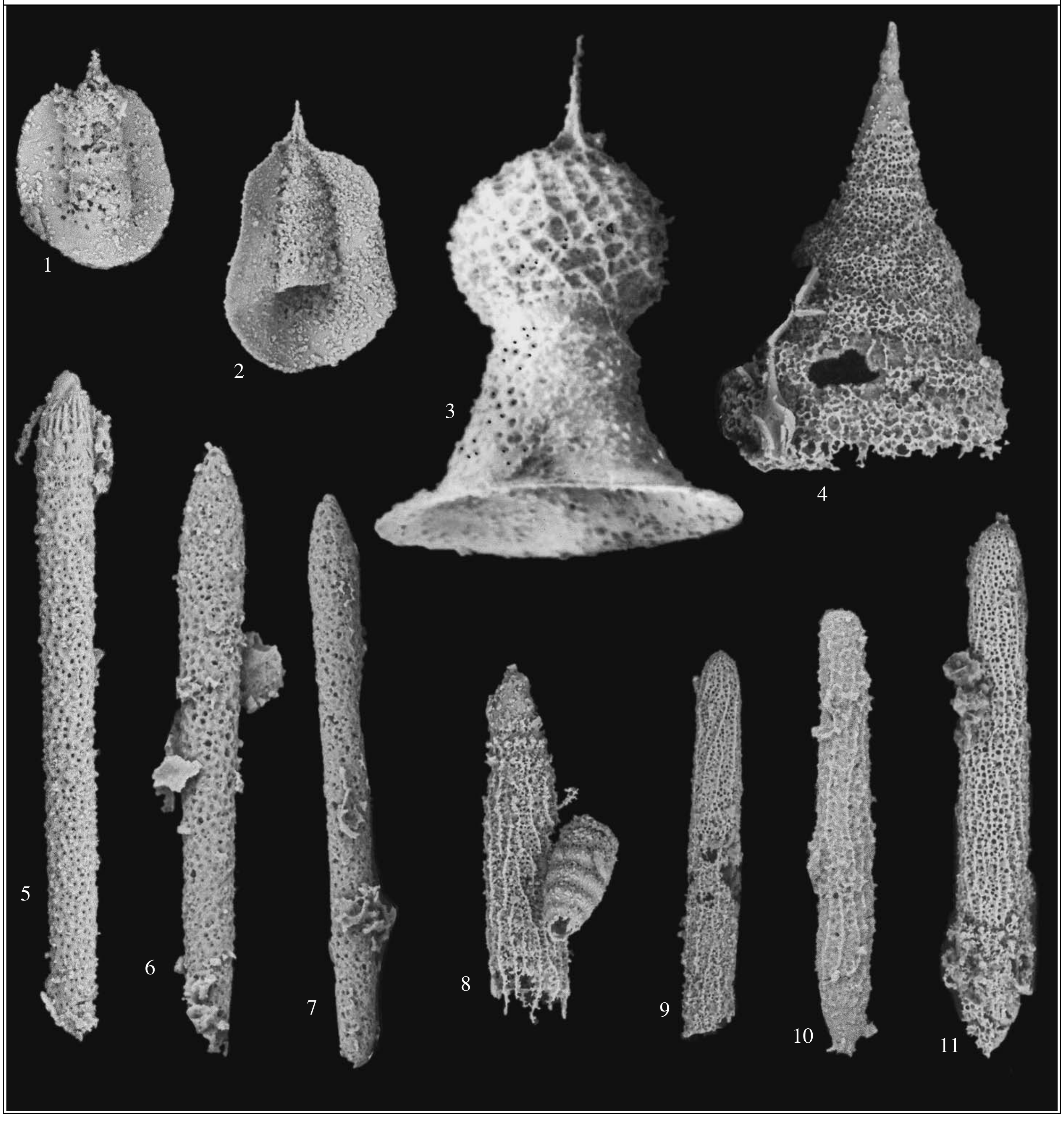
M a t e r i a l. Eight specimens from the Ayia Varvara locality.

Family Bulbocyrtidae Kozur et Mostler, 1981

Bulbocyrtidae: Kozur et Mostler, 1981, p. 106.

D i a g n o s i s. Multicyrtoid Nassellaria. Cephalis large, spherical, inflated, with complex external sculp-

Plate 16



Explanation of Plate 16

Figs. 1 and 2. *Papiliocampe tokerae* Tekin, Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170: (1) GIN, no. 4858-229 and (2) GIN, no. 4858-230.

Fig. 3. *Bulbocyrtium latum* Bragin, holotype GIN, no. 4858-23; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×300.

Fig. 4. *Conospongocyrtis tekini* sp. nov., holotype GIN, no. 4858-106; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×170.

Figs. 5–7. *Mostlericyrtium sitepesiformis* Tekin; Phasoula Formation, Lower Norian: (5) GIN, no. 4858-231, Ayia Varvara locality, sample 90-39, ×170; (6, 7) Lara section, sample 98-2-2, ×170: (6) GIN, no. 4858-232 and (7) GIN, no. 4858-233.

Figs. 8–11. *Mostlericyrtium striata* Tekin; Phasoula Formation, Lower Norian: (8, 9, 11) Ayia Varvara locality, sample 90-39, ×150: (8) GIN, no. 4858-234, (9) GIN, no. 4858-235, and (11) GIN, no. 4858-237; (10) GIN, no. 4858-236, Lara section, sample 98-2-2, ×150.

turing of crossing ridges, with or without apical horn. Thorax subcylindrical. Postthoracic chambers gradually expanding, forming subconical apertural part of shell. Shell wall porous, last segment sometimes lacking pores.

G e n e r i c c o m p o s i t i o n. *Bulbocyrtium* Kozur et Mostler, 1981, *Quasipetasus* Blome, 1984, and *Pessagnocyrtium* Kozur et Mostler, 1981 from the Carnian–Middle Norian.

C o m p a r i s o n. The family Bulbocyrtidae differs from other multicyrtoid nassellarians in the large inflated cephalis.

Genus *Bulbocyrtium* Kozur et Mostler, 1981

Bulbocyrtium: Kozur and Mostler, 1981, p. 106.

T y p e s p e c i e s. *Bulbocyrtium reticulatum* Kozur et Mostler, 1981; Upper Triassic, Carnian; Göstling, Austria.

D i a g n o s i s. Shell tricyrtid or tetra-chambered, with large spherical cephalis, larger than thorax, having apical horn. Last chamber without pores.

S p e c i e s c o m p o s i t i o n. Three species from the Carnian–Middle Norian of the Mediterranean and Pacific regions.

C o m p a r i s o n. *Bulbocyrtium* differs from *Pessagnocyrtium* Kozur et Mostler, 1981 in the cephalis being larger than the thorax.

Bulbocyrtium latum Bragin, 1999

Plate 16, fig. 3

Bulbocyrtium aff. *reticulatum*: Carter et al., 1989, pl. 1, fig. 1.

Bulbocyrtium latum: Bragin and Krylov, 1999b, p. 560, text-figs. 11I and 11J.

H o l o t y p e. GIN, no. 4858-23; Cyprus, village of Ayia Varvara; Lower Norian (Bragin and Krylov, 1999b, text-fig. 11I).

D e s c r i p t i o n. The shell is four-chambered. The cephalis is large, spherical, with a narrow three-bladed apical horn. The surface of the cephalis has a reticular system of small tubercles connected by narrow ridges. The cephalic pores are small, circular, randomly scattered. The thorax is subcylindrical, less than half as long as the cephalis. The abdomen ranges from subcylindrical to subtrapezoid. The postabdominal segment has an expanded apertural part and a wide open aperture. The postcephalic segments are lower than the cephalis. The cephalis, thorax, and abdomen are separated by weak constrictions. The pores of postcephalic segments are small, circular, randomly scattered.

M e a s u r e m e n t s, μm. Shell length without apical horn, 260–320; width of the cephalis, 165–175; greatest shell width, 280–340; length of the apical horn, 80.

C o m p a r i s o n. *B. latum* differs from *B. reticulatum* Kozur et Mostler, 1981 in the larger cephalis with fine reticular surface structure and in the wider last segment. It differs from *B. globosus* Tekin, 1999 in the relatively smaller cephalis.

O c c u r r e n c e. Lower Norian of Cyprus and British Columbia.

M a t e r i a l. Fourteen specimens from the Lara and Ayia Varvara localities.

Family Spongolophophaenidae Kozur et Mostler, 1994

Spongolophophenidae: Kozur and Mostler, 1994, p. 124.

D i a g n o s i s. Cephalis large, conical or hemispherical, with or without apical horn. Test consisting of two or many chambers, with spongy shell and wide open aperture, occasionally covered with apertural spines, or without apertural spines.

G e n e r i c c o m p o s i t i o n. Three genera, *Spongolophophaena* Kozur et Mostler, 1994, *Conospongocyrtis* Kozur et Mostler, 1994, and *Triassospongocyrtis* Kozur et Mostler, 1994, from the Middle and Upper Triassic.

C o m p a r i s o n. The family Spongolophophenidae differs from Bulbocyrtidae Kozur et Mostler in the spongy shell wall.

Genus *Conospongocyrtis* Kozur et Mostler, 1994

Conospongocyrtis: Kozur and Mostler, 1994, p. 125.

T y p e s p e c i e s. *Conospongocyrtis cephaloconica* Kozur et Mostler, 1994; Lower Ladinian of Italy.

D i a g n o s i s. Shell multicyrtoid, conical; cephalis conical, with large apical horn, without pores. Thorax and succeeding segments truncated conical, with spongy shell. Postthoracic segments sometimes separated from each other by narrow constrictions, although, in some species, constrictions extremely poorly pronounced.

C o m p a r i s o n. *Conospongocyrtis* differs from *Spongolophophaena* Kozur et Mostler, 1994 and *Triassospongocyrtis* Kozur et Mostler, 1994 in the presence of the apical horn.

S p e c i e s c o m p o s i t i o n. Four species from the Middle and Upper Triassic of the Mediterranean Region.

R e m a r k s. According to the original diagnosis (Kozur and Mostler, 1994), the genus *Conospongocyrtis* Kozur et Mostler, 1994 comprises species without distinct constrictions, which were interpreted as double-chambered forms. To date, some species have been described that are externally similar to the previously known members of this genus, having a spongy conical shell, but possessing distinct interchamber constrictions (Tekin and Mostler, 2005). Therefore, the diagnosis of the genus is changed. Nevertheless, additional examination of this genus, primarily of its type species, is required to specify the character of division into chambers.

Conospongocyrtis tekini **sp. nov.**

Plate 16, fig. 4

H o l o t y p e. GIN, no. 4858-106; Cyprus, village of Ayia Varvara, Lower Norian (Pl. 16, fig. 4).

E t y m o l o g y. The species is named in honor of U.K. Tekin, a leading expert on Triassic radiolarians of Turkey.

D e s c r i p t i o n. The shell is large, conical. The cephalis is small, conical, without pores, with a massive, smooth apical horn. The thorax and abdomen are relatively small, truncated conical, with small, widely spaced pores. The postabdominal segments are short, truncated conical, separated from each other by distinct constrictions. The wall of postabdominal segments is thick, spongy, with small, irregularly arranged pores and many small tubercles. The aperture is wide.

M e a s u r e m e n t s, μm. Shell length, 440–470; greatest shell width, 290–300.

C o m p a r i s o n. *C. tekini* differs from *C. cephaloconica* Kozur et Mostler, 1994 in the presence of distinct constrictions between postthoracic segments. It differs from *C. bragini* Tekin et Mostler, 2005 in the more massive and long apical horn, more distinct constrictions, small tubercles on postabdominal segments, and in the absence of apertural spines.

O c c u r r e n c e. Lower Norian of Cyprus.

M a t e r i a l. Three specimens from the Ayia Varvara locality.

Nassellaria incertae familiae

Genus *Mostlericyrtium* Tekin, 1999

Mostlericyrtium: Tekin, 1999, p. 180.

T y p e s p e c i e s. *Mostlericyrtium sitepesiformis* Tekin, 1999; Lower Norian of Turkey.

D i a g n o s i s. Shell cylindrical, consisting of more than 20 segments. Cephalis high, dome-shaped, with vertical horn and, sometimes, with small apical horn. Transverse row of small circular pores developed at boundary between cephalis and thorax. Thorax and abdomen subtrapezoid in outline, gradually expanding distally, with small pores. Postabdominal segments subcylindrical, extended to form tube.

S p e c i e s c o m p o s i t i o n. Two species from the Lower Norian of Cyprus and Turkey.

C o m p a r i s o n. *Mostlericyrtium* differs from *Xiphotheca* De Wever, 1979 in the structure of the apical part of the shell, i.e., the presence of a vertical horn and the absence of expansion or swelling of the first postabdominal segment.

Mostlericyrtium sitepesiformis **Tekin, 1999**

Plate 16, figs. 5–7

Mostlericyrtium sitepesiformis: Tekin, 1999, p. 180, pl. 44, figs. 11–15.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 44, fig. 11); collection number not indicated; housed in MTA, Ankara.

D e s c r i p t i o n. The shell is multicyrtoid, very long and narrow, consists of 30 or more segments. The cephalis is dome-shaped, smooth, with a small vertical horn, without pores. The constriction between the cephalis and thorax has small pores. The thorax is truncated conical, with distinct, smooth, densely spaced longitudinal ridges, with narrow slitlike, longitudinally directed pores between the ridges. The constriction between the thorax and abdomen is poorly pronounced. The abdomen is slightly wider than the thorax, with small, widely spaced pores, but without longitudinal ridges. The postabdominal segments are cylindrical, almost constant in width. Their surface has narrow, variously directed ridges, connected to each other to form a cellular structure. Small, randomly scattered pores are observed inside the cells. Towards the distal end of the shell, the cells become smooth and almost disappear. The last segment is gently rounded, without an aperture.

M e a s u r e m e n t s, μm. Shell length, 600–800; greatest shell width, 60–75.

C o m p a r i s o n. *M. sitepesiformis* differs from *M. striata* Tekin, 1999 in the cellular surface of the postabdominal part of the shell and in the distinct and sharp longitudinal ridges of the thorax.

O c c u r r e n c e. Lower Norian of Cyprus and Turkey.

M a t e r i a l. Two complete and nine incomplete specimens from the Lara locality.

Mostlericyrtium striata **Tekin, 1999**

Plate 16, figs. 8–11

Xiphotheca? sp.: Bragin and Krylov, 1999b, p. 567, text-fig. 13H.

Mostlericyrtium striata: Tekin, 1999, p. 181, pl. 44, figs. 16–18.

H o l o t y p e. Turkey, Yailakuzdere section; Upper Carnian–Lower Norian (Tekin, 1999, pl. 44, fig. 16); collection number is not indicated; housed in MTA, Ankara.

D e s c r i p t i o n. The shell is multicyrtoid, very long and narrow, consists of 25 segments or more. The cephalis is dome-shaped, smooth, with a narrow apical horn and a vertical horn, without pores. The constriction between the cephalis and thorax has small pores. The thorax is truncated conical, with small pores and hardly discernible longitudinal ridges. The constriction between the thorax and abdomen is poorly pronounced. The abdomen is slightly wider than the thorax, with small pores and longitudinal ridges extending into the postabdominal part of the shell. The postabdominal segments are cylindrical, almost constant in width. The longitudinal ridges are long, distinct, interrupted, nonparallel to each other, slightly curved, sometimes bifurcating; small, randomly scattered pores are observed between these ridges. The last segment is smoothly rounded, without an aperture.

M e a s u r e m e n t s, μm. Shell length, 400–700; greatest shell width, 40–55.

Comparison. *M. striata* differs from *M. sitepesiformis* Tekin, 1999 in the long, distinct longitudinal ridges of the postabdominal part of the shell.

Occurrence. Lower Norian of Cyprus and Turkey.

Material. Four complete and 18 incomplete specimens from the Lara and Ayia Varvara localities.

Mostlericyrtium bacilliformis **sp. nov.**

Plate 17, figs. 1–3

Etymology. From the Latin *bacillus* (stick).

Holotype. GIN, no. 4858-103; Cyprus, Akamas Peninsula; Lara section, Phasoula Formation, Lower–Middle Norian (Pl. 17, fig. 3).

Description. The shell is multicyrtoid, very long and narrow, consists of 25 or more segments. The cephalis is dome-shaped, smooth, without an apical horn, without pores. The constriction between the cephalis and thorax has small pores. The thorax is truncated conical, with small pores, sometimes, with poorly pronounced longitudinal ridges. The constriction between the thorax and abdomen is poorly pronounced. The abdomen is slightly wider than the thorax, has many small pores. The postabdominal segments are cylindrical, almost constant in width, without longitudinal ridges or cellular structures, with many relatively large pores, which form poorly pronounced longitudinal and transverse rows. The last segment is smoothly rounded, without an aperture.

Measurements, μm. Shell length, 400–600; greatest shell width, 40–55.

Comparison. *M. bacilliformis* is distinguished by the smooth surface of the postabdominal part of the shell, without longitudinal ridges or cellular sculpturing.

Occurrence. Lower Norian of Cyprus.

Material. Six complete and 23 incomplete specimens from the Lara locality.

Genus *Multimonilis* Yeh, 1989

Multimonilis: Yeh, 1989, p. 72.

Type species. *Multimonilis pulcher* Yeh, 1989; Lower Norian of Oregon.

Diagnosis. Shell conical, polychambered, consisting of six or more postabdominal segments. Cephalis dome-shaped, without pores or apical horn. Thorax truncated conical, with small, randomly scattered tubercles. Abdomen and postabdominal segments truncated conical, with small randomly scattered pores. Segments separated by transverse tuberculate ridges.

Species composition. Up to five species from the Upper Triassic of Oregon, the Philippines, and Mediterranean.

Comparison. *Multimonilis* differs from *Whalenella* Kozur, 1984 in the tuberculate structure of transverse ridges of the shell.

Multimonilis pulcher **Yeh, 1989**

Plate 17, fig. 4

Multimonilis pulcher: Yeh, 1989, p. 72, pl. 9, figs. 9 and 19; Bragin and Krylov, 1999b, p. 566, text-fig. 14D; Wang et al., 2002, p. 332, pl. 2, figs. 1 and 2.

Holotype. NMNS, no. 000887; USA, Oregon; Upper Carnian–Middle Norian (Yeh, 1989, pl. 9, fig. 9); housed in the National Museum of Natural History of Taiwan.

Description. The shell is conical, consists of 10–12 segments. The cephalis is small, dome-shaped, without an apical horn or pores. The thorax is truncated conical, tuberculate, with widely spaced pores. The abdomen and postabdominal segments are tuberculate; on each segment, tubercles form transverse rows. Abundant small circular and elliptical pores form rows along the ridges of tubercles.

Measurements, μm. Shell length, 270–300; greatest shell width, 140–150.

Comparison. *M. pulcher* differs from *M. splendidus* Yeh, 1989 in the presence of pores on the thorax, abdomen, and the first postabdominal segments.

Occurrence. Upper Carnian–Middle Norian of Oregon, Cyprus, and Tibet.

Material. Eight specimens from the Ayia Varvara locality.

Genus *Senelella* Tekin, 1999

Senelella: Tekin, 1999, p. 172.

Type species. *Senelella triassica* Tekin, 1999; Upper Triassic, Lower Norian of Turkey, Yailakuzdere section.

Diagnosis. Long tubular beaded polychambered shell. Some postabdominal segments larger than first postabdominal segment and having belt of spines in equatorial plane.

Comparison. *Senelella* differs from *Xiphotheca* De Wever, 1979 in the inflated second and third (or only second) postabdominal segments which are larger than the first postabdominal segment and have belts of spines.

Remarks. The internal structure of the cephalis is not known.

Species composition. Three species from the Lower Norian of the Philippines, Cyprus, and Turkey.

Senelella spinellifera **(Bragin, 1999)**

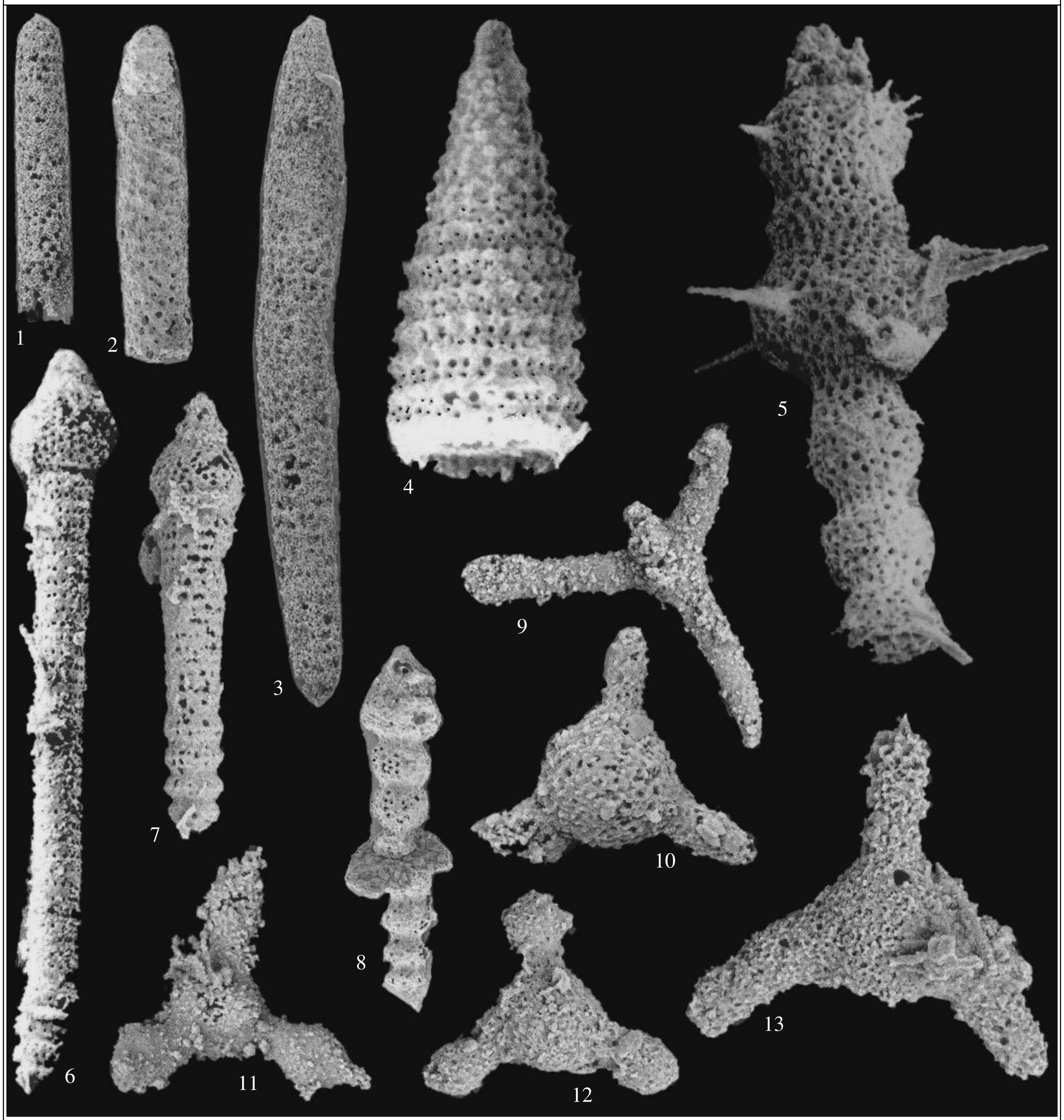
Plate 17, fig. 5

Xiphotheca (?) spinellifera: Bragin and Krylov, 1999b, p. 567, text-figs. 13J and 13K.

Holotype. GIN, no. 4858-3; Cyprus, village of Ayia Varvara, Lower Norian (Bragin and Krylov, 1999b, text-fig. 13J).

Description. The shell is very long, multicyrtoid. The cephalis is small, dome-shaped. The thorax is

Plate 17



small, hemispherical. The cephalis and thorax lack pores. The abdomen is large, inflated, with narrow short spines in the equatorial plane. The first postabdominal segment is twice as large as the abdomen, lacks spines. The second postabdominal segment is inflated, larger than the abdomen, has spines in the equatorial plane. These spines are longer and thicker than the spines of the abdomen. Three succeeding postabdominal segments are moderately inflated, smaller than the abdomen; they lack subsidiary spines. The last segment has relatively small apertural spines. The aperture is small, open, circular. All postthoracic segments have small circular pores in irregularly polygonal frames.

M e a s u r e m e n t s, μm. Shell length, 700; greatest width of the first postabdominal segment, 150–180; greatest width of the second postabdominal segment without equatorial spines, 165–225.

Explanation of Plate 17

Figs. 1–3. *Mostlericyrtium bacilliformis* sp. nov., Phasoula Formation, Lower Norian; Lara section, sample 98-2-2, ×170: (1) paratype GIN, no. 4858-238, (2) paratype GIN, no. 4858-239, and (3) holotype GIN, no. 4858-103.

Fig. 4. *Multimonilis pulcher* Yeh, specimen GIN, no. 4858-240; Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×300.

Fig. 5. *Senelella spinellifera* (Bragin), holotype GIN, no. 4858-3, Phasoula Formation, Lower Norian; Ayia Varvara locality, sample 90-39, ×250.

Figs. 6 and 7. *Xiphotheca rugosa* Bragin, Phasoula Formation, Lower Norian; (6) GIN, no. 4858-241, Ayia Varvara locality, sample 90-39, ×170; (7) GIN, no. 4858-242, Lara section, sample 98-2-4, ×170.

Fig. 8. *Xiphotheca longa* Kozur et Mock, specimen GIN, no. 4858-243; Phasoula Formation, Lower Norian; Lara section, sample 98-2-4, ×170.

Fig. 9. *Livarella longa* Yoshida, specimen GIN, no. 4858-244; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170.

Fig. 10. *Livarella densiporata* Kozur et Mostler, specimen GIN, no. 4858-245; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×200.

Figs. 11 and 12. *Livarella inflata* Yeh: (11) GIN, no. 4858-246, Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×170; and (12) GIN, no. 4858-247, Phasoula Formation, Upper Norian, Lara section, sample 98-2-9, ×170.

Fig. 13. *Ayrtonius elisabethae* Sugiyama, specimen GIN, no. 4858-248; Vlambouros Formation, Upper Norian, Dhiarizos section, sample 90-28-1, ×200.

Comparison. *S. spinellifera* differs from *S. triassica* Tekin, 1999 in the large size of the second (rather than first) postabdominal segment.

Occurrence. Lower Norian of Cyprus.

Material. Three complete and 12 incomplete specimens from the Lara and Ayia Varvara localities.

Genus *Xiphotheca* De Wever, 1979

Xiphotheca: De Wever et al., 1979, p. 93.

Type species. *Xiphotheca karpenissionensis* De Wever, 1979; Lower Norian of Greece.

Diagnosis. Shell very long, rod-shaped, polychambered. First postabdominal segment inflated, larger than other segments. Subsidiary spines undeveloped.

Species composition. Seven species from the Carnian–Lower Norian of Greece, Turkey, Italy, Slovakia, Japan, Sikhote Alin, Sakhalin, the Koryak Upland, and Cyprus.

Comparison. *Xiphotheca* differs from *Senelella* Tekin, 1999 in the fact that the first postabdominal segment is larger than other segments and in the absence of subsidiary spines.

Remarks. The internal structure of the cephalis is not known.

Xiphotheca rugosa Bragin, 1991

Plate 17, figs. 6 and 7

Xiphotheca karpenissionensis: De Wever et al., 1979, pl. 7, fig. 3.

Xiphotheca rugosa: Bragin, 1991a, p. 107, pl. V, figs. 11 and 13; Bragin and Krylov, 1999b, p. 567, text-figs. 13A–13C and 13I; Tekin, 1999, p. 175, pl. 42, figs. 15–18; pl. 43, figs. 1–5; Tekin et al., 2002, p. 132, text-figs. 5.12 and 5.13.

Xiphotheca sp. *A*: Yeh, 1992, pl. 9, figs. 8 and 9.

Xiphotheca sp.: Otsuka et al., 1992, pl. 3, figs. 20 and 21; Halamic and Gorican, 1995, pl. 1, fig. 24; Gorican et al., 1999, figs. 3–12.

Holotype. GIN 4738-84B-1-43a; Upper Carnian; Sikhote Alin, Dal'negorsk (Bragin, 1991a, pl. 5, fig. 11).

Description. The shell is long, narrow, subcylindrical, includes 15–24 postabdominal segments. The cephalothorax is subconical, lacks pores; sometimes, it has a very small apical horn. The constriction between the cephalis and thorax is undeveloped, while the constriction between the thorax and abdomen is well pronounced. The abdomen is hemispherical, lacks pores. The first postabdominal segment is subspherical, inflated, approximately twice as large as the abdomen, has many circular pores. Succeeding (9–17) postabdominal segments extend to form a straight tube; each segment has two transverse rows of circular pores. The last five or six segments are slightly inflated, separated from each other by constrictions. The aperture is small, circular.

Measurements, μm. Shell length, more than 2500; length of the cephalothorax, 25–30; length of the abdomen, 10–15; length of the first postabdominal segment, 55–65.

Comparison. *X. rugosa* differs from *X. longa* Kozur et Mock, 1981 in the first 9–17 segments from the first postabdominal segment, which are very slightly separated by constrictions, so that the shell in this part is in the shape of an even tube.

Occurrence. Upper Carnian–Lower Norian of Greece, Sikhote Alin, Sakhalin, the Koryak Upland, the Philippines, Oman, Croatia, Cyprus, and Turkey.

Material. Thirty-three specimens from the Lara and Ayia Varvara localities.

Xiphotheca longa Kozur et Mock, 1981

Plate 17, fig. 8

Xiphotheca sp.: Pessagno et al., 1979, pl. 5, fig. 5.

Xiphotheca longa Kozur et Mock: Kozur and Mostler, 1981, p. 113, pl. 41, fig. 2; Yeh, 1989, p. 71, pl. 8, fig. 1; Bragin and Krylov, 1999b, p. 567, text-figs. 13E and 13G; Tekin, 1999, p. 174, pl. 42, figs. 13 and 14; Wang et al., 2002, p. 331, pl. 2, figs. 20 and 21; Tekin and Yurtsever, 2003, p. 158, pl. 2, fig. 14.

Xiphotheca karpenissionensis: Sato et al., 1986, text-fig. 16.14; Otsuka et al., 1992, pl. 3, figs. 17 and 18.

Xiphotheca cf. *longa:* Otsuka et al., 1992, pl. 3, fig. 19.

H o l o t y p e. KoMo, no. 1980 I-133; Slovakia, western Carpathians, Sulov; Lower Norian (Kozur and Mostler, 1981, pl. 41, fig. 2); depository not indicated.

D e s c r i p t i o n. The shell is long, narrow, subcylindrical, contains 15–24 postabdominal segments. The cephalothorax is subconical, lacks pores, sometimes has a very small apical horn. The constriction between the cephalis and thorax is poorly pronounced. The constriction between the thorax and abdomen is distinct. The abdomen is hemispherical, with small pores. The first postabdominal segment is subspherical, inflated, approximately twice as large as the abdomen, with many circular pores. The succeeding 9–15 segments are also inflated, somewhat smaller than the first postabdominal segment, separated from each other by distinct constrictions, their wall is pierced by small circular pores.

M e a s u r e m e n t s, μm. Shell length, 1500 or more; cephalothorax length, 25–30; abdominal length, 10–15; length of the first postabdominal segment, 50–65.

C o m p a r i s o n. *X. longa* differs from *X. rugosa* Bragin, 1991 in the inflated postabdominal segments separated from each other by distinct deep constrictions.

O c c u r r e n c e. Lower–Middle Norian of Mexico, Slovakia, Japan, Oregon, Oman, Cyprus, Turkey, and Tibet.

M a t e r i a l. Thirty-nine specimens from the Lara, Ayia Varvara, and Parekklisia localities.

Polycystina incertae ordinis

Genus *Livarella* Kozur et Mostler, 1981

Livarella: Kozur and Mostler, 1981, p. 114.

T y p e s p e c i e s. *Livarella densiporata* Kozur et Mostler, 1981; Rhaetian of Austria.

D i a g n o s i s. Shell stauraxonic, trilobate in outline. Central part of shell subspherical, sometimes with large tubercle on one side. Lobes subcylindrical, rounded in outline, slightly curved, located in one plane. Shell wall entirely pierced by simple circular pores, pore frames undeveloped. Both central part and lobes hollow.

S p e c i e s c o m p o s i t i o n. Four species from the Upper Norian–Rhaetian of Austria, Japan, China, Oregon, the Philippines, eastern Russia, British Columbia, Cyprus, and Turkey.

C o m p a r i s o n. *Livarella* differs from *Ayrtonius* Sugiyama, 1997 in the porous wall.

R e m a r k s. The taxonomic position of this genus is uncertain. Some researchers (Yeh, 1989) assign it to nassellarians based on the structure of the internal nuclei of *Livarella* Kozur et Mostler, 1981, which were extracted from the siliceous matrix. Other researchers (Carter, 1993) refer this genus to spumellarians, because, in well-preserved specimens extracted from limestones, no internal structures have been recognized.

***Livarella longa* Yoshida, 1986**

Plate 17, fig. 9

Poulpus (?) sp. *A*: Yao et al., 1982, pl. 2, fig. 8.

Livarella longus: Yoshida, 1986, p. 14, pl. 2, figs. 3–5; Bragin, 1991a, p. 96, pl. X, fig. 5; Yeh, 1992, p. 67, pl. 3, figs. 9 and 12, pl. 4, figs. 1–4 and 7; Bragin and Krylov, 1996, pl. I, fig. 1.

Livarella validus: Zhang et al., 1997, pl. 2, fig. 3b.

Livarella valida: Sugiyama, 1997, p. 183, text-fig. 50.18.

Livarella magna: Tekin, 1999, p. 148, pl. 33, figs. 3–6.

H o l o t y p e. ESN, no. 36228/2046; Japan, Kagamigahara section; Upper Norian–Rhaetian (Yoshida, 1986, pl. 2, fig. 4); housed in Nagoya University.

D e s c r i p t i o n. The shell has a small, subspherical central part and narrow, long lobes slightly curved at the end. Judging from the curvature of the lobes, one side of the central part of the shell had a large conical tubercle. The pores are very small, circular, evenly covering the surface of the shell.

M e a s u r e m e n t s, μm. Diameter of the central part of the shell, 90–100; length of lobes, 150–180; width of lobes, 35–40.

C o m p a r i s o n. *L. longa* differs from *L. densiporata* Kozur et Mostler, 1981 in the longer and relatively narrow lobes and in the small pores.

O c c u r r e n c e. Upper Norian–Rhaetian of Japan, the Far East of Russia, the Philippines, northeastern China, Turkey, and Cyprus.

M a t e r i a l. Eighteen specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

***Livarella densiporata* Kozur et Mostler, 1981**

Plate 17, fig. 10

Livarella densiporata: Kozur and Mostler, 1981, p. 115, pl. 9, fig. 1; Yoshida, 1986, pl. 2, figs. 1 and 2; Carter, 1990, pl. 1, fig. 3; Yeh, 1992, pl. 4, figs. 8, 11, 12, and 15; Carter, 1993, p. 116, pl. 21, figs. 1, 5, 10, 13, and 16; Sugiyama, 1997, text-fig. 50.20; Tekin, 1999, p. 148, pl. 33, figs. 1 and 2.

Livarella gifuensis: Bragin, 1991a, pl. VIII, fig. 4; Bragin and Krylov, 1996, pl. I, fig. 3.

Livarella sp. cf. *L. densiporata:* Bragin and Krylov, 1996, pl. I, fig. 2.

Livarella validus: Zhang et al., 1997, pl. 2, fig. 3a.

H o l o t y p e. KoMo, no. 1980 I-115; Austria, Zlambachgraben; Rhaetian Stage (Kozur and Mostler, 1981, pl. 9, fig. 1); collection number and depository are not indicated.

D e s c r i p t i o n. The shell has a large subspherical central part and thick, slightly curved lobes. Judging from the curvature of the lobes, one side of the central part of the shell had a large conical tubercle. The pores are circular, relatively small, equal in size, evenly covering the surface of the shell.

Measurements, μm. Diameter of the central part of the shell, 100–110; length of lobes, 75–90; width of lobes, 35–40.

Comparison. *L. densiporata* differs from *L. longa* Yoshida, 1986 in the thicker and shorter lobes and the larger pores.

Occurrence. Upper Norian–Rhaetian of Austria, Japan, British Columbia, Sikhote Alin, the Koryak Upland, northeastern China, the Philippines, and Turkey.

Material. Twenty-five specimens from the Lara, Khapotami, Dhiarizos, and Mavrokolymbos localities.

Livarella inflata Yeh, 1992

Plate 17, figs. 11 and 12

Livarella inflata: Yeh, 1992, p. 67, pl. 3, figs. 5, 10, and 13.

Holotype. NMNS, no. 010128; Philippines, Uson Island; Upper Norian–Rhaetian (Yeh, 1992, pl. 3, fig. 5); housed in the National Museum of Natural History of Taiwan.

Description. The shell has a massive subspherical central part and short, thick, considerably inflated lobes; the shell surface is fine-porous.

Measurements, μm. Width of the central part of the shell, 75–90; length of lobes, 75–90; width of lobes, 60–65.

Comparison. *L. inflata* differs from other species in the short, strongly inflated lobes.

Occurrence. Upper Norian–Rhaetian of the Philippines and Cyprus.

Material. Six specimens from the Lara, Khapotami, Dhiarizos, Mavrokolymbos localities.

Genus *Ayrtonius* Sugiyama, 1997

Ayrtonius: Sugiyama, 1997, p. 145.

Type species. *Ayrtonius elisabethae* Sugiyama, 1997; Upper Norian of Japan.

Diagnosis. Shell trilobate, with spongy wall. All lobes located in one plane. Circular aperture located between two lobes. Central part of shell and its lobe hollow.

Species composition. Type species from the Upper Norian–Rhaetian of Japan and Sikhote Alin.

Comparison. *Ayrtonius* differs from *Livarella* Kozur et Mostler, 1981 in the spongy wall.

Remarks. Sugiyama (1997) assigned this genus to nassellarians, presuming that the shell is divided into a cephalis, thorax, and abdomen and that the apertural lobes are extensions of elements L. This ideas seem questionable, judging from the figures given, in which external segmentation and, the more so, internal structure are not seen. It is not improbable that this genus is related to *Livarella* Kozur et Mostler, 1981.

Ayrtonius elisabethae Sugiyama, 1997

Plate 17, fig. 13

Ayrtonius elisabethae: Sugiyama, 1997, p. 145, text-figs. 39.7 and 39.9; Tekin, 2002, p. 433, pl. 4, fig. 16.

Holotype. ESN, no. 148004; Japan, Kiso River; lower part of the Upper Norian (Sugiyama, 1997, text-fig. 39.7); housed in Nagoya University.

Description. The shell is bilaterally symmetrical, trilobate, with a spongy wall. All lobes are in one plane. Two lobes are slightly curved and longer than the third. A relatively small circular aperture is between these lobes. The central part of the shell and its lobes are hollow. The apical horn and segmentation are undeveloped.

Measurements, μm. Shell length, 290–310; length of large lobes, 170–190; length of small lobe, 140–160.

Remarks. The genus is monotypic. It resembles the genus *Livarella* Kozur et Mostler, 1981 and differs in the spongy wall and bilateral symmetry of the shell.

Occurrence. Upper Norian–Rhaetian of Japan, Sikhote Alin, Turkey, and Cyprus.

Material. Three specimens from the Khapotami and Mavrokolymbos localities.

CONCLUSIONS

In this study, radiolarians from the Upper Triassic of southern Cyprus are thoroughly investigated for the first time. The following conclusions were drawn:

(1) Representative radiolarian assemblages were recorded in the Triassic beds of the allochthonous Mamonia Complex along with other fossils (conodonts); this provides the opportunity of a detailed study of stratigraphical distribution of radiolarian species.

(2) Radiolarians occur at several stratigraphical levels of the Phasoula Formation, represented by the basic volcanics with lenses and interbeds of micritic limestones and cherts. It has yielded a rich *Capnodoce crystallina–Trialatus robustus* assemblage dated Early Norian, with *Capnodoce anapetes* De Wever, *C. crystallina* Pessagno, *Capnuchosphaera deweveri* Kozur et Mostler, *C. theloides* De Wever, *C. triassica* De Wever, *C. tricornis* De Wever, *Deflandrecyrtium curvatum* Kozur et Mostler, *Carinaheliosoma carinata* (Kozur et Mostler), *Icrioma cruciformis* Tekin, *Kahlerosphaera norica* Kozur et Mock, *Kinyrosphaera helicata* Bragin, *Mostlericyrtium sitepesiformis* Tekin, *Palaeosaturnalis latiannulatus* Kozur et Mostler, *P. raridenticulatus* Kozur et Mock, *Spongostylus tortilis* Kozur et Mostler, *Xiphotheca rugosa* Bragin, *Zhamojdasphaera procerusp inosa* Lahm, and others, and the Middle Norian *Capnodoce sarisa* assemblage, including *Capnuchosphaera concava* De Wever, *C. silviesensis* Blome, *C. triassica* De Wever, *Loffa mulleri* Pessagno, *Nabolella trispinosa* Bragin, *Podobursa yazgani* Tekin, *Praexehasaturnalis tenuispinosus* (Donofrio et Mostler), and others. Upward in the section, a Late Norian assemblage with *Livarella densiporata–Lysemelas olbia* is established.

Sections of the Vlambouros Formation, composed of clastic turbidites and contourites with micritic limestone interbeds, have yielded Late Norian radiolarians of the *Livarella densiporata–Lysemelas olbia* assemblage, including *Livarella densiporata* Kozur et Mostler, *L. longus* Yoshida, *Lysemelas olbia* Sugiyama, *Pentactinocarpus sevaticus* Kozur et Mostler, *Praemesosaturnalis gracilis* (Kozur et Mostler), *P. multidentatus* (Kozur et Mostler), and others.

(3) Assemblages revealed in the sections of southern Cyprus are correlated with associations of the same age from radiolarian zones proposed previously based on the material from the Far East of Russia (Bragin, 2000b), i.e., *Capnodoce crystallina* (Lower and Middle Norian) and *Lysemelas olbia* (lower Upper Norian). The differences in taxonomic composition between Early and Middle Norian assemblages of various areas provide the basis for the elaboration of a more detailed division of the Norian Stage based on radiolarians, because radiolarians from the Upper Triassic of Cyprus, Turkey, and other areas of the Mediterranean Region are rather similar in taxonomic composition.

(4) A hundred and one radiolarian species belonging to 3 orders, 24 families, and 59 genera are described; of them 2 genera, 9 species, and 1 subspecies were previously described by the author; 14 new species and 1 new subspecies are established. The diagnoses of many genera and species are amended, the stratigraphic and geographical ranges of the majority of taxa are expanded considerably.

ACKNOWLEDGMENTS

I am grateful to Yu.B. Gladenkov, V.S. Vishnevskaya, V.A. Zakharov, and L.G. Bragina (Geological Institute of the Russian Academy of Sciences) for their interest and valuable remarks during the preparation of this publication, and to the leading specialists in Triassic radiolarians P. Dumitrica (Institute of Geology, Bern, Switzerland) and U.K. Tekin (University Hacettepe, Ankara, Turkey) for important remarks during the preparation of the study. I am thankful to A.A. Shevyrev and L.A. Nevesskaja (Paleontological Institute of the Russian Academy of Sciences) for perusal of the manuscript. I am indebted to A.L. Knipper, V.A. Krasheninnikov (GIN), K. Xenophontos (Geological Service of the Republic of Cyprus), I.S. Barskov (Geological Faculty of Moscow State University), and K.A. Krylov (Stanford University, USA) for invaluable help in the organization and realization of field work in Cyprus. I am grateful to N.V. Gor'kova (GIN) for producing photographs of microfossils under an electron microscope.

This study was supported by the Russian Foundation for Basic Research (project nos. 03-05-64964 and 03-05-64303).

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