

LONGOBARDIAN (LATE LADINIAN) OERTLISPONGIDAE (RADIOLARIA) FROM THE REPUBLIC OF BOSNIA-HERCEGOVINA AND THE STRATIGRAPHIC VALUE OF ADVANCED OERTLISPONGIDAE

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With 2 figures, 1 table and 15 plates

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Abstract:

A very rich radiolarian fauna was found in a limestone with the conodont *Budurovignathus mungoensis* (DIEBEL) at the locality Varoški creek, 2 km W of Fojnica (south of Sarajevo, Republic of Bosnia-Herzegovina). This radiolarian fauna is characteristic of the lower part of the upper subzone (*Spongoserrula fluegeli* Subzone) of *Muelleritortis cochleata* Zone and indicates an early late Longobardian age. The stratigraphically important Oertlispongidae of this fauna are described in the present paper. For comparison, some Oertlispongidae are described from the lower and middle Subzone of the *M. cochleata* Zone of Southern Alps and from the Cordevolian of Sicily. 84 oertlispongid species and subspecies, 69 of which are new, have been found in the *Muelleritortis cochleata*- and *Tritortis kretaensis* zones (middle Longobardian to Cordevolian) of the Tethys.

Zusammenfassung:

Eine sehr reiche Radiolarienfauna wurde aus einem Kalkstein mit der Conodontenart *Budurovignathus mungoensis* (DIEBEL) von der Lokalität Varoški-Bach, 2 km westlich von Fojnica (südlich von Sarajevo, Republik Bosnien-Herzegowina) nachgewiesen. Diese Radiolarienfauna ist charakteristisch für den unteren Teil der oberen Subzone (*Spongoserrula fluegeli* Subzone) der *Muelleritortis cochleata*-Zone und zeigt frühes-spätlongobardisches Alter an. In der vorliegenden Arbeit werden die stratigraphisch wichtigen Oertlispongidae aus dieser Fauna beschrieben. Zu Vergleichszwecken werden auch einige Oertlispongidae aus der unteren und mittleren Subzone der *M. cochleata*-Zone aus den Südalpen sowie aus dem höheren Cordevol von Sizilien beschrieben. 84 Arten und Unterarten der Oertlispongidae, von denen 69 neu sind, wurden in der *Muelleritortis cochleata*- und *Tritortis kretaensis*-Zone (Mittellongobard-Cordevol) der Tethys nachgewiesen.

1. Introduction

Oertlispongidae KOZUR & MOSTLER (in DUMITRICA et al., 1980) are stratigraphically decisive important radiolarians for the Ladinian of the Tethyan realm. They are characterized by a highly differentiated recurved main (apical) polar spine. Often the end of this polar spine is bifurcated and both ends are recurved. One or both ends of the recurved polar spine may join the shell. On different ways a ring-like structure evolved from the highly

differentiated polar spine and by this the saturniid radiolarians evolved at the base of the Late Triassic from oertlispongid ancestors (KOZUR & MOSTLER, 1983).

The degree of bending, the length of the straight lower part of the main polar spine show taxonomically important differentiations in advanced Oertlispongidae, but also the width of the main polar spine is taxonomically very important. It may become blade-like and sculptured with spines or rounded appendages. The form and sculpture of

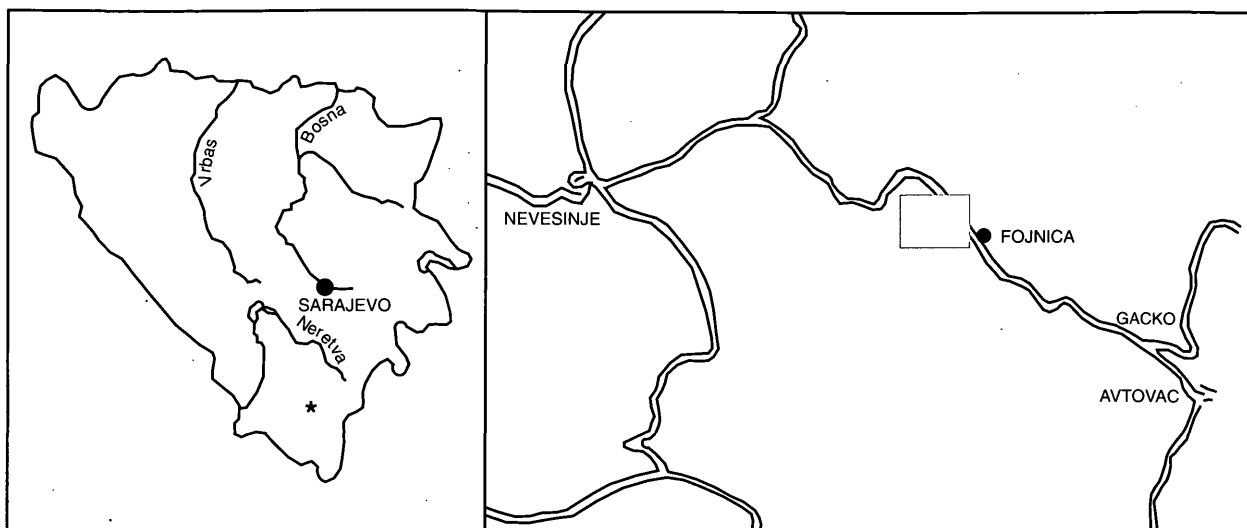


Fig. 1: Locality map. a) Geographic position of the locality (asterisk) in the Republic Bosnia-Herzegowina. b) Detailed locality map from MUDRENOVIĆ & GAKOVIĆ (1964).

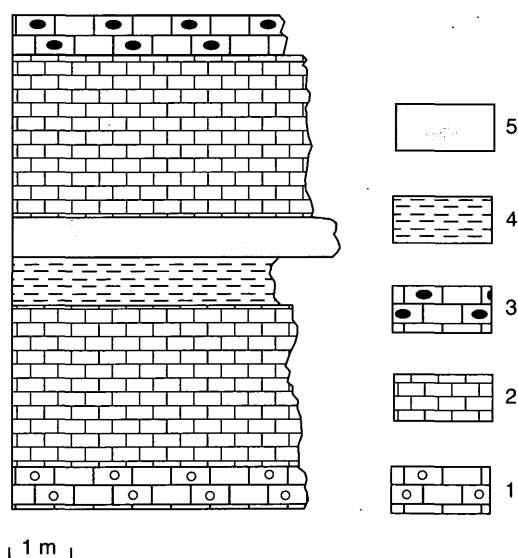


Fig. 2: Lithostratigraphic sequence with radiolarian-bearing limestone below and above a thin radiolarite-tuffit intercalation (from MUDRENOVIĆ & GAKOVIĆ, 1964). Vertical scale indicated.

- 1 = Calcarenite
- 2 = radiolarian-bearing limestone
- 3 = cherty limestone with *Joannites klipsteini* and *J. cymbiformis*
- 4 = tuffitic claystones
- 5 = red radiolarite

the main polar spine is so characteristic that genera and species of Oertlispongidae can be easily determined on the base of isolated main polar spines. Several species and genera established by DUMITRICĂ (1982) were based on such isolated main polar spines.

After the Oertlispongidae have been established by KOZUR & MOSTLER (in DUMITRICĂ et al., 1980), this family became one of the stratigraphically most important Triassic radiolarian groups. Advanced Oertlispongidae with differentiated main polar spine characterize the Tethyan Ladinian. Outside the Tethys, Oertlispongidae have been reported from the Philippines (YEH, 1990, 1992), Japan (SASHIDA et al., 1993) and from British Columbia, Canada (CORDEY et al., 1988), but the most Oertlispongidae have been described from the Eurasiatic Tethys (DUMITRICĂ, KOZUR & MOSTLER, 1980, DUMITRICĂ, 1982, DUMITRICĂ & MELLO, 1982, KOZUR & MOSTLER, 1981, 1983, 1994, DE WEVER, 1984, LAHM, 1984, KOLAR-JURKOVŠEK, 1989, MARTINI et al., 1989, BUDAI & DOSZTÁLY, 1990, DE WEVER et al., 1990, GORIČAN

& BUSER, 1990, DOSZTÁLY, 1991, 1994, DOSZTÁLY & JÓZSA, 1993). The Oertlispongidae are typical radiolarians of the tropical sea.

As shown by DUMITRICĂ (1982), DOSZTÁLY (1994) and KOZUR & MOSTLER (1994), the Oertlispongidae are extraordinarily important for the Ladinian stratigraphy, both for the definition of the priority Anisian-Ladinian boundary at the base of the *Reitziites reitzi* ammonoid zone and for subdivisions within the Ladinian. Advanced Oertlispongidae are present also in the Cordevolian, but the reports about the occurrence of advanced Oertlispongidae in the Tuvalian by DUMITRICĂ (1982) could not be confirmed. Therefore alone the presence of the easily recognizable isolated recurved main spines of advanced Oertlispongidae can be used as one of the best evidences for Ladinian age, if Cordevolian age can be excluded. This is in so far especially important, because the radiolarian biostratigraphy can be also applied to the widespread radiolarite facies of ancient oceans which is free of any macrofossils and often very poor in conodonts. The stratigraphically important adult platform conodonts are very rare or absent in this facies.

The first Oertlispongidae with recurved main polar spine appeared at the priority base of the Ladinian, at the base of the *Reitziites reitzi* Zone. Because this level can be also recognized by ammonoids, conodonts and sporomorphs, there is no reason to change this priority base of the Ladinian to any other level. This priority remained unchanged for about 100 years. Even those proposals in the end of the last century that placed the Anisian-Ladinian boundary between the *Paraceratites trinodosus* Zone and the *Eoprotrachyceras curionii* Zone, in reality used the base of the *Reitziites reitzi* Zone as base of the Ladinian (in this time still named as Norian) because in the "*Trachyceras*" *curionii* Zone the "*Ceratites*" *reitzi* Zone was included as the lowermost horizon (see KOZUR & MOSTLER, 1994).

Within the Tethyan Ladinian, advanced oertlispongids are common in all stratigraphic levels. The evolution of these forms is very rapid and allows detailed subdivisions and correlations. Only few advanced oertlispongids are known

from the Cordevolian, where they are replaced by their successors, the parasaturnalids (*Paleosaturnalis*).

Many new taxa of advanced oertlispongids have been described from the Early Ladinian in KOZUR & MOSTLER (1994). In the present paper several new taxa are described from the Longobardian. The present material was derived from the Dinarides of the Republic Bosnia-Herzegovina at the locality Varoški creek, about 2 km W of Fojnica (Geological Map 135 GACKO 1: 50 000) that was described by MURGENOVIĆ & ĆAKOVIĆ (1964). This locality is situated south of Sarajevo near the road Mostar-Gacko. The material (insoluble residues of limestone solved in acetic acid) was given to us by L. KRISTYN, Vienna. His sample no. is 88/272. The age determination was originally based on the radiolarian fauna that is characteristic of the lower part of the upper Subzone (*Spongoserrula fluegeli* Subzone) of *Muelleritortis cochleata* Zone indicating an early late Longobardian age. Later, we recovered in the voluminous insoluble residues *Budurovignathus mungoensis* (DIEBEL), the conodont index species of the middle to late Longobardian *B. mungoensis* Zone.

Material of the lower and middle subzones of the *M. cochleata* Zone (*Pterospongius priscus*- and *Spongoserrula rarauana* subzones) have been investigated from the Karawanken (Southern Alps, samples St 1 and Bi 1, locality data see MOSTLER & KRAINER 1994). Material from the middle subzone and the lower part of the upper subzone of the *M. cochleata* Zone was investigated in Hungary (section Köveskál, locality data see KOZUR & MOSTLER, 1994). Oertlispongidae from the upper part of the upper Subzone of *M. cochleata* Zone and from the early Cordevolian have been studied from the section Dallapuszta (northern Hungary). These rich radiolarian faunas from red radiolarite blocks in a Middle Jurassic to Oxfordian accretionary complex of the Meliaticum are unfortunately rather fragmentary preserved. Late Cordevolian Oertlispongidae have been studied from a section about 500 m south of Pietra dei Saracini in the Sosio Valley area, western Sicily (Italy).

2. Systematic part

If not otherwise indicated, the described and figured material is from radiolarian-bearing micritic limestones of the locality Varoški creek. It is the type locality for all new species, where no type locality is indicated. The limestone was a floated block of a radiolarian-bearing limestone with an intercalation of tuffitic shales and radiolarites (see Fig. 2). The material is deposited in the Institute of Geology and Paleontology, Innsbruck University, if not otherwise indicated.

Subclass Radiolaria MÜLLER, 1858

Order Polycystina EHRENBERG, 1838

Suborder Spumellaria EHRENBERG, 1875

Superfamily Sponguracea HAECKEL, 1862
emend. KOZUR & MOSTLER, 1981

Family Oertlispongidae KOZUR & MOSTLER, 1980

Subfamily Oertlisponginae KOZUR & MOSTLER, 1980

Description: Spongy shell consisting of 5–7 concentric shells around a tiny microsphere. One or two polar spines are present. One of them (main polar spine) is recurved at one side or at two sides, exceptionally at three sides in triangular position. The recurved end(s) may join the shell. The main polar spine is often strongly differentiated to a blade-like shape. It may be smooth or with denticles or rounded appendages on its outer margin. The most primitive ancestral forms (*Paroertlispon- gus*) display a straight, also distally not curved main polar spine with circular outline. But even in these forms the main polar spine may be differentiated (e.g. by a small, flat lobe). The second polar spine (if present) is needle-like and mostly long. Further needle-like by spines may be present in the antapical hemisphere of the spongy shell. They are often arranged in a bunch.

Assigned genera:

Oertlispon- gus DUMITRICĂ, KOZUR & MOSTLER, 1980

Baumgartneria DUMITRICĂ, 1982

Falcispon- gus DUMITRICĂ, 1982

Pterospon- gus DUMITRICĂ, 1982

Spongoser- rula DUMITRICĂ, 1982

Paroertli- spon- gus KOZUR & MOSTLER, 1981

Angulocir- cus LAHM, 1984

Bogdanella KOLAR-JURKOVŠEK, 1989

Turosp- on- gus KOZUR & MOSTLER, 1994

Gibberospon- gus n. gen.

Scutispon- gus n. gen.

Steigerispon- gus n. gen.

Occurrence: Illyrian (only primitive forms without recurved differentiated main polar spine), Ladinian-Cordevolian. Very common in the Tethys, rare in the Circum-Pacific realm.

Remarks: The Intermediellinae LAHM, 1984, display three main spines in triangular position.

At the base of the Carnian the saturniid Parasaturniidae KOZUR & MOSTLER, 1972, evolved from Oertlisponginae. *Angulocircus* LAHM (1984) is a transitional form, in which the saturniid ring is not yet closed (see KOZUR & MOSTLER, 1990).

Genus *Oertlispon- gus* DUMITRICĂ, KOZUR & MOSTLER, 1980

Type species: *Oertlispon- gus inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER, 1980

Oertlispon- gus inaequispinosus DUMITRICĂ, KOZUR & MOSTLER, 1980 (Pl. 14, Figs. 10, 11)

1980 *Oertlispon- gus inaequispinosus* n. sp. – DUMITRICĂ, KOZUR & MOSTLER, p. 5, Pl. 10, Fig. 7

1982 *Oertlispon- gus inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – DUMITRICĂ, p. 64–65, Pl. 1, Figs. 6, 7, 9, non! Figs. 2, 4

1982 *Oertlispon- gus inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – DUMITRICĂ & MELLO, Pl. 2, Figs. 1, 2

- 1984 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – LAHM, p. 48, Pl. 8, Fig. 2
- 1986 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – KOZUR & RÉTI, Fig. 5
- 1989 *Oertlispongos inaequispinosus* KOZUR & MOSTLER (sic!) – MARTINI et al., Pl. 3, Fig. 14
- 1990 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – GORIČAN & BUSER, p. 148–149, Pl. 3, Figs., 10, 11
- 1990 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR and MOSTLER – YEH, p. 16, Pl. 4, Fig. 1
- 1990 *Oertlispongos inaequispinosus* KOZUR & MOSTLER (sic!) – DE WEVER, MARTINI & ZANINETTI, Pl. 1, Fig. 16
- 1993 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – DOSZTÁLY & JÓZSA, Pl. 1, Fig. 5
- 1994 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – DOSZTÁLY, Pl. 2, Figs. 7, 8, non! Figs 3–6
- 1994 *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER – KOZUR & MOSTLER, p. 59, Pl. 10, Figs. 1–4, 5 (?), 6, 7, 11, 13, Pl. 11, Figs. 2, 6, 7, 9, 11(?); Pl. 47, Figs. 6, 7

Occurrence: Common from the middle *Reitziites reitzi* Zone to *Eoprotrachyceras curionii* Zone, rare in the early and middle Longobardian. Tethys and Circum-Pacific realm. One of the best guide forms for Ladinian age (see KOZUR & MOSTLER, 1994).

Remarks: The taxonomy of *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER, 1980 was discussed in detail by KOZUR & MOSTLER (1994). Several subspecies have been discriminated. Forms with long, straight stem were separated as independent species. For details of taxonomy see KOZUR & MOSTLER (1994).

Oertlispongos deweveri n. sp

(Pl. 7, Fig. 5)

Derivation of name: In honour of Dr. P. DE WEVER, Paris.

Holotype: The specimen on Pl. 7, Fig. 5; rep.-no. KOMO 1994 IV-1

Material: 6 specimens.

Diagnosis: Main polar spine clothes hook-shaped. Straight stem narrow, moderately long. The main polar spine is broadest in the turning point of the curve.

Measurements:

Length of straight stem above the shell surface: 65–70 µm

Total length of the main polar spine above the shell surface: 160–165 µm

Occurrence: Stratigraphically youngest representative of the genus *Oertlispongos*. Rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: The clothes-hook shaped main polar spine is very different from all other (Early Ladinian) *Oertlispongos* species which are curved in one direction.

Genus *Baumgartneria* DUMITRICĂ 1982

Type species: *Baumgartneria retrospina* DUMITRICĂ, 1982

Baumgartneria curvispina DUMITRICĂ, 1982

(Pl. 14, Figs. 8, 9, 12)

1982 *Baumgartneria curvispina* n. sp. – DUMITRICĂ, p. 71, Pl. 12, Figs. 1, 2, 4

Occurrence: *Pterospongos priscus*- and *Spongoserrula rarauana* subzones of *Muelleritortis cochleata* Zone (middle Longobardian) of the Tethys.

Remarks: *Baumgartneria curvispina* DUMITRICĂ, 1982 is the forerunner of *Pterospongos* DUMITRICĂ, 1982. The transition forms are described in the present paper (*Pterospongos priscus* n. sp.).

Baumgartneria curvispina DUMITRICĂ, 1982, is not more a typical *Baumgartneria*, because opposite to the stem a very small, moderately flattened blade-like part is present. It is not the type species of *Baumgartneria* DUMITRICĂ, 1982, as errone-

ously designated by DE WEVER (1984, p. 303, by misspelling named as *Baumgartneria curvispina* DUMITRICĂ). There are two morphotypes in *Baumgartneria curvispina*, already figured in DUMITRICĂ (1982). Morphotype 1 displays a semielliptical or rounded subtriangular small blade above the stem. To this morphotype belongs the holotype and the specimen figured on Pl. 14, Fig. 12). Morphotype 2 displays a straight or very slightly concave portion opposite to the stem (Pl. 14, figs. 8, 9). In this morphotype a bladelike portion at the branching point stem-open ring is missing. This latter morphotype is the ancestral form of *Pterospongos priscus* n. sp. Perhaps these two morphotypes represent independent subspecies.

Genus *Falcispongos* DUMITRICĂ, 1982

Type species: *Falcispongos falciformis* DUMITRICĂ, 1982

Falcispongos falciformis minor n. subsp. (Pl. 14, Fig. 4)

Derivation of name: According to the small size of the polar spine.

Holotype: The specimen on Pl. 14, Fig. 4; rep.-no. KOMO 1994 IV-173

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 6 specimens.

Diagnosis: Spongy shell and spine rather small. Stem moderately long, narrow. Blade rather broad, semielliptical to semicircular in outline, present only on the outer side of the spine. The distal portion of the polar spine is strongly backward curved (nearly parallel to the stem).

Measurements:

Length of polar spine above the shell surface: 117–128 μm

Maximum width of polar spine (maximum distance between the inner and outer margins of the blade): 60–62 μm

Length of straight stem above the shell: 39–44 μm

Width of straight stem in its middle part: 25–27 μm

Occurrence: Rare in the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality. Rare in the early Cordevolian of Hungary.

Remarks: *Falcispongos falciformis falciformis* DUMITRICĂ, 1982, is considerably larger, the blade is present at the outer and inner side of the spine and the distal part of the spine is obliquely backward directed and not so strong backward curved as in *F. falciformis minor* n. subsp.

Falcispongos hamatus DUMITRICĂ, 1982, corresponds in size and strongly backward curved polar spine to *Falcispongos falciformis minor* n. subsp. However, the straight stem is very short or absent above the shell. Moreover, the shape of the blade is triangular, widest near to its proximal end.

Falcispongos hamatus DUMITRICĂ, 1982 (Pl. 9, Figs. 1, 5; Pl. 14, Figs. 2, 3)

1982 *Falcispongos hamatus* n. sp., pars – DUMITRICĂ, p. 66–67, only the specimen on Pl. 3, Fig. 1

1990 *Falcispongos hamatus* DUMITRICĂ, 1982 a – GORIČAN & BUSER, p. 145, Pl. 3, Fig. 7

Occurrence: The holotype was derived from the Tuvalian according to DUMITRICĂ (1982). However, we could not find this species in beds younger than Cordevolian.

Remarks: The holotype displays a subtriangular blade, widest at its proximal end, where it has a slightly concave external margin. Several specimens have a semielliptical blade with convex external margin (Pl. 9, Fig. 5, and the specimen figured by GORIČAN & BUSER, 1990). The width of the blade is variable. Specimens with very narrow blade are assigned herein to *Falcispongos* cf. *hamatus* DUMITRICĂ, 1982 (Pl. 14, Fig. 1). They are transition forms to advanced *Oertlispongos inae-*

quispinosus DUMITRICĂ, KOZUR & MOSTLER, 1980. The main difference to *Falcispongus falciformis* DUMITRICĂ, 1982 is the length of the stem above the shell and the stronger backward curved spine. Moreover, as already stated by DUMITRICĂ (1982), the size of typical *Falcispongus falciformis* is distinctly larger than in *Falcispongus hamatus*. However, in the early Longobardian and early middle Longobardian, a new subspecies of *Falcispongus falciformis* occurs that is as small as *Falcispongus hamatus*. The stem is moderately long to long in *F. falciformis*, but very short or missing in *F. hamatus*.

***Falcispongus transitus* n. sp.**

(Pl. 8, Fig. 3; Pl. 9, Figs. 4, 10, 13, 14;
Pl. 13; Fig. 5; Pl. 14, Fig. 5)

1982 *Falcispongus hamatus* n. sp., pars – DUMITRICĂ, p. 66–67, only the specimen on Pl. 3, Fig. 4

Derivation of name: According to the transitional character between the genera *Falcispongus* DUMITRICĂ, 1982 and *Gibberospongus* n. gen.

Holotype: The specimen on Pl. 9, Fig. 13; rep.-no KOMO 1994 IV-5

Material: 103 specimens.

Diagnosis: Globular spongy shell with tiny, irregularly distributed by-spines. Straight stem of the polar spine outside the shell absent or very short. Immediately above the shell the polar spine is blade-like widened. This blade is of about the same width throughout its length, in typical specimens long, in primitive forms rather short. Its external margin is slightly convex or straight, its inner margin slightly concave. Its distal end is broadly rounded and mostly a little expanded, but not in form of an appendage. The spine is included into the inner margin of the blade. Its free part is narrow and strongly recurved. Its length is variable.

Measurements: See under the subspecies.

Occurrence: Common in the lower and middle subzones of *Muelleritortis cochleata* Zone (middle Longobardian) of Southern Alps, Romania and Bosnia-Herzegovina.

Remarks: *Falcispongus transitus* n. sp. is the ancestor of *Gibberospongus* n. gen. In *Falcispongus* aff. *F. transitus* (Pl. 8, Fig. 2) the distal expansion of the blade becomes larger. Such forms are very similar to *Gibberospongus kraineri* n. sp. that displays a cylindrical appendage at the outer distal corner of the blade.

In *Falcispongus* cf. *transitus* n. sp. there is no distal expansion. This form is somewhat similar to *Falcispongus hamatus* DUMITRICĂ, 1982, in which, however, the width of the blade gradually decreases from its widest part near the proximal end in distal direction.

The holotype of *Falcispongus hamatus* DUMITRICĂ, 1982 displays a subtriangular blade that is in the distal part distinctly narrower than in the proximal part. The two other specimens assigned by DUMITRICĂ (1982) to *Falcispongus hamatus* do not belong to this species. One of them (DUMITRICĂ, 1982, Pl. 3, Fig. 4) belongs to *Falcispongus transitus* n. sp., the other one (DUMITRICĂ, 1982, Pl. 4, Fig. 1) is a *Falcispongus rostratus* DUMITRICĂ, 1982.

***Falcispongus transitus transitus* n. subsp.**

(Pl. 9, Figs. 4, 10, 13, 14)

Holotype: = holotype of the species.

Material: 54 specimens.

Diagnosis: With the character of the species. Blade long, mostly relatively narrow, distally somewhat expanded.

Measurements:

Length of polar spine above the shell surface: 130–171 µm

Length of blade: 145–176 µm

Maximum width of polar spine: 45–83 µm

Length of straight stem: 0–12 µm

Width of straight stem: 23–35 µm

Length of the recurved part of the polar spine: 145–294 µm

Occurrence: Common in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

***Falcispongos transitus brevifoliaceus* n. subsp.**

(Pl. 8, Fig. 3; Pl. 13, Fig. 5; Pl. 14, Fig. 5)

Derivation of name: According to the short blade.

Holotype: The specimen on Pl. 8, Fig. 3; rep.-no. KOMO 1994 IV-8

Material: 47 specimens.

Diagnosis: With the character of the species. Blade short and relatively to its length broad.

Measurements:

Diameter of spongy shell: 78–111 μm

Length of polar spine above the shell surface: 100–130 μm

Length of blade: 108–120 μm

Maximum width of polar spine: 55–61 μm

Length of straight stem above the shell: 0–10 μm

Width of straight stem: 25 μm

Length of recurved part of polar spine: 175–277 μm

Occurrence: Common in the lower subzone (*Pterospongos priscus* Subzone) of the *Muelleritortis cochleata* Zone (early middle Longobardian) and rare in the lower *Spongoserrula fluegeli* Subzone of *M. cochleata* Zone (early late Longobardian) of Southern Alps and Bosnia-Herzegovina.

Remarks: See also under the species.

Falcispongos transitus transitus n. subsp. displays a longer blade.

Genus *Pterospongos* DUMITRICĂ, 1982

Type species: *Pterospongos patrulii* DUMITRICĂ, 1982

***Pterospongos alatus* DUMITRICĂ 1982**

(Pl. 15, Fig. 1)

1982 *Pterospongos alatus* n. sp. – DUMITRICĂ, p. 69, Pl. 4, Fig. 7, Pl. 5, Fig. 3, non! Fig. 1

Material: 3 specimens.

Occurrence: *Pterospongos priscus*- and *Spongoserrula rarauana* subzones of *Muelleritortis cochleata* Zone (middle Longobardian) of Romania, Hungary and Southern Alps.

Remarks: *Pterospongos alatus* DUMITRICĂ, 1982 evolved from *Pterospongos priscus* n. sp. by development of a larger, symmetrical blade with broad and moderately deep apical incision.

Our material from the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) belongs probably to a new subspecies. Typical forms from the *Spongoserrula rarauana* Subzone of *Muelleritortis cochleata* Zone (middle Longobardian) displays a horizontally wider and generally higher blade. Probably the terminal spines of the wings are shorter. However, these terminal spines are neither in the type material (DUMITRICĂ, 1982) nor in our material fully preserved. For this reason and for the fact that neither in the type material nor in our material the intra-specific variability is well known, we do not establish this new subspecies before further material is known.

***Pterospongos altofissus* n. sp.**

(Pl. 15, Figs. 4, 5)

Derivation of name: According to the deep apical incision.

Holotype: The specimen on Pl. 15, Fig. 5; rep.-no. KOMO 1994 IV-191

Material: 5 specimens.

Diagnosis: Stem short to moderately long, narrow. Blade large, high, bilateral, asymmetrical. At one side, the transition to the short-moderately long terminal spine of the wing is gradual. At the other side, the blade becomes abruptly narrower at the base of the terminal spine. Incision narrow to moderately broad, deep.

Measurements:

Length of polar spine above the shell surface: 213–242 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 100–142 μm

Length of straight stem above the shell: 75–87 μm

Width of straight stem in its middle part: 23–27 μm

Length of terminal spines of the wings: Maximally 100 µm

Occurrence: Rare in the lower subzone (*Pterospongos priscus* Subzone) of the *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: The blade of *Pterospongos incissus* DUMITRICĂ, 1982 is symmetrical, but otherwise similar (large, high, with deep apical incision). However, the straight stem above the shell is either very short or absent. The contemporaneous species *Pterospongos parvifissus* n. sp. and *P. priscus* n. sp. have not a high blade and their apical incision is considerably shallower.

***Pterospongos parvifissus* n. sp.**
(Pl. 14, Fig. 16; Pl. 15, Figs. 2, 3)

Derivation of name: According to the small incision.

Holotype: The specimen on Pl. 14, Fig. 16; rep.-no. KOMO 1994 IV-184

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 43 specimens.

Diagnosis: Straight stem of polar spine moderately long, narrow. Blade small and low to moderately high, horizontally short, with narrow, moderately deep incision. Terminal spines very long, backward, in the distal part also curved inwards. They form an antapically open elliptical ring with the spongy shell in the centre.

Measurements:

Diameter of spongy shell: 113–150 µm

Length of polar spine above the shell surface: 166–176 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 61–80 µm

Length of straight stem above the shell: 73–106 µm

Width of straight stem in its middle part: 26–33 µm

Length of terminal spines of the wings: up to 335 µm (mostly not fully preserved)

Occurrence: Common in the lower subzone (*Pterospongos priscus* Subzone) of the *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: *Pterospongos alatus* DUMITRICĂ, 1982, is distinguished by a longer and higher blade and a much wider apical incision. Moreover, the terminal spines of the blade do not form an antapically open ring. The few specimens from the lower subzone (*Pterospongos priscus* Subzone) of the *Muelleritortis cochleata* Zone (early middle Longobardian) display a short blade and are therefore similar to *Pterospongos parvifissus*. They are distinguished from this species by a wide apical incision and obliquely backward directed terminal spines of the wings.

Pterospongos priscus n. sp. displays a low blade with wide, shallow, often indistinct apical incision.

***Pterospongos priscus* n. sp.**
(Pl. 14, Figs. 13, 14, 17, 18)

Derivation of name: Stratigraphically earliest known *Pterospongos*.

Holotype: The specimen on Pl. 14, Fig. 14; rep.-no. KOMO 1994 IV-183

Material: 65 specimens.

Diagnosis: Stem of polar spine moderately long, narrow. Blade low, rather short, slightly asymmetric, with wide, but shallow and sometimes indistinct apical incision. The platform portions at the end of the incision may be twisted against each other (at one side upward bent, on the other side downward bent). The very long terminal spines of the wings are backward curved and form an apically open, elliptical or subcircular ring with the shell in the centre.

Measurements:

Diameter of spongy shell: 100–127 µm

Length of polar spine above the shell surface: 133–153 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 47–67 µm

Length of straight stem above the shell: 67–106 μm
Width of straight stem in its middle part: 21–23 μm
Length of the terminal spines of the wings:
> 235 μm (not fully preserved)

Occurrence: Common in the lower subzone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality and in Hungary.

Remarks: In *Pterospongius parvifissus* n. sp. the blade is higher. The apical incision is narrower, but deeper.

Pterospongius priscus n. sp. is a transition from between *Baumgartneria* DUMITRICĂ, 1982 of *B. curvispina* group and *Pterospongius* DUMITRICĂ, 1982, of *P. alatus* group. The terminal spines of the wings form an antapically open ring as in *Baumgartneria curvispina*. However, there is a distinct blade with an apical incision as in all *Pterospongius* species. In some specimens of *Baumgartneria curvispina* DUMITRICĂ, 1982 a very small blade may be present, but an apical incision is absent.

***Pterospongius priscus priscus* n. subsp.**
(Pl. 14, Figs. 13, 14)

Holotype: = holotype of the species.

Material: 53 specimens.

Diagnosis: With the character of the species. The blade portions at the ends of the incision are not twisted against each other.

Measurements: As for the species.

Occurrence: Common in the lower subzone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality and in Hungary.

***Pterospongius priscus tortilis* n. subsp.**
(Pl. 14, Figs. 17, 18)

Derivation of name: According to the twisted blade.

Holotype: The specimen on Pl. 14, Fig. 18; rep.-no. KOMO 1994 IV-186

Material: 12 specimens.

Diagnosis: With the character of the species. The blade portions adjacent to the incision are twisted against each other. At one side of the incision, the blade is upward, on the other side downward curved.

Measurements: As for the species.

Occurrence: Rare in the lower subzone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: See also under the species.

In *Pterospongius priscus priscus* n. sp. the blade is not twisted.

Genus *Spongoserrula* DUMITRICĂ, 1982

Type species: *Spongoserrula rarauana* DUMITRICĂ, 1982

Occurrence: Longobardian and Cordevolian. Very common in the Tethys, rare to common in the Circum-Pacific realm (Philippines and British Columbia, Canada). The occurrence in the Tuvalian mentioned by DUMITRICĂ (1982) could not be confirmed.

Remarks: DUMITRICĂ (1982) assigned to *Spongoserrula* two species, the type species *S. rarauana* DUMITRICĂ and *S. cristagalli* DUMITRICĂ. Both species display a completely flattened polar spine with rounded or blunt flattened subcylindrical spines at the external margin. However, in the type species *S. rarauana* the blade-like polar spine is sickle-shaped, recurved only to one side. In *S. cristagalli* the straight stem is long and the blade-like polar spine is bilateral with distal recurving on both sides. This species belong to a new genus, *Steigerispongius* n. gen., which is distinguished from *Pterospongius* DUMITRICĂ, 1982 by the missing distinct incision opposite to the stem of the polar spine. Moreover, most, but not all *Steigerispongius* species are asymmetric, whereas *Pterospongius* is symmetric.

All transitions from *Falcispongius* to *Spongoserrula* have been observed in our material. The most primitive *Spongoserrula*, *S. nuda* n. sp. and

S. antiqua n. sp., display a sickle-shaped main spine with a smooth external margin. They are distinguished from *Falcispongus* by the completely flattened, blade-like spine which is, however, narrow. In the likewise sickle-shaped, but somewhat broader *Spongoserula falcata* n. sp., some undulations on the external margin indicate the beginning of the denticulation of the external margin. The most primitive forms with denticles on the external margin of the blade display only a few, very short semicircular or rounded triangular to short-subcylindrical denticles. Typical *Spongoserula* display numerous, long, flattened cylindrical spines with blunt or rounded ends. A group with long pointed spines evolved from these forms. Transitional forms to *Steigerispongus* n. gen. display a large proximal denticle which is directed opposite to the recurved distal end. In *Steigerispongus* n. gen., this spine becomes longer, broader, recurved and on the external margin spiny. By this, it is transformed in a second recurved branch of blade that becomes finally as large as the primary branch to form more symmetrical blades with recurvation on both sides.

Spongoserula rarauana rarauana

DUMITRICĂ, 1982

(Pl. 5, Figs. ? 10, 11, 13–15;

Pl. 6, figs. 1–3, 6, 9; Pl. 8, Fig. 9)

1982 *Spongoserula rarauana* n. sp. – DUMITRICĂ, p. 67, Pl. 5, Fig. 5–7; Pl. 6, Figs. 1–5; Pl. 12, Figs. 10–13; non! Pl. 7, Fig. 4

1990 *Spongoserula rarauna* (sic!) DUMITRICĂ-DOSZTÁLY, p. 69, Pl. 1 Fig. 2

1994 *Spongoserula rarauna* (sic!) DUMITRICĂ-DOSZTÁLY, p. 63, Pl. 1 Fig. 6

1994 *Spongoserula rarauna* (sic!) DUMITRICĂ-DOSZTÁLY, Pl. 1, Fig. 6

Description: Globular spongy shell with a big, blade-like polar spine and several small, needle-like by-spines which are concentrated to the hemisphere opposite to the main spine. A part of them is arranged in a bunch in some distance from the antapical pole. The polar spine widens

considerably after a short, distally widened stem. In the level of the largest widening, a heel-shaped lobe is present on the external margin. After this lobe the blade becomes gradual and slowly narrower toward the distal end; the distal, undenticulated part of the polar spine is narrow, needle shaped, moderately recurved. The distal end of the polar spine lies about in the level of the shell equator. Exceptionally, it joins the shell. On the external margin of the polar spine 4–7 flattened subcylindrical, distally rounded or blunt denticles are present. The proximal denticles are long; their length is decreasing in distal direction. Exceptionally, all denticles have the same length (Pl. 5, Fig. 11). The moderately long, needle-shaped distal part of the polar spine is undenticulated.

Occurrence: Middle late Longobardian. Tuvalian occurrences, reported by DUMITRICĂ (1982) cannot be confirmed.

Remarks: Specimens with 3 short node-like to rounded subtriangular appendages at the external margin of the blade-like polar spine are separated as an independent subspecies. These forms have a sickle-shaped, blade-like polar spine without lobe and the blade is not significantly broadened above the stem. They are transitional forms from *Spongoserula falcata* n. sp. to *S. rarauana rarauana* DUMITRICĂ.

DUMITRICĂ (1982) correctly mentioned that the teeth have blunt tips. Later authors assigned forms with needle-shaped teeth and pointed tips into *S. rarauana* (DE WEVER, 1984, CORDEY et al., 1988, DOSZTÁLY, 1991). These forms, however, belong to an independent species which has a narrower blade without lobe.

***Spongoserula rarauana trinodosa* n. subsp.**

(Pl. 5, Fig. 8, 12; Pl. 12, Fig. 3)

Derivation of name: According to the three node-like elevations on the external margin of the polar spine.

Holotype: The specimen on Pl. 5, Fig. 8; rep.-no. KOMO 1994 IV-36

Material: 15 specimens.

Diagnosis: Spongy shell with few tiny by-spines. Polar spine completely flattened, sickle-shaped, narrow for the genus. The stem is short and as wide as the widest part of the polar spine or only a little narrower. Its distal end is moderately long, needle-shaped, strongly recurved. External margin in the middle part of the polar spine with three node-like, rounded subtriangular to flattened subcylindrical denticles.

Measurements:

Diameter of shell: 118–154 μm

Length of polar spine above the shell surface (without nodes): 126–192 μm

Maximum width of polar spine: 63–88 μm

Length of recurved part of polar spine: 206–257 μm

Maximum length of nodes: 23 μm

Occurrence: *Spongoserrula rarauana* Subzone and lower *S. fluegeli* Subzone of *Muelleritortis cochleata* Zone (middle to early late Longobardian) of Bosnia-Herzegovina and Hungary.

Remarks: *Spongoserrula rarauana trinodosa* n. subsp. is a transition form between *S. falcata* n. sp. and *S. rarauana rarauana* DUMITRICĂ, 1982. The first species displays the same shape of the polar spine that is in the same manner curved. However, the external margin of the polar spine is only slightly undulated and it bears never nodes. The polar spine of *S. rarauana rarauana* is strongly widened, bears more denticles and in the proximal part on the external margin a heel-shaped lobe. Some specimens of *S. rarauana trinodosa* (Pl. 5, Fig. 12) display an indistinct, small, subtriangular lobe and the three denticles are elongated node-like (maximum length 29 μm). The polar spine is, however, nearly as narrow as in typical *S. rarauana trinodosa*. These forms are transition forms to *S. rarauana rarauana*. Among this latter subspecies transition forms are rarely present as well (*S. cf. rarauana rarauana*, Pl. 5, Fig. 15). In these forms the widening of the polar spine is only somewhat stronger than in typical *S. rarauana trinodosa* and the lobe is small and indistinct. But there are already 3 flattened subcylindrical teeth (maximum length 47 μm) and a fourth small rounded subtriangular denticle.

Spongoserrula cf. rarauana trinodosa (Pl. 12, Fig. 2) displays additionally to the three small

node-like denticles one or two broadly node-like to lobe-like undulations. The blade has the same shape as in *S. rarauana trinodosa*.

Spongoserrula cf. dehli CORDEY, F.,
DE WEVER, P., DUMITRICĂ, P., DANELIAN, T.,
KITO, N. & VRIELYNCK, B., 1988
(Pl. 13, Fig. 8)

1988 *Spongoserrula dehli* n. sp. – CORDEY et al.,
p. 31–32, Pl. 1, Figs. 1–5

Occurrence: Cordevolian of North America and Sicily. CORDEY et al. (1988) assigned this fauna to the late Anisian to Early Ladinian. However, the association with *Tritortis kretaensis kretaensis* (KOZUR & KRAHL, 1984) and *Spongoserrula dehli* CORDEY et al. occurs in Sicily in Cordevolian beds with *Paragondolella polygnathiformis* (BUDUROV & STEFANOV) and other Carnian guideforms. *Tritortis kretaensis kretaensis* did not appear before the late Longobardian and *Spongoserrula dehli* was so far only found in Cordevolian beds.

Remarks: *Spongoserrula dehli* CORDEY et al. (1988) belongs to the late Longobardian-Cordevolian *Spongoserrula fluegeli* group that is characterized by pointed, often needle-like denticles. *Spongoserrula fluegeli* n. sp. is very similar, but the large proximal spine is in this species always upside convex. The direction of this denticle is variable, mostly obliquely downward directed, but also perpendicularly to the stem or obliquely upward directed. The proximal spine of *S. dehli* is always slightly to distinctly upside concave and nearly perpendicularly to the stem or (mostly) obliquely upward directed.

In the figured specimen a somewhat smaller denticle is intercalated between the two largest proximal teeth. Therefore the distance between the first three proximal teeth is rather small compared with typical *Spongoserrula dehli*. Because only one specimen of this type is present, we assign this form to *Spongoserrula cf. dehli*. It may be, however, described as an independent subspecies, if more material can be found.

The forerunner of typical *Spongoserrula dehli* CORDEY et al., 1988 is known from the *Spongoserrula rarauana* Subzone of Hungary. In this form the first proximal spine is basally broad, but considerably shorter than the first proximal spine in *Spongoserrula dehli*, but also upside concave. The denticulation is similar to *Spongoserrula dehli* n. sp., but in this species the first proximal denticle is needle-like and straight.

***Spongoserrula antiqua* n. sp.**

(Pl. 14, Figs. 6,7)

Derivation of name: Stratigraphically oldest species of *Spongoserrula*.

Holotype: The specimen on Pl. 14, Fig. 6; rep.-no. KOMO 1994 IV-175

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRÄINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 5 specimens.

Diagnosis: Spongy shell with few, needle-like, short by-spines, irregularly distributed over the entire shell surface. Antapical polar spine needle-shaped, rather long. Main (apical) polar spine completely flattened, sickle-shaped. Straight stem above the shell very short or absent. Distal part of the polar spine moderately curved backwards.

Measurements:

Length of polar spine above the shell surface: 107–113 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 47–67 µm

Length of straight stem above the shell: 0–20 µm

Width of straight stem: 33–43 µm

Occurrence: Rare in the lower subzone (*Pterospungus priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: *Spongoserrula nuda* n. sp. displays a considerably longer straight portion of the polar

spine that is therefore considerably higher. Both species are completely undenticulated.

Spongoserrula falcata n. sp. displays a broader blade with undulated external margin. This species is the transition form between *Spongoserrula antiqua* n. sp. with completely smooth blade and denticulated typical *Spongoserrula* of the *S. rarauana* group.

In *Falcispongus* DUMITRICĂ, 1982 only the blade is flattened, whereas the spine remain circular in cross section. *Spongoserrula antiqua* n. sp. is therefore the link between *Falcispongus* and *Spongoserrula*.

***Spongoserrula bidentata* n. sp.**

(Pl. 5, Fig. 9; Pl. 12, Fig. 5)

1982 *Spongoserrula rarauana* n. sp., pars - DUMITRICĂ, p. 67, only the specimen on Pl. 7, Fig. 4

Derivation of name: According to the presence of two, rather long denticles at the external margin of the blade-like polar spine.

Holotype: The specimen on Pl. 5, Fig. 9; rep.-no. KOMO 1994 IV-41

Material: 7 specimens.

Diagnosis: Polar spine completely flattened, moderately broad, blade-like. Straight stem very short, with gradual transition to the blade-like broadened part of the polar spine. Heel-like lobe on the external margin of the proximal blade distinct, but not high. On the upper external margin of the blade two widely separated, diverging, flattened subcylindrical denticles with rounded or blunt ends are present. At the base of the moderately long, needle-like distal spine an undulation or small, rounded triangular lobe may be present, which corresponds to a third denticle. The terminal spine is moderately recurved and ends somewhat above the upper pole of the shell. Sometimes its distal end is upward curved.

Measurements:

Length of polar spine above the shell surface (without denticles): 141–176 µm

Maximum width of polar spine: 82–132 µm

Length of recurved part of the polar spine: 145–178 µm
Maximum length of denticles: 24–72 µm

Occurrence: *Spongoserrula rarauana* Subzone and lower *S. fluegeli* Subzone of *Muelleritortis cochleata* Zone (middle to early late Longobardian) of Romania, Hungary and Bosnia-Herzegovina.

Remarks: *Spongoserrula rarauana* DUMITRI-CĂ, 1982 displays 4–7 denticles in specimens with likewise broad blade and likewise long denticles.

***Spongoserrula bifurcata* n. sp.**
(Pl. 5, Figs. 4, 7; Pl. 13, Fig. 2)

Derivation of name: According to the bifurcated distal end of the polar spine.

Holotype: The specimen on Pl. 5, Fig. 7; rep.-no. KOMO 1994 IV-40

Material: 7 specimens.

Diagnosis: Spongy shell with several very small by-spines in the lower hemisphere. Antapical polar spine short, needle-like. Main (apical) polar spine completely flattened, broad to very broad, blade-like. Straight stem short. Heel-like lobe on the external margin of the proximal blade high. Three or four flattened subcylindrical denticles with rounded ends are present. Distal part of the polar spine very narrow, needle-like, moderately recurved. It ends in the level of the upper pole of the shell or a little above it. In its proximal part a short subtriangular spine or a shallow lobe is present. A second long, needle-like spine or short cylindrical spine branches off near the base of the terminal spine. This second terminal spine is either parallel to the stem or a little obliquely downward directed.

Measurements: See under the subspecies.

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: The only similar species is *Spongoserrula ornata* n. sp. This species is distinguished by the presence of three needle-like terminal spines. Moreover, the denticles have the form of partly bifurcated large lobes.

***Spongoserrula bifurcata bifurcata* n. subsp.**
(Pl. 5, Figs. 4, 7)

Holotype: = holotype of the species.

Material: 4 specimens.

Diagnosis: With the character of the species. There are 3 large denticles and a fourth small denticle on the proximal part of the outer terminal spine. The inner terminal spine is long and needle-like.

Measurements:

Length of polar spine above the shell surface (without denticles): 139–178 µm

Maximum width of polar spine: 106–128 µm

Length of straight stem above the shell surface: 44–50 µm

Length of recurved distal part of the polar spine: around 220 µm

Length of outer terminal spine: 160–166 µm

Length of inner terminal spine: 89–139 µm

Maximum length of denticles: 61–67 µm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: S

ee also under the species.

Spongoserrula bifurcata parvispina n. subsp. displays four denticles on the blade. The proximal part of the outer terminal spine has no denticle, but only a shallow lobe in the position of a denticle. The outer terminal spine is needle-like, but rather short. The inner terminal spine is very short, cylindrical.

***Spongoserrula bifurcata parvispina* n. subsp.**
(Pl. 13, Fig. 2)

Derivation of name: According to the very smaller inner terminal spine.

Holotype: The specimen on Pl. 13, Fig. 2; rep.-no. KOMO 1994 IV-160

Material: 3 specimens.

Diagnosis: With the character of the species. The stem is rather long for the genus. The blade bears

four denticles. On the base of the outer terminal spine lies a shallow lobe in position of a further denticle. The outer terminal spine is needle-like, but short. The inner terminal spine is very short and narrow-cylindrical.

Measurements:

Length of polar spine above the shell surface (without denticles): 169–192 μm

Maximum width of polar spine: 111–119 μm

Length of straight stem above the shell: 54–61 μm

Width of straight stem in its middle part: 62 μm

Length of recurved distal part of the polar spine: 269–308 μm

Length of outer terminal spine: 106–110 μm

Length of inner terminal spine: 29–32 μm

Maximum length of denticles: 62–69 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Spongoserrula bifurcata bifurcata* n. subsp. displays only three denticles on the blade, but a fourth one on the proximal part of the outer terminal spine. Outer and inner terminal spines are long and needle-like.

***Spongoserrula bipolaris* n. sp.**

(Pl. 6, Fig. 4; Pl. 12, Fig. 4)

Derivation of name: According to the bipolar arrangement of the two polar spines.

Holotype: The specimen on Pl. 6, Fig. 4; rep.-no. KOMO 1994 IV-44

Material: 12 specimens.

Diagnosis: Surface of the spongy shell with tiny spines and 1–3 very small, needle-like by-spines in the lower hemisphere. The antapical polar spine is long, needle-like, straight. The apical polar spine (main polar spine) is situated somewhat obliquely to the axis of the antapical polar spine. It is completely flattened, blade-like. In the widest part of the broad blade a rounded triangular to hemielliptical heel-like lobe is present on the external margin of the blade. The moderately recurved distal part of the main polar spine is needle-like, rather short. It ends in the level of the upper

pole of the shell or somewhat above it. The blade bears 3–4 denticles. The two proximal denticles are of nearly equal length. The following one is a little to distinctly shorter and the fourth denticle, if present, is always very small. The distal ends of the denticles are narrowly rounded, the two proximal denticles may be pointed, but not needle-like. The terminal spine-like end of the blade may display a little undulated external margin.

Measurements:

Diameter of shell: 107–130 μm

Length of main polar spine above the shell surface (without denticles): 143–207 μm

Maximum width of polar spine: 93–117 μm

Length of recurved part of the polar spine: 157–250 μm

Maximum length of denticles: 43–50 μm

Length of needle-like antapical polar spine: 243–257 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: Most similar is *Spongoserrula rarauana* DUMITRICĂ, 1982, especially species with subtriangular heel-like lobe on the external side of the proximal blade (Pl. 6, Figs. 2, 6). *S. rarauana* has, however, more denticles with blunt to rounded ends. The spongy shell displays several needle-like by-spines, often arranged in a bunch in the shell half opposite to the flattened polar spine. A needle-like antapical polar spine is absent.

***Spongoserrula cordeyi* n. sp.**

1984 *Spongoserrula rarauana* DUMITRICĂ, 1980 (sic!), pars – DE WEVER, p. 303, Pl. 1, Fig. 2 (?), 5 (most specimens are broken and indeterminable)

1988 *Spongoserrula rarauana* DUMITRICĂ – CORDEY et al., Pl. 1, Figs. 6, 7

Derivation of name: In honour of Dr. F. CORDEY, Vancouver

Holotype: The specimen figured in CORDEY et al. (1988, Pl. 1, Fig. 7 ; rep.-no. 85–311 (U.P.M.C. Paris))

Type locality: Southwest side of Harrison Lake, southern British Columbia, Canada (locality and sample data see CORDEY et al. (1988).

Type stratum: Siliceous argillite of the Camp Cove Formation, sample MV890. *Tritortis kretaensis* Zone.

Material: 43 broken specimens from the basal Cordevolian of Darnó-hegy area (locality and sample data see CORDEY et al. (1988)).
Diagnosis: Polar spine completely flattened to an unilateral sickle-shaped blade without separated stem above the shell surface. It is widest in its proximal third and becomes gradually narrower toward the distal end. No proximal lobe at the external margin. The 6–7 straight spines are proximally moderately long and their size gradually decreases toward the distal end of the blade. The spines are terminally needle-like, pointed, in the distal part of the blade more slender-triangular, but also pointed. The distance between the two proximal spines is considerably larger than the distances between the other spines.

Measurements:

Length of polar spine above the shell surface (without spines): 145–152 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 60–82 µm

Maximum length of spines: 50–74 µm

Occurrence: Common in the lower *Tritortis kretaensis* Zone of the Darnó-hegy area. *Tritortis kretaensis* Zone of British Columbia, Canada. This fauna was erroneously assigned to the Late Anisian-Early Ladinian by CORDEY et al. (1988), but *Tritortis kretaensis* (KOZUR & KRAHL, 1984) and *Spongoserrula* with pointed spines begin only in the late Longobardian and are still common in the Cordevolian *Tritortis kretaensis* Zone.

Remarks: As in the material figured by DE WEVER (1984) our radiolarian fauna from the Darnó-hegy consists mostly of broken specimens. All specimens of *Spongoserrula cordeyi* n. sp. are fragmentary. Therefore the holotype was chosen from the better preserved material figured by CORDEY et al. (1988).

Spongoserrula dehli CORDEY et al. (1988) displays considerably larger spines. The very large proximal spine is always upside concave.

In *Spongoserrula goricanae* n. sp. the distance between the spines is either equal on the entire blade or decreases gradually and slowly toward the distal end of the blade.

In *Spongoserrula fluegeli* n. sp. the proximal spine is distinctly longer than the following spines and the distances between the spines are either equal on the entire blade or decrease slowly and gradually toward the distal end of the blade. Moreover, the spines are generally more needle-like.

***Spongoserrula falcata* n. sp.**

(Pl. 5, Figs. 2, 3, 5, 6)

Derivation of name: According to the sickle-shaped polar spine.

Holotype: The specimen on Pl. 5, Fig. 2; rep.-no. KOMO 1994 IV-32

Material: 34 specimens.

Diagnosis: Spongy shell small, with tiny spines. Polar spine completely flattened, sickle-shaped, narrow for the genus. Its proximal portion is short, flat and wide, its distal portion is needle-shaped, short to moderately long, moderately recurved. It ends in the level of the upper part of the shell or somewhat above it. The external margin of the middle part of the polar spine is slightly undulated, but nodes or spines are missing.

Measurements:

Diameter of shell: 95–112 µm

Length of polar spine above the shell surface: 115–171 µm

Maximum width of polar spine: 50–62 µm

Length of recurved part of the polar spine: 135–205 µm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Spongoserrula falcata* n. sp. is a transition form between *Spongoserrula antiqua* n. sp. and *Spongoserrula trinodosa* n. sp. The first species has no undulations at the external margin of the polar spine. *Spongoserrula rarauana trinodo-*

sa n. subsp. has the same shape and degree of recurvation of the polar spine, but its external margin bears three nodes.

The straight proximal part of the polar spine in *S. nuda* n. sp. is longer and its distal end lies considerably above the shell. Moreover, this species displays a completely smooth outer margin of the blade without undulations.

***Spongoserrula fluegeli* n. sp.**

(Pl. 6, Figs. 5, 7, 8, 10, 11)

Derivation of name: In honour of o. Univ. Prof. Dr. HELMUT FLÜGEL, Graz.

Holotype: The specimen on Pl. 6, Fig. 8; rep.-no. KOMO 1994 IV-45

Material: More than 100 specimens.

Diagnosis: Spongy shell with two polar spines. The antapical one is small, needle-like, straight. The main (apical) polar spine is completely flattened, blade-like, on the external side with 7-8 long, slender spines; rarely on the inner side a spine is present opposite to the last spine on the outer side. The straight stem is short. The blade is relatively narrow, widest in its proximal third. Toward the distal side its width slowly and gradually decreases. Distal part of the main polar spine needle-like, considerably recurved, without spines on its external margin. Its distal end lies in the level of the lower part of the shell or a little below the shell. The proximal spine on the external side is very large, needle-like. It is very slightly to distinctly convex. It may be obliquely upward directed, perpendicular to the polar axis or downward-recurved. Occasionally a small denticle is present on its outer side above in the mid-length of the spine. The following spines are large, but considerably smaller than the proximal spine. They are very slender, partly needle-like, with long, needle-like tips. Their length decreases slowly toward the distal end of the blade. The distances between the spines decrease gradually and slowly toward the distal end of the blade or are nearly equal on the entire blade.

Measurements:

Diameter of shell: 100–125 μm

Length of polar spine above the shell surface (without spines): 100–125 μm

Maximum width of polar spine: 50–69 μm

Length of recurved part of the polar spine: 263–333 μm

Length of proximal spine: 130–225 μm

Maximum length of other spines: 83–100 μm

Occurrence: Common in the late Longobardian of the Tethys.

Remarks: Most similar is *Spongoserrula dehli* CORDEY et al., 1988. In this species the proximal spine is also distinctly larger than the other ones, but it is always obliquely upward directed and up-side concave. Moreover, there are fewer and wider separated spines on the external margin of the blade.

The *Spongoserrula fluegeli* group is the ancestral group of *Steigerispongos*. From the very large, convex and partly downward recurved proximal spine evolved in *Steigerispongos* a second, downward recurved blade with outer spines that is situated opposite to the primary recurved blade. In most species of *Steigerispongos*, this second blade is somewhat different from the primary recurved blade in form and its position to the stem. The beginning of this development is indicated in *Spongoserrula fluegeli multispinosa*, in which the big proximal spine displays a small denticle on its outer side. However, all *Steigerispongos* species have a long stem. Therefore, *Spongoserrula fluegeli* n. sp. is not the immediate ancestor of *Steigerispongos*, but rather a side branch, which indicates, however, the way, by which *Steigerispongos* evolved from *Spongoserrula*.

***Spongoserrula fluegeli fluegeli* n. subsp.**

(Pl. 6, Figs. 5, 7, 8, 11; Pl. 13, Fig. 4)

Holotype, measurements and occurrence: As for the species.

Diagnosis: With the character of the species. Proximal spine without secondary denticle on its

external margin. Without spine at the inner margin of the blade.

Occurrence: Common in the *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (late Longobardian) of the Tethys.

Remarks: See also remarks to the species.

Spongoserrula fluegeli multispinosa displays a small denticle on the outer (upper) margin of the proximal spine. Moreover, a spine is present on the inner margin of the blade opposite to the smallest, distal outer spine of the blade.

***Spongoserrula fluegeli multispinosa* n. subsp.**
(Pl. 6, Fig. 10)

Derivation of name: According to the numerous spines.

Holotype: The specimen on Pl. 6, Fig. 10; rep.-no. KOMO 1994 IV-49

Material: 2 specimens.

Diagnosis: With the character of the species. Proximal spine with a small denticle on its external (upper) margin about in the midlength of the spine. On the inner side of the blade a spine is present opposite to the smallest, distal spine on the exterior margin of the blade.

Measurements: As for the species.

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Spongoserrula fluegeli fluegeli* n. subsp. has no denticle on the external (upper) margin of the proximal spine and the inner margin of the blade has no denticle.

***Spongoserrula goricanae* n. sp.**
(Pl. 13, Fig. 1)

1991 *Spongoserrula rarauna* (sic !) DUMITRICĂ – DOSZTÁLY, Pl. 3, Fig. 1

Derivation of name: In honour of Dr. S. GORIČAN, Ljubljana.

Holotype: The specimen on Pl. 13, Fig. 1; rep.-no. KOMO 1994 IV-159

Material: 23 specimens.

Diagnosis: Spongy shell with long, needle-like antapical polar spine and few needle-like by-spines of different length in the lower hemisphere. Polar spine completely flattened, sickle-shaped. Blade widest at the end of the proximal third. Its width decreases slowly and gradually toward the pointed, distal end. Distal part rather strongly recurved. No lobe on the external margin of the proximal blade. The 6–8 denticles are slender, in their distal part needle-shaped, pointed or slender-triangular, saw-tooth shaped. The distal denticles are generally slender subtriangular. The first 2–4 denticles are largest, distally their length decreases. The distances between the denticles are in the proximal portion of the blade nearly equal and somewhat lower in the distal portion of the blade.

Measurements:

Diameter of spongy shell: 131–146 µm

Length of polar spine above the shell surface (without denticles): 132–231 µm

Maximum width of polar spine: 56–92 µm

Length of recurved part of the polar spine: 260–308 µm

Maximum length of denticles: 55–74 µm

Occurrence: Late Longobardian of Hungary and Bosnia-Herzegovina.

Remarks: *Spongoserrula rarauna* DUMITRICĂ, 1982 displays a broader blade with distinct heel-like lobe on the external margin of the proximal blade. The distal end of the denticles are blunt or broadly rounded.

In *Spongoserrula cordeyi* n. sp., the distance between the first two proximal denticles is by far larger than between the following denticles.

Spongoserrula fluegeli n. sp. displays longer spines. Especially the first proximal spine is very long and slightly to strongly convex.

Spongoserrula semicircularis n. sp. displays a semicircular blade, widest in its middle part. The proximal lobe is distinct. The triangular denticles are shorter and at least in the distal part inward-bent from the plane of the blade.

***Spongoserrula nuda* n. sp.**

(Pl. 9, Fig. 7)

Derivation of name: According to the completely missing spines or undulations on the external margin of the polar spine.

Holotype: The specimen on Pl. 9, Fig. 7; rep.-no. KOMO 1994 IV-31

Material: 3 specimens.

Diagnosis: Spongy shell small with slightly spiny surface. Polar spine sickle shaped, completely flat, rather narrow. There is a gradual, but very slow widening from the base to the bend of the polar spine and a likewise gradual, a little faster narrowing toward the needle-shaped distal end. The straight proximal part of the polar spine is rather long, with gradual transition to the curved part. The distal part of the polar spine is short and rather slightly recurved. Therefore the polar spine ends considerably above the level of the shell.

Measurements:

Diameter of spongy shell: 80–87 μm

Length of polar spine above the shell surface: 227–233 μm

Maximum width of polar spine: 53 μm

Length of recurved part of the polar spine: 164–167 μm

Remarks: *Spongoserrula nuda* n. sp. remembers in its shape of the polar spine to *Falcispongius* DUMITRICA, 1982. However, the entire polar spine is completely flattened to a rather narrow blade, whereas in all *Falcispongius* species the rounded primary spine is always recognizable near the inner side of a blade-like part.

Most similar is *Spongoserrula antiqua* n. sp. that has also a smooth external margin. Like in typical *Spongoserrula*, in *S. antiqua* n. sp. the stem is very short or absent.

***Spongoserrula ornata* n. sp.**

(Pl. 5, Fig. 1)

Derivation of name: According to the sculpture.

Holotype: The specimen on Pl. 5, Fig. 1; rep. no. KOMO 1994 IV-38

Material: 1 specimen.

Diagnosis: Polar spine completely flattened, very broad, blade-like. Stem short, relatively narrow. Heel-like lobe at the proximal external margin of the blade high. Two lobe-like, very broad teeth with blunt ends are present, the proximal one is distally bifurcated into two flattened subcylindrical denticles with blunt ends. There is no distal recurved part of the polar spine, but instead of them three long, needle-like teeth are present, from which the uppermost is obliquely upward directed, whereas the other two teeth are obliquely downward directed.

Measurements:

Length of polar spine above the shell surface (without teeth):

195 μm

Maximum width of polar spine: 167 μm

Length of straight stem above the shell surface: 55 μm

Length of proximal teeth: 39–44 μm

Length of needle-like distal spines: 56–106 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Spongoserrula bifurcata* n. sp. is the only similar species. However, it displays distally two long, obliquely downward-directed spines, one of them (the upper one) corresponds to the needle-like terminal recurved end of the polar spine in other *Spongoserrula* species. In the proximal part of this terminal spine a short outer spine is present, which is obliquely upward directed. If this spine will be prolonged to a long, needle-like spine, then this form would be nearly identical with *S. ornata*. It cannot be excluded that *S. ornata* is a pathological form, because only one specimen is present.

***Spongoserrula raridenticulata* n. sp.**

(Pl. 12, Fig. 1)

Derivation of name: According to the low number of denticles, unusual for species with pointed denticles.

Holotype: The specimen on Pl. 12, Fig. 1; rep.-no. KOMO 1994 IV-141

Material: 4 specimens.

Diagnosis: Polar spine completely flattened. Stem very short or absent. Blade relatively narrow, in the proximal half of nearly equal width, distally the width decreases slowly. Proximal lobe on the external margin indistinct. Distal end of the blade with short needle-like terminal spine. The 4 widely spaced denticles are short. Three of them are slender triangular, distally pointed, without distinct size differences. The second or the proximal denticle is somewhat longer than the other two denticles. The distal denticle is very low, broad, rounded, rather a small lobe.

Measurements:

Length of the polar spine above the shell surface (without denticles): 115–123 μm

Maximum width of the polar spine: 54–59 μm

Length of recurved part of the polar spine: 294–312 μm

Maximum length of denticles: 38–54 μm

Occurrence: Very rare in the early late Longobardian *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone at the type locality.

Remarks: All other *Spongoserrula* species of the *S. fluegeli* group with pointed or needle-like spines display a larger number of spines. *Spongoserrula rarauana trinodosa* n. subsp. and *S. bidentata* n. sp. of the *S. rarauana* group display few denticles, but all of them are rounded.

Spongoserrula semicircularis n. sp.

(Pl. 9, Fig. 3)

Derivation of name: According to the semicircular blade-like polar spine.

Holotype: The specimen on Pl. 9, Fig. 3; rep.-no. KOMO 1994 IV-43

Material: 4 specimens.

Diagnosis: Polar spine completely flattened, narrow blade-like, with semicircular outline. The blade is widest in its middle part and decreases slowly and gradual toward the needle-like distal part and very slowly and gradual toward the proximal

stem, which is very short and distinctly narrower than the blade. Distal part of polar spine strongly recurved, nearly parallel to the proximal stem. The distal end of the polar spine is situated about in the level of the central part of the shell. Heel-like lobe on the external margin of the proximal blade distinct, but rather small. The 5-6 denticles at the external margin of the blade are short, triangular, with pointed tips. The first 2 or 3 denticles have about the same length, the distally following denticles decreases in length, but their width at the base remains nearly constant.

Measurements:

Length of polar spine above the shell surface (without denticles): 167–172 μm

Maximum width of polar spine: 50–56 μm

Length of recurved part of the polar spine: 159–190 μm

Maximum length of denticles: 28–33 μm

Maximum length of denticles: 28–39 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: The polar spine of *Spongoserrula rarauana* DUMITRIČĂ, 1982 is not semicircular, displays a broader blade and the mostly larger denticles are distally blunt or rounded.

The polar spine of *Spongoserrula goricanæ* n. sp. is not semicircular, the denticles are larger and there is no heel-like lobe on the external margin of the proximal blade.

Genus *Paroertlispongus*

KOZUR & MOSTLER, 1981

Type species: *Paroertlispongus multispinosus* KOZUR & MOSTLER, 1981

Paroertlispongus lobatus n. sp.

(Pl. 7, Fig. 11)

Derivation of name: According to the lateral lobe on the polar spine.

Holotype: The specimen on Pl. 7, Fig. 11; rep.-no. KOMO 1994 IV-86

Material: 2 specimens.

Diagnosis: Spongy shell with one large, straight, needle-like polar spine that displays at the end of the proximal third a shallow, but distinct semielliptical lobe.

Measurements:

Diameter of shell: 92–100 µm

Length of polar spine (only in one specimen fully preserved): 280 µm

Width of polar spine in its proximal third: 8 µm

Width of lobate part of the polar spine: 16 µm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: Stratigraphic youngest known species of *Paroertlispongius*. *Paroertlispongius lobatus* n. sp. is distinguished from Anisian and Early Ladinian species of *Paroertlispongius* by the presence of a lobe on the straight, long, needle-like polar spine.

Genus *Bogdanella*

KOLAR-JURKOVŠEK, 1989 emend.

Type species: *Bogdanella trentana* KOLAR-JURKOVŠEK, 1989

Occurrence: Longobardian of southern Tethys.

Remarks: KOLAR-JURKOVŠEK (1989) placed in this genus all oertlispongiids with strongly curved spines. Beside the type species with corkscrew-like twisted polar spine, she assigned to this genus also *Oertlispongius* species with strongly, but simply recurved polar spines. *Bogdanella* is herein restricted to species with corkscrew-like apical polar spine. A short, needle-like antapical polar spine is often present, but may be replaced by a bunch of short, needle-like by-spines near the antapical pole.

Bogdanella KOLAR-JURKOVŠEK, 1989 is near related to *Oertlispongius* DUMITRICA, KOZUR & MOSTLER, 1980. Like in this genus, the primitive *Bogdanella precursor* n. sp. from the lower sub-

zone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone displays a long straight, distally slightly curved stem before the corkscrew-like twisted part, whereas this part is very short in the stratigraphically youngest *Bogdanella cordevolica* n. sp. In primitive forms there are two, in advanced forms three distinct turns.

***Bogdanella trentana* KOLAR-JURKOVŠEK, 1989**
(Pl. 7, Figs. 7–9, 12, 13)

1989 *Bogdanella trentana* n. g. n. sp. – KOLAR-JURKOVŠEK, p. 162, Fig. 3, no. 1

Description: Spongy shell with tiny spines and short, needle-like antapical polar spine. Main (apical) polar spine corkscrew-like twisted. The straight proximal part is short and followed by a very slight, partly indistinct turn and two or three large turns. The main polar spine is round to moderately flattened (circular to elliptical cross section).

Occurrence: Common in the *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (late Longobardian) of Slovenia and Bosnia-Herzegovina.

Remarks: In *Bogdanella bosniensis* n. sp. the second large turn is acute and the polar spine is in this level even a little recurved. After this turn the polar spine is rather broad and displays a distinct furrow.

In *Bogdanella cordevolica* n. sp. the straight proximal part is extremely short to nearly missing and also the first turn is very distinct.

***Bogdanella trentana balkanica* n. subsp.**
(Pl. 7, Figs. 7–9, 12, 13)

Derivation of name: According to the common occurrence in the Balkan region.

Holotype: The specimen on Pl. 7, Fig. 7; rep.-no. KOMO 1994 IV-88

Material: More than 100 specimens.

Diagnosis: With the character of the species. Straight stem short, with circular cross section.

First turn very indistinct. The following three large turns are in lateral view visible as large waves. Polar spine in the twisted part moderately flattened, with elliptical cross section.

Measurements:

Diameter of spongy shell: 80–100 μm

Length of polar spine: 275–360 μm

Maximum width of polar spine: 18–25 μm

Length of straight proximal part of polar spine: 35–80 μm

Length of twisted part of polar spine: 225–280 μm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: See also under the species.

According to KOLAR-JURKOVŠEK (1989) the cross section of the polar spine is circular. In *Bogdanella trentana balkanica* n. subsp. only the straight short proximal portion of the polar spine displays a circular cross section. The large twisted part of the main polar spine is moderately flattened and displays an elliptical cross section. Moreover, *Bogdanella trentana trentana* KOLAR-JURKOVŠEK, 1989, displays only two big turns.

***Bogdanella bosniensis* n. sp.**

(Pl. 7, Fig. 6)

Derivation of name: According to the occurrence in Bosnia-Herzegovina.

Holotype: The specimen on Pl. 7, Fig. 6; rep.-no. KOMO 1994 IV-87

Material: 4 specimens.

Diagnosis: Polar spine corkscrew-like twisted. In the proximal straight part the cross section of the polar spine is circular, in the very distal part oval, in the remaining parts the polar spine is moderately flattened. In lateral view the first turn of twisting is broadly rounded, the second one is acute with a slight backward recurving. The third turn is again broadly rounded. After the second turn the polar spine is rather broad, with a deep median furrow that becomes shallower and finally indistinct towards the distal end.

Measurements:

Length of polar spine: 233–253 μm

Length of straight proximal portion of polar spine: 50–53 μm

Length of twisted portion of polar spine: 183–200 μm

Maximum width of polar spine: 28–30 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Bogdanella trentana* KOLAR-JURKOVŠEK, 1989 has no acute turn in the polar spine and a median furrow is absent.

***Bogdanella cordevolica* n. sp.**

(Pl. 13, Fig. 12)

Derivation of name: According to the occurrence in the Cordevolian of Sicily.

Holotype: The specimen on Pl. 13, Fig. 12; rep.-no. KOMO 1994 IV-169

Material: 2 specimens.

Diagnosis: Spongy shell with tiny spines. Polar spine not flattened, with circular cross section. Straight proximal portion above the shell very short. All three turns large, in lateral view visible as large waves.

Measurements:

Diameter of spongy shell: 152–158 μm

Length of polar spine: 377–400 μm

Length of straight proximal portion of polar spine: 5–27 μm

Length of twisted portion of polar spine: 372–373 μm

Maximum width of polar spine: 31 μm

Occurrence: Very rare in the Cordevolian of the Sosio Valley area, Sicily.

Remarks: *Bogdanella trentana* KOLAR-JURKOVŠEK, 1989 displays a somewhat longer straight proximal part of the polar spine. The first turn is indistinct and only the following 2–3 turns are strong.

In *Bogdanella bosniensis* n. sp. the first turn is also strong, but the polar spine is broad in the distal half and displays there a median furrow.

***Bogdanella praecursor* n. sp.**

(Pl. 15, figs. 13-15)

1991 *Bogdanella trentana* KOLAR-JURKOVŠEK - DOSZTÁLY, Pl. 1, Fig. 4

Derivation of name: According to the ancestral position to the other known *Bogdanella* species.

Holotype: The specimen on Pl. 15, Fig. 13; rep.-no. KOMO 1994 IV-199

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 34 specimens.

Diagnosis: Spongy shell with a bunch of needle-like, very short by-spines around the antapical pole. Polar spine cork-screw-like twisted, with long straight proximal part and moderately long twisted part with two large turns, visible in lateral view as large waves. The entire polar spine has a circular cross section or it is slightly flattened around the first turn, where the cross section may be broadly elliptical.

Measurements:

Diameter of spongy shell: 106–142 µm

Length of polar spine: 282–383 µm

Length of straight proximal portion of polar spine: 88–133 µm

Length of twisted portion of polar spine: 188–233 µm

Maximum width of polar spine: 23–33 µm

Occurrence: Common in the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality. Rare in the middle Subzone (*Spongoserula rarauana* Subzone) of *M. cochleata* Zone (middle Longobardian) of Hungary.

Remarks: All other known *Bogdanella* species display a shorter straight part of the polar spine. Moreover, in *Bogdanella trentana balkanica* n. subsp., *B. bosniensis* n. sp. and *B. cordevolica* n. sp. three strong turns are present. In *Bogdanella trentana balkanica* n. subsp. the polar spine is moderately flattened and displays an elliptical cross section except the short straight proximal part with circular cross section. In *Bogdanella bosniensis* n. sp. the distal half of the polar spine is strongly flattened and displays a median furrow.

Genus *Gibberospongos* n. gen.

Type species: *Gibberospongos spinosus* n. gen. n. sp.

Derivation of name: According to the cylindrical or spine-like process.

Diagnosis: The spongy spherical shell displays a differentiated apical polar spine and several small needle-like by spines of irregular distribution. The polar spine is proximally blade-like widened. The original spine is included into the inner side of the blade, but partly not more recognizable. The distal part of the spine is long, needle-like and moderately to strongly recurved. At the distal external end of the blade a spine or a cylindrical appendage is present. Rarely this appendage starts somewhat distally of the blade. A second spine may be present in the proximal part of the blade.

Assigned species:

Gibberospongos spinosus n. gen. n. sp.

Gibberospongos bispinosus n. sp.

Gibberospongos kraineri n. sp.

Gibberospongos tichyi n. sp.

Occurrence: Common in the lower *Spongoserula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) of Bosnia-Herzegovina.

Remarks: *Gibberospongos* n. gen. has evolved from *Falcispongos transitus* n. sp. by development of one or two appendages on the blade-like part of the polar spine. It is seemingly restricted to the late Longobardian.

In *Spongoserula* DUMITRICĂ, 1982 the largest part of the polar spine is blade-like and the external margin displays several denticles or cylindrical appendages.

***Gibberospongos spinosus* n. gen. n. sp.**

(Pl. 8, Fig. 6; Pl. 9, Figs. 6, 9, 11, 12, 16, 18; Pl. 12, Fig. 15)

Derivation of name: According to the spine-like appendage of the blade.

Holotype: The specimen on Pl. 9, Fig. 9; rep.-no. KOMO 1994 IV-12

Material: More than 100 specimens.

Diagnosis: Straight stem of the polar spine short, rarely absent. Blade-like part of the polar spine elongated, rounded subrectangular. It is situated in prolongation of the stem or slightly oblique to it. External margin of the blade straight to slightly convex; inner margin straight to slightly concave. At the outer distal corner of the blade a spine is always present. This spine and the distal corner of the blade may be upward bent (Pl. 9, figs. 6, 11). The polar spine is included into the inner margin of the blade, but sometimes not well separable from the blade. The distal portion of the polar spine is needle-like and strongly recurved. This part of the polar spine is very long.

Measurements:

Length of straight stem of polar spine: 0–20 μm

Length of the blade-like part of the polar spine: 127–150 μm

Maximum width of the blade-like part of the polar spine: 50–75 μm

Length of recurved narrow part of the polar spine: 200–278 μm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Gibberospongus kraineri* n. sp. displays a cylindrical appendage at the distal outer end of the blade instead of a spine.

Gibberospongus bispinosus n. sp. displays a long, distally broadened, flat stem and an additional spine at the transition between the stem and the blade.

***Gibberospongus bispinosus* n. sp.**

(Pl. 9, Fig. 8)

Derivation of name: According to the presence of two spine-like appendages.

Holotype: The specimen on Pl. 9, Fig. 8; rep.-no. KOMO 1994 IV-19

Material: 4 specimens.

Diagnosis: Straight stem of the polar spine long, but only basally roundish. Its distal part is flat and blade-like widened. The blade-like part lies about in the

midst of the polar spine. Its transitions to the stem and to the recurved part of the polar spine are gradual. It has a straight external margin and a strongly concave inner margin. At the outer distal end of the blade a spine is present. A second long, slightly recurved spine is situated at the transition between the stem and the blade. It is directed in opposite direction to the distal end of the main spine. The recurved part of the polar spine is relatively short, in its proximal part rather broad and blade-like, flat. It tapers gradually to a needle-like distal part.

Measurements:

Length of straight stem of polar spine: 108–119 μm

Length of the blade-like part of the polar spine: 112–120 μm

Maximum width of the blade-like part of the polar spine: 69–73 μm

Length of recurved part of the polar spine: 155–167 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Gibberospongus bispinosus* n. sp. is clearly distinguished from all other *Gibberospongus* species by the form of the polar spine with two spines at the ends of the blade. Except the base of the stem and the distal end, the polar spine is blade-like without separation of spine and blade. By this character, *Gibberospongus bispinosus* is similar to *Spongoserrula* DUMITRICĂ, 1982. However, the spine at the distal outer end of the blade lies exactly in the same position as in the other *Gibberospongus* species.

In *Gibberospongus* cf. *bispinosus* that is probably a pathological form (only one specimen is present), the spine on the distal end of the blade is recurved and its distal end joins the proximal part of the terminal spine of the blade, where a further spine is situated.

***Gibberospongus kraineri* n. sp.**

(Pl. 8, Figs. 1; Pl. 9, Fig. 17)

Derivation of name: In honour of Doz. Dr. K. KRAINER, Innsbruck.

Holotype: The specimen on Pl. 9, Fig. 17; rep.-no. KOMO 1994 IV-2

Material: 23 specimens.

Diagnosis: The globular spongy shell displays one polar spine and several short, irregularly distributed needle-like by-spines. The polar spine widens immediately above the shell surface to a rounded, elongated subrectangular blade which is situated obliquely to the polar axis. The blade has a straight or convex outer, and a concave inner margin. At the outer part of the distal end of the blade a short cylindrical appendage is present. The spine is included into the inner margin of the blade. Its long recurved part is narrow and ends parallel to the centre of the shell.

Measurements:

Diameter of shell: 104–120 µm

Length of straight stem: 0–15 µm

Length of blade-like part of the polar spine: 95–117 µm

Maximum width of blade-like part of the polar spine: 53–61 µm

Length of recurved narrow part of the polar spine: 200–250 µm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: In *Gibberospongius tichyi* n. sp. the round, but rather narrow appendage does not branch off from the end of the blade, but from the basal part of the recurved spine.

In *Gibberospongius spinosus* n. sp. and in *G. bispinosus* n. sp. the appendages are spines.

Gibberospongius kraineri n. sp. is a transitional form between typical *Gibberospongius* with 1–2 spine-like appendages at the outer distal corner of the blade-like part of the polar spine, and *Falcispongius* without such appendages. Close relations exists to *Falcispongius transitus* n. sp., the ancestral form of *Gibberospongius*. In this species, there is a round distal widening of blade, but not yet an appendage. Rare transition forms between both species are present (*Falcispongius* cf. *transitus* n. sp., Pl. 8, Fig. 2). In these forms the distal expansion of the blade is almost as long as the cylindrical appendage of *Gibberospongius kraineri* n. sp., but

it is not yet separated from the blade to form an appendage at the outer distal corner.

***Gibberospongius tichyi* n. sp.**

(Pl. 9, Fig. 2)

Derivation of name: In honour of Prof. Dr. G. TICHY, Salzburg.

Holotype: The specimen on Pl. 9, Fig. 2; rep.-no. KOMO 1994 IV-20

Material: 3 specimens.

Diagnosis: Straight stem of the polar spine short. Blade wing-like, not much separated from the spine. Recurved part of the polar spine long, needle-shaped. On its basal part a perpendicular, cylindrical appendix is present.

Measurements:

Length of straight stem of polar spine: 11–17 µm

Length of blade-like part of the polar spine: 105–117 µm

Maximum width of blade-like part of the polar spine: 52–58 µm

Length of recurved part of the polar spine: 306–333 µm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Gibberospongius tichyi* n. sp., is distinguished from all other *Gibberospongius* species by the position of the cylindrical appendage at the base of the recurved part of the polar spine and not at the outer distal end of the blade.

Genus *Scutispongius* n. gen.

Type species: *Scutispongius tortilispinus* n. gen. n. sp.

Derivation of name: According to the shield-like blade of the polar spine.

Diagnosis: Spongy shell with few to numerous needle-like by-spines in the antapical hemisphere. A small needle-like antapical polar spine may be

present, but it is not distinctly larger than the by-spines. The main (apical) polar spine is very large. Straight stem always present, mostly long, partly broad, a little to completely flattened. Blade large, completely flattened, but in prolongation of the stem the primary polar spine may be still visible as an axial swelling. The blade is bilateral, mostly symmetrical, partly asymmetrical, rarely strongly asymmetrical. Its wings terminate on both sides in a needle-like spine. Only in the most primitive form, transitional to *Falcispongius* DUMITRICĂ, 1982, on one side the wing lacks a terminal spine. A partly twisted apical spine of different length is often present opposite to the stem. It may be cylindrical or completely flattened. External margin generally without denticles, but often with slight to strong undulations or lateral incisions. Long, needle-like denticles may be present only in very few aberrant forms.

Assigned species:

Scutispongius tortilispinus n. gen. n. sp.
Falcispongius rostratus DUMITRICĂ, 1982
Pterospongius rostratus rostratus (DUMITRICĂ, 1982)
Pterospongius rostratus incurvatus n. subsp.
Pterospongius rostratus parvispinus n. subsp.
Pterospongius undulatus DUMITRICĂ, 1982
Pterospongius bogdani KOLAR-JURKOVŠEK, 1989
Scutispongius bogdani bogdani (KOLAR-JURKOVŠEK, 1989)
Scutispongius bogdani ancoraeformis n. subsp.
Pterospongius aquilus DOSZTÁLY, 1991 nom. corr.
Scutispongius alienus n. sp.
Scutispongius baloghi n. sp.
Scutispongius bicornutus n. sp.
Scutispongius bituberosus n. sp.
Scutispongius cephalus n. sp.
Scutispongius dimitricai n. sp.
Scutispongius gackoensis n. sp.
Scutispongius ? gracilispinosus n. sp.
Scutispongius latus n. sp.
Scutispongius ? parvifolius n. sp.
Scutispongius ? parvifolius parvifolius n. subsp.
Scutispongius ? parvifolius postera n. subsp.
Scutispongius ploechingeri n. sp.
Scutispongius ploechingeri ploechingeri n. subsp.

Scutispongius ploechingeri lobatus n. subsp.

Scutispongius reschi n. sp.

Scutispongius sagittaeformis n. sp.

Scutispongius semifusus n. sp.

Occurrence: One of the most characteristic radiolarian genera of the Tethyan Longobardian, but still present in the Cordevolian.

Remarks: Within *Scutispongius* n. gen. two species groups can be observed. In one group, an apical spine of different shape and size is present and the external margin is distinctly undulated. The type species belongs to this group. In the other group, the external margin of the blade is smooth or slightly undulated. *Scutispongius bogdani* (KOLAR-JURKOVŠEK, 1989) is a typical representative of this latter group. There are all transitions between these two groups. Transition forms display mostly an undulation on one side and the apical end is pointed or displays a node-like apical prolongation as equivalent of the apical spine.

Pterospongius DUMITRICĂ, 1982 displays a distinct apical incision opposite to the stem. This genus is restricted to the lower and middle *Muelletortis cochleata* Zone. The smooth forms are morphologically similar to *Scutispongius*, but the presence of an incision opposite to the stem is a good distinctive feature. All transition forms between smooth *Pterospongius* DUMITRICĂ, 1982 and *Baumgartneria* DUMITRICĂ, 1982 of the *B. curvispina* group are known. On the contrary, *Scutispongius* evolved from *Falcispongius* DUMITRICĂ, 1982 (see below). The ancestors of the spined *Pterospongius* (type species *Pterospongius patrulei* DUMITRICĂ, 1982) are not known yet. They probably evolved from *Baumgartneria dimitricae* DOSZTÁLY, 1991, by developing a wider blade and more spines. In this case *Pterospongius* would be a natural unit, morphologically connected by the incision opposite to the stem. However, at the present stage of our knowledge, direct relations of the spined (type) *Pterospongius* to *Steigerispongius* n. gen. cannot be excluded, from which they are distinguished by the apical incision opposite to the stem. The stratigraphic succession of the forms favours the above mentioned close relations between the smooth and spined *Pterospongius* as originally assumed by DUMITRICĂ (1982).

Scutispongos n. gen. has evolved from *Falcispongos* DUMITRICĂ, 1982, to which a part of *Scutispongos* was placed by DUMITRICĂ (1982). The transitional form is *Scutispongos rostratus* (DUMITRICĂ, 1982). This species displays already a bilateral, but still strongly asymmetric shield-like blade. Only on one side a spined wing is present. The wing on the other side has no terminal spine. *Scutispongos rostratus* is therefore different from *Falcispongos*, in which only unilateral an unilateral polar spine is present. It is closer related to *Scutispongos*, but distinguished from typical *Scutispongos* by the asymmetric blade (rarely present in typical *Scutispongos*) and above all by the missing terminal spine at one of the wings. *S. rostratus* begins stratigraphically before the first typical *Scutispongos* species that are bilateral symmetric and display spined wings on both sides.

***Scutispongos tortilispinus* n. gen. n. sp.**

(Pl. 1, Figs. 7, 9–11; Pl. 8, Figs. 7, 8)

Derivation of name: According to the twisted, flattened apical spine.

Holotype: The specimen on Pl. 1, Fig. 11; rep.-no. KOMO 1994 IV-93

Material: More than 100 specimens.

Diagnosis: Spongy shell with numerous needle-like by-spines in the lower hemisphere. Around the antapical pole, these by-spines are moderately long, the remaining ones are short. Apical polar spine completely flattened, with shield-like, large, broad blade, which has two distinct, rather deep incisions above the wings. Blade above the incision distinctly larger than blade of the wings below the incision. Immediately below the incisions, on the proximal part of the wing, broad undulations or shallow nodes are present. Immediately above the incision an undulation or shallow node may be also present. Apical spine completely flattened, twisted, mostly with bifurcated or modified bifurcated apical end. Rarely the end of the apical spine is round or blunt. Often it is blunt with two short spines at the corners (modified bifurcated). The twisted margins of the flattened apical

spine are connected with the external margin of the blade which is in the apical half of the blade up-turned in the direction of the twisting (in opposite direction on the two sides of the blade). The wings end in moderately long, needle-like spines that are obliquely backward directed. Stem short to moderately long, in the upper part distinctly widened.

Measurements:

Diameter of shell: 100–110 µm

Length of polar spine above the shell surface (without apical spine): 200–220 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 109–146 µm

Length of straight stem above the shell: 60–88 µm

Width of straight stem in its middle part: 29–36 µm

Length of terminal spines of the wings: 105–167 µm

Length of apical spine: 20–47 µm

Occurrence: Very common in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongos undulatus* (DUMITRICĂ, 1982) displays a strongly and regularly undulated surface of the blade. The apical spine is cylindrical and represent the continuation of an axial cylindrical or flattened cylindrical elevation within the blade and stem.

Scutispongos latus n. sp. displays a flattened triangular, apically pointed spine that is not or only slightly twisted.

Scutispongos longispinosus n. sp. displays a very long, needle-like apical spine. The lateral incisions are situated somewhat above the midst of the blade. Therefore the upper part of the blade is smaller than the blade of the wings.

***Scutispongos rostratus* (DUMITRICĂ, 1982)**

(Pl. 15, Figs. 6–10, 12)

1982 *Falciformis* (sic!) *rostratus* n. sp., pars – DUMITRICĂ, p., 66, Pl. 3, Figs. 8, 9; Pl. 4, Figs. 2, 3 (?), 5, 6 (?); Pl. 5, Figs. 2 (?), 4 (?)

1982 *Falcispongos* sp. 1 – DUMITRICĂ, p. 67, Pl. 33, Fig. 7

1990 *Falcispongius rostratus* DUMITRICĂ, 1982 a
- GORIČAN & BUSER, p. 145, Pl. 3, Fig. 12

1991 *Falcispongius rostratus* DUMITRICĂ – DOSZ-
TÁLY, Pl. 1, Fig. 1

Material: More than 100 specimens.

Description: Spongy shell with several needle-like by-spines in the lower hemisphere. One of these by-spines is generally situated in the position of an antapical polar spine, but it is not larger than the other by-spines. Stem moderately long. Blade large, bilateral, but strongly asymmetric. At one side (primary blade), the wing ends rather invariably in a needle-like terminal spine that is obliquely backward directed, rarely strongly curved out of the blade's plane. At the other side (secondary blade) the wing is either rounded triangular with rounded end or blunt. In the latter case often a lobe with round, rarely blunt end is present. Between all these morphotypes transition forms are present during the entire stratigraphic range of the species. Rarely, the lobe may have a tiny terminal spine.

Occurrence: Early Longobardian *Budurovignathus hungaricus* conodont zone to middle subzone (*Spongoserula rarauana* Subzone) of *Muelleritortis cochleata* Zone (middle Longobardian). Common in the lower subzone (*Pterospongius priscus* Subzone) of *M. cochleata* Zone (early middle Longobardian). Romania, Slovenia, Hungary, Bosnia-Herzegovina.

S. rostratus (DUMITRICĂ, 1982) begins according to DUMITRICĂ (1982) in the lower Fassanian. However, from all his assumed Fassanian samples, *S. rostratus* was only reported from sample 78/1. In our material, *S. rostratus* is not present before the Longobardian and in our rich early and middle Fassanian samples with several thousands oertlispongiids, *S. rostratus* is never present. In our late Fassanian material this species was not found as well, but from this stratigraphic level we have only a few thousands radiolarians with only about 100 oertlispongiids.

Remarks: *Scutispongius rostratus* (DUMITRICĂ, 1982) is a transition form between *Falcispongius* DUMITRICĂ, 1982 and *Scutispongius* n. gen. Like in all *Scutispongius* species, the blade is bilateral. However, the blade is strongly asymmetric,

whereas most of *Scutispongius* species are bilateral symmetric or nearly symmetric. Exceptionally, also the blade of typical *Scutispongius* is strongly asymmetrical (*S. dimitricai* n. sp., *S. parvifolius* n. sp. and *S. reschi* n. sp.). In typical *Scutispongius*, also in forms with strongly asymmetric blade, both wings ends in needle-like spines. In *Scutispongius rostratus*, however, only at one side (primary blade) the wing ends in a needle-like terminal spine. At the other side, the wing ends rounded triangular, blunt or lobe-like with rounded end. In *Scutispongius rostratus minutispinus* n. subsp. a tiny spine is present at the end of the lobe. This form is a transition form to advanced *Scutispongius*.

Scutispongius rostratus rostratus
(DUMITRICĂ, 1982)

(Pl. 15, Figs. 6, 7, 10, 12)

1982 *Falciformis* (sic!) *rostratus* n. sp., pars –
DUMITRICĂ, p., 66, Pl. 3, Figs. 8, 9; Pl. 4,
Figs. 2, 3(?), 5, 6(?); Pl. 5, Figs. 2(?), 4(?)

1990 *Falcispongius rostratus* DUMITRICĂ, 1982 a
- GORIČAN & BUSER, p. 145, Pl. 3, Fig. 12

1991 *Falcispongius rostratus* DUMITRICĂ – DOSZ-
TÁLY, Pl. 1, Fig. 1

Material: More than 100 specimens.

Description: With the character of the species. Terminal spine of primary blade situated in the plane of blade and backward directed. Secondary blade without terminal spine, but otherwise variable in shape and size. The secondary blade is mostly triangular with rounded distal end. It may be also blunt or oblique, mostly with a lobe in the lower portion that ends roundish, rarely blunt. This lobe may gradually develop from the secondary blade or it is distinctly separated. Between all these different morphotypes transitions are present throughout the stratigraphic range of the sub-species.

Measurements:

Diameter of spongy shell: 120–127 µm

Length of polar spine above the shell surface:
219–237 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 127–140 µm

Length of straight stem above the shell: 80–100 µm

Width of straight stem in its middle part: 27–33 µm

Length of the terminal spine of the primary blade: 80–147 µm

Occurrence: Common in the lower and middle Longobardian. Peak occurrence in the lower subzone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian). So far only known from the European Tethys.

Remarks: See also under the species.

In *Scutispongius rostratus incurvatus* n. subsp. the terminal spine of the primary blade is strongly curved out the blade's plane.

In *Scutispongius rostratus minutispinus* n. subsp. the rather long lobe bears a tiny terminal spine.

***Scutispongius rostratus incurvatus* n. subsp.**
(Pl. 15, Fig. 8)

Derivation of name: According to the terminal spine of the primary blade that is strongly curved out of the blade's plane.

Holotype: The specimen on Pl. 15, Fig. 8; rep.-no. KOMO 1994 IV-196

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 2 specimens.

Diagnosis: With the character of the species. Terminal spine of primary blade strongly curved out of the blade's plane. Secondary blade large, rounded triangular.

Measurements:

Length of polar spine above the shell surface: 164–170 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 103–107 µm

Length of straight stem above the shell: 55–61 µm

Width of straight stem in its middle part: 23 µm

Occurrence: Very rare in the lower subzone (*Pterospongius priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: See also under the species.

The terminal spine of the primary blade of *Scutispongius rostratus rostratus* (DUMITRICĂ, 1982) lies in the plane of the blade.

***Scutispongius rostratus minutispinus* n. sp.**
(Pl. 15, Fig. 9)

1982 *Falcispongius* sp. 1 – DUMITRICĂ, p. 67, Pl. 33, Fig. 7

Derivation of name: According to the tiny terminal spine on the lobe.

Holotype: The specimen on Pl. 15, Fig. 9; rep.-no. KOMO 1994 IV-197

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: One specimen.

Diagnosis: With the character of the species. Blade strongly asymmetric. Primary curved spine well visible within the blade. Inner part of the blade narrow, outer part wide as typical for *S. rostratus*. Lobe long, obliquely backward directed, with blunt end that bears at the inner side a tiny terminal spine. The lobe is distinctly separated from the blade that has a vertical external margin above the lobe.

Measurements:

Diameter of spongy shell: 120–127 µm

Length of polar spine above the shell surface: 247 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 141 µm

Length of straight stem above the shell: 93 µm

Width of straight stem in its middle part: 30 µm

Length of terminal spine of the primary blade: 100 µm

Length of lobe: 100 µm

Length of terminal spine on the lobe: 20 μm

Occurrence: Very rare in the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: DUMITRICĂ (1982) figured a broken specimen which occur together with *Scutispongos rostratus* (DUMITRICĂ, 1982). He stated that this form belongs „undoubtedly to a different species.“ Our well preserved specimen can be rather regarded as subspecies of *Scutispongos rostratus* (DUMITRICĂ, 1982), but we cannot exclude that DUMITRICĂ (1982) was right in regarding this form as a independent species.

Scutispongos rostratus rostratus (DUMITRICĂ, 1982) has no terminal spine on the lobe that is terminally rounded.

Scutispongos rostratus minutispinus n. subsp. is a transition form from *S. rostratus* to advanced *Scutispongos* that have a terminal spine on both wings of the blade.

***Scutispongos undulatus* (DUMITRICĂ, 1982)**
(Pl. 1, Figs. 4–6)

1982 *Pterospongos undulatus* n. sp. – DUMITRICĂ, p. 69, Pl. 6, Fig. 6; Pl. 7, Figs. 1–3

Description: Polar spine flattened, spear-shaped, with axial cylindrical or slightly flattened cylindrical part that is prolonged in a cylindrical apical spine ending in a short, needle-like tip. External margin of the blade with 2–3 lobes. The wings end in short to moderately long, needle-like, obliquely backward directed spines. Stem moderately long, in its upper part considerably widened.

Occurrence: Common in the middle and late Longobardian of Romania, Hungary and Bosnia-Herzegovina. According to DUMITRICĂ (1982) this species was derived from the Cordevolian sample R 88. The Cordevolian age was determined by radiolarians. However, this sample has a typical oertlispongid fauna of the middle *Muelleritortis cochleata* Zone with *Falcispongos* ? *rostratus* DUMITRICĂ, *Spongoserrula*

rarauana DUMITRICĂ (typical specimens with rounded spines) and *Scutispongos undulatus* (DUMITRICĂ). In our material, this species is not present in the Cordevolian, but rare in the middle Longobardian and common in the late Longobardian.

Remarks: Already DUMITRICĂ (1982) stated that this species is not near related to the other *Pterospongos* species. It fits well into the new genus *Scutispongos*, but can be easily separated from the other *Scutispongos* species by the cylindrical apical spine in continuation of a cylindrical or slightly flattened cylindrical axial part within the otherwise completely flattened blade.

Scutispongos bogdani
(KOLAR-JURKOVŠEK, 1989)
(Pl. 3, figs. 13, 5, 10;
Pl. 4, Figs. 2, 4, 9; Pl. 8, Fig. 9)

1982 *Falcispongos* sp. 2 – DUMITRICĂ, p. 67, Pl. 4, Fig. 4

1989 *Pterospongos bogdani* n. sp. – KOLAR-JURKOVŠEK, p. 160–161, Fig. 3, no. 3

Description: Spongy shell in the lower hemisphere with several short, small, needle-like by-spines or with 1–2, long, needle-like spines near the antapical pole. Stem short or long. Blade subhemispherical to subhemielliptical. External margin smooth, rarely at the base of the wings with indistinct, shallow incision. Terminal spines of wings needle-like, moderately long to long, rarely rather short, obliquely backward directed.

Measurements: See under the subspecies.

Occurrence: Very common in the late Longobardian of Slovenia, Hungary, and Bosnia-Herzegovina.

Remarks: The type material is badly preserved. Therefore by-spines are not preserved.

DUMITRICĂ (1982) assigned a typical specimen of *Scutispongos bogdani* (KOLAR-JURKOVŠEK) to *Falcispongos* sp. 2. However, the bilateral symmetrical or nearly symmetrical shield-like blade with two wings ending in long needle-like termi-

nal spines excludes this form from *Falcispongius* DUMITRICĂ, 1982.

KOLAR-JURKOVŠEK (1989) assigned *Scutispongius bogdani* (KOLAR-JURKOVŠEK, 1989) to *Pterospongius* DUMITRICĂ (1982). However, all *Pterospongius* species display a distinct apical incision opposite to the stem and the type species displays additionally a distinct denticulation of the external margin.

Scutispongius ploechingeri n. sp. displays a subtriangular shield with distinct undulation at least on one side of the shield. *Scutispongius* cf. *bogdani bogdani* (KOLAR-JURKOVŠEK) displays a rounded subtriangular shield with slight undulations on both sides. It is a transition form between *S. bogdani* and *S. ploechingeri*.

Scutispongius baloghi n. sp. displays a node-like, rounded triangular prolongation at the apical end. The distal part of the backward directed terminal spines of the wings are inward curved and join the shell, partly also the stem or they end immediately beside the shell.

Most similar is *Scutispongius semifusus* n. sp., but in this species the shield is subtriangular and one of the terminal wing spines join the shell.

Two subspecies can be discriminated.

Scutispongius bogdani bogdani
(KOLAR-JURKOVŠEK, 1989)
(Pl. 3, Figs. 1, 2, 5, 6; Pl. 4, Fig. 2)

1982 *Falcispongius* sp. 2 – DUMITRICĂ, p. 67, Pl. 4, Fig. 4

1989 *Pterospongius bogdani* n. sp. – KOLAR-JURKOVŠEK, p. 160–161, Fig. 3, no. 3

Holotype: = holotype of the species.

Material: More than 100 specimens.

Diagnosis: With the character of the species. Stem short. Spongy shell with several small, needle-like by-spines near the lower hemisphere.

Measurements:

Diameter of spongy shell: 100–111 μm

Length of polar spine above the shell surface: 167–222 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 111–161 μm

Length of straight stem above the shell: 56–77 μm

Width of straight stem in its middle part: 25–28 μm

Length of terminal spines of the wings: 106–200 μm

Occurrence: Very common in the late Longobardian of the Tethys.

Remarks: See also under the species.

Scutispongius bogdani ancoraeformis n. subsp. is distinguished by a longer stem. Moreover, the spongy shell is rather small and displays 1–2 long, needle-like spines situated near the antapical pole.

***Scutispongius bogdani ancoraeformis* n. subsp.**
(Pl. 3, Figs. 3; 10; Pl. 4, Figs. 4, 9)

Derivation of name: According to the anchor-shaped polar spine.

Holotype: The specimen on Pl. 4, Fig. 9; rep.-no. KOMO 1994 IV-109

Material: More than 50 specimens.

Diagnosis: With the character of the species. Spongy shell with 1–2 long needle-like by-spines near the antapical pole. Stem of the polar spine long. Blade narrow to moderately wide, external margin with 1–2 slight undulations.

Measurements:

Diameter of shell: 83–106 μm

Length of polar spine above the shell surface: 170–207 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 83–100 μm

Length of straight stem above the shell: 100–117 μm

Width of straight stem in its middle part: 20–23 μm

Length of terminal spines of the wings: 65–105 μm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongus bogdani bogdani* (KOLAR-JURKOVŠEK, 1989) has a shorter stem, the shield-like blade is in average higher, weak undulations are only exceptionally present.

***Scutispongus alienus* n. sp.**
(Pl. 7, Fig. 3)

Derivation of name: According to the presence of lateral spines on the blade, unusual for *Scutispongus*.

Holotype: The specimen on Pl. 7, Fig. 3; rep.-no. KOMO 1994 IV-116

Material: One specimen.

Diagnosis: Polar spine completely flattened. Stem long. Blade large, subtriangular, with a deep incision on both sides. At one side below and above the incision two needle-like, very large spines are present. They are laterally curved and reach until the opposite margin of the blade (lower spine) and somewhat beyond this margin (upper spine) respectively. Apical horn pointed, slightly twisted. Terminal spines of the wings needle-like, long.

Measurements:

Length of polar spine above the shell surface (without apical spine): 250 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 144 µm

Length of straight stem above the shell: 100 µm

Width of straight stem in its middle part: 28 µm

Length of terminal spines of the wings: 139 µm

Length of apical spine: 22 µm

Occurrence: One specimen in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongus latus* n. sp. displays a triangular apical spine and no other spines on the external margin of the blade.

Scutispongus longispinosus n. sp. displays a very long needle-like apical spine and no spines on the external margin of the blade.

It cannot be excluded that *Scutispongus alienus* n. sp. is a pathological form. However, also according to the form of the apical spine it is different from other known *Scutispongus* species.

***Scutispongus baloghi* n. sp.**
(Pl. 4, Figs. 5, 10)

Derivation of name: In honour of Dr. Z. BALOGH, Innsbruck, who prepared the SEM photos of this paper.

Holotype: The specimen on Pl. 4, Fig. 5; rep.-no. KOMO 1994 IV-114

Material: 4 specimens.

Diagnosis: Spongy shell slightly spiny, by-spines not preserved. Stem moderately long to long. Blade narrow to high, with rounded triangular, node-like apical prolongation and at least at one side with distinct apical shoulder that may be slightly elevated. Terminal spines of the wings long, strongly backward and distally somewhat inward curved. Their ends join the upper part of the shell or the lower part of the stem or ends a little outside the shell surface.

Measurements:

Diameter of shell: 86–91 µm

Length of polar spine above the shell surface (without apical spine): 159–200 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 64–118 µm

Length of straight stem above the shell: 82–105 µm

Width of straight stem in its middle part: 18–29 µm

Length of terminal spines of the wings: 118–159 µm

Length of apical prolongation: 18–29 µm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: In *Scutispongus semifusus* n. sp. only one terminal spine of the two wings join the upper shell or basal stem, whereas the other one is obliquely backward directed and ends far away from the shell.

Scutispongus bicornutus n. sp.
(Pl. 12, Fig. 12)

Derivation of name: According to the two short horns at the ends of the strongly inward-curved apical part of the blade.

Holotype: The specimen on Pl. 12, Fig. 12; rep.-no. KOMO 1994 IV-152

Material: 2 specimens.

Diagnosis: Polar spine completely flattened. Only the basal part of the stem is not or only slightly flattened. Stem relatively short, proximally narrow, distally rapidly widening. Blade large, asymmetrical. On one side a long, needle-like terminal spine of the wing is present. On the other side the wing ends in a rounded triangular, backward directed lobe. Apical portion of the blade strongly inward bent. At the ends of this inward bent portion two short apical horns are present.

Measurements:

Length of polar spine above the shell surface (without apical horns): 231–254 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 138–154 μm

Length of straight stem above the shell: 92–100 μm

Width of straight stem in its middle part: 42–46 μm

Length of terminal spine of spined wing: 215–154 μm

Length of apical horns: 9–23 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: The apical incision is a “pseudo-incision”, caused by the inward bent of the apical portion of the blade. It has nothing to do with the real apical incision of then *Pterospongus* blade.

Most similar is *Scutispongus rostratus* DUMITRICA, 1982. However, in this stratigraphically older species the apical part is not inward bent and apical horns are absent.

Scutispongus bituberosus n. sp.
(Pl. 11, Fig. 9)

Derivation of name: According to the two nodes on the shoulder.

Holotype: The specimen on Pl. 11, Fig. 9; rep.-no. KOMO 1994 IV-117

Material: 2 specimens.

Diagnosis: Spongy shell with few small, needle-like by-spines, one of them in position of an antapical polar spine. Polar spine completely flattened, except the stem, that is cylindrical in its lower part and marginally flattened in its upper part. Blade of polar spine completely flattened, rather low, with two distinct shoulders that bears shallow, triangular node-like swellings. The central part of the blade displays a shallow, semielliptical elevation. Terminal spines of the wings needle-like, long, obliquely backward directed.

Measurements:

Diameter of shell: 123–131 μm

Length of polar spine above the shell surface: 204–208 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 77–92 μm

Length of straight stem above the shell: 115 μm

Width of straight stem in its middle part: 27–29 μm

Length of terminal spines of the wings: 138–177 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: There are 4 species with shoulders in *Scutispongus*, *S. aquilus* (DOSZTÁLY, 1991), *S. baloghi* n. sp., *S. bituberosus* n. sp. and *S. cephalus*. *S. aquilus* displays a long, laterally bent apical spine and a rather short stem. *S. baloghi* displays a short, rounded triangular apical denticle and the terminal spines of the wings are backward and distally inward curved to join the shell or the basal part of the stem. Near related to *S. bituberosus* is seemingly *S. cephalus*. In this species the shallow, semielliptical blade above the shoulder is strongly enlarged to a large, mushroom-like blade.

Scutispongus cephalus n. sp.
(Pl. 11, Fig. 13; Pl. 12, Fig. 9)

Derivation of name: According to the head-like shape of the blade above the deep incisions.

Holotype: The specimen on Pl. 12, Fig. 9; rep.-no. KOMO 1994 IV-119

Material: 4 specimens.

Diagnosis: Polar spine flattened and blade-like, but in the stem an eccentric, axial, subcylindrical swelling may be present. The wings are narrow, with a distinct shoulder on one or both sides that bear a terminal shallow swelling. Terminal spine of wings large, strongly backward curved, needle-like. Its distal part lies parallel to the stem. On both sides a deep incision is present above the wings. The blade above the wings is inflated mushroom-shaped.

Measurements:

Length of polar spine above the shell surface: 233–242 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 127–162 μm

Length of straight stem above the shell: 110–131 μm

Width of straight stem in its middle part: 33–38 μm

Length of terminal spines of the wings: 140–192 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: Near related to *Scutispongus bituberosus* n. sp., that is distinguished by the small, shallow, semielliptical blade above the shoulders.

Scutispongus dimitricai n. sp.

(Pl. 4, Figs. 11)

Derivation of name: In honour of Dr. P. DUMITRI-CĂ, Bern

Holotype: The specimen on Pl. 4, Fig. 11; rep.-no. KOMO 1994 IV-120

Material: 3 specimens.

Diagnosis: Spongy shell slightly spiny, with few very short by-spines in the lower hemisphere. Polar spine completely flattened, with moderately long stem and bilateral, asymmetric blade. One wing of the blade begins considerably higher at the stem than the other wing. The terminal spine of the wings is at one side long and strongly backward curved, on the other side relatively short and

obliquely backward directed. Above one wing, there is a deep incision and the proximal end of this wing has a shoulder. On the other side no incision is present. The main blade lies opposite to the stem and is also asymmetric.

Measurements:

Diameter of shell: 89–94 μm

Length of polar spine above the shell surface: 178–183 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 107–111 μm

Length of straight stem above the shell: 78–89 μm

Width of straight stem in its middle part: 22 μm

Length of terminal spines of the wings: 83–111 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongus reschi* n. sp. is distinguished by the presence of an apical spine and by different shape of the blade.

Scutispongus gackoensis n. sp.

(Pl. 12, Fig. 7)

Derivation of name: According to the occurrence in the Gacko area, Bosnia-Herzegovina.

Holotype: The specimen on Pl. 12, Fig. 7; rep.-no. KOMO 1994 IV-147

Material: 3 specimens.

Diagnosis: Polar spine completely flattened. Stem relatively short, in the upper part very broad with gradual transition into the moderately large blade. External side of the blade at one or both sides with a shallow lobe. Apical spine broad, triangular, lobe-like with gradual transition to the blade. Terminal spine of the wings moderately long, needle-like, obliquely backward directed.

Measurements:

Length of polar spine above the shell surface: 221–227 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 128–138 μm

Length of straight stem above the shell: 80–87 μm

Width of straight stem in its middle part: 63–67 μm
Length of terminal spines of the wings: 93–113 μm
Length of apical spine: 33–37 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongus latus* n. sp. displays a narrower stem, the apical spine is narrower and distinctly separated from the blade that displays at one or (mostly) at both sides a deep incision and large lobes.

Scutispongus ploechingeri n. sp. displays a rather indistinct apical lobe instead of an apical spine. The stem is much narrower than in *S. gackoensis*.

Scutispongus baloghi n. sp. displays a similar lobe-like apical spine and a similar blade, but the terminal spines of the wings are strongly backward and inward curved and join at least at one side the spongy shell or the basal part of the stem.

***Scutispongus ? gracilispinosus* n. sp.**
(Pl. 7, Fig. 2; Pl. 12, Fig. 11)

Derivation of name: According to the delicate, needle-like apical spines.

Holotype: The specimen on Pl. 7, Fig. 2; rep.-no. KOMO 1994 IV-115

Material: 3 specimens.

Diagnosis: Polar spine completely flattened. Stem moderately long, rapidly widening in its upper part. Blade large, with shallow to deep lateral incision at one or both sides. Two laterally curved, needle-like, long apical spines are situated opposite to the stem in a short distance from each other. Between these two apical spines the blade may be slightly incised. A third needle-like, side-ward-directed spine may be present or in this position the shell is inward curved.

Measurements:

Length of polar spine above the shell surface (without apical spine): 178–262 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 100–154 μm

Length of straight stem above the shell: 89–95 μm
Width of straight stem in its middle part: 27–30 μm
Length of terminal spines of the wings: 139–165 μm
Length of apical spines: 78–131 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: 3 specimens with similar, laterally curved, needle-like apical spines are present. For this reason, it is not a pathological form. In the holotype one of the terminal spines of the wings is partly disintegrated into two needle-like spines. This is a pathological feature.

***Scutispongus latus* n. sp.**
(Pl. 1, Figs. 1–3; Pl. 11, Fig. 12)

Derivation of name: According to the broad blade.

Holotype: The specimen on Pl. 1, Fig. 1; rep.-no. KOMO 1994 IV-123

Material: More than 100 specimens.

Diagnosis: Surface of spongy shell spiny, with several rather long, needle-like by-spines in the lower hemisphere. One of them lies in the position of an antapical polar spine, but is not larger than the other by-spines. Apical polar spine completely flattened. Stem relatively short. Blade large and wide, with a distinct, rarely indistinct incision above the wings. Apical spine triangular, pointed, sometimes insignificantly twisted. Terminal spines of wings needle-like, mostly moderately long, obliquely backward-directed.

Measurements:

Diameter of shell: 83–87 μm

Length of polar spine above the shell surface (without apical spine): 195–260 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 119–170 μm

Length of straight stem above the shell: 75–100 μm

Width of straight stem in its middle part: 20–31 μm

Length of terminal spines of the wings: 90–130 μm

Length of apical spine: 35–62 μm

Occurrence: Very common in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: In *Scutispongus latus* n. sp. the number of pathological forms is rather high (about 1–2 per 100 specimens). Especially frequent is the splitting of spines or spine-like parts of the completely flattened polar spine in 2–3 needle-like spines. In *Scutispongus* cf. *latus* n. sp. (Pl. 4, Fig. 3) a very narrow, needle-like spine is present parallel to the stem. In a pathological *S. latus* n. sp. (Pl. 11, Fig. 12) one of the terminal spines of the wings is subdivided into two needle-like spines.

Scutispongus undulatus (DUMITRICĂ, 1982) is distinguished by the cylindrical apical spine in prolongation of an axial cylindrical elevation within the blade and stem. Moreover, the margin of the blade is stronger undulated.

Scutispongus tortilispinus n. sp. displays a strongly twisted apical spine.

Scutispongus longispinosus n. sp. displays a very long, needle-like apical spine.

***Scutispongus longispinosus* n. sp.**
(Pl. 1, Fig. 8)

Derivation of name: According to the very long apical spine.

Holotype: The specimen on Pl. 1, Fig. 8; rep.-no. KOMO 1994 IV-127

Material: 3 specimens.

Diagnosis: Polar spine completely flattened. Stem long, narrow. Blade moderately large, subtriangular with two deep incisions above the large wings. That portion of the blade lying above the wings is a little smaller than or of the same size as the wings. Apical spine very long and except its very base needle-like. Terminal spines of wings needle-like, moderately long.

Measurements:

Length of polar spine above the shell surface (without apical spine): 200–212 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 91–97 μm

Length of straight stem above the shell: 103–109 μm

Width of straight stem in its middle part: 24 μm

Length of terminal spines of the wings: 84–103 μm

Length of apical spine: 127–133 μm

Occurrence: Very rare in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongus longispinosus* n. sp. is distinguished by its very long apical spine from all other *Scutispongus* species.

***Scutispongus mocki* n. sp.**
(Pl. 13, Fig. 10)

1984 *Baumgartneria stellata* DUMITRICĂ, 1980 (sic!) – DE WEVER, p. 304, Pl. 1, Fig. 1

Derivation of name: In honour of Dr. R. MOCK, Bratislava.

Holotype: The specimen on Pl. 13, Fig. 10; rep.-no. KOMO 1994 IV-168

Type locality: Outcrop along a road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy).

Type stratum: Sample RW 13. Reddish limestone with late Cordevolian radiolarians and conodonts.

Material: 2 specimens.

Diagnosis: Polar spine completely flattened. Stem long, slender. Blade semicircular to rounded subtriangular. Terminal spines of the wings moderately long, distally needle-like. Margin of the blade smooth, except a slender triangular, distally needle-like apical spine.

Measurements:

Length of polar spine above the shell surface (without apical spine): 240–251 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 131–154 μm

Length of straight stem above the shell: 96–112 μm

Width of straight stem in its middle part: 29–31 μm

Length of terminal spines of the wings: around 160 μm (not fully preserved)

Length of apical spine: 38–40 μm

Occurrence: Very rare in the late Cordevolian at the type locality. Longobardian-Cordevolian boundary beds of the Darnó-hegy (northern Hungary).

Remarks: The blade of the polar spine is very similar to that of *Scutispongus bogdani ancoraeformis* n. subsp. which displays, however, no apical spine.

The specimen assigned by DE WEVER (1984) to *Baumgartneria stellata* DUMITRICĂ, 1982, corresponds to the new *Scutispongus* species. This form is not related to *Baumgartneria stellata* that displays terminally forked branches, whereas the form figured by DE WEVER (1984) displays an obliquely backward directed terminal spine on the wing of a bilateral blade. The sample H 198 was derived from a level above well dated latest Longobardian and below conodont proven Cordevolian. This level is already dominated by *Tritortis kretaensis kretaensis* (KOZUR & KRAHL, 1984) assigned to *Sepsagon longispinosus* ? (KOZUR & MOSTLER) and *Eptingium manfredi* DUMITRICĂ? by DE WEVER (1984). *Muelleritortis cochleata* (NAKASEKO & NISHIMURA, 1979) assigned by DE WEVER to *Plafkerium* sp. is very subordinate in this level that belongs to the *Tritortis kretaensis* Zone. Our material from this level contains conodonts that belong mostly to *Paragondolella foliata* BUDUROV that is common in the lower Cordevolian, but begins in the latest Longobardian. Transition forms to *Paragondolella tadpole* (HAYASHI) are common. This indicates rather earliest Cordevolian age.

***Scutispongus* ? *parvifolius* n. sp.**

(Pl. 13, Fig. 6; Pl. 14, Fig. 15)

Derivation of name: According to the small blade.

Holotype: The specimen on Pl. 13, Fig. 6; rep.-no. KOMO 1994 IV-164

Material: 13 specimens.

Diagnosis: Polar spine completely flattened, but the proximal portion of the long, narrow stem is only slightly flattened. Blade small, bilateral, but asymmetric. It is situated obliquely to the polar axis and at one side distinctly higher than at the other side. One wing begins considerably higher

than the other one. At the side with the upper wing the blade may be rudimentary. External margin of the blade smooth. Terminal spines of the wings moderately long to long, needle-like, at different angle obliquely backward directed.

Measurements: See under the subspecies.

Occurrence: Rare in the lower subzone (*Pterospongus priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) and in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian). Southern Alps and Bosnia-Herzegovina. **Remarks:** *Scutispongus bogdani ancoraeformis* n. subsp. displays often a similar small blade that is, however, bilaterally symmetrical.

Scutispongus reschi n. sp. displays a similar small and asymmetric blade, but it displays an eccentric apical spine and a distinct incision between the blade and one of the terminal spines.

Despite the similarity with *Scutispongus* of the *S. bogdani* group, the assignment of *Scutispongus* ? *parvifolius* n. sp. to this genus is not sure. Whereas typical *Scutispongus* evolved from *Falcispongus* DUMITRICĂ, 1982 through the transition form *Scutispongus rostratus* (DUMITRICĂ, 1982), the derivation of *Scutispongus* ? *parvifolius* n. sp. is not clear. A derivation from the *Baumgartneria curvispina* group cannot be excluded for *Scutispongus* ? *parvifolius primitivus* n. subsp. that is similar to *Baumgartneria curvispina* DUMITRICĂ, 1982, with small subtriangular blade above the stem. In this case *Scutispongus* ? *parvifolius* would be closer related to *Pterospongus* than to *Scutispongus*. However, *Baumgartneria curvispina* displays a bilateral symmetric polar spine. Because of the asymmetric blade of *Scutispongus* ? *parvifolius*, a derivation from *Falcispongus* DUMITRICĂ, 1982, cannot be excluded.

***Scutispongus* ? *parvifolius parvifolius*
n. subsp.**

(Pl. 13, Fig. 6)

Holotype: = holotype of the species.

Material: 3 specimens.

Diagnosis: With the character of the species. Asymmetric blade on both sides well-developed, but at the side with the upper wing somewhat smaller than at the other side. Terminal spines of both wings moderately backward directed.

Measurements:

Length of polar spine above the shell surface: 200–221 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 91–104 μm

Length of straight stem above the shell: 97–109 μm

Width of straight stem in its middle part: 20 μm

Length of terminal spines of the wings: around 160 μm (not fully preserved)

Occurrence: Very rare in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: See also under the species.

The blade of *Scutispongos ? parvifolius primitivus* n. subsp. is at the side of the upper wing very small and the terminal spine of the upper wing is only slightly backward directed.

Scutispongos ? parvifolius primitivus n.
subsp.

(Pl. 14, Fig. 15)

Derivation of name: According to the very primitive character for the genus *Scutispongos*.

Holotype: The specimen on Pl. 14, Fig. 15; rep.-no. KOMO 1994 IV-205

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRÄINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 10 specimens.

Diagnosis: With the character of the species. Blade very small for the genus. Terminal spine of the upper wing only slightly backward directed. Terminal spine of the lower wing moderately backward directed. At the side of the upper wing, the blade is only rudimentary.

Measurements:

Length of polar spine above the shell surface: 180–187 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 75–81 μm

Length of straight stem above the shell: 107–115 μm

Width of straight stem in its middle part: 21–23 μm

Length of terminal spines of the wings: >100 μm (not fully preserved).

Occurrence: Rare in the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: See also under the species.

Scutispongos ? parvifolius parvifolius n. subsp. displays a larger blade that is also at the side of the upper wing well developed. The terminal spines of the wings are stronger backward directed.

Scutispongos ploechingeri n. sp.

(Pl. 3, Figs. 4, 9, 11; Pl. 4, Figs. 7, 8)

Derivation of name: In honour of Prof. B. PLÖCHINGER, Mödling.

Holotype: The specimen on Pl. 3, Fig. 9; rep.-no. KOMO 1994 IV-128

Material: More than 100 specimens.

Diagnosis: Spongy shell with few, relatively long, needle-like by-spines in the lower hemisphere, partly with needle-like antapical polar spine and short needle-like by-spines in the lower hemisphere. Apical (main) polar spine completely flattened. Stem moderately long to long, partly in its upper part rather wide. Blade large, broad, subtriangular, symmetrical or asymmetrical. Different deep, mostly shallow incisions are present on both sides, rarely only on one side of the blade. Apical end narrowly rounded to acute, but not pointed, partly somewhat separated to form a distinct to indistinct, rounded triangular, rarely triangular lobe that is often inward-bent. Inner sides of one wing or stem may display a large lobe.

Measurements: See under the subspecies.

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Scutispongos bogdani* KOLAR-JURKOVŠEK (1989) displays a broadly rounded apical end of the mostly subsemicircular blade. Incisions, if present at one side of the blade, are always very shallow and indistinct.

Scutispongos sagittaeformis n. sp. displays a arrow-like polar spine with triangular, apically pointed blade.

Scutispongos ploechingeri ploechingeri
n. subsp.

(Pl. 3, Figs. 4, 9, 11)

Holotype: = holotype of the species.

Material: More than 100 specimens.

Diagnosis: With the character of the species. Spongy shell with two relatively large and one or two smaller, needle-like by-spines. One of the larger by-spines may be in the position of an antapical polar spine. Blade mostly bilateral symmetrical, rarely slightly asymmetrical. Apical end narrowly rounded to acute, with rounded triangular, rarely triangular lobe. Inner sides of wings or stem without lobe.

Measurements:

Diameter of shell: 90–125 μm

Length of polar spine above the shell surface : 214–250 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 135–145 μm

Length of straight stem above the shell: 95–115 μm

Width of straight stem in its middle part: 20–35 μm

Length of terminal spines of the wings: 125–133 μm

Occurrence: Common in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: See also under the species.

Scutispongos ploechingeri lobatus n. subsp. displays an asymmetrical blade without apical lobe.

Scutispongos ploechingeri lobatus

n. subsp.

(Pl. 4, Figs. 7, 8)

Derivation of name: According to the distinct lobe on the upper part of the stem or on the inner margin of one of the wings.

Holotype: The specimen on Pl. 4, Fig. 7; rep.-no. KOMO 1994 IV-131

Material: 9 specimens.

Diagnosis: With the character of the species. Spongy shell with small, needle-like antapical polar spine and few very small, needle-like by-spines in its lower hemisphere. The apical (main) polar spine displays a stem that considerably widens in its upper part. There may be on one side a large lobe in the upper part of the stem. Blade of the main polar spine asymmetrically triangular with acute to slightly rounded apical end that has no lobe. At one side of the blade a distinct wide and moderately deep incision is present above the wing. Terminal spines of the wings moderately long to short. These obliquely backward directed terminal spines are in their distal portion needle-like. At one side, a large lobe may be present on the inner side of the wing

Measurements:

Diameter of shell: 100–111 μm

Length of polar spine above the shell surface: 209–219 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 127–139 μm

Length of straight stem above the shell: 64–83 μm

Width of straight stem in its middle part: 33–45 μm

Length of terminal spines of the wings: 83–133 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: See also under the species.

Scutispongos ploechingeri ploechingeri n. subsp. displays an apical lobe in the position of an apical spine on the symmetrical or subsymmetrical blade. A lobe on the stem or inner side of the wings is absent.

***Scutispongus reschi* n. sp.**

(Pl. 7, Fig. 1)

Derivation of name: In honour of Doz. Dr. W. RESCH, Innsbruck.

Holotype: The specimen on Pl. 7, Fig. 1; rep.-no. KOMO 1994 IV-113

Material: 2 specimens.

Diagnosis: Polar spine nearly completely flattened. Only the basal part of the stem is subcylindrical and only slightly flattened. Blade relatively small, asymmetrical, at one side with deep incision above the base of the terminal spine of the wing. Apical spine pointed, sideways and somewhat inward bent, situated slightly eccentric and not directly opposite to the stem. Terminal spines of the wing needle-like, long.

Measurements:

Length of polar spine above the shell surface (without apical spine): 176–180 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 94–100 µm

Length of straight stem above the shell: 80–90 µm

Width of straight stem in its middle part: 20 µm

Length of terminal spines of the wings: 150–161 µm

Length of apical spine: 35 µm

Occurrence: Very rare in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: The blade is very similar to that of *Gibberospongus spinosus*, but the polar spine is unilateral in *Gibberospongus*, whereas *Scutispongus reschi* n. sp. displays a bilateral polar spine with long terminal spines on the wings at both sides. Perhaps the similarity to *Gibberospongus spinosus* is only a homeomorphy, because the stem of this species is very short to missing.

In *Scutispongus* aff. *S. reschi* n. sp. one terminal spine of the wings is short and incompletely subdivided into two needle-like spines. The other terminal spine of the wings is replaced by 3 very short needle-like spines. This form may be a pathological form of *S. reschi*, because only one specimen is present.

***Scutispongus sagittaeformis* n. sp.**

(Pl. 9, Fig. 15; Pl. 13, Fig. 9)

Derivation of name: According to the arrow-like polar spine.

Holotype: The specimen on Pl. 13, Fig. 9; rep.-no. KOMO 1994 IV-167

Type locality: Outcrop along a road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy).

Type stratum: Sample RW 13. Reddish limestone with late Cordevolian radiolarians and conodonts.

Material: 15 specimens.

Diagnosis: Spongy shell with several small, needle-like by-spines in the lower hemisphere. Polar spine completely flattened, arrow-like. Stem long, narrow. Blade triangular with pointed apical end, but without apical spine. External margin straight or at the proximal end of the wings with incision at one side. Terminal spines moderately long, obliquely backward directed.

Measurements:

Diameter of shell: 131–155 µm

Length of polar spine above the shell surface: 200–269 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 113–173 µm

Length of straight stem above the shell: 63–100 µm

Width of straight stem in its middle part: 28–31 µm

Length of terminal spines of the wings: 138–164 µm

Occurrence: Rare from the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) to late Cordevolian. Bosnia-Herzegovina and Sicily.

Remarks: The blade in *Scutispongus ploechingeri* n. sp. is subtriangular with either an apical lobe in position of an apical spine or a lobe on the stem or inner side of one wing.

Scutispongus cf. *sagittaeformis* (Pl. 3, Fig. 8; Pl. 12, Fig. 10) is not so distinctly arrow-like and displays a horizontally wider, rather subtriangular blade with rounded external margin or the terminal spines are fewer backward directed. Partly this may be intraspecific variability (Pl. 12, Fig. 10), partly these forms are transition forms to *Scutispongus ploechingeri* n. sp. (Pl. 3, Fig. 8).

***Scutispongus semifusus* n. sp.**

(Pl. 4, Figs. 1, 6)

Derivation of name: According to the character of the terminal wing spines.

Holotype: The specimen on Pl. 4, Fig. 6; rep.-no. KOMO 1994 IV-135

Material: 4 specimens.

Diagnosis: Spongy shell with a very small, needle-like antapical polar spine and some very small, needle-like by-spines. Apical (main) polar spine completely flattened. Stem moderately long. Blade subtriangular, slightly asymmetrical. Terminal ends of the wings needle-like. One of them is obliquely backward directed and slightly curved. The other one is backward and inward curved and its distal end joins the upper margin of the shell near the stem or the very base of the stem at the upper margin of the shell.

Measurements:

Diameter of shell: 95–100 µm

Length of polar spine above the shell surface: 215–220 µm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 100–125 µm

Length of straight stem above the shell: 95–100 µm

Width of straight stem in its middle part: 30–34 µm

Length of terminal spines of the wings: 100–160 µm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: In *Scutispongus bogdani* (KOLAR-JURKOVŠEK, 1989) the terminal spines of the wings are not inward curved to join the shell or basal part of the stem.

In *Scutispongus baloghi* n. sp. the terminal spines of both wings are backward and inward curved to join the shell or basal part of the stem.

Genus *Steigerispongus* n. gen.

Type species: *Steigerispongus subsymmetricus* n. gen. n. sp.

Diagnosis: Spongy shell with needle-like by-spines in its lower hemisphere. Main polar spine with

long, straight stem that is narrow, subcylindrical, slightly flattened, rarely somewhat broader and completely flattened. The flattened blade is bilateral, mostly slightly to strongly asymmetric, on both sides ending in a generally long, needle-like, moderately to strongly recurved spine. External surface with pointed, rarely blunt, in the central part mostly long denticles. A second, needle-like polar spine may be present opposite to the flattened main polar spine.

Assigned species:

Steigerispongus subsymmetricus n. gen. n. sp.

Steigerispongus subsymmetricus subsymmetricus n. subsp.

Steigerispongus subsymmetricus fissus n. subsp.

Steigerispongus subsymmetricus latopediculus n. subsp.

Steigerispongus subsymmetricus longiaculeata n. subsp.

Spongoserrula cristagalli DUMITRICĂ, 1982

Steigerispongus asymmetricus n. sp.

Steigerispongus asymmetricus asymmetricus n. subsp.

Steigerispongus asymmetricus rectangularis n. subsp.

Steigerispongus asymmetricus triangulodentatus n. subsp.

Steigerispongus brevipediculus n. sp.

Steigerispongus ? curvispinus n. sp.

Steigerispongus dosztalyi n. sp.

Steigerispongus fojnicaensis n. sp.

Steigerispongus latofoliatus n. sp.

Steigerispongus obliquus n. sp.

Steigerispongus primus n. sp.

Steigerispongus symmetricus n. sp.

Occurrence: Common in the Longobardian and with decreasing frequency also in the Cordevolian; Tethys.

Remarks: The likewise completely flat, and except the most primitive forms denticulated blade of the polar spine in *Spongoserrula* DUMITRICĂ, 1982, is always unilateral. The straight stem is short or missing. *Spongoserrula* is the ancestral genus of *Steigerispongus*. In the strongly asymmetrical *Steigerispongus asymmetricus* n. sp. the blade is well developed on one side as in *Spongoserrula*. On the other side, a smaller, narrower and

mostly shorter blade with fewer denticles is present. This blade evolved from an especially large proximal spine on the external surface of the unilateral blade of *Spongoserrula*. As seen in *Spongoserrula fluegeli multispinosa* n. subsp., this originally obliquely upwards directed spine may downward recurve and may develop a secondary denticle on its upper margin. If this spine becomes broader and blade-like in its proximal part, the asymmetric bilateral blade of primitive *Steigerispongus* evolved. In advanced *Steigerispongus* the secondary blade becomes more and more similar to the primary one. By this at first a slightly asymmetrical bilateral blade evolved, like in *Steigerispongus subsymmetricus* n. sp. and finally bilateral symmetric forms, like *Steigerispongus symmetricus* evolved. However, the above mentioned *Spongoserrula fluegeli multispinosa* is not the direct forerunner of *Steigerispongus*. It has no long straight stem as all *Steigerispongus* species. Therefore, the direct forerunner of *Steigerispongus* should be a *Spongoserrula* species of the *S. fluegeli* group with a rather long straight stem.

***Steigerispongus subsymmetricus* n. gen. n. sp.**

(Pl. 2, Figs. 4–7, 9–11; Pl. 10, Figs. 2–4, 7, 8, 12, 14, 15; Pl. 12, Figs. 16–18)

Derivation of name: According to the subsymmetrical, slightly asymmetrical blade of the polar spine.

Holotype: The specimen on Pl. 2, Fig. 7; rep.-no. KOMO 1994 IV-50

Material: More than 100 specimens.

Diagnosis: Spongy shell with a bunch of needle-like by-spines near the antapical pole and a large, flattened apical polar spine. The polar spine displays a long, subcylindrical, somewhat flattened to broad and completely flattened stem. The blade is broad, bilateral, subsymmetrical, slightly asymmetrical. One side of the blade begins mostly in a higher level of the stem than the other side. If the blade begins on both sides of the stem in the same level, one side of the blade is broader. The 4–6 denticles are long, slender, pointed.

They are largest in the middle part of the blade and their length decreases toward both distal ends of the blade. The distal denticles on both sides are often very low, rounded triangular or reduced to a slight undulation. Opposite to the stem lies mostly a interspine space, but there may be also the largest spine opposite to the stem. This spine may be terminally bifurcated. The number of spines may be on both sides of the blade equal, but often on one side there are one, rarely two denticles fewer than on the other side. Both distal ends of the blade are terminated by a long to very long, narrow, needle-like spine that is obliquely backward directed to a different degree. In general, the distal ends of these terminal spines are situated in the level of the equator to lower pole of the shell.

Measurements: See under the subspecies.

Occurrence: Very common in the late Longobardian of the Tethys.

Remarks: *Steigerispongus cristagalli* (DUMITRICĂ, 1982) displays flattened cylindrical denticles with blunt ends.

Steigerispongus symmetricus n. sp. and *S. brevipediculus* n. sp. display a symmetrical or nearly symmetrical blade with three symmetrically arranged denticles. *S. brevipediculus* has additionally a short stem.

Steigerispongus asymmetricus n. sp. and *S. obliquus* n. sp. display a very asymmetric blade.

***Steigerispongus subsymmetricus subsymmetricus* n. subsp.**

(Pl. 2, Figs. 4, 7, 11; Pl. 10, Figs. 2, 4, 7, 8 14; Pl. 12, Figs. 16–18)

Derivation of name, holotype and occurrence: As for the species.

Material: More than 100 specimens.

Diagnosis: With the character of the species. Straight stem long, narrow. All spines unbranched, long. Opposite to the stem, there is an interspine space and only exceptionally an unbranched spine. The terminal spines of the wings are strongly backward directed.

Measurements:

Diameter of shell: 119–125 µm

Length of polar spine above the shell surface (without denticles): 140–193 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 62–88 µm

Length of straight stem above the shell: 78–100 µm

Width of straight stem in its middle part: 22–28 µm

Length of terminal spines of the wings: 125–233 µm

Maximum length of denticles: 66–82 µm

Occurrence: Common in the *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (late Longobardian) of the Tethys.

Remarks: See also under the species.

In *Steigerispongos longidentatus* n. subsp. the 3–4 proximal spines on the external margin of the blade are very large and the needle-like distal terminal spines of the wings are slightly to moderately backward directed. They terminate above the level of the shell.

Steigerispongos subsymmetricus latopediculus n. subsp. displays a broad, completely flattened, long, straight stem and the denticles are rather short.

Steigerispongos subsymmetricus fissus n. subsp. displays a terminally bifurcated spine opposite to the stem.

***Steigerispongos subsymmetricus fissus* n. subsp.**

(Pl. 10, Figs. 3, 15)

Derivation of name: According to the distally furcated spine opposite to the stem.

Holotype: The specimen on Pl. 10, Fig. 3; rep.-no. KOMO 1994 IV-57

Material: 7 specimens.

Diagnosis: With the character of the species. Straight stem narrow, short to moderately long. Opposite to the stem lies a distally bifurcated spine on the external margin of the blade. Distal terminal spines of the wings rather short, moderately to strongly backward directed, partly terminally bifurcated.

Measurements:

Length of polar spine above the shell surface (without denticles): 131–200 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 85–94 µm

Length of straight stem above the shell: 63–107 µm

Width of straight stem in its middle part: 25–27 µm

Length of terminal spines of the wings: around 100 µm

Maximum length of denticles: 91–94 µm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: See also under the species.

Steigerispongos subsymmetricus fissus n. subsp. is distinguished from the other subspecies of *Steigerispongos subsymmetricus* by the distally bifurcated spine opposite to the stem and by the rather short stem.

***Steigerispongos subsymmetricus latopediculus* n. subsp.**

(Pl. 2, Figs. 5, 6, 10)

Derivation of name: According to the broad, flattened stem.

Holotype: The specimen on Pl. 2, Fig. 10; rep.-no. KOMO 1994 IV-53

Material: 13 specimens.

Diagnosis: With the character of the species. Straight stem broad, long and completely flattened. Denticles on the external side of the stem relatively short.

Measurements:

Length of polar spine above the shell surface (without denticles): 165–210 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 70–90 µm

Length of straight stem above the shell: 90–120 µm

Width of straight stem in its middle part: 39–51 µm

Length of terminal spines of the wings: 144–157 µm

Maximum length of denticles: 42–60 µm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos subsymmetricus latopediculus* n. subsp. is distinguished from other

subspecies of *Steigerispongos subsymmetricus* n. sp. by its completely flattened, broad stem. In *Steigerispongos* cf. *subsymmetricus latopediculus* n. subsp. (Pl. 2, Fig. 9) the stem begins above the shell as narrow as in *Steigerispongos subsymmetricus subsymmetricus* n. subsp., but it widens distinctly in direction to the blade. This form may be a transitional form between *Steigerispongos subsymmetricus subsymmetricus* and *S. subsymmetricus latopediculus*.

***Steigerispongos subsymmetricus longiaculeatus*
n. subsp.**
(Pl. 10, Figs. 8, 12)

? 1984 *Falcispongos* sp. - DE WEVER, Pl. 3, Fig. 6

Derivation of name: According to the very long proximal spines on the external margin of the blade.

Holotype: The specimen on Pl. 10, Fig. 8; rep.-no. KOMO 1994 IV-62

Material: 4 specimens.

Diagnosis: With the character of the species. Proximal spines on the external margin of the blade very long. Distal terminal needle-like spine of the wings only slightly to moderately backward directed.

Measurements:

Length of polar spine above the shell surface (without denticles): about 200 µm (proximal part of the stem in none of the specimens preserved).

Maximum width of polar spine (distance from inner to outer margins of the blade): 100–120 µm

Width of straight stem in its middle part: 30–35 µm

Length of terminal spines of the wings: 325–345 µm

Maximum length of spines: 150–219 µm

Occurrence: Very rare in the *Spongoserrula fluege-li* Subzone of the *Muelleritortis cochleata* Zone (late Longobardian) and in the basal Tritortis kretaensis Zone (Longobardian-Cordevolian boundary level) of Bosnia-Herzegovina and Hungary.

Remarks: *Steigerispongos subsymmetricus longiaculeatus* n. subsp. is distinguished from other subspecies of *Steigerispongos subsymmetricus* by its very long proximal denticles. Moreover, the

terminal needle-like spine of the wings is only slightly to moderately backward directed.

***Steigerispongos asymmetricus* n. sp.**

(Pl. 2, Fig. 8; Pl. 11, Figs. 2-8, 11; Pl. 13, Fig. 7)

Derivation of name: According to the bilateral, but strongly asymmetrical blade.

Holotype: The specimen on Pl. 11, Fig. 4; rep.-no. KOMO 1994 IV-67

Material: More than 100 specimens.

Diagnosis: Straight stem slender, long, rarely moderately long, subcylindrical, slightly flattened. Blade completely flattened, bilateral, but strongly asymmetrical. Main blade (primary blade) large, moderately broad, rarely narrow, always strongly recurved. Terminal spine needle-shaped of the wings short to moderately long, ending in the level of the central or upper part of the shell. External margin of main blade with 5–6 mostly slender, terminally needle-like spines that distalwards decrease in size. Distal one-two denticles rather short, triangular, sometimes reduced to an undulation of the external margin. In *S. asymmetricus triangulodentatus* n. subsp. all denticles of the main blade are rather short and triangular. Secondary blade considerably smaller, narrower, with one-two small to large spine on its external margin. The secondary blade is either perpendicularly to the stem or recurved. It begins always in a lower level of the stem than the main blade. Terminal spine of the wings needle-like, short to long.

Measurements: See under the subspecies.

Occurrence: Common in the *Spongoserrula fluege-li* Subzone of the *Muelleritortis cochleata* Zone (late Longobardian) and in the Cordevolian of the Tethys.

Remarks: *Steigerispongos asymmetricus* n. sp. is the most primitive *Steigerispongos* species with transition character to *Spongoserrula* DUMITRICĂ, 1982. The main (primary) blade corresponds to the blade of *Spongoserrula* of the *S. fluege-li* group. The much smaller secondary blade is partly not yet downward curved and bears only one denticle. It has clearly developed from an especially large

proximal spine in *Spongoserrula*, which may have exceptionally already a tiny spine (*Spongoserrula fluegeli multispinosa* n. subsp.), but is not yet widened to a flat blade in *Spongoserrula*.

On the other hand, there are also transition forms to *Steigerispongos subsymmetricus* (Pl. 11, Fig. 2; Pl. 13, Fig. 7), in which the secondary blade becomes somewhat larger and displays two-three denticles. In these forms the asymmetry of the blade is not more so strong as in typical *Steigerispongos asymmetricus*.

***Steigerispongos asymmetricus asymmetricus*
n. subsp.**

(Pl. 2, Fig. 8; Pl. 11, Figs. 4, 5, 7)

Holotype: As for the species.

Material: 83 specimens.

Diagnosis: With the character of the species. Stem long. Main blade with long, terminally needle-like spines. Only distal spines of main blade triangular. The secondary blade with long, needle-like terminal spine is always recurved. It begins in a considerably lower level of the stem than the main blade.

Measurements:

Length of polar spine above the shell surface (without denticles): 145–167 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 56–70 µm

Length of straight stem above the shell: 55–78 µm

Width of straight stem in its middle part: 20–25 µm

Length of terminal spine of the wings: 94–118 µm

Maximum length of spines of the main blade: 59–85 µm

Maximum length of spines of the secondary blade: 22–55 µm

Occurrence: Common in the *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (late Longobardian) and in the Cordevolian of the Tethys.

Remarks: See also under the species.

In *Steigerispongos asymmetricus rectangularis* n. subsp. and *S. asymmetricus triangulodentatus* n. sp. the short secondary blade is situated perpendicularly to the stem and bears only a small denti-

cle. In *S. asymmetricus triangulodentatus* additionally the denticles of the main blade are short and triangular, whereas *S. asymmetricus rectangularis* displays a rather short stem.

In *Steigerispongos* cf. *asymmetricus asymmetricus* n. subsp. (Pl. 11, Fig. 8) the rather large spine on the secondary blade is terminally bifurcated.

Steigerispongos asymmetricus subsp. indet. (Pl. 11, Fig. 11) displays a narrow main blade, not wider than the secondary blade.

***Steigerispongos asymmetricus rectangularis* n.
subsp.**

(Pl. 11, Fig. 6; Pl. 13, Fig. 3)

Derivation of name: According to the right angle between the stem and secondary blade.

Holotype: The specimen on Pl. 11, Fig. 6; rep.-no. KOMO 1994 IV-73

Material: 9 specimens.

Diagnosis: With the character of the species. Stem relatively short. Secondary blade short with a small pointed spine and a rather short needle-like terminal prolongation, perpendicularly to the stem. Proximal denticles of the main blade long, needle-shaped, only basally broader. Needle-like terminal spine of the main blade rather short.

Measurements:

Length of polar spine above the shell surface (without denticles): 152–160 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 69–75 µm

Length of straight stem above the shell: 45–53 µm

Width of straight stem in its middle part: 26–30 µm

Length of terminal spine of the main blade: 91–133 µm

Length of terminal spine of the secondary blade: 73–77 µm

Maximum length of spines of the main blade: 95–147 µm

Maximum length of spines of the secondary blade: 22–25 µm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: In *Steigerispongos asymmetricus asymmetricus* n. subsp. the secondary blade is longer and recurved. The stem is longer.

Steigerispongos asymmetricus triangulodentatus n. subsp. has a longer stem and shorter, triangular proximal denticles on the main blade.

***Steigerispongos asymmetricus
triangulodentatus* n. subsp.**

(Pl. 11, Fig. 3)

Derivation of name: According to the triangular denticles on the main blade.

Holotype: The specimen on Pl. 11, Fig. 3; rep.-no. KOMO 1994 IV-72

Material: 3 specimens.

Diagnosis: With the character of the species. The secondary blade is very short with short terminal spine and a very small rounded triangular denticle.

Measurements:

Length of polar spine above the shell surface (without denticles): 140–145 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 55–60 µm

Length of straight stem above the shell: 72–78 µm

Width of straight stem in its middle part: 20–22 µm

Length of terminal spine of the secondary blade: 25–30 µm

Maximum length of denticles on the main blade: 28–31 µm

Maximum length of denticle on the secondary blade: 10–13 µm

Occurrence: Very rare in the middle Longobardian at the type locality.

Remarks: See also under the species.

The secondary blade of *Steigerispongos asymmetricus asymmetricus* n. subsp. is larger, recurved and its distal part is obliquely backwards directed. The proximal spines on the main blade are long and terminally needle-like.

In *Steigerispongos asymmetricus rectangularis* n. subsp. the size and arrangement of the secondary blade is similar, but the stem is longer and the

proximal spines on the main blade are long and terminally needle-like.

***Steigerispongos brevipediculus* n. sp.**
(Pl. 2, Fig. 3)

Derivation of name: According to the short stem.

Holotype: The specimen on Pl. 2, Fig. 3; rep.-no. KOMO 1994 IV-76

Material: 4 specimens.

Diagnosis: Spongy shell slightly spiny, with few needle-like by-spines, mostly arranged in a bunch somewhat beside the antapical pole. Polar spine completely flattened. Stem short for the genus and rather broad. Blade very broad, nearly bilateral-symmetrical. 3 spines are present in the apical region of the blade arranged in a line perpendicularly to the polar axis. The largest, needle-like spines lies opposite to the stem. The other two spines are shorter, broader, but also pointed. They are symmetrically arranged on both sides of the middle spine. In distal direction of these spines on each side a further, short, rounded triangular denticle or shall node is present. The terminal spine of the wings are symmetrically arranged, sword-like, obliquely backward directed. They end in the level of the upper part of the shell.

Measurements:

Diameter of shell: 122–139 µm

Length of polar spine above the shell surface (without denticles): 144–156 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 83–94 µm

Length of straight stem above the shell: 41–56 µm

Width of straight stem in its middle part: 42–46 µm

Length of the terminal spine of the wings: 106–139 µm

Maximum length of spines: 83–97 µm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos symmetricus* n. sp. displays a long, slender stem. The denticles are shorter, the terminal spine of the wings is needle-

like and mostly longer. All other *Steigerispongos* species display asymmetric blades.

***Steigerispongos ? curvispinus* n. sp.**

(Pl. 10, Fig. 9; Pl. 11., Fig. 10)

Derivation of name: According to the strongly sideways curved large spine on the external margin of the blade.

Holotype: The specimen on Pl. 11, Fig. 10; rep.-no. KOMO 1994 IV-64

Material: 3 specimens.

Diagnosis: Polar spine with somewhat flattened, large, narrow straight stem and completely flattened, strongly asymmetric bilateral, spined blade. One side of the blade (main blade) is downward curved and terminates in a long, needle-like, strongly downward directed terminal spine. This main blade displays 3 spines on its external margin. The proximal one is very large, the other two are considerably smaller. The large spine is laterally curved toward the other side of the blade (secondary blade), where it is fused with the only denticle of the secondary blade or reaches beyond this denticle a short distance above it. By this arrangement and shape of the adjacent denticles on the main and secondary blades a partly open pore or incision in the blade is formed. The secondary blade is smaller to much smaller than the main blade, obliquely upward directed and only the terminal spine is downward curved (but this terminal part is broken away after its very base in all present specimens). A denticle on the proximal end of the external margin of the secondary blade is fused with the laterally curved part of the large spine on the main blade or it ends somewhat below it.

Measurements:

Length of polar spine above the shell surface (without denticles): 173–178 μm

Maximum width of polar spine (distance from inner to outer margins of the blade): 67–80 μm

Length of straight stem above the shell: 80–83 μm

Width of straight stem in its middle part: 28–30 μm

Length of terminal spine of the wings: Around 200 μm

Length of curved spine (including the curved part): 93–200 μm

Maximum length of the other spines: 33–56 μm

Occurrence: Very rare in the lower *Spongoserrula fluegeli* Subzone of the *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos ? curvispinus* n. sp. is distinguished from all other described *Steigerispongos* species by the laterally curved largest spine on the external margin of the blade. By the partly open pore or incision opposite to the stem, this species is similar to *Pterospongos* DUMITRICA, 1982. However, this is probably only a homeomorph feature, because this pore or incision developed by the sideways bending of the largest proximal spine and it is not an original feature of the blade as in *Pterospongos*. On the other side, there is a considerable similarity with *Spongoserrula* DUMITRICA, 1982. However, the blade is already bilateral, but strongly asymmetrical. Moreover, the straight stem is long.

Steigerispongos ? curvispinus n. sp. probably belongs to the *Steigerispongos asymmetricus* group, in which the second blade is still very different from the main (primary) blade.

Steigerispongos asymmetricus n. sp. has no laterally curved spine and the secondary blade lies either perpendicularly to the stem or it is obliquely downward directed.

***Steigerispongos dosztalyi* n. sp.**

(Pl. 12, Figs. 13, 14)

Derivation of name: In honour of Dr. L. DOSZTÁLY, Budapest.

Holotype: The specimen on Pl. 12, Fig. 13; rep.-no. KOMO 1994 IV-153

Material: 10 specimens.

Diagnosis: Spongy shell with needle-like antapical polar spine. Main (apical) polar spine flattened, with relatively small blade. Stem long, narrow, basally not flattened, distally flattened. The rather narrow blade is bilateral asymmetric. It is situated obliquely to the polar axis. At one side, the

wing begins considerably higher than at the other side. Both wings ends in terminal, moderately long to long, needle-like spines that are obliquely backward directed. Two node-like, rounded, small denticles are present in the apical portion of the blade, but they may be shifted in a more lateral position.

Measurements:

Diameter of spongy shell: 100–115 μm

Length of polar spine above the shell surface (without denticles): 189–197 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 54–69 μm

Length of straight stem above the shell: 93–106 μm

Width of straight stem in its middle part: 20–29 μm

Length of terminal spine of the wings: 106–118 μm

Maximum length of denticles: 21–24 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos fojnicaensis* n. sp. displays three denticles and at one side the terminal spine of the wing lies parallel to the stem.

Steigerispongos obliquus n. sp. displays three pointed, distally needle-like spines.

***Steigerispongos fojnicaensis* n. sp.**

(Pl. 10, Figs. 10, 13)

Derivation of name: According to the occurrence in the locality Varoski creek near Fojnica, Bosnia-Herzegovina.

Holotype: The specimen on Pl. 10, Fig. 10; rep.-no. KOMO 1994 IV-84

Material: 11 specimens.

Diagnosis: Spongy shell with a bunch of needle-like, short by-spines near to the antapical pole. Stem long, narrow, in its upper part often slightly curved. Blade obliquely to the polar axis, bilateral, asymmetrical, with 3 rounded denticles. One of these denticles may be reduced to a tiny node. The denticles are arranged in a line, oblique to the polar axis. The central spine is not situated in the polar axis. It is always the largest denticle. Dis-

talwards from these denticle a small, shallow lobe may be present on the external margin of the blade. Terminal spine of the wings long, needle-like. At one side of the blade the terminal spine is obliquely backward directed and ends in the level of the upper part of the shell. At the other side of the blade the terminal spine is strongly backward curved and ends also in the level of the upper part of the shell. It is situated parallel to the stem. Sometimes at one side two terminal needle-like spines are present. One of them is situated parallel to the stem, the other one is obliquely backward directed and may join the middle part of the stem.

Measurements:

Diameter of shell: 131–138 μm

Length of polar spine above the shell surface (without denticles): 180–200 μm

Maximum width of polar spine (distance from inner to outer margins of the blade): 77–100 μm

Length of stem above the shell: 83–131 μm

Width of stem in its middle part: 28–34 μm

Length of obliquely backward direct terminal spines: 145–164 μm

Length of the backward recurved terminal spine: 100–115 μm

Maximum length of denticles: 27–38 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: On that side, where the terminal spine of the wing is situated parallel to the stem, a second terminal spine may be present that is obliquely inward directed and joins the stem. This form may represent an independent subspecies, but so far only one specimen with bifurcated terminal spine at one wing is present among 11 specimens of *Steigerispongos fojnicaensis* n. sp.

In *Steigerispongos obliquus* n. sp. the denticles are pointed and both terminal spines of the wings are obliquely backward directed.

Steigerispongos dosztalyi n. sp. displays only two rounded spines and both terminal spines of the wings are obliquely backward directed. Moreover, this species has a needle-like antapical spine.

***Steigerispongos latofolius* n. sp.**

(Pl. 11, Fig. 1)

Derivation of name: According to the very wide secondary blade.

Holotype: The specimen on Pl. 11, Fig. 1; rep.-no. KOMO 1994 IV-77

Material: 6 specimens.

Diagnosis: Stem of polar spine short, subcylindrical, slightly flattened. Blade completely flattened, bilateral, but very asymmetric. One side is moderately wide, rather long, terminated in a moderately long, needle-like spine. This side corresponds to the main (primary) blade of other asymmetric *Steigerispongos* species. Other side shorter, very broad, with very short terminal spine. This side corresponds to the secondary blade of other asymmetrical *Steigerispongos* species. External margin spined. The denticulation on the primary blade is regular, with two large, needle like proximal spines and two considerably smaller, subtriangular distal denticles. The denticulation on the secondary blade is rather irregular. Proximally a long, needle-like spine is present. The distalwards following 3 denticles are very small to small, but their size may increase toward the distal end. The denticle opposite to the stem is in general small and triangular.

Measurements:

Length of polar spine above the shell surface (without denticles): 163–175 µm

Maximum width of polar spine (distance from inner to outer margins of the blade): 81–100 µm

Length of straight stem above the shell: 29–32 µm

Width of straight stem in its middle part: 25–28 µm

Length of distal terminal spine of the wings: 44–62 µm

Maximum length of spines: 63–94 µm

Occurrence: Very rare in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos latofolius* n. sp. is distinguished from other *Steigerispongos* species with strongly asymmetric bilateral blade by the very broad secondary blade, which is distinctly broader than the primary blade.

***Steigerispongos obliquus* n. sp.**

(Pl. 10, Figs. 1, 11)

Derivation of name: According to the oblique blade and the obliquely arranged denticles.

Holotype: The specimen on Pl. 10, Fig. 11; rep.-no. KOMO 1994 IV-82

Material: 31 specimens.

Diagnosis: Polar spine totally flattened. Stem long. Blade obliquely to the polar axis, bilateral, asymmetrical, with 3 pointed denticles. The denticles are arranged in a line, oblique to the polar axis. The central denticle is the largest one, or all three denticles have equal length. The terminal spines of the wings are long, needle-like, obliquely backward directed. They end at one side in the level of the upper part of the shell, at the other side somewhat above it.

Measurements:

Occurrence: Common in the lower *Spongoserula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos symmetricus* n. sp. displays a bilateral symmetric blade. The 3 denticles are arranged in a line perpendicularly to the polar axis. *S. cf. symmetricus* n. sp. displays a slightly oblique blade and one side of the blade is very strongly recurved. This form may be a transition form between *S. symmetricus* n. sp. and *S. obliquus* n. sp. Similar to it are such forms of *S. obliquus*, in which the blade is not strongly oblique (Pl. 10, Fig. 1).

Steigerispongos subsymmetricus n. sp. has more denticles and the outline of the blade is different.

Steigerispongos fojnicaensis n. sp. displays the same shape and arrangement of the blade. The 3 denticles display, however, rounded ends and on one side the terminal spine of the wing is strongly backward curved and lies parallel to the stem.

***Steigerispongos primus* n. sp.**

(Pl. 15, Fig. 11)

Derivation of name: Stratigraphically oldest *Steigerispongos* species of the *S. cristagalli* group.

Holotype: The specimen on Pl. 15, Fig. 11; rep.-no. KOMO 1994 IV-198

Locus typicus: Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994).

Type stratum: Middle part of Buchenstein Beds, sample St 1.

Material: 3 specimens.

Diagnosis: Spongy shell relatively large. Straight stem moderately long. Blade very small, bilateral, asymmetric. One wing with moderately long, obliquely backward directed terminal spine. The other wing with short terminal spine, perpendicularly to the stem. Two short, rounded denticles in apical position.

Measurements:

Diameter of spongy shell: 144–156 μm

Length of polar spine above the shell surface (without apical spine): 138–144 μm

Maximum width of polar spine (maximum distance from inner to outer margins of the blade): 62–63 μm

Length of straight stem above the shell: 63 μm

Width of straight stem in its middle part: 31 μm

Length of long terminal spine of wings: 106–109 μm

Length of short terminal spine of wings: 31–38 μm

Maximum length of denticles: 19–25 μm

Occurrence: Very rare in the lower subzone (*Pterospongos priscus* Subzone) of the *Muelleritortis cochleata* Zone (early middle Longobardian) at the type locality.

Remarks: *Steigerispongos cristagalli* (DUMITRI-CĂ, 1982) from the middle subzone (*Spongoserrula rarauana* Subzone) of the *Muelleritortis cochleata* Zone (middle Longobardian) displays more and longer denticles and an almost symmetrical, larger blade.

Steigerispongos sp. A displays three denticles, two of them with pointed end. One terminal spine is long and strongly backward curved.

***Steigerispongos symmetricus* n. sp**

(Pl. 2, Figs. 1, 2)

Derivation of name: According to the symmetric or nearly symmetric polar spine.

Holotype: The specimen on Pl. 2, Fig. 2; rep.-no. KOMO 1994 IV-78

Material: 17 specimens.

Diagnosis: Spongy shell slightly spiny, in the lower hemisphere with several needle-like by-spines, that may be partly arranged in a bunch. Straight stem very long, subcylindrical, slightly flattened. Blade completely flattened, bilaterally symmetrical or nearly so. On the apical end of the blade three triangular to slender triangular denticles are arranged in a straight line perpendicularly to the polar axis. The middle denticle of them, situated opposite to the stem, is the largest, the other two are symmetrically arranged on both sides of the central denticle and somewhat shorter; occasionally one of these denticles may be reduced to a node. Distalward from these three spines a partly indistinct node may be present on both sides of the blade. The terminal spines on both sides of the blade are long and strongly backward directed. Their ends are situated in the level of the central to upper parts of the shell.

Measurements:

Diameter of shell: 89–106 μm

Length of polar spine above the shell surface (without denticles): 178–194 μm

Maximum width of polar spine (distance from inner to outer margins of the blade): 56–75 μm

Length of straight stem above the shell: 100–111 μm

Width of straight stem in its middle part: 19–25 μm

Length of terminal spine of the wings: 111–194 μm

Maximum length of denticles: 28–39 μm

Occurrence: Rare in the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: *Steigerispongos* cf. *symmetricus* n. sp. (Pl. 10, Fig. 5) displays a slightly oblique bilateral blade. The denticles terminate in a needle-like spine. The recurvation of the terminal spines of the blade is very strong and its distal end may reach on one side the margin of the shell. Moreover, a distinct, rather long and needle like antapical polar spine is present. This latter feature indicates that *Steigerispongos* cf. *symmetricus* n. sp. may belong at least to an independent subspecies, which is similar to *Steigerispongos* ? sp. A, in which, however, the blade is strongly reduced at one side to a broad, rounded teeth. From this form only one specimen

is present (Pl. 10, Fig. 6), that may be a pathological form. By the reduction of the blade at one side, this form is homeomorph to *Spongoserrula* DUMITRICĂ, 1982 that has, however, a short stem.

Steigerispongos brevipediculus n. sp. has a similar denticulation, but a higher blade and a shorter stem.

Steigerispongos subsymmetricus n. sp. has a slightly asymmetric blade which bears more denticles.

Steigerispongos obliquus n. sp. displays an oblique, asymmetric blade. The denticles are similarly arranged as in *S. symmetricus*, but in a line distinctly oblique to the polar axis.

***Steigerispongos* ? sp. A**

(Pl. 10, Fig. 6)

Material: One specimen.

Occurrence: Lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian) at the type locality.

Remarks: It is not clear, whether the long proximal spine of the blade is a spine of an unilateral blade (in this case the specimen would belong to *Spongoserrula* DUMITRICĂ, 1982) or a reduced terminal spine of a wing of a bilateral blade (similar to *Steigerispongos primus* n. sp.).

***Steigerispongos* sp. B**

(Pl. 7, Fig. 4)

Remarks: Only one specimen is known from a *Steigerispongos* species, in which all 4 spines are laterally and (or) inward curved. It may be a pathological form.

***Steigerispongos* sp. C**

(Pl. 13, Fig. 11)

Remarks: A single, not fully preserved specimen of a *Steigerispongos* species with very short trian-

gular stem is known from the Cordevolian of Sicily. It represents surely a new species distinguished by the very short, rapidly widening triangular stem from other species of the *Steigerispongos fluegeli* group.

Biostratigraphic evaluation

The Oertlispongidae KOZUR & MOSTLER, 1980, are the stratigraphically most important Ladinian radiolarians of pelagic deposits in the tropical Tethyan sea. In the Circum-Pacific realm Oertlispongidae are also present, but mostly rare. Because the curved and often bladelike modified, partly denticulated or spined apical polar spine is the most significant and rapidly evolving feature of the Oertlispongidae, isolated apical polar spines can be well determined in species or even subspecies level.

As shown in KOZUR & MOSTLER (1994) and DOSZTÁLY (1994), Oertlispongidae with curved main (apical) polar spine began at the priority base of the Ladinian stage (base of the *Reitziites reitzi* Zone), where also distinct changes in ammonoids, conodont and sporomorph associations can be observed. This boundary is therefore most suitable as Anisian-Ladinian boundary and can be recognized not only in ammonoid-bearing beds (about 5% of the Triassic rocks near the Anisian-Ladinian boundary), but also in continental beds (more than 50% of the beds in this stratigraphic interval) and in radiolarites, where ammonoids are missing and conodonts (if present in such beds) are mostly represented by juvenile specimens unsuitable for detailed stratigraphic evaluations.

As shown by KOZUR & MOSTLER (1994), the Fassanian Oertlispongidae are characterized by an unilateral or bilateral curved apical polar spine without blade-like differentiation (*Oertlispongos* DUMITRICĂ, KOZUR & MOSTLER, 1980, *Baumgartneria* DUMITRICĂ, 1982) or by an unilateral curved apical polar spine with blade-like widenings at the distal end of straight stem and the very base of the curved portion of the polar spine.

Whereas *Baumgartneria* is a rather conservative genus, rapid evolution within *Oertlispongus* and partly also within *Falcispongus* allows detailed stratigraphic subdivisions of the Fassanian (see KOZUR & MOSTLER, 1994).

Within the Longobardian advanced Oertlispongidae evolved. They are characterized by completely flattened apical polar spines with bilateral, smooth, denticulated or spined blades, partly with apical incision (*Pterospongus* DUMITRICĂ, 1982, *Scutispongus* n. gen., *Steigerispongus* n. gen.) or by denticulated unilateral blades (*Spongoserrula* DUMITRICĂ, 1982). Rapid evolution within these genera allows a subdivision of the middle to late Longobardian *Muelleritortis cochleata* Zone (contemporaneous with the *Budurovignathus mungoensis* conodont zone) into 3 subzones, defined below. Advanced *Baumgartneria*, *Falcispongus* and *Oertlispongus* are with decreasing frequency present up to the middle subzone of the *Muelleritortis cochleata* Zone (middle Longobardian). Exceptionally, last advanced *Oertlispongus* occur in the upper subzone of the *M. cochleata* Zone (late Longobardian). Additionally the very characteristic corkscrew-like twisted *Bogdanella* KOLAR-JURKOVŠEK, 1989 is present in the entire Longobardian.

In the Cordevolian advanced Oertlispongidae are present with decreasing frequency. Partly they range up from the late Longobardian upper subzone of *M. cochleata* Zone (*Scutispongus sagittaeformis* n. sp., *Steigerispongus asymmetricus* n. sp.), partly they represent species not yet present in the Longobardian (*Scutispongus mocki* n. sp., *Steigerispongus* sp. C). The first occurrences of *Spongoserrula dehli* CORDEY et al. and *Spongoserrula cordeyi* n. sp., common in the Cordevolian, are not yet clear. They may begin in the latest Longobardian, but are characteristic forms of the Cordevolian.

Occurrences of Oertlispongidae in the Tuvalian (DUMITRICĂ, 1982) cannot be confirmed.

In the following, three new subzones of the middle to late Longobardian *Muelleritortis cochleata* Zone will be introduced. In the definition only Oertlispongidae are considered.

Pterospongus priscus Subzone

Definition: Common occurrence of *Pterospongus priscus* n. sp., *P. altofissus* n. sp., *Scutispongus rostratus* DUMITRICĂ, 1982 (primitive *Scutispongus* with only a terminal spine only at one wing), advanced *Baumgartneria* (*B. curvispina* DUMITRICĂ, 1982), advanced *Falcispongus* (*F. hamatus* DUMITRICĂ, 1982, *F. falciformis minor* n. subsp., *F. transitus brevifoliaceus* n. subsp.) and *Bogdanella praecursor* n. sp. Denticulated *Spongoserrula* are missing, denticulated *Steigerispongus* with round denticles (*S. parvifoliatus primitivus* n. sp.) are very rare.

Lower boundary: Appearance of *Pterospongus priscus* n. sp., *P. latofissus* n. sp., primitive *P. alatus* DUMITRICĂ, 1982, *Bogdanella praecursor* n. sp., *Falcispongus transitus brevifoliaceus* n. subsp., *Steigerispongus primus* n. sp.

Upper boundary: First appearance of *Spongoserrula* with round or blunt denticles (*S. raraauana* group).

Present Oertlispongidae (see table 1).

Age: Lower subzone of *Muelleritortis cochleata* Zone. Lower part of *Budurovignathus mungoensis* conodont zone (early middle Longobardian).

Occurrence: Tethys and Philippines.

Remarks: This subzone represent the beginning of the Longobardian radiation of advanced Oertlispongidae. Some Fassanian guideforms (e.g. *Oertlispongus inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER, 1980, are still present. The typical Longobardian and Cordevolian *Scutispongus* is already common, but mostly represented by transition forms to *Falcispongus* in which the terminal wing spine is only present at one side of the blade (*Scutispongus rostratus*). Exceptionally primitive *Scutispongus* with terminal spines at both sides of the blade are present, but they have an asymmetric small blade. Very primitive *Steigerispongus* with round spines (*S. cristagalli* group) are rarely present (*Steigerispongus primus* n. sp.) and undenticulated *Spongoserrula* made their first appearance.

Especially characteristic of the *Pterospongus priscus* Subzone is the rich occurrence of *Pterospongus*. This genus occurs also in the following

Spongoserrula rarauana Subzone, but with other species (*Pterospongos incisus* DUMITRICĂ, 1982, *P. patrulii* DUMITRICĂ, 1982). *Pterospongos alatus* DUMITRICĂ, 1982 is already present, but with primitive forms that probably belong to a different subspecies.

Spongoserrula rarauana Subzone

Definition: Occurrence of denticulated *Spongoserrula* with round or blunt spines (*Spongoserrula rarauana* group) and denticulated *Steigerispongos* with round spines [*Steigerispongos cristagalli* (DUMITRICĂ, 1982)] without *Spongoserrula* with pointed spines (*S. fluegeli* group) and without spined *Steigerispongos* with pointed or needle-like spines (*Steigerispongos subsymmetricus* group). Occurrence of last primitive *Scutispongos* (*S. rostratus* group) and of advanced *Pterospongos* (*P. alatus* DUMITRICĂ, 1982, *P. incisus* DUMITRICĂ, 1982, *P. patrulii* DUMITRICĂ, 1982).

Lower boundary: First appearance denticulated *Spongoserrula* with round or blunt denticles (*S. rarauana* group).

Upper boundary: First appearance of *Spongoserrula* with pointed or needle-like spines (*Spongoserrula fluegeli* group).

Present Oertlispongidae: See table 1.

Age: Middle subzone of *Muelleritortis cochleata* Zone. Upper part of lower *Budurovignathus mungoensis* conodont zone (middle Longobardian).

Occurrence: Tethys.

Remarks: This subzone is characterized by denticulated Oertlispongids with round or blunt denticles, e. g. *Spongoserrula rarauana* DUMITRICĂ, 1982, *Steigerispongos cristagalli* (DUMITRICĂ, 1982), whereas *Spongoserrula* and *Steigerispongos* with pointed or needle-like spines are still missing. For the last time primitive *Scutispongos* with only one terminal spine are present (*Scutispongos rostratus* group). Advanced *Pterospongos* (*P. alatus* DUMITRICĂ, 1982, *P. incisus* DUMITRICĂ, 1982, *P. patrulii* DUMITRICĂ, 1982) are also characteristic and this genus has its stratigraphi-

cally youngest occurrence in the *Spongoserrula rarauana* Subzone.

Spongoserrula fluegeli Subzone

Definition: Occurrence of several *Spongoserrula* and *Steigerispongos* species with pointed or needle-like denticles or spines, e. g. *Spongoserrula fluegeli* n. sp., *Spongoserrula goricanae* n. sp., *Steigerispongos asymmetricus* n. sp., *Steigerispongos subsymmetricus* n. sp., *Steigerispongos symmetricus* n. sp. together with advanced *Scutispongos*, e. g. *Scutispongos bogdani* (KOLAR-JURKOVŠEK, 1989), *Scutispongos latus* n. sp., *Scutispongos ploechingeri* n. sp., *Scutispongos longispinosus* n. sp., *Scutispongos tortilispinus* n. sp., and several *Gibberospongos* species (*Gibberospongos spinosus* n. gen. n. sp., *Gibberospongos bispinosus* n. sp., *Gibberospongos kraineri* n. sp., *Gibberospongos tichyi* n. sp.).

Lower boundary: First appearance of *Spongoserrula fluegeli* n. sp., *Steigerispongos subsymmetricus* n. sp. and other *Spongoserrula* and *Steigerispongos* species with pointed or needle-like denticles or spines. First appearance of *Gibberospongos*.

Upper boundary: = Upper boundary of the *Muelleritortis cochleata* Zone. Sudden drastic drop in the frequency of *M. cochleata* (NAKASEKO & NISHIMURA, 1979) and beginning dominance of *Tritortis kretaensis kretaensis* KOZUR & KRAHL, 1984. First appearance of *Palaeosaturnalis*.

Present Oertlispongidae: See table 1.

Age: Upper Subzone of the *Muelleritortis cochleata* Zone, late Longobardian.

Occurrence: Tethys, Philippines, western North America.

Remarks: In the *Spongoserrula fluegeli* Subzone, the maximum diversity of advanced Oertlispongidae can be observed. *Gibberospongos* seems to be restricted to this subzone. Other characteristic forms, like *Steigerispongos asymmetricus* and *Scutispongos sagittaeformis* n. sp. reaches into the Cordevolian *Tritortis kretaensis* Zone that is dominated by *Spongoserrula dehli* CORDEY et al., 1988,

	Middle-late Longobardian			Cordevolian
	Muelleritortis cochleata Zone			Tritortis kretaensis Zone
Subzones:	P. priscus	S. rarauna	S. fluegeli	undivided
Baumgartneria curvispina	XXXXXXXXXX	0000000000		
Baumgartneria dumitricae		0000000000		
Bogdanella bosniensis			00000	
Bogdanella cordevolica				000000000000
Bogdanella praecursor	XXXXXXXXXX	0000000000		
Bogdanella trentana balkanica			XXXXX	
Bogdanella trentana trentana			++++++	
Falcispongius falciformis minor	0000000000	0000000000	??????????	000
Falcispongius hamatus	XXXXXXXXXX	+++++000000		
Falcispongius transitus brevifoliaceus	XXXXXXXXXX	??????????	00000	
Falcispongius transitus transitus			XXXXX	
Gibberospongius bispinosus			00000	
Gibberospongius kraineri			++++	
Gibberospongius spinosus			XXXXX	
Gibberospongius tichyi			00000	
Oertlispongius deweveri			00000	
Oertlispongius inaequispinosus	<++++00000	???		
Paroertlispongius ? lobatus			00000	
Pterospongius alatus	000000	+++++00000		
Pterospongius altofissus	0000000000			
Pterospongius aquilus		0000000000		
Pterospongius incisus		0000000000		
Pterospongius patulii		++++++		
Pterospongius parvifissus	XXXXXXXXXX			
Pterospongius priscus priscus	XXXXXXXXXX			
Pterospongius priscus tortilis	++++++			
Scutispongius alienus			0	
Scutispongius baloghi			00	
Scutispongius bicornutus			00	
Scutispongius bituberosus			00	
Scutispongius bogdani ancoraeformis			XXXXX	
Scutispongius bogdani bogdani			XXXXXXXXXX	
Scutispongius cephalus			00	
Scutispongius dumitricai			00	
Scutispongius gackoensis			00	
Scutispongius gracilispinosus			00	
Scutispongius latus			XXXXXXXXXX	
Scutispongius longispinosus			00	
Scutispongius mocki				000000000000000000000000
Scutispongius ? parvifolius parvifolius			00000	
Scutispongius ? parvifolius primitivus	++++++			
Scutispongius ploechingeri lobatus			++++	
Scutispongius ploechingeri ploechingeri			XXXXXXXXXX	
Scutispongius reschi			00	
Scutispongius rostratus incurvatus	0000000000			
Scutispongius rostratus minutispinus	000000			
Scutispongius rostratus rostratus	<XXXXXXXXX	+++++00000		
Scutispongius sagittaeformis			0000000000	+++++
Scutispongius semifusus			00000	
Scutispongius tortilispinus			XXXXXXXXXX	
Scutispongius undulatus		+++++	XXXXXXXXXX	

Table 1: Distribution of Oertlispongiidae in the *Muelleritortis cochleata*-*Tritortis kretaensis* zones (middle Longobardian to Cordevolian)
x = common, + = rare, o = very rare, ? = assumed, but unproven
< = also present in older Ladinian beds

	Middle-late Longobardian			Cordevolian
	Muelleritortis cochleata Zone			Tritortis kretaensis Zone
Subzones:	P. priscus	S. rarauana	S. fluegeli	undivided
Spongoserrula antiqua	0000000000			
Spongoserrula bidentata		0000000000	00000	
Spongoserrula bifurcata bifurcata			00000	
Spongoserrula bifurcata parvispina			00	
Spongoserrula bipolaris			00	
Spongoserrula cordeyi			?	XXXXXXXXXXXXX0000000
Spongoserrula dehli			??	XXXXXXXXXXXXX+++++++
Spongoserrula falcata			+++++	
Spongoserrula fluegeli fluegeli			XXXXXX+++++	
Spongoserrula fluegeli multispinosa			00	
Spongoserrula goricanae			+++++++	
Spongoserrula nuda			00	
Spongoserrula ornata			00	
Spongoserrula rarauana rarauana		00+XXXXXX	XX+++000	
Spongoserrula rarauana trinodosa		+++++++	00000	
Spongoserrula raridenticulata			00000	
Spongoserrula semicircularis			00000	
Steigerispongos asymmetricus asymmetricus			XXXXXXXXXX	XXXXXX+++++++00000
Steigerispongos asymmetricus rectangularis			+++++++	
Steigerispongos asymmetricus triangulodentatus			00000	
Steigerispongos brevipediculus			00000	
Steigerispongos cristagalli		+++++++		
Steigerispongos ? curvispinus			00	
Steigerispongos dosztalyi			+++++	
Steigerispongos fojnicaensis			+++++	
Steigerispongos latofoliatus			00000	
Steigerispongos obliquus			XXXXXXXXXX	
Steigerispongos primus	0000000000			
Steigerispongos ? sp. A			0	
Steigerispongos sp. B			0	
Steigerispongos sp. C				0
Steigerispongos subsymmetricus fissus			00000	
Steigerispongos subsymmetricus latopediculus			+++++000000	
Steigerispongos subsymmetricus longiaculeatus			0000000000	??
Steigerispongos subsymmetricus subsymmetricus			XXXXXXXXXX	
Steigerispongos symmetricus			+++++++	

Table 1 (continued)

and *Spongoserrula cordeyi* n. sp. (first appearance of these two species perhaps in the upper *Spongoserrula fluegeli* Subzone). Only 4 Cordevolian species are so far known that are unknown from the *Spongoserrula fluegeli* Subzone, but may begin in its upper, not yet well known part: *Bogdanella cordevolica* n. sp., *Scutispongos mocki* n. sp., *Spongoserrula cordeyi* n. sp. and *Steigerispongos* sp. C. A lot of species of the *Spongoserrula fluegeli* Subzone are not known from the Cordevolian. However, we have only investigated rich well preserved

radiolarian faunas from the upper Cordevolian, where Oertlispongidae are already rare. The lower Cordevolian faunas of the Darnostly represented by juvenile Oertlispongidae, but mostly broken specimens, difficult to determine. Like the faunas of the upper *Spongoserrula fluegeli* Subzone, they are dominated by *Spongoserrula* and *Steigerispongos* with pointed or needle-like spines, but with other species than in the *Spongoserrula fluegeli* Subzone (*Spongoserrula dehli* CORDEY et al., 1988, *S. cordeyi* n. sp.). *Gibberospongos* is not

more present and *Scutispongus* is very rare and only represented by *Scutispongus sagittaeformis* n. sp. and *Scutispongus mocki* n. sp. The Oertlispongidae show therefore at the upper boundary of the *Spongoserrula fluegeli* Subzone a distinct decrease in diversity and only few forms begin new in the Cordevolian. The stratigraphic importance of the Oertlispongidae is therefore in the Cordevolian considerably smaller than in the Ladinian. One of the stratigraphically most important Cordevolian (and entire Late Triassic) radiolarians are the Parasaturnalidae that have evolved from the Oertlispongidae.

Our investigated Longobardian samples with Oertlispongidae are partly rich in conodonts, partly conodonts are missing or very rare. Sample 88-272 from Bosnia-Herzegovina yielded a few *Budurovignathus mungoensis* (DIEBEL). Therefore it belongs to the *B. mungoensis* conodont zone, but its position within this zone cannot be determined by conodonts. The presence of *Spongoserrula* and *Steigerispongus* with pointed or needle-like spines is characteristic of the *Spongoserrula fluegeli* Subzone of late Longobardian age. The genus *Tritortis* KOZUR & KRAHL is still rare in this sample which is clearly dominated by *Muelleritortis*. Therefore, the uppermost *Muelleritortis cochleata* Zone (upper *Spongoserrula fluegeli* Subzone) can be excluded for this sample. For this reason, the sample belongs to the lower *Spongoserrula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian).

The exact age of this sample within the *Muelleritortis cochleata* Zone could not be determined by Hungarosaturnalidae, because these radiolarians are so far only described from scattered occurrences within the *Muelleritortis cochleata* Zone and the phylogenetic lines within the Hungarosaturnalidae are not yet well known. Therefore this sample was erroneously placed into the lower *Muelleritortis cochleata* Zone by MOSTLER & KRAINER (1994).

The conodont-free sample Bi 1 from Bielschitz Mt. (Karawanken Mountains, southern Austria) was assigned to the uppermost Longobardian by MOSTLER & KRAINER (1994) because it lies immediately below the Schlern Dolomite which is placed into the Carnian with a local beginning in the latest

Cordevolian. However, the sample Bi 1 belongs to the middle Longobardian *Spongoserrula rarauana* Subzone. Therefore the Schlern Dolomite begins locally within the middle Longobardian.

These two examples show the importance of the Longobardian Oertlispongidae for detailed stratigraphic assignment of beds that have no conodonts or conodont zonal index forms that do not allow a subdivision of the conodont zone. Sometimes the radiolarians are better suitable for stratigraphic assignments than the conodonts. Thus, the radiolarian sample investigated by CORDEY et al. (1988) from British Columbia was by conodonts placed into the Late Anisian to Early Ladinian. The radiolarian fauna, however, indicates clearly the presence of the lower *Tritortis kretaensis* Zone. The *Tritortis kretaensis* Zone characterizes the Cordevolian and does not begin before the latest Longobardian. The presence of *Tritortis kretaensis kretaensis* (KOZUR & KRAHL, 1984), *Spongoserrula dehli* CORDEY et al. and *Spongoserrula cordeyi* n. sp. excludes any age older than late Longobardian. The latter two species are advanced representatives of the *Spongoserrula fluegeli* group (*Spongoserrula* with pointed or needle-like spines) that does not begin before the late Longobardian. *Tritortis kretaensis kretaensis* does not begin before the late Longobardian as well. A Late Anisian to Early Ladinian age can be therefore definitely excluded, even if we take into consideration that the Anisian-Ladinian boundary is placed at the base of the *Eoprotrachyceras* fauna in North America.

The radiolarian zonation based on Oertlispongidae is more detailed than the ammonoid- and conodont zonations. Like in the Fassanian, also the Longobardian subzones can be still further subdivided at least in lower and upper parts. However, the subzones are defined here as wide as possible to assign also poor radiolarian faunas without difficulties.

Acknowledgements

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Explanation of Plates

All specimens for which no locality and age data are given were derived from sample 88-272 from the locality Varoski creek near Fojnica, Republic Bosnia-Herzegovina. They belong to the lower *Spongoserpula fluegeli* Subzone of *Muelleritortis cochleata* Zone (early late Longobardian).

Plate 1

- Figs. 1–3: *Scutispongos latus* n. sp.; Fig. 1: holotype, x 200, rep.-no. KOMO 1994 IV-123; Fig. 2: x 160, rep.-no. KOMO 1994 IV-124; Fig. 3: x 200, rep.-no. KOMO 1994 IV-125.
- Figs. 4–6: *Scutispongos undulatus* (DUMITRICA, 1982); Fig. 4: x 170, rep.-no. KOMO 1994 IV-99; Fig. 5: x 180, rep.-no. KOMO 1994 IV-100; Fig. 6: x 170, rep.-no. KOMO 1994 IV-101.
- Figs. 7, 9–11: *Scutispongos tortilispinus* n. sp.; Fig. 7: x 150, rep.-no. KOMO 1994 IV-94; Fig. 9: x 170, rep.-no. KOMO 1994 IV-95; Fig. 10: x 150, rep.-no. KOMO 1994 IV-96; Fig. 11: holotype, x 200, rep.-no. KOMO 1994 IV-93.
- Fig. 8: *Scutispongos longispinosus* n. sp., holotype, x 165, rep.-no. KOMO 1994 IV-127.

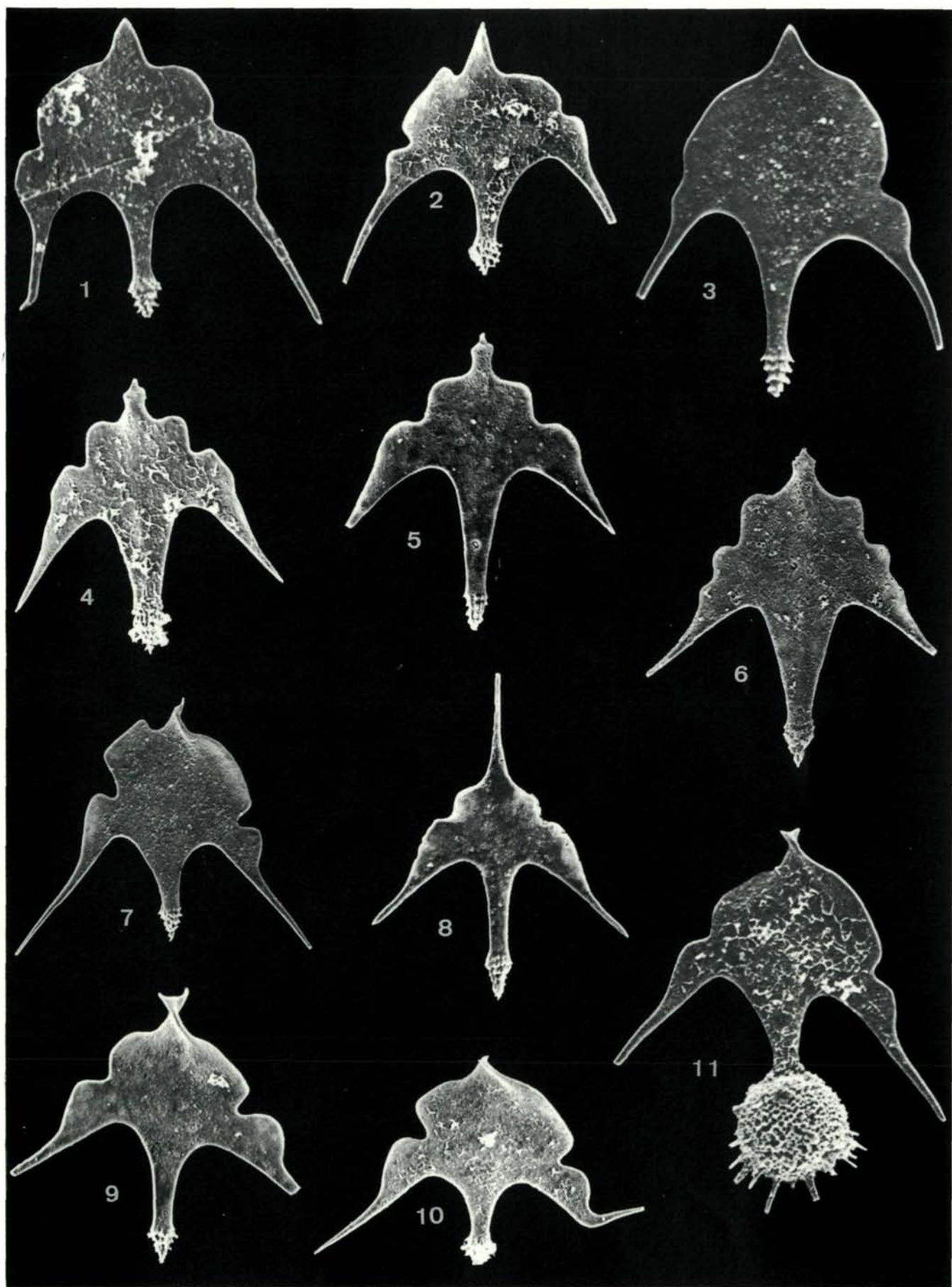


Plate 2

- Figs. 1, 2: *Steigerispongos symmetricus* n. sp.; Fig. 1: x 180, rep.-no. KOMO 1994 IV-79; Fig. 2: holotype, x 180, rep.-no. KOMO 1994 IV-78.
- Fig. 3: *Steigerispongos brevipediculus* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-76.
- Figs. 4, 7, 11: *Steigerispongos subsymmetricus subsymmetricus* n. subsp.; Fig. 4: x 160, rep.-no. KOMO 1994 IV-51; Fig. 7: holotype, x 180, rep.-no. KOMO 1994 IV-50; Fig. 11: x 170, rep.-no. KOMO 1994 IV-52.
- Figs. 5, 6, 10: *Steigerispongos subsymmetricus latopediculus* n. subsp.; Fig. 5: x 200, rep.-no. KOMO 1994 IV-54; Fig. 6: x 200, rep.-no. KOMO 1994 IV-138; Fig. 10: holotype, x 200, rep.-no. KOMO 1994 IV-53.
- Fig. 8: *Steigerispongos asymmetricus asymmetricus* n. subsp., x 200, rep.-no. KOMO 1994 IV-68.
- Fig. 9: *Steigerispongos* cf. *subsymmetricus latopediculus* n. subsp., x 250, rep.-no. KOMO 1994 IV-51.

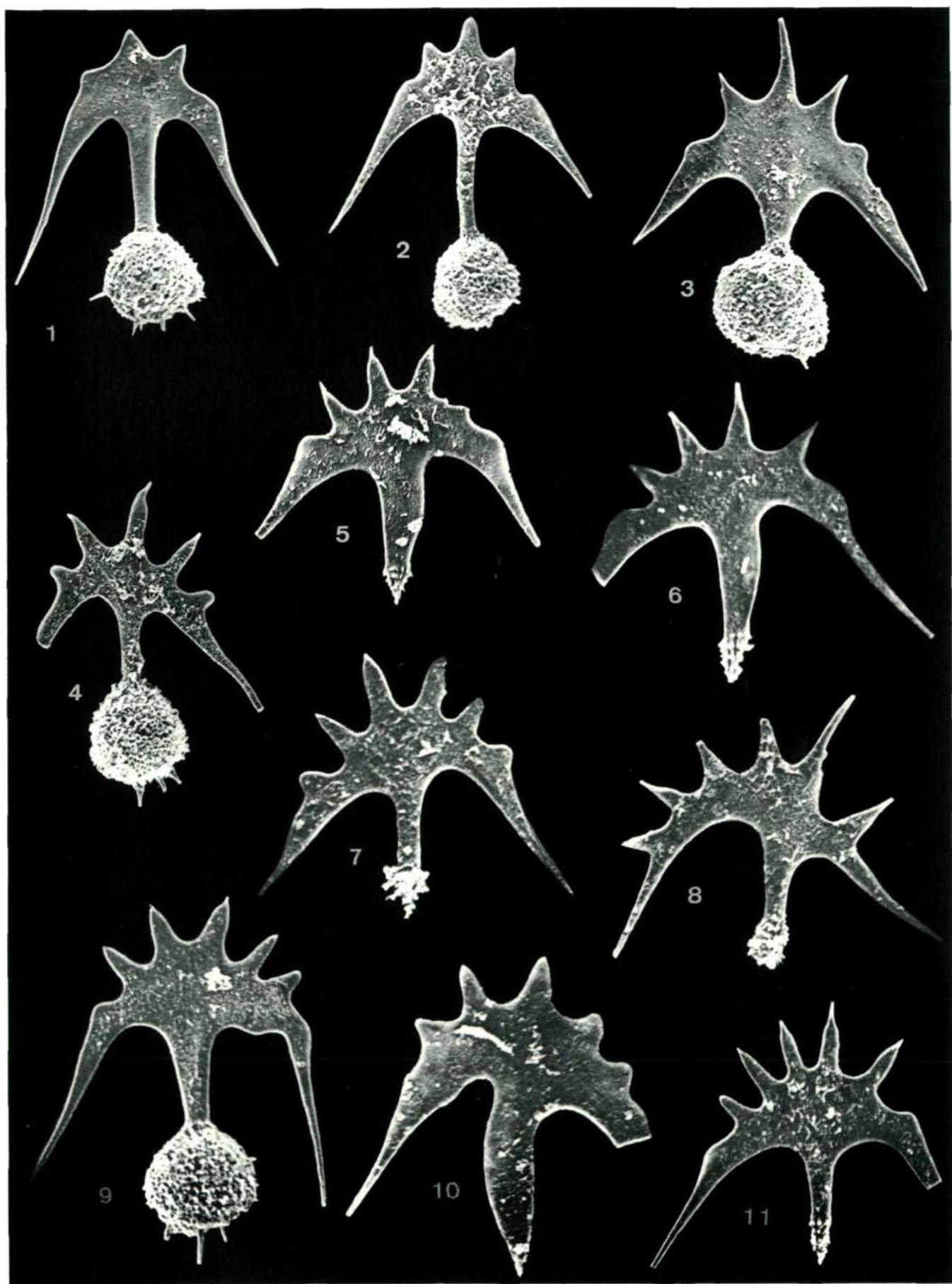


Plate 3

- Figs. 1, 2, 5, 6: *Scutispongos bogdani bogdani* (KOLAR-JURKOVŠEK, 1989); Fig. 1: x 180, rep.-no. KOMO 1994 IV-105; Fig. 2: x 150, rep.-no. KOMO 1994 IV-106; Fig. 5: x 180, rep.-no. KOMO 1994 IV-107; Fig. 6: x 200, rep.-no. KOMO 1994 IV-138.
- Figs. 3, 10: *Scutispongos bogdani ancoraeformis* n. subsp.; Fig. 3: x 230, rep.-no. KOMO 1994 IV-110; Fig. 10: x 200, rep.-no. KOMO 1994 IV-111.
- Figs. 4, 9, 11: *Scutispongos ploechingeri ploechingeri* n. subsp.; Fig. 4: x 210, rep.-no. KOMO 1994 IV-129; Fig. 9: holotype, x 200, rep.-no. KOMO 1994 IV-128; Fig. 11: x 200, rep.-no. KOMO 1994 IV-130.
- Fig. 7: *Scutispongos* cf. *bogdani bogdani* (KOLAR-JURKOVŠEK, 1989), transition form to *Scutispongos ploechingeri* n. sp., x 180, rep.-no. KOMO 1994 IV-104.
- Fig. 8: *Scutispongos* cf. *sagittaeformis* n. sp., transition form to *Scutispongos ploechingeri* n. sp., x 200, rep.-no. KOMO 1994 IV-137.

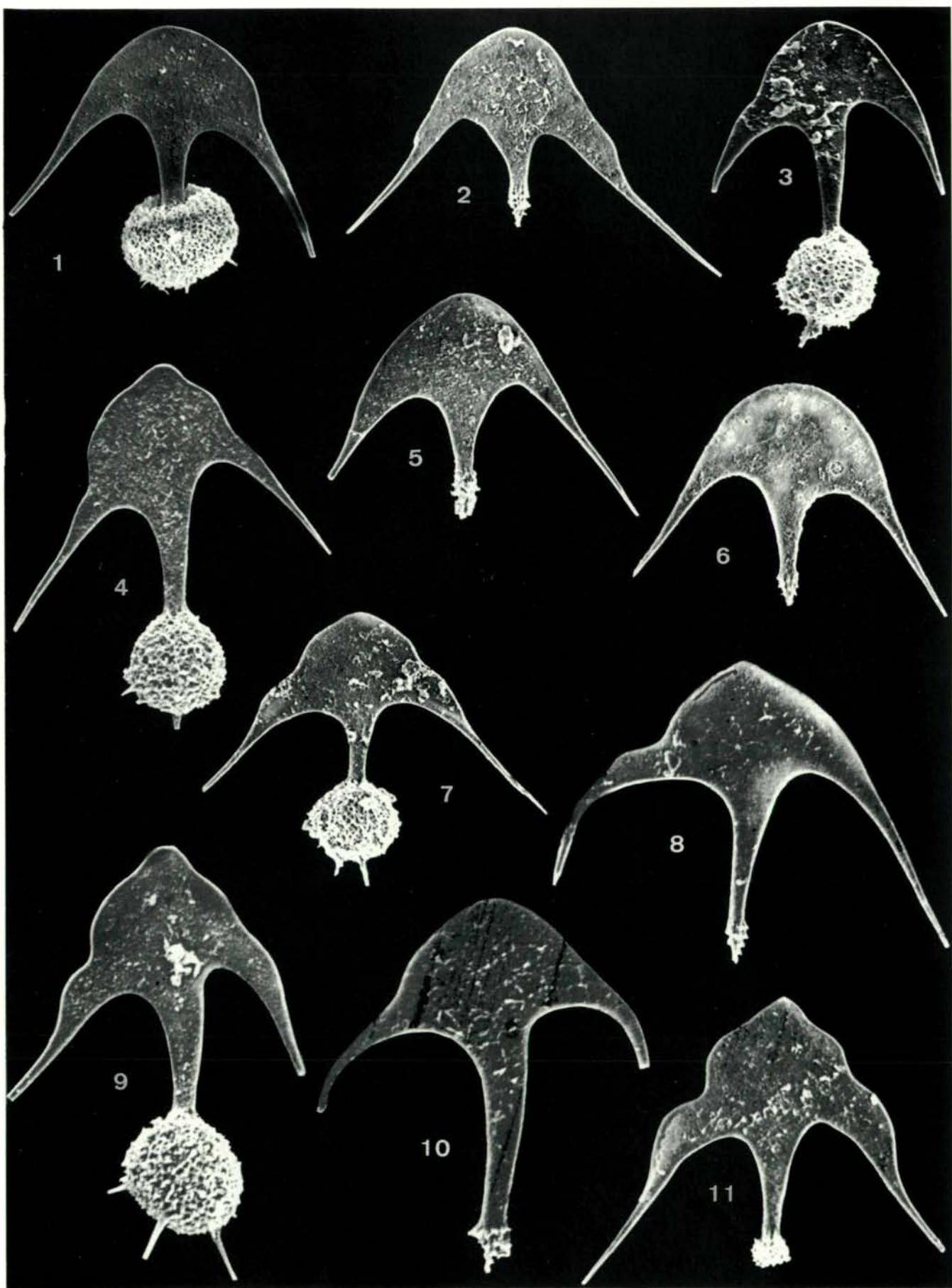


Plate 4

- Figs. 1, 6: *Scutispongus semifusus* n. sp.; Fig. 1: x 250, rep.-no. KOMO 1994 IV-236; Fig. 6: holotype, x 200, rep.-no. KOMO 1994 IV-235.
- Fig. 2: *Scutispongus bogdani bogdani* (KOLAR-JURKOVŠEK, 1989), x 180, rep.-no. KOMO 1994 IV-108.
- Fig. 3: *Scutispongus* cf. *latus* n. sp., x 300, rep.-no. KOMO 1994 IV-122.
- Fig. 4: *Scutispongus* cf. *bogdani ancoraeformis* n. subsp., x 300, rep.-no. KOMO 1994 IV-112.
- Figs. 5, 10: *Scutispongus baloghi* n. sp.; Fig. 5: holotype, x 220, rep.-no. KOMO 1994 IV-114; Fig. 10: x 170, rep.-no. KOMO 1994 IV-115.
- Figs. 7, 8: *Scutispongus ploechingeri lobatus* n. subsp.; Fig. 7: holotype, x 220, rep.-no. KOMO 1994 IV-131; Fig. 8: x 180, rep.-no. KOMO 1994 IV-132.
- Fig. 9: *Scutispongus bogdani ancoraeformis* n. subsp., holotype, x 180, rep.-no. KOMO 1994 IV-109.
- Fig. 11: *Scutispongus dimitricai* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-120.

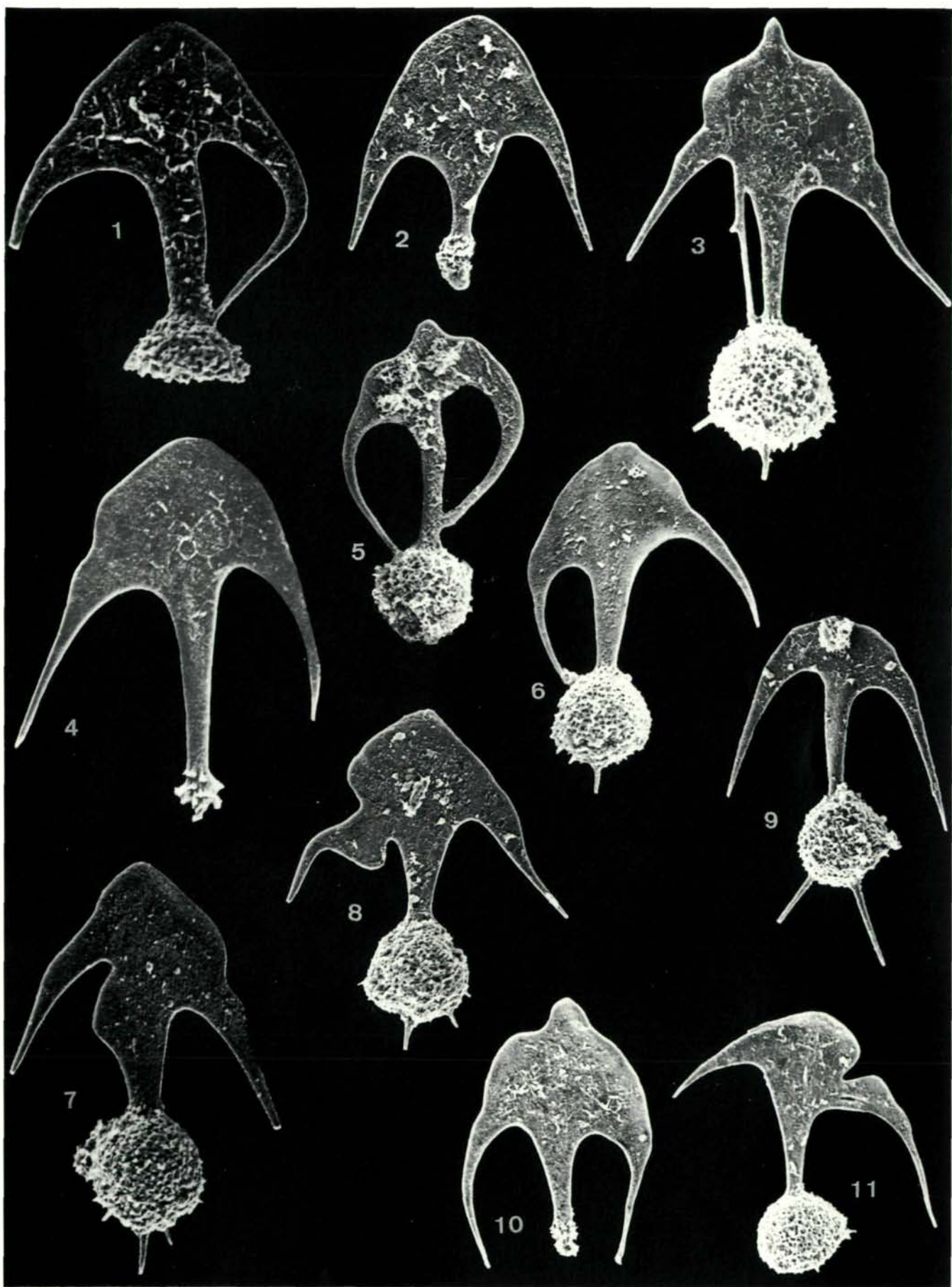


Plate 5

- Fig. 1: *Spongoserrula ornata* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-38.
- Figs. 2, 3, 5, 6: *Spongoserrula falcata* n. sp.; Fig. 2: holotype, x 170, rep.-no. KOMO 1994 IV-32; Fig. 3: x 220, rep.-no. KOMO 1994 IV-33; Fig. 5: x 220, rep.-no. KOMO 1994 IV-34; Fig. 6: x 260, rep.-no. KOMO 1994 IV-35.
- Figs. 4, 7: *Spongoserrula bifurcata bifurcata* n. subsp.; Fig. 4: x 180, rep.-no. KOMO 1994 IV-39; Fig. 7: holotype, x 180, rep.-no. KOMO 1994 IV-40.
- Fig. 8: *Spongoserrula rarauana trinodosa* n. subsp., holotype, x 175, rep.-no. KOMO 1994 IV-36.
- Fig. 9: *Spongoserrula bidentata* n. sp., holotype, x 170, rep.-no. KOMO 1994 IV-41.
- Figs. 10, 11, 13, 14: *Spongoserrula rarauana rarauana* DUMITRICĂ, 1982; Fig. 10: x 180, rep.-no. KOMO 1994 IV-21; Fig. 11: x 180, rep.-no. KOMO 1994 IV-22; Fig. 13: x 170, rep.-no. KOMO 1994 IV-23; Fig. 14: x 170, rep.-no. KOMO 1994 IV-24.
- Fig. 12: *Spongoserrula* cf. *raarauana trinodosa* n. subsp., transition form between *S. rarauana trinodosa* n. subsp. and *S. rarauana rarauana* DUMITRICĂ, 1982, x 170, rep.-no. KOMO 1994 IV-37.
- Fig. 15: *Spongoserrula* cf. *raarauana rarauana* DUMITRICĂ, 1982, x 170, rep.-no. KOMO 1994 IV-25.

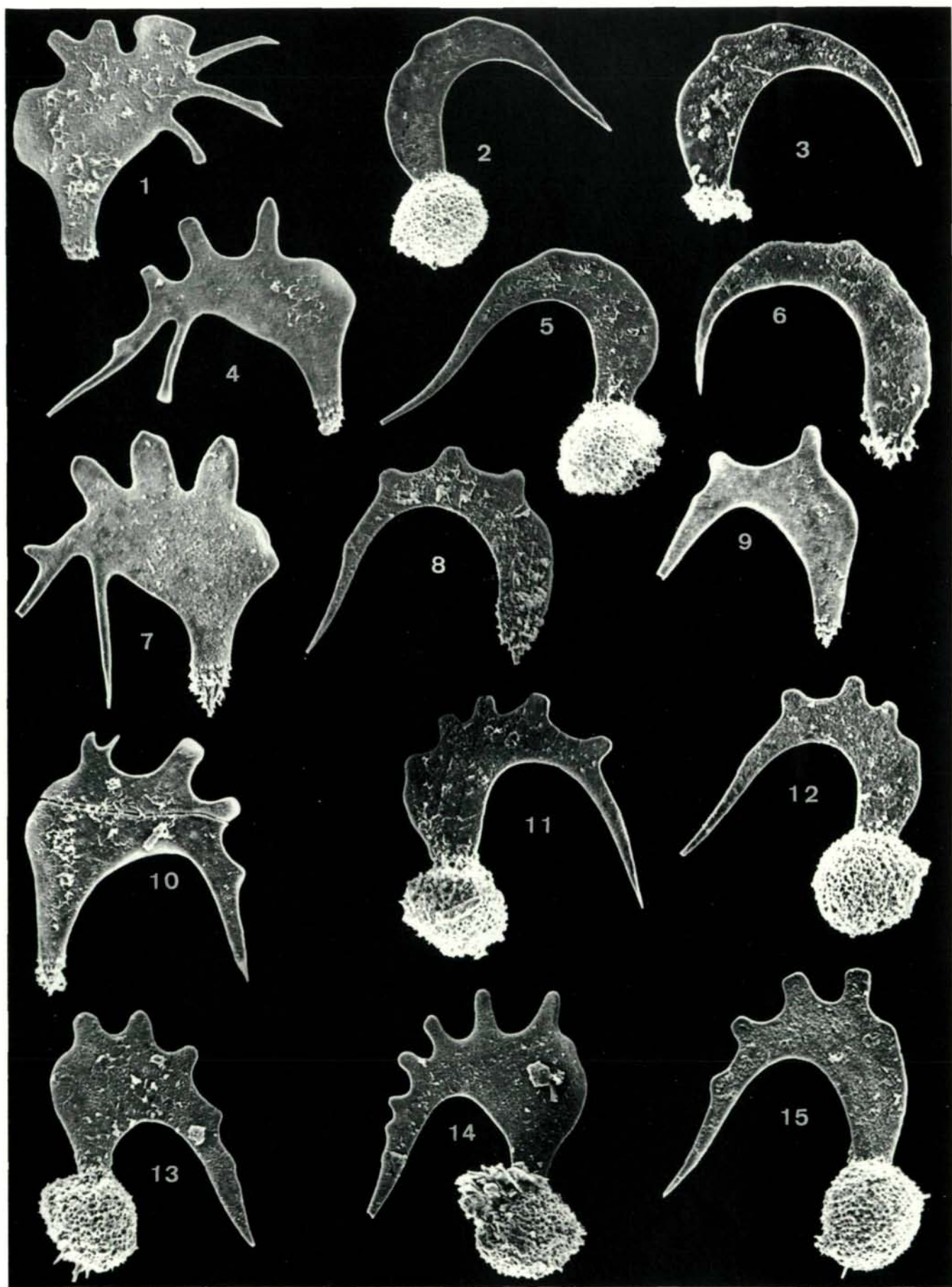


Plate 6

- Figs. 1–3, 6, 9: *Spongoserrula rarauana rarauana* DUMITRICĂ, 1982; Fig. 1: x 180, rep.-no. KOMO 1994 IV-26; Fig. 2: x 180, rep.-no. KOMO 1994 IV-27; Fig. 3: x 250, rep.-no. KOMO 1994 IV-28; Fig. 6: x 200, rep.-no. KOMO 1994 IV-29; Fig. 9: x 170, rep.-no. KOMO 1994 IV-30.
- Fig. 4: *Spongoserrula bipolaris* n. sp., holotype, x 140, rep.-no. KOMO 1994 IV-44.
- Figs. 5, 7, 8, 11: *Spongoserrula fluegeli fluegeli* n. subsp.; Fig. 5: x 160, rep.-no. KOMO 1994 IV-46; Fig. 7: x 150, rep.-no. KOMO 1994 IV-47; Fig. 8: holotype, x 220, rep.-no. KOMO 1994 IV-45; Fig. 11: x 180, rep.-no. KOMO 1994 IV-48.
- Fig. 10: *Spongoserrula fluegeli multispinosa* n. subsp., holotype, x 140, rep.-no. KOMO 1994 IV-49.

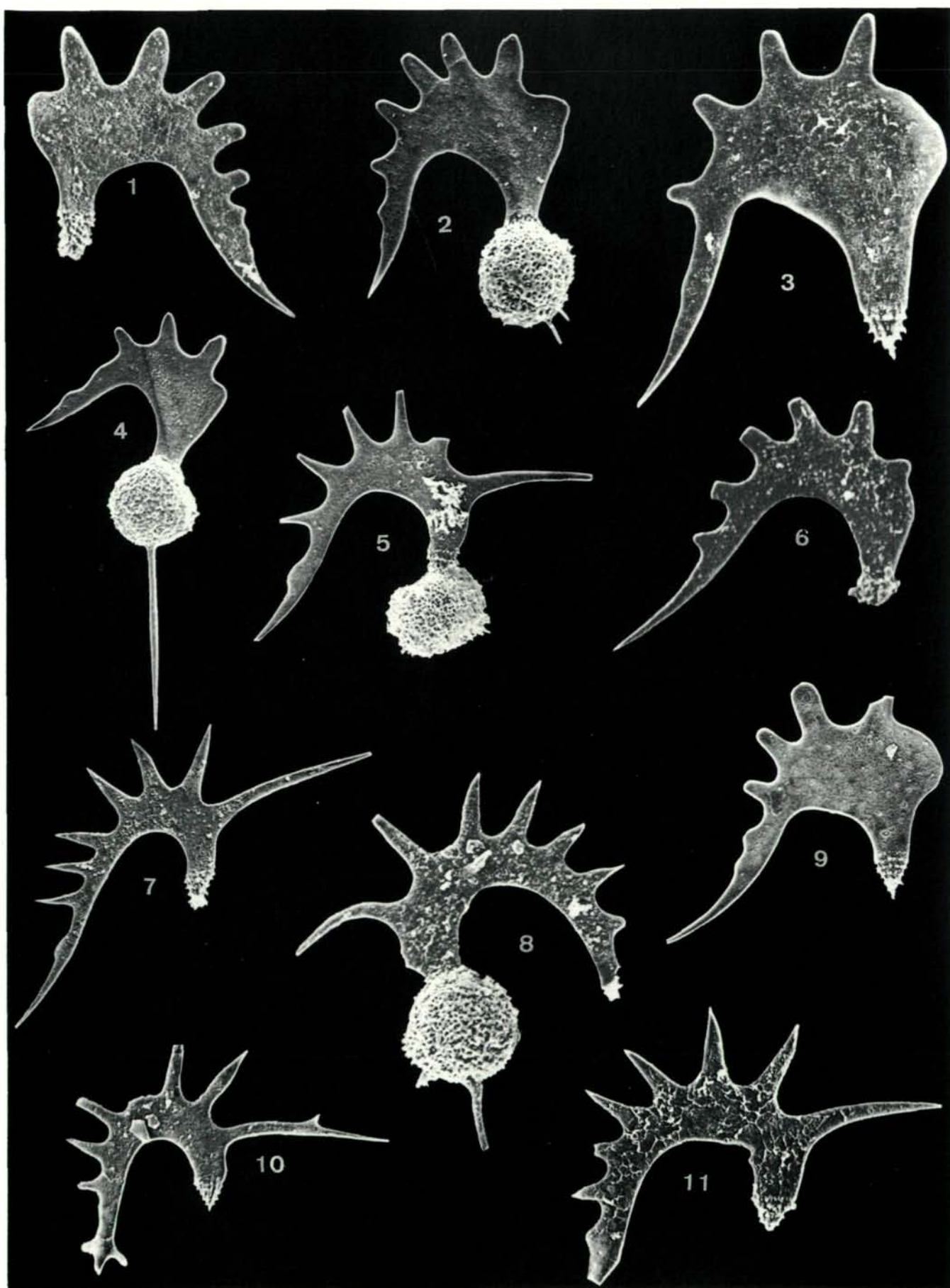


Plate 7

- Fig. 1: *Scutispongos reschi* n. sp., holotype, x 200, rep.-no. KOMO 1994 IV-113.
Fig. 2: *Scutispongos gracilispinosus* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-115.
Fig. 3: *Scutispongos alienus* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-116.
Fig. 4: *Steigerispongos* sp. B, x 160, rep.-no. KOMO 1994 IV-63.
Fig. 5: *Oertlispongos deweveri* n. sp., holotype, x 200, rep.-no. KOMO 1994 IV-1.
Fig. 6: *Bogdanella bosniensis* n. sp., holotype, x 300, rep.-no. KOMO 1994 IV-87.
Figs. 7–9, 12, 13: *Bogdanella trentana balkanica* n. subsp.; Fig. 7: holotype, x 200, rep.-no. KOMO 1994 IV-88; Fig. 8: x 200, rep.-no. KOMO 1994 IV-89; Fig. 9: x 200, rep.-no. KOMO 1994 IV-92; Fig. 12: x 250, rep.-no. KOMO 1994 IV-90; Fig. 13: x 250, rep.-no. KOMO 1994 IV-91.
Fig. 10: *Spongoserrula* sp., x 250, rep.-no. KOMO 1994 IV-66.
Fig. 11: *Paroertlispongos ? lobatus* n. sp., holotype, x 250, rep.-no. KOMO 1994 IV-86.

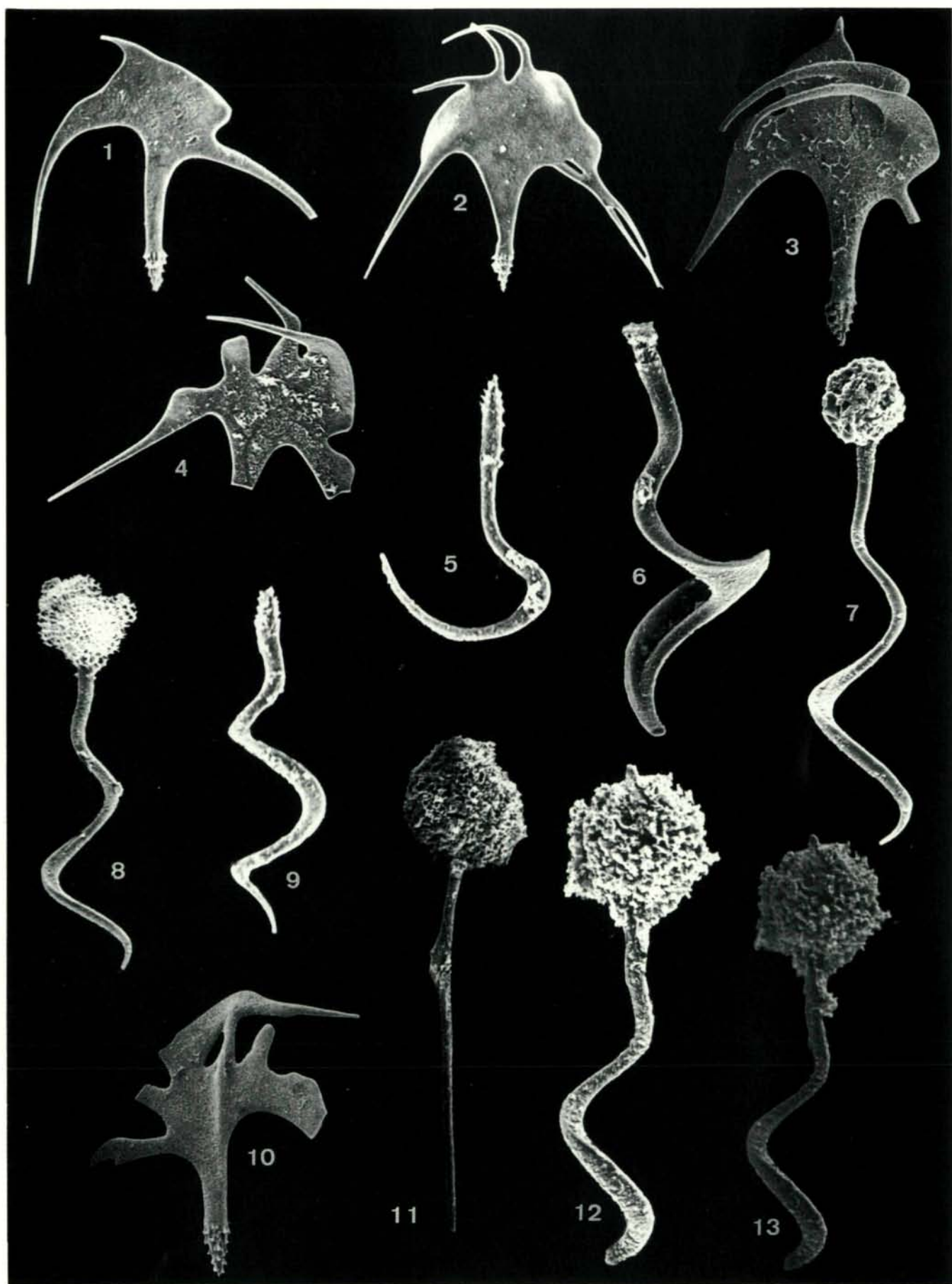


Plate 8

- Fig. 1: *Gibberospongia kraineri* n. sp., x 200, rep.-no. KOMO 1994 IV-3.
Fig. 2: *Falcispongia* aff. *F. transitus* n. sp., x 230, rep.-no. KOMO 1994 IV-4.
Fig. 3: *Falcispongia transitus brevifoliaceus* n. subsp., holotype, x 400, rep.-no. KOMO 1994 IV-8.
Fig. 4: *Scutispongia latus* n. sp., x 250, rep.-no. KOMO 1994 IV-126.
Fig. 5: *Spongoserrula* cf. *rarauana* DUMITRICĂ, 1982, x 130, rep.-no. KOMO 1994 IV-140.
Fig. 6: *Gibberospongia spinosus* n. sp., x 200, rep.-no. KOMO 1994 IV-17.
Figs. 7, 8: *Scutispongia tortilispinus* n. sp.; Fig. 7: x 220, rep.-no. KOMO 1994 IV-97; Fig. 8: x 220, rep.-no. KOMO 1994 IV-98.
Fig. 9: *Spongoserrula rarauana rarauana* DUMITRICĂ, 1982, x 250, rep.-no. KOMO 1994 IV-102.
Fig. 10: *Scutispongia bogdani bogdani* (KOLAR-JURKOVŠEK, 1989), x 400, rep.-no. KOMO 1994 IV-103.

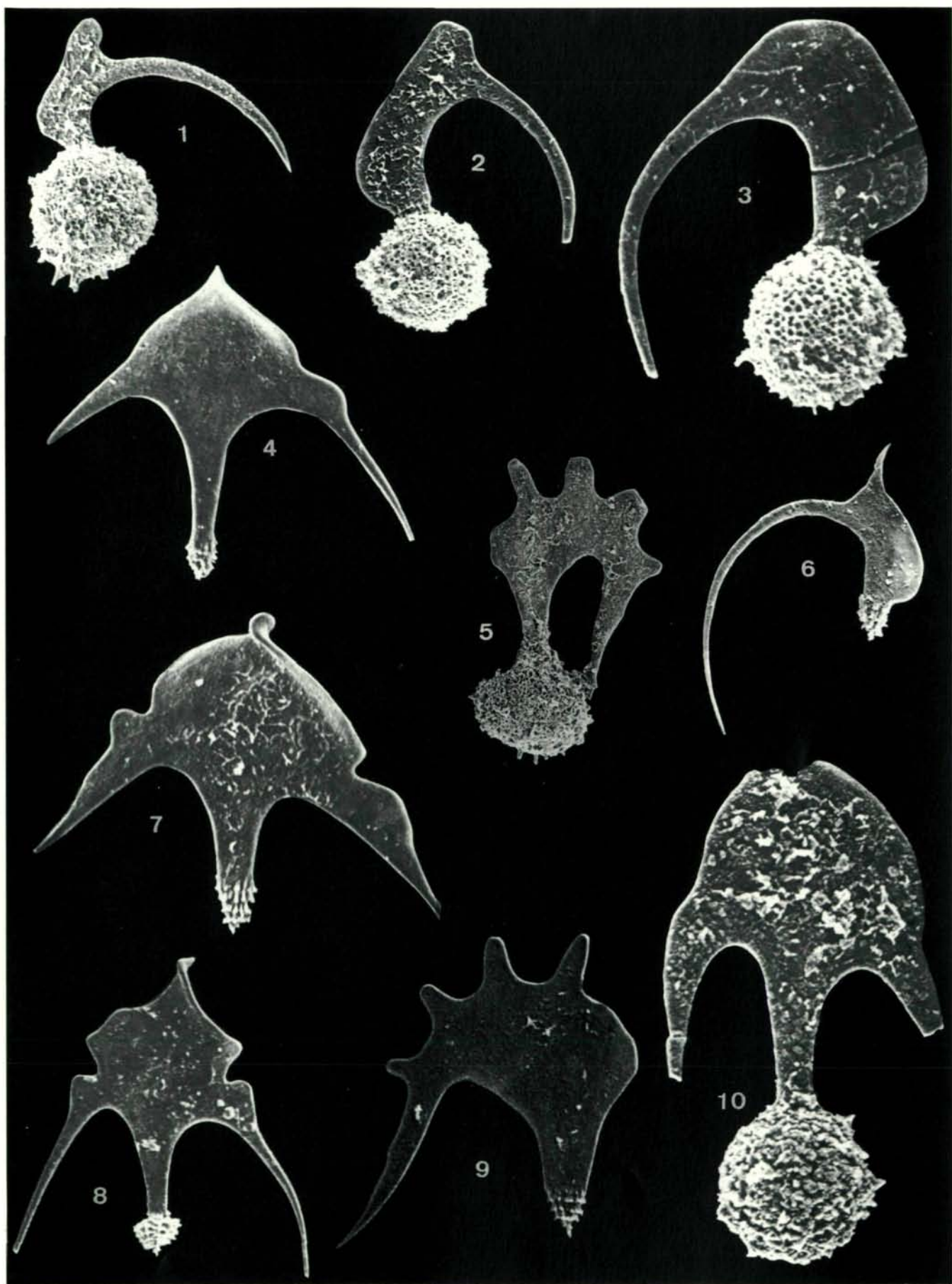


Plate 9

- Figs. 1, 5: *Falcispongus hamatus* DUMITRICĂ, 1982; Fig. 1: x 180, rep.-no. KOMO 1994 IV-10; Fig. 5: x 200, rep.-no. KOMO 1994 IV-11.
- Fig. 2: *Gibberospongus tichyi* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-20.
- Fig. 3: *Spongoserrula semicircularis* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-43.
- Figs. 4, 10, 13, 14: *Falcispongus transitus transitus* n. sp.; Fig. 4: x 200, rep.-no. KOMO 1994 IV-6; Fig. 10: x 200, rep.-no. KOMO 1994 IV-7; Fig. 13: holotype, x 170, rep.-no. KOMO 1994 IV-5; Fig. 14: x 180, rep.-no. KOMO 1994 IV-9.
- Figs. 6, 9, 11, 12, 16, 18: *Gibberospongus spinosus* n. sp.; Fig. 6: x 200, rep.-no. KOMO 1994 IV-13; Fig. 9: holotype, x 180, rep.-no. KOMO 1994 IV-12; Fig. 11: x 200, rep.-no. KOMO 1994 IV-14; Fig. 12: x 200, rep.-no. KOMO 1994 IV-15; Fig. 16: x 180, rep.-no. KOMO 1994 IV-16; Fig. 18: x 180, rep.-no. KOMO 1994 IV-42.
- Fig. 7: *Spongoserrula nuda* n. sp., holotype, x 150, rep.-no. KOMO 1994 IV-31.
- Fig. 8: *Gibberospongus bispinosus* n. sp., holotype, x 170, rep.-no. KOMO 1994 IV-19.
- Fig. 15: *Scutispongus sagittaeformis* n. sp., x 180, rep.-no. KOMO 1994 IV-134.
- Fig. 17: *Gibberospongus kraineri* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-2.

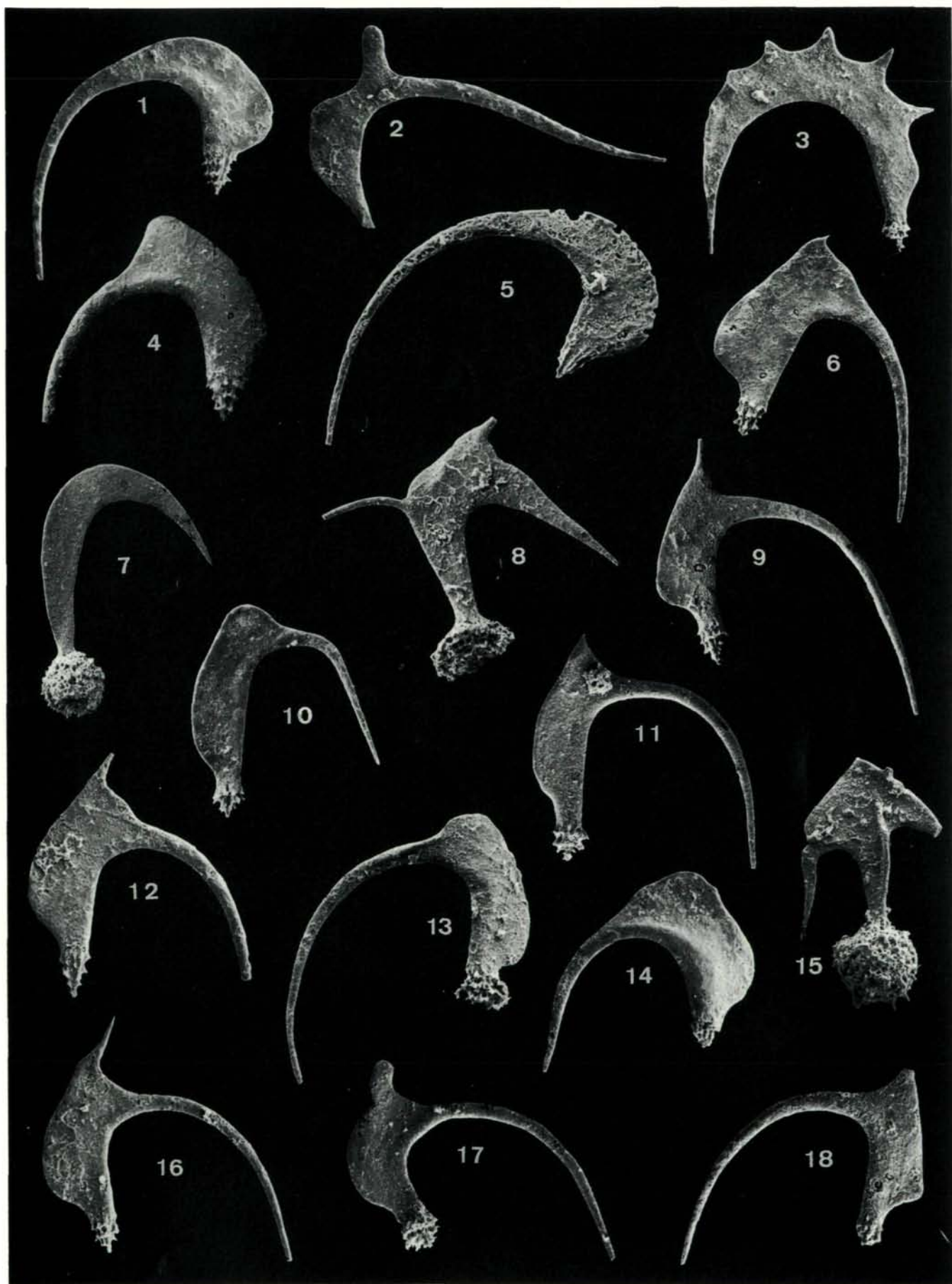


Plate 10

- Figs. 1, 11: *Steigerispongos obliquus* n. sp.; Fig. 1: x 150, rep.-no. KOMO 1994 IV-83; Fig. 11: holotype, x 170, rep.-no. KOMO 1994 IV-82.
- Fig. 2: *Steigerispongos subsymmetricus subsymmetricus* n. sp., pathologic form, x 150, rep.-no. KOMO 1994 IV-56.
- Figs. 3, 15: *Steigerispongos subsymmetricus fissus* n. subsp.; Fig. 3: holotype, x 160, rep.-no. KOMO 1994 IV-57; Fig. 15: x 150, rep.-no. KOMO 1994 IV-58.
- Figs. 4, 7, 14: *Steigerispongos subsymmetricus subsymmetricus* n. subsp.; Fig. 4: x 130, rep.-no. KOMO 1994 IV-59; Fig. 7: x 150, rep.-no. KOMO 1994 IV-60; Fig. 14: x 170, rep.-no. KOMO 1994 IV-61.
- Fig. 5: *Steigerispongos* cf. *symmetricus* n. sp., x 130, rep.-no. KOMO 1994 IV-80.
- Fig. 6: *Steigerispongos* ? sp. A, x 120, rep.-no. KOMO 1994 IV-81.
- Figs. 8, 12: *Steigerispongos subsymmetricus longiaculeatus* n. subsp.; Fig. 8: x 110, rep.-no. KOMO 1994 IV-62; Fig. 12: x 100, rep.-no. KOMO 1994 IV-63.
- Fig. 9: *Steigerispongos* ? *curvispinus* n. sp., x 150, rep.-no. KOMO 1994 IV-65.
- Fig. 10, 13: *Steigerispongos fojnicaensis* n. sp.; Fig. 10: holotype, x 150, rep.-no. KOMO 1994 IV-84; Fig. 13: specimen with bifurcated terminal spine in one wing, x 130, rep.-no. KOMO 1994 IV-85.

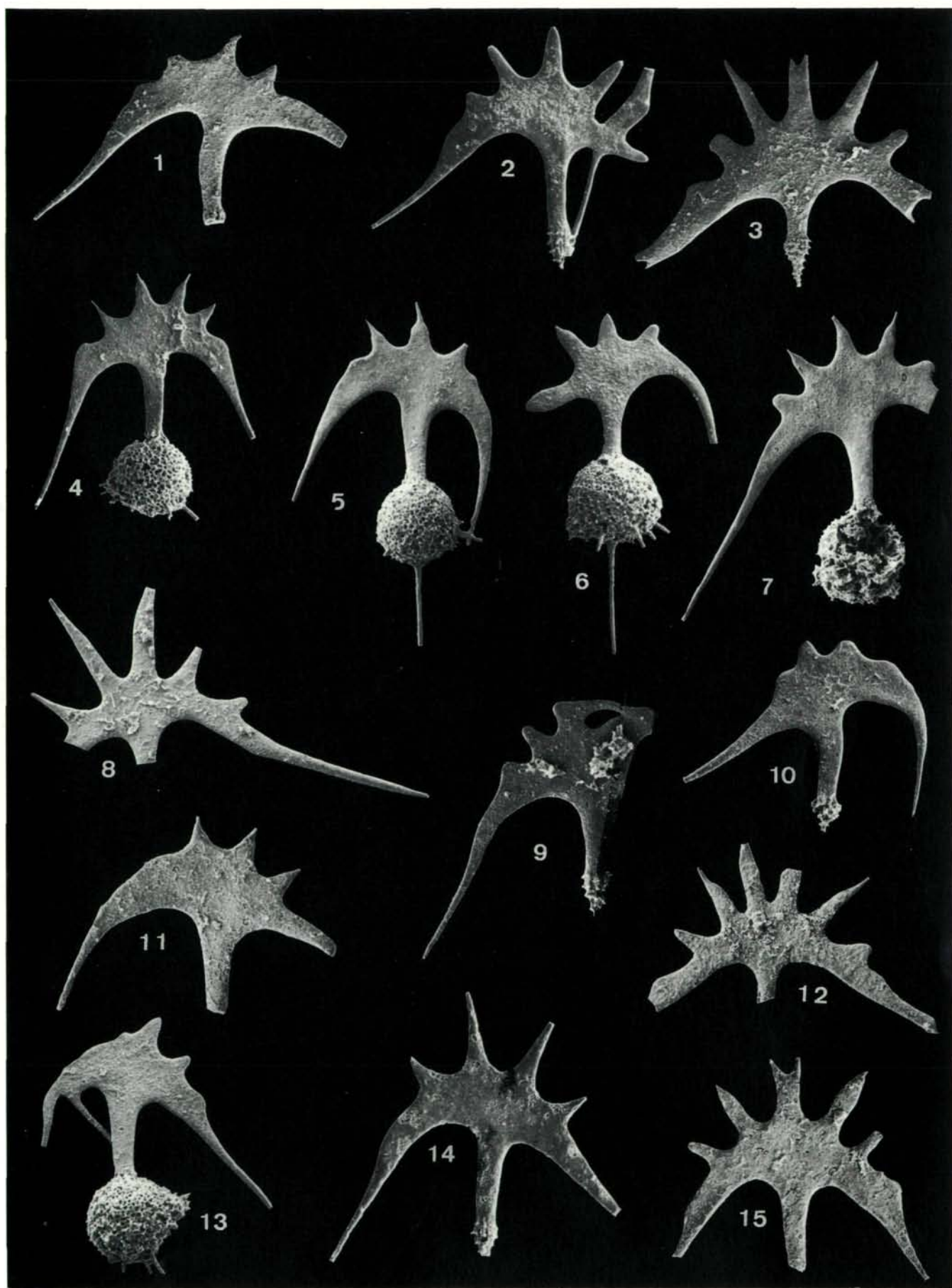


Plate 11

- Fig. 1: *Steigerispongos latofolius* n. sp., holotype, x 160, rep.-no. KOMO 1994 IV-77.
- Fig. 2: *Steigerispongos* cf. *asymmetricus* n. sp. with two spines on the secondary blade, x 150, rep.-no. KOMO 1994 IV-69.
- Figs. 4, 5, 7: *Steigerispongos asymmetricus asymmetricus* n. subsp.; Fig. 4: holotype, x 170, rep.-no. KOMO 1994 IV-67; Fig. 5: x 180, rep.-no. KOMO 1994 IV-70; Fig. 7: x 160, rep.-no. KOMO 1994 IV-71.
- Fig. 3: *Steigerispongos asymmetricus triangulodentatus* n. subsp., holotype, x 200, rep.-no. KOMO 1994 IV-72.
- Fig. 6: *Steigerispongos asymmetricus rectangularis* n. subsp., holotype, x 160, rep.-no. KOMO 1994 IV-73.
- Fig. 8: *Steigerispongos* cf. *asymmetricus asymmetricus* n. subsp., x 180, rep.-no. KOMO 1994 IV-74.
- Fig. 9: *Scutispongos bituberosus* n. sp., holotype, x 130, rep.-no. KOMO 1994 IV-117.
- Fig. 10: *Steigerispongos* ? *curvispinus* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-64.
- Fig. 11: *Steigerispongos asymmetricus* subsp. indet., x 160, rep.-no. KOMO 1994 IV-75.
- Fig. 12: *Scutispongos latus* n. sp., pathologic form with two terminal spines at one wing, x 150, rep.-no. KOMO 1994 IV-118.
- Fig. 13: *Scutispongos cephalus* n. sp., holotype, x 180, rep.-no. KOMO 1994 IV-64.

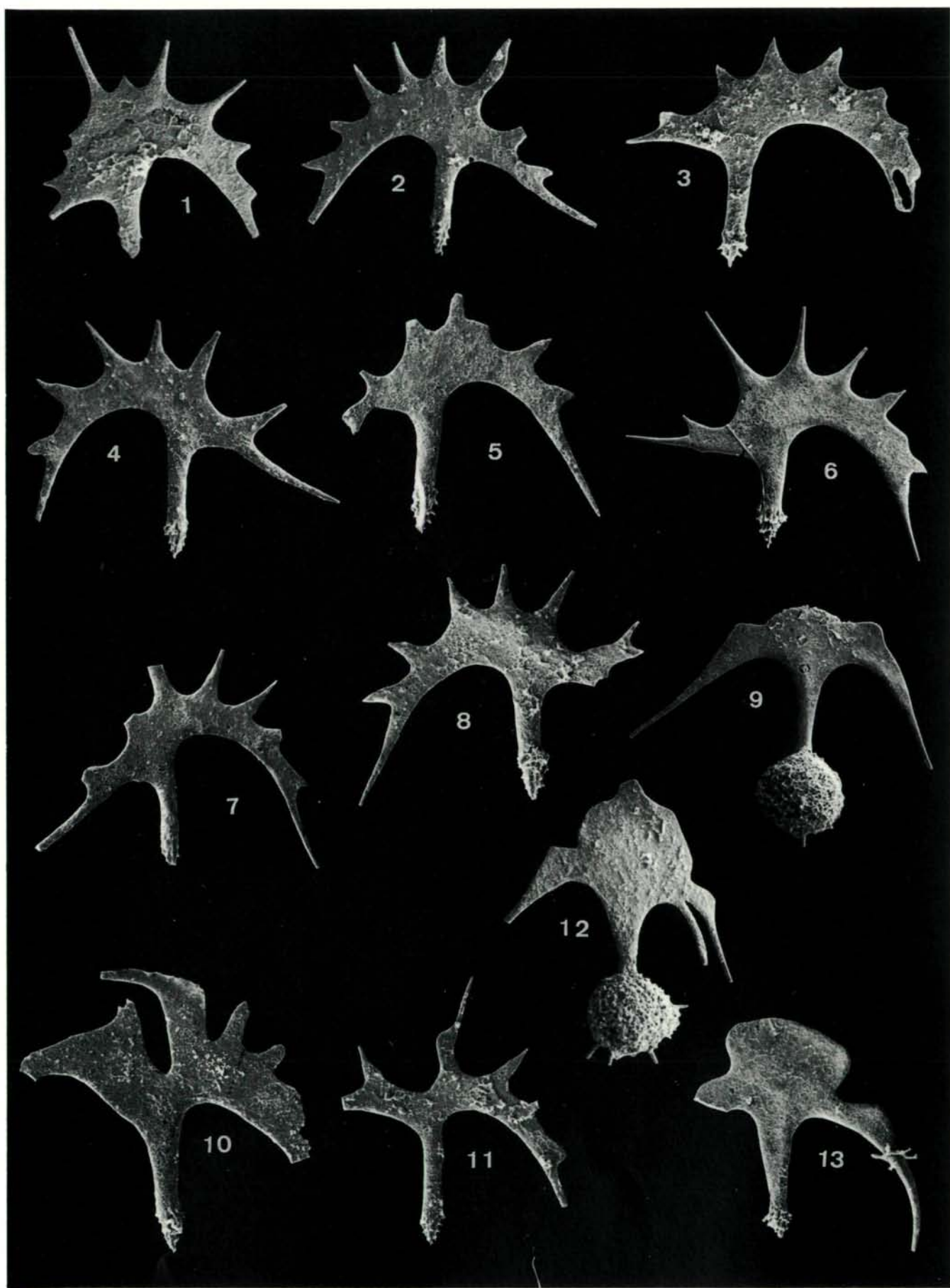


Plate 12

- Fig. 1: *Spongoserrula raridenticulata* n. sp., holotype, x , rep.-no. KOMO 1994 IV-141.
Fig. 2: *Spongoserrula* cf. *rarauana trinodosa* n. subsp., x 150, rep.-no. KOMO 1994 IV-142.
Fig. 3: *Spongoserrula rarauana trinodosa* n. subsp. x 130, rep.-no. KOMO 1994 IV-143.
Fig. 4: *Spongoserrula bipolaris* n. sp., x 120, rep.-no. KOMO 1994 IV-144
Fig. 5: *Spongoserrula bidentata* n. sp., x 170, rep.-no. KOMO 1994 IV-145.
Fig. 6: *Gibberospongus* cf. *bispinosus* n. sp., pathologic form, x 150, rep.-no. KOMO 1994 IV-146.
Fig. 7: *Scutispongus gackoensis* n. sp., holotype, x 150, rep.-no. KOMO 1994 IV-147.
Fig. 8: *Scutispongus* aff. *S. reschi* n. sp., pathologic form (?), x 130, rep.-no. KOMO 1994 IV-148.
Fig. 9: *Scutispongus cephalus* n. sp., holotype, x 130, rep.-no. KOMO 1994 IV-119.
Fig. 10: *Scutispongus* cf. *sagittaeformis* n. sp., x 110, rep.-no. KOMO 1994 IV-150.
Fig. 11: *Scutispongus gracilispinosus* n. sp., x 130, rep.-no. KOMO 1994 IV-151.
Fig. 12: *Scutispongus bicornutus* n. sp., holotype, x 130 rep.-no. KOMO 1994 IV-152.
Figs. 13, 14: *Steigerispongus dosztalyi* n. sp.; Fig. 13: holotype, x 130, rep.-no. KOMO 1994 IV-153; Fig. 14: x 170, rep.-no. KOMO 1994 IV-154.
Fig. 15: *Gibberospongus spinosus* n. sp., x 130, rep.-no. KOMO 1994 IV-155.
Figs. 16–18: *Steigerispongus subsymmetricus subsymmetricus* n. subsp.; Fig. 16: x 130, rep.-no. KOMO 1994 IV-156; Fig. 17: x 130, rep.-no. KOMO 1994 IV-157; Fig. 18: x 130, rep.-no. KOMO 1994 IV-158.

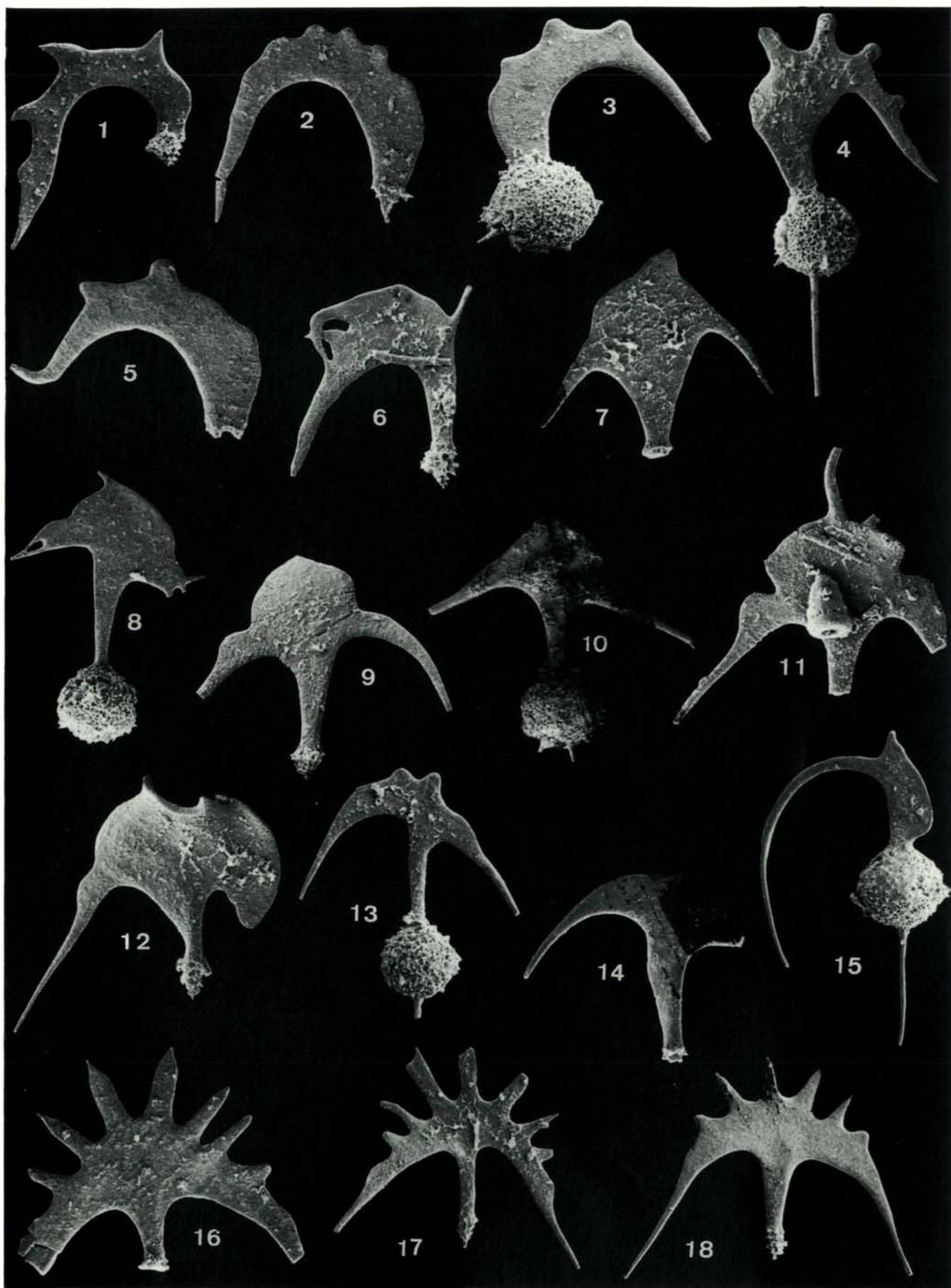


Plate 13

- Fig. 1: *Spongoserrula goricanae* n. sp., holotype, x 130, rep.-no. KOMO 1994 IV-159.
- Fig. 2: *Spongoserrula bifurcata parvispina* n. subsp., holotype, x 130, rep.-no. KOMO 1994 IV-160.
- Fig. 3: *Steigerispongos asymmetricus rectangularis* n. subsp., x 150, rep.-no. KOMO 1994 IV-161.
- Fig. 4: *Spongoserrula fluegeli fluegeli* n. subsp., x 120, rep.-no. KOMO 1994 IV-162
- Fig. 5: *Falcispongos transitus brevifoliaceus* n. subsp., x 200, rep.-no. KOMO 1994 IV-163.
- Fig. 6: *Scutispongos ? parvifolius parvifolius* n. subsp., holotype, x 200, rep.-no. KOMO 1994 IV-164.
- Fig. 7: *Steigerispongos asymmetricus asymmetricus* n. subsp., x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-165.
- Fig. 8: *Spongoserrula dehli* CORDEY et al., 1988, x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-166.
- Fig. 9: *Scutispongos sagittaeformis* n. sp., holotype, x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-167.
- Fig. 10: *Scutispongos mocki* n. sp., holotype, x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-168.
- Fig. 11: *Steigerispongos* sp. C, x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-204.
- Fig. 12: *Bogdanella cordevolica* n. sp., holotype, x 130, sample RW 13, reddish late Cordevolian limestone, outcrop at the road about 500 m south of Pietra dei Saracini, Sosio Valley area, Sicily (Italy), rep.-no. KOMO 1994 IV-169.

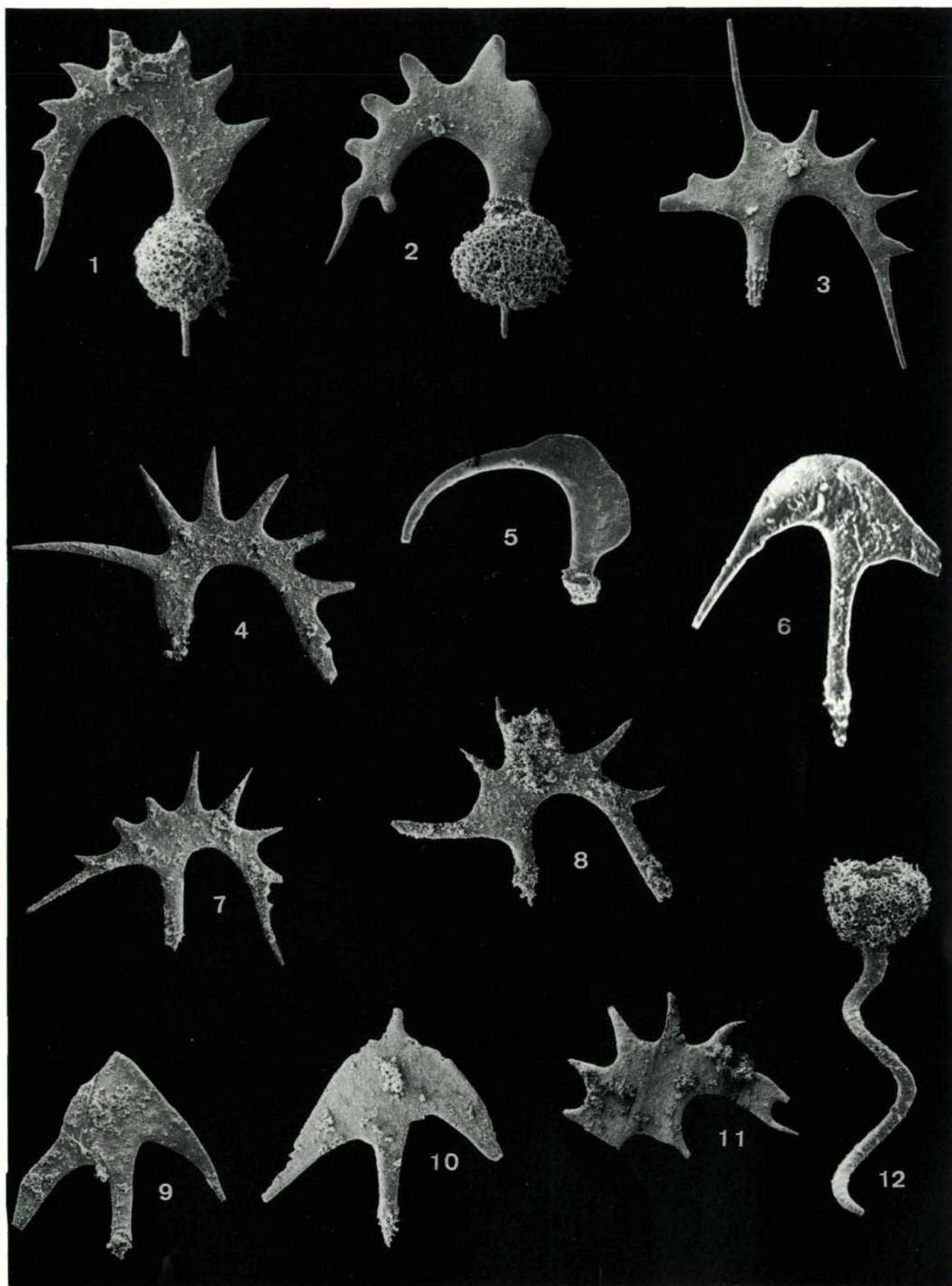


Plate 14

All figured specimens are from the middle part of Buchenstein Beds, sample St 1, at locality Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994). They belong to the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian).

- Fig. 1: *Falcispongos* cf. *hamatus* DUMITRICĂ, 1982, x 180, rep.-no. KOMO 1994 IV-170.
Figs 2, 3: *Falcispongos hamatus* DUMITRICĂ, 1982; Fig. 2: x 150, rep.-no. KOMO 1994 IV-171; Fig. 3: x 150, rep.-no. KOMO 1994 IV-172.
Fig. 4: *Falcispongos falciformis minor* n. subsp., holotype, x 180, rep.-no. KOMO 1994 IV-173.
Fig. 5: *Falcispongos transitus brevifoliaceus* n. subsp., x 180, rep.-no. KOMO 1994 IV-174.
Figs. 6, 7: *Spongoserrula antiqua* n. sp.; Fig. 6: holotype, x 150, rep.-no. KOMO 1994 IV-175; Fig. 7: x 150, rep.-no. KOMO 1994 IV-176.
Figs. 8, 9, 12: *Baumgartneria curvispina* DUMITRICĂ, 1982; Fig. 8: x 160, rep.-no. KOMO 1994 IV-177; Fig. 9: x 160, rep.-no. KOMO 1994 IV-178; Fig. 12: specimen with beginning development of a blade, x 150, rep.-no. KOMO 1994 IV-179.
Figs. 10, 11: *Oertlispongos inaequispinosus* DUMITRICĂ, KOZUR & MOSTLER, 1980; Fig. 10: x 150, rep.-no. KOMO 1994 IV-180; Fig. 11: x 170, rep.-no. KOMO 1994 IV-181.
Figs. 13, 14: *Pterospongos priscus priscus* n. subsp.; Fig. 13: x 150, rep.-no. KOMO 1994 IV-182; Fig. 14: holotype, x 170, rep.-no. KOMO 1994 IV-183.
Fig. 15: *Scutispongos* ? *parvifolius primitivus* n. subsp., holotype, x 180, rep.-no. KOMO 1994 IV-205.
Fig. 16: *Pterospongos parvifissus* n. sp., holotype, x 150, rep.-no. KOMO 1994 IV-184.
Figs. 17, 18: *Pterospongos priscus tortilis* n. sp.; Fig. 17: x 170, rep.-no. KOMO 1994 IV-185; Fig. 18: holotype, x 150, rep.-no. KOMO 1994 IV-186.

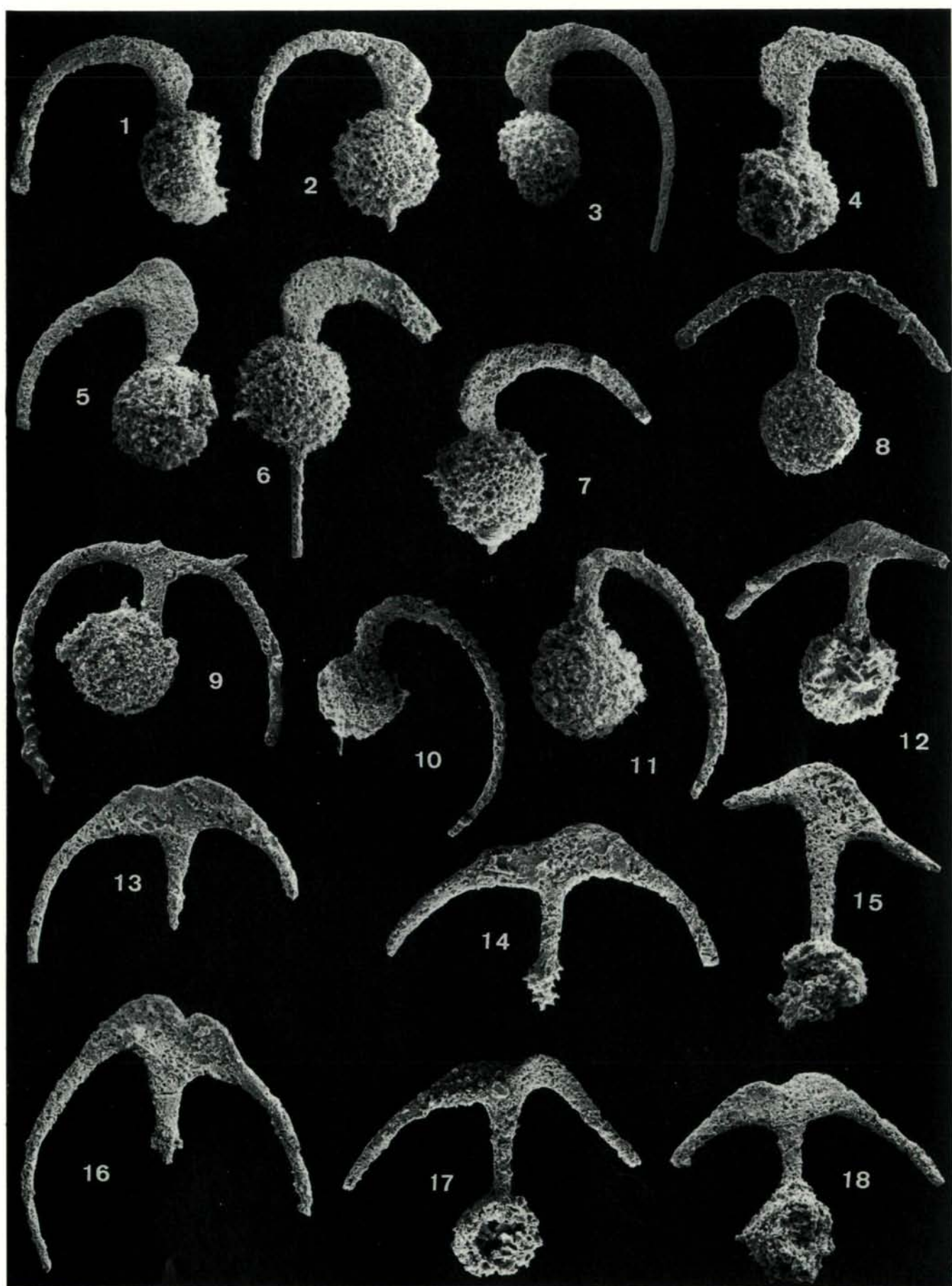


Plate 15

The specimens on Figs. 1-11, 13-15 are from the middle part of Buchenstein Beds, sample St 1, at locality Stinzesteig (Karawanken Mountains, southern Austria), locality and sample data see MOSTLER & KRAINER (1994). This sample belongs to the lower subzone (*Pterospongos priscus* Subzone) of *Muelleritortis cochleata* Zone (early middle Longobardian).

The specimens on Figs. 12, 16, 17 are from the uppermost Buchenstein Beds, 7 m below the Schlern Dolomite, sample Bi 1 of the section at the NE slope of Bielschitz Mt. about 1700 above sea level (Karawanken Mts., southern Austria), locality and sample data see MOSTLER & KRAINER (1994). This sample belongs to the middle subzone (*Spongoserula rarauana* Subzone) of *Muelleritortis cochleata* Zone (middle Longobardian).

- Fig. 1: *Pterospongos alatus* DUMITRICĂ, 1982, x 180, rep.-no. KOMO 1994 IV-187.
Figs. 2, 3: *Pterospongos parvifissus* n. sp.; Fig. 2: holotype x 150, rep.-no. KOMO 1994 IV-188; Fig. 3: x 170, rep.-no. KOMO 1994 IV-189.
Figs. 4, 5: *Pterospongos altofissus* n. sp.; Fig. 4: x 150, rep.-no. KOMO 1994 IV-190; Fig. 5: holotype, x 120, rep.-no. KOMO 1994 IV-191.
Figs. 6, 7, 10, 12: *Scutispongos rostratus rostratus* (DUMITRICĂ, 1982); Fig. 6: x 150 rep.-no. KOMO 1994 IV-192; Fig. 7: x 150, rep.-no. KOMO 1994 IV-193; Fig. 10: x 150, rep.-no. KOMO 1994 IV-194; Fig. 12: x 150, rep.-no. KOMO 1994 IV-195.
Fig. 8: *Scutispongos rostratus incurvatus* n. subsp., holotype, x 200, rep.-no. KOMO 1994 IV-196.
Fig. 9: *Scutispongos rostratus minutispinus* n. subsp., holotype, x 150, rep.-no. KOMO 1994 IV-197.
Fig. 11: *Steigerispongos primus* n. sp., holotype, x , rep.-no. KOMO 1994 IV-198.
Figs. 13–15: *Bogdanella praecursor* n. sp.; Fig. 13: holotype, x 150, rep.-no. KOMO 1994 IV-199; Fig. 14: x 170, rep.-no. KOMO 1994 IV-200; Fig. 15: x 150, rep.-no. KOMO 1994 IV-201.
Fig. 16: *Spongoserula rarauana rarauana* DUMITRICĂ, 1982, x 130, rep.-no. KOMO 1994 IV-202.
Fig. 17: *Falcispongos* cf. *transitus* n. sp., x 150, rep.-no. KOMO 1994 IV-203.

