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NEW MIDDLE TRIASSIC BELL-SHAPED NASSELLARIAN RADIOLARIA FROM ALPINE AND CARPATHIAN AREAS

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Abstract. This paper is a continuation of a previous one in which I described and revised different Middle Triassic nassellarian Radiolaria from the Alps and Carpathians illustrated with drawings. On the present paper, are described two new groups of Middle Triassic dicyrtid Nassellaria with bell-shaped shell from the same area to enrich the inventory of these microfossils. Two new families (Gorispelidae and Humerocyrtiidae), five new genera (*Silicotintinnabulum*, *Colpotrelus*, *Gorispela*, *Pozsvartia* and *Humerocyrtis*) and 30 new species are described from these genera and illustrated with drawings.

Keywords: Middle Triassic, Radiolaria, Nassellaria, new taxa, Alps, Carpathians.

INTRODUCTION

The present study is a continuation of the paper published six years ago (Dumitrică, 2017) in which I emended the taxonomy of the Middle Triassic nassellarian Radiolaria family Tetraspinocyrtiidae Kozur & Mostler 1994, originally erected on the basis of four species assigned to the genus *Tetraspinocyrtis* Kozur & Mostler, species which I demonstrated as belonging, in fact, to four different genera. Based on their well-preserved skeletons and using hyrax as mounting medium with a refracting index greater than that of the Canada balsam, I also described many other more or less related Triassic nassellarian genera and species mounted in hyrax on individual slides and illustrated by drawings with drawing ink. If the illustration is good, this is the best method to study most well-preserved Mesozoic Nassellaria because, by comparison with SEM images, it allows us to see rather easily the inside skeleton as, for instance, the structure (massive or hollow) of the apical and ventral spines and the composition of the spicular system, elements important for the determination of families, genera and species.

STUDIED SAMPLES

The species described in the present paper were extracted from Middle Triassic samples collected from different areas of the Alpes and Carpathians, as mentioned below, and collected by the author or provided many years ago by other geologist colleagues.

BV 85-70. Livinallongo Formation, Monte de Saline, SE of Marmolada Massif, North Italy. The radiolarian fauna from this sample was partly studied by Kellici & De Wever (1995) and Dumitrică (2004, 2017). For a detailed description of the location of this sample collected by Bruno Vrielynck in 1985 see Kellici & De Wever, 1995, p. 141. The age is probably rather similar to that of the samples from the Buchenstein Formation or a little different because the assemblages are relatively similar. The conodont assemblage contains *Gondolella constricta* Mosher & Clark, *G. pseudolonga* Kovacs, Kozur & Mietto, *G. longa* (Budurov & Stefanov), *Paragondolella excelsa* Mosher which, according to Kellici & De Wever (1995) is of lower Ladinian age.

CR 24, CR 25 (Fig. 1). Grey limestone of Guttenstein type with rare thin interbeds of grey chert; the age of the samples is rather similar to that of the samples CRH, Cristian village, Brașov district, Fabricii valley, southern end of Eastern Carpathians, but represent an upper level of the Pelsonian because they overlain the CRH samples. For detailed stratigraphy of the CR samples see especially Dumitrică (1991) in which I described new genera and species of the family Tripedurnulidae Dumitrică. According to E. Grădinaru (personal communication), who studied this area, these limestones are underlined by the limestones with roe-like cherts (samples CRH). The two CR samples were collected from a small road cut outcrop facing the old waste-dump (Dumitrică, 1978). It is the road that connects the locality Cristian with the tourist station Poiana Brașov. The exposure was covered several years after the first and second collections of the samples. According to the previous determinations of conodonts by Elena Mirăuță and the very recent ones by Tea Kolar-Jurkovsek from Ljubljana (personal communication), these samples contain *Paragondolella bulgarica* that, in Slovenia, extends from the middle Aegean to the early Pelsonian.

CRH (Fig. 1). Grey limestone of Guttenstein type with small roe-like cherts, Fabricii valley, Cristian village, Brașov district, southern end of Eastern Carpathians, Romania. A series of samples with radiolarians were collected from the waste dump of the old fire-clay mine.

The ammonoid fauna collected by Eugen Grădinaru about 50 years ago (personal communication) belongs to the *Balatonites balatonicus* Zone, a marker species for the

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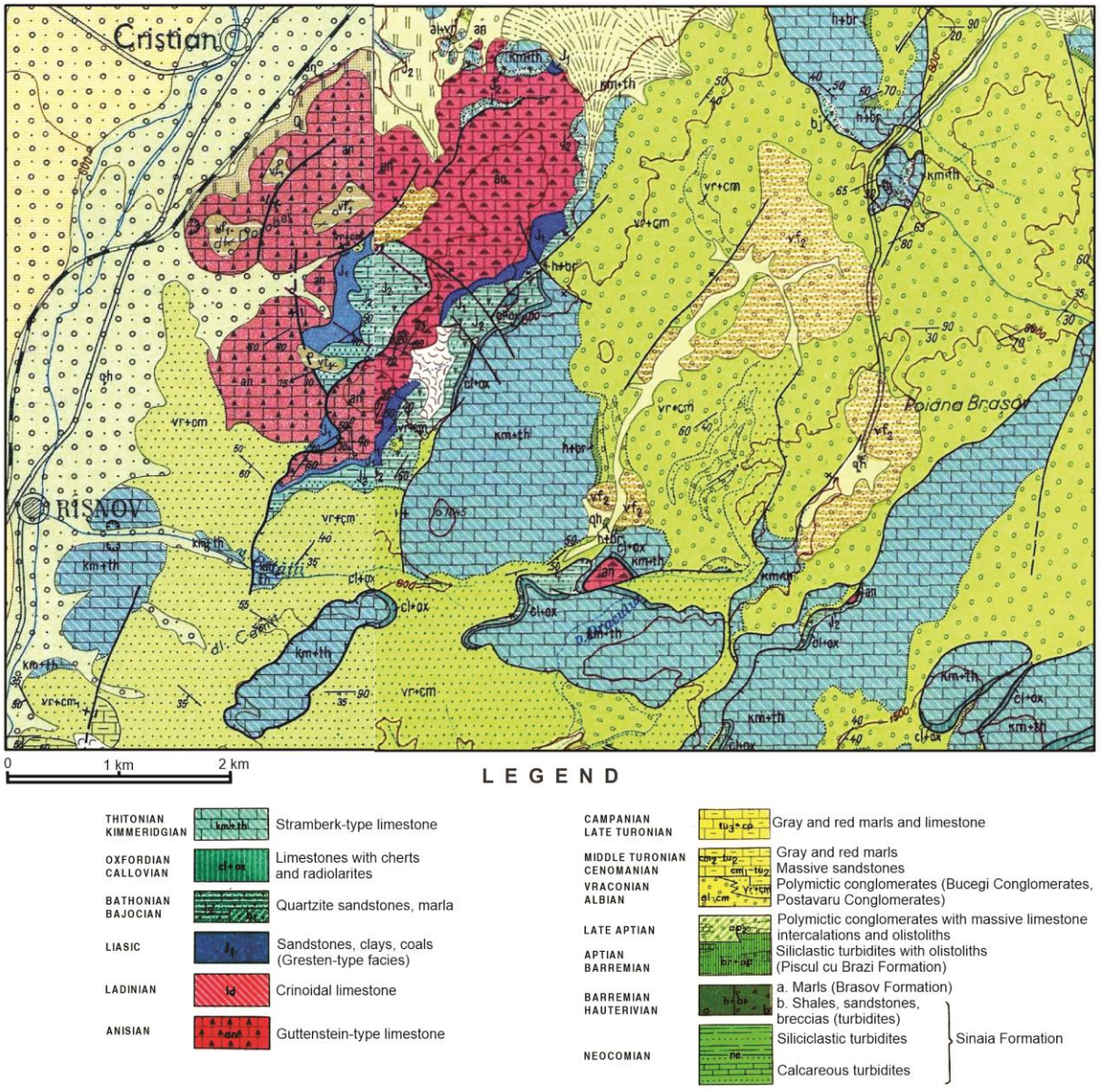

Fig. 1. Geological map of the locality Cristian area, Braşov Mountains, Romania, modified from the geological maps Zărneşti and Braşov sheets, scale 1:50000, Săndulescu et al. (1972).

Pelsonian stage. The conodonts, collected by the present author and determined by Mirăuță, 45 years ago, are indicative of the *Paragondolella bulgarica* Zone, also of Pelsonian age.

FÖ 87. Upper Anisian (Illyrian) sample from the Forrás-hegy section near the locality Felsőörs (Balaton Highland, Hungary), bed 87. According to Kozur & Mostler (1994, p. 178), this bed consists of limestone with greenish tuffits and belongs to the *Paraceratites trinodosus* subzone of the Trinodosus zone and, according to Vörös et al. (2003), to the base of the *Camunum* subzone, at the boundary with the *Trinodosus* subzone. The same interval contains conodonts of the late Anisian *Neogondolella constricta* conodont Zone. The sample was provided many years ago by Eugen Grădinaru from Faculty of Geology and Geophysics, University of Bucharest.

Rc1, Rc2, Rc4. Buchenstein cherty Limestone, about 500 m northeast of Monte Anghebe, Recoaro, Vicentinian Alps, North Italy. The samples were provided in 1974 by Manfred Epting who studied this region during the field research for his doctoral thesis. According to Epting et al. (1976, p. 10), the Buchenstein Limestone from Recoaro contains an ammonoid assemblage with *Eoprotrachyceras curionii* (Mojsisovics.) already described by Mojsisovics (in Bittner, 1883, p. 596). According to the Global boundary Stratotype Section and Point (GSSP) of the Ladinian Stage (Brack et al., 2005) this species marks the base of the Ladinian stage. Unfortunately, we do not know from which level of the formation the studied samples have been collected relative to this marker species because, according to Vörös et al. (2003) and Brack et al. (2005), the lower part of the Buchenstein Formation includes also the

uppermost part of the Illyrian. In this situation we consider the age of all samples from this formation as lower Ladinian (Fassanian) with the possibility of being also uppermost Anisian.

Rh03. Buchenstein Limestone, lower Ladinian (Fassanian) about 600 m southwest of Monte Falison, Recoaro, Vicentinian Alps, North Italy. Sample provided by Manfred Epting mentioned above.

R78/1. A small outcrop of grey cherty limestone with radiolarians, conodonts and foraminiferas, near the base of the huge Piatra Zimbrului olistolith, Rarău Mountain, northern part of Eastern Carpathians, Romania, lower Ladinian (Fassanian) with *Oertlispongus inaequispinosus* Dumitrică, Kozur & Mostler, *O. calcaneum* Dumitrică, *O. falciformis* Dumitrică (Dumitrică, 1982) and other radiolarians.

SMF4. Buchenstein Limestone, lower Ladinian (Fassanian), South of Monte Falison, Recoaro, Vicentinian Alps, North Italy, sample provided by Manfred Epting.

SKELETAL MORPHOLOGY AND INNER CEPHALIC STRUCTURE OF BELL-SHAPED NASSELLARIA

The few genera and species herein described expose other Triassic nassellarian morphologies and structures than those I published in 2017, cited above, or before (Dumitrică, 1978, 1980, 1991) from the same samples. With them I tried to enrich the inventory of the radiolarian fauna during the diversification explosion of the siliceous microplankton after the Permo-Triassic crisis.

One of such structural types is represented by the hollow apical and ventral spines or horns. This hollow structure is common to many Triassic radiolarians with unbladed spines, be they nassellarians, spumellarians, or entactinarians, and becomes very rare in the Lower Jurassic radiolarians and practically absent later. The hollow structure of several Cenozoic radiolarians illustrated by Deflandre (1972) at *Nothotripodiscinus* Deflandre or supposed in several drawings in Haeckel (1887: pl. 54, fig. 6; pl. 61, figs. 3, 17; pl. 82, figs. 1, 4, 10, 12; pl. 84, fig. 10; pl. 85, figs. 4, 5, etc.) seems to be the result of the alteration of some inner initial silica layers of their skeleton or of still unknown causes (Dumitrică, 1989, pl. 13, figs. 1-23). In the Triassic radiolarians the hollow structure of some spines was of primary nature and has evolutionary and taxonomic values at family or genus levels (*Gradinaria* Dumitrică 2017, *Turrinasus* Dumitrică 2017, Capnuchosphaeridae De Wever 1979, etc), being generally characteristic of taxa with thick cylindrical or conical projections (spines or tubes), probably to facilitate their buoyancy. This structure suggests radiolarians that lived in rather superficial water columns.

The bell-shaped species described in the first part of the present article resemble some species of the genera *Goestlingella* Kozur & Mostler 1979 or *Tristylosaltatrix* Dumitrică 2017, whereas other species have morphologies not yet known in the Middle Triassic or later. All species described in this study are considered to be dicyrtid, although the thorax may have one or more circumferential rings on the surface that could be considered intersegmental markers. However, these rings do not correspond to any inner segmentations as it would be normal when the shell is really segmented. They seem to be just ornamentations of the shell built to reinforce the skeleton.

Based on the experience with other groups of radiolarians from the Cenozoic or Mesozoic faunas I have thought that the presence or absence of the dorsal ray (D) in the initial spicule could have, generally, a taxonomic value. However, at least two cases of two species described in this paper suggest that there are cases when the genetic information of the development of this structural element can be activated or deactivated in different genera of a family.

One case is represented by the family Pseudosaturniformidae Kozur & Mostler. This family, represented until 2005 by only upper Triassic species of the the genus *Pseudosaturniforma* Kozur & Mostler, has an initial spicular system consisting of apical, ventral, dorsal, primary lateral and secondary lateral rays, no one prolonged outside shell wall into spines (see illustrations in Blome, 1984, pl. 13, figs. 11, 18), the cephalis being poreless and having a smooth spherical shape, and thorax consisting only of a distal ring connected to cephalis through 6 longitudinal bars. In 2005 Tekin & Mostler described, from the upper Longobardian (uppermost Middle Triassic), *Pseudosaturniforma ladinica*, which became the oldest species of the genus. This species is slightly different from the Upper Triassic species, having a small pointed three-bladed apical spine, very small ventral and primary lateral spines (Tekin & Mostler, 2005, fig. 7.) and 6-8 longitudinal bars connecting the cephalis with the circular distal ring and, also, a few scattered and very small pores at the lower part of the cephalis, just above the boundary with the thorax. Based on this morphology the authors emended the definition of the genus *Pseudosaturniforma*. We do not know if this species has also a dorsal ray in the initial spicular system as the Upper Triassic species because the authors presented no basal view of this species. It would have been interesting to know this for the following discussion because, by its morphology, the new upper Anisian and lower Ladinian genus *Silicotintinnabulum* with two new species, *S. formosum* and *S. transitum*, represent undoubtedly the forerunner genus of the family Pseudosaturniformidae and the oldest members of the very well documented and logical evolutionary lineage *Silicotintinnabulum formosum* (Upper Anisian to lower Ladinian) – *S. transitum* (lower Ladinian) – *Pseudosaturniforma ladinica* (uppermost Ladinian) –

P. latimarginata Kozur & Mostler (upper Carnian), *P. carnica* Kozur & Mostler (upper Carnian to upper-middle Norian) and *P. minuta* Blome (lower to upper middle Norian). The problem is that the oldest species of this lineage, *Silicotintinnabulum formosum*, has no dorsal ray in its initial spicular system.

We do not know exactly when this ray appeared in the initial spicular system of this family. It is very probable that it could not appear in the lower Ladinian species *Silicotintinnabulum transitum* because the coeval species *Silicotintinnabulum formosum*, with which it resembles very much so that initially was included in *S. formosum*, does not have it. The only species that can be the best candidat for the resolution of this problem is *Pseudosaturniforma ladinica*. Why? Because, except for the reduction of the long apical horn of *Silicotintinnabulum* and of the number of the thoracic pores of the species of this genus, it has some structural characters absent before it and after, such as the ventral and primary lateral rays extended outside shell into very small spines. It is very possible that, on this occasion, the dorsal ray, encoded in the genetic code of nassellarians, but not expressed in *Silicotintinnabulum*, was activated in the first species of the genus *Pseudosaturniforma* and remained like this until the extinction of this genus. This is the only logical possibility.

Another case concerns the systematic position of the species *Gorispela* (?) *triangulocephalis* n. sp. The genus *Gorispela* n. gen. is used for a group of Middle Triassic bell-shaped nassellarians without dorsal ray in the initial spicule, and apical and ventral horns partly conical and hollow on the proximal portions, and conical or three-bladed on the distal one. The species *Gorispela* (?) *triangulocephalis* was questionably included in this genus because, although the two horns are very robust and the shell very similar morphologically to the other species of this genus, its initial spicule contains the dorsal ray and the horns are hollow only in their proximal portion which give the cephalic cavity a triangular shape. In this case, the only practical solution is to consider, in some cases, of secondary systematic value the presence or absence of the dorsal ray.

Another problem concerns the knowledge of the variability degree of the species herein studied. It concerns especially some species of the new genus *Humerocyrtis*. Without its knowledge one could describe a species at each small variation of the skeleton. It is for this reason that I illustrated, when possible, several specimens of the same species from the same sample. They show that the variability is not excessively high so that it is possible to describe a species even when it is represented by a single specimen (see the case of *Silicotintinnabulum formosum*, *Gorispela hungarica*, *G. tuba*, G. (?). *triangulocephalis*, *Humerocyrtis gracilis*, etc. They show that the specimens of a species are rather similar.

All holotypes, paratypes and other illustrated or non-illustrated specimens on which the paper is based are stored in the Muséum cantonal des sciences naturelles, Département de géologie of Lausanne under the numbers 110268-110301 and are mounted in hyrax on individual slides.

TAXONOMY

Class Radiolaria Müller, 1859
Subclass Polycystinea Ehrenberg, 1839
Order Nassellaria Ehrenberg, 1876
Family **PSEUDOSATURNIFORMIDAE** Kozur & Mostler 1979, emend. herein
Type genus: *Pseudosaturniforma* Kozur & Mostler, 1979, emend. Tekin & Mostler, 2005

Emended diagnosis. Middle to Upper Triassic bell-shaped dicyrtid nassellarians consisting of a globular cephalis with or without apical horn and ventral spine, as external extention of the apical and ventral rays of the initial spicule, and a truncate conical thorax. Initial spicule with primary and secondary lateral rays not extended outside, and the dorsal ray absent or present. Usually, distal end of shell with a circumferential ring.

Remarks. Until present, the family was represented by only the type genus. With the two new genera - *Silicotintinnabulum* n. gen. and *Colpotrelus* n. gen. and their species, both older than the already known Triassic species of this type, I enriched the knowledge of the diversity and evolution of this family. This required an emendation of its diagnosis after the first one of the type species by Tekin & Mostler (2005) based on the discovery of a new late Ladinian species of *Pseudosaturniforma* (*P. ladinica*) in the Dinarides of Bosnia and Hercegovina. In their emended diagnosis they considered that this genus may also have a three-bladed apical horn and a similarly three-bladed ventral and primary lateral spines, morphology not known before at the late Triassic species of this family. Moreover, they also considered that the genus *Pseudosaturniforma* is a dicyrtid, not a monocyrtid nassellarian as defined in the original definition by Kozur & Mostler (1979), an opinion with which I completely agree.

Stratigraphic range. Upper Anisian (Illyrian) to Lower or Middle Norian as far as known.

Genus ***Silicotintinnabulum*** n. gen.
Type species. *Silicotintinnabulum formosum* n. sp.

Diagnosis. Test dicyrtid, bell-shaped bearing a tricostate apical horn with hollow cylindrical or conical base, globular cephalis and wide conical thorax. Initial spicule without dorsal ray, and all the other rays of the initial spicule, except the apical one, not extended outside.

Etymology. From Latin *silica* – silicon dioxide, and *tintinnabulum* – small bell, neuter gender.

Remarks. Morphologically, this genus resembles, partly, the upper Ladinian to upper Triassic genus *Pseudosaturniforma* Kozur & Mostler from which it

differs by having a well-developed apical horn, thorax with pores of various locations and sizes, instead of only a row of large pores separated by longitudinal rays, and the initial spicule without dorsal ray. The two genera differ also by having different stratigraphical distributions, the genus *Silicotintinnabulum* being known only in the Middle Triassic (uppermost Anisian to Lower Ladinian), whereas the species of the genus *Pseudosaturniforma* are known from the upper Ladinian (Tekin & Mostler, 2005) to Upper Triassic according to Kozur & Mostler (1979), Blome (1984), Tekin (1991), Bragin (2007) and Ozsvárt et al. (2017).

The morphological similarities and differences between the two genera and their different ranges suggest that the genus *Silicotintinnabulum* was the forerunner of the genus *Pseudosaturniforma.* The trend toward the transition to the genus *Pseudosaturniforma* started in the lower Ladinian with the appearance of the transitional species *Silicotintinnabulum transitum* n. sp., represented until present by a single specimen, and continued during the lower part of upper Ladinian (Longobardian), a period when many evolutionary changes took place in the families Oertlispongidae (Kozur & Mostler, 1996b), Muelleritortiidae (Kozur, 1988; Kozur & Mostler, 1996a) and many other radiolarian groups (Tekin & Mostler, 2005; Kozur & Mostler, 2006). For *Silicotintinnabulum* this change signified: a) the reduction and, finally, disappearance of the apical horn, b) the reduction of the number of thoracic pores to a single row of 5-8 and, finally, to only 6 wide circumferential windows between cephalis and the distal ring of the thorax, and c) the appearance of the dorsal ray in the initial spicular system. The apical horn is completely missing in the Upper Triassic (upper Carnian to lower or upper Middle Norian) species *Pseudosaturniforma carnica* Kozur & Mostler 1979, *P. latimarginata* Kozur & Mostler 1979 and *P. minuta* Blome 1984, but it is present to a small three-bladed spine at the oldest upper late Ladinian species *P. ladinica* Tekin & Mostler 2005 from the Dinarides of Bosnia and Herzegovina. The reduction of the thoracic pores to a single row of 5-8 large circumferential windows between cephalis and the distal circle determined the appearance of 5-8 straight thoracic rays that represent intervening bars of these large pores, and are remnants of the thorax of *Silicotintinnabulum transitum* n. sp. A trend towards the appearance of such windows can be seen at the species *S. transitum* n. sp. (fig. 1e) of the present study, where the thorax has a distal circumferential row of large pores resembling the pores of *Pseudosaturniforma ladinica*. Moreover, the continuation of this trend toward reduction of the thoracic elements to six can be remarked if we compare species *P. ladinica* with the younger species (*P. carnica*, *P. latimarginata* and *P. minuta*) that have only six pores or windows and radial thoracic bars, respectively, situated in the space between the base of the cephalis and the distal circle (see Blome, 1984, pl. 13, figs. 11, 18).

Due to its simple shell, the genus *Pseudosaturniforma* was initially considered a monocyrtid nassellarian by Kozur & Mostler (1979) and Blome (1984), but Tekin & Mostler (2005) emended this assignation and considered it as a dicyrtid genus, an opinion with which I completely agree. Its relationship with *Silicotintinnabulum*, described in this study, confirms this opinion. It proves that *Pseudosaturniforma* is a true dicyrtid resulted by a trend toward simplification of the thorax of its forerunner and reduction and finally, complete disappearance of the apical horn.

Stratigraphic range. Upper Anisian to lower Ladinian so far as known.

***Silicotintinnabulum formosum* n. sp.**

Figs. 2 a-d

Diagnosis. Shell dicyrtid, campanulate. Cephalis globular, imperforate or bearing sparse and very small circular or oval pores, especially on its distal part. Apical horn relatively long, cylindrical and hollow on its proximal third and three-bladed and pointed on its distal part. Blades thin or thick separated by wide grooves, and bearing a few short teeth or, very rarely, numerous and very short spinules on their distal end. Initial spicule with apical ray vertically positioned and prolonged into the apical horn, and ventral ray not extended outside into a spine or horn. Thorax conical with about two or three irregularly disposed ranges of large pores that increase in size very fast distally so that on the distal part only about five large pores can be seen on half the perimeter. Pores circular, oval or rounded polygonal and commonly intricately arranged (fig. 1a-d). Distal end well-marked by a thin circumferential ring disposed in horizontal plane and another circumferential ring with the blade in vertical plane, both originated in the same region of the distal end of shell. Collar boundary marked by a slight constriction and considered as being situated at the appearance of larger pores, a little below the level of the median bar of the initial spicule.

Studied material. Nine specimens in the samples Rc1, Rc4, and SMF4 from the Buchenstein Formation, and two in the sample FÖ 87, from Hungary.

Holotype. Figure 2d, sample Rc1, coll. MGL.110268.

Paratype. Figure 2c, sample FÖ 87, coll. MGL.110269.

Dimensions. Total length of shell 100-104 µm, of cephalis with apical horn 65-70 µm, of apical horn 40 µm, of thorax 30-40 µm; diameter of cephalis 35-40 µm, of distal part of thorax 83-95 µm.

Variability. As the drawings show, the variability of this species is especially visible in the shape and arrangement of pores and less in the size of specimens.

Etymology. From the Latin *formosus*, *-a*, *-um* – beautiful.

Remarks. The apical part of shell, including cephalis and apical horn, has a rather constant morphology, except a single specimen (Fig. 2c) of Illyrian age from the sample FÖ 87 that bears a bunch of short spinules on its distal

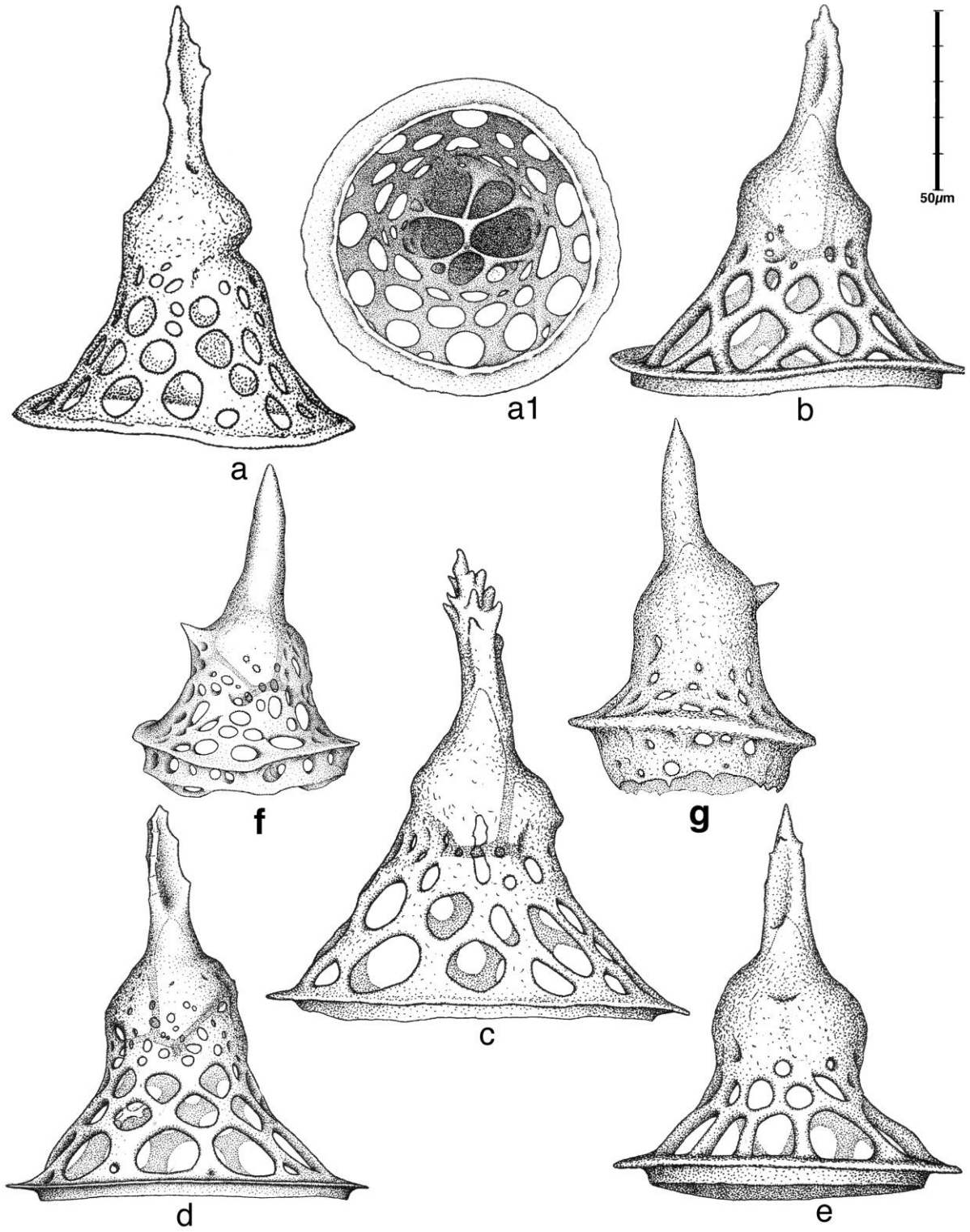

Fig. 2. **a-d.** – *Silicotintinnabulum formosum* n. sp.: **a**, **a1**, **b.** – sample Rc4; **a1.** basal view of fig. **a.** showing the initial spicule without D ray; **c.** – paratype, FÖ 87; **d.** – holotype, Rc1. **2e.** – *Silicotintinnabulum transitum* n. sp., holotype, Rc4; **f**, **g.** – *Colpotrelus campanuliformis* n. sp., Rc4. Scale bar of 50 µm is for all figures.

end. Interestingly, that a rather similar type of short distal spinules is present on the apical horn of the species *Gorispela mimetica* n. sp. and *Gorispela hungarica* n. sp. (see below), two species occurring in the same sample FÖ 87 from the Felsőörs section. Pores of thorax are very variable in shape and arrangement but are always very large.

Stratigraphic range. Upper Anisian (Illyrian) from Hungary and lower Ladinian (Fassanian) of the Buchenstein Formation from Recoaro area, Vicentinian Alps, Italy.

***Silicotintinnabulum transitum* n. sp.**
Fig. 2e

Diagnosis. Shell bell-shaped with a relatively large spherical and poreless cephalis with a relatively long three-bladed, axially directed and pointed apical horn. Collar boundary with a well-marked depression due to the spherical shape of the cephalis and its bigger size. Thorax short, wide conical bearing a distal row of around 12 wide elongate pores or windows and an irregular row of smaller, circular or oval pores above it, below the collar boundary. A few much smaller and irregularly arranged pores may also occur above these smaller pores. Distal end with a circular horizontal platy ring and, below it, a circular band with smaller diameter. Initial spiculat system not known, but should be similar to that of the type species.
Studied material. A single specimen in sample Rc4.
Holotype. Fig. 2e, sample Rc4, coll. MGL.110270.
Dimensions. Total length of shell 107 µm, of thorax 37 µm, diameter of cephalis 44 µm, of distal end of thorax 98 µm.
Etymology. From the Latin *transitus*, *-a*, *-um* – transitional, this species being considered transitional between the genus *Silicotintinnabulum* and the genus *Pseudosaturniforma*.
Remarks. Although this species is only based on the holotype, it differs essentially from the type species of the genus *Silicotintinnabulum* by its morphology and especially by the larger size and spherical shape of the cephalis and the appearance of the row of wide and logitudinally elongated distal pores that suggest the beginning of the transition to the genus *Pseudosaturniforma*. As remains of the genus *Silicotintinnabulum* we can mention the small pores from the base of the cephalis and the long and three-bladed apical horn.
Stratigraphic range. Very rare in the lower Ladinian of the Buchenstein Formation, Recoaro.

Genus ***Colpotrelus*** n. gen.
Type species: *Colpotrelus campanuliformis* n. sp.

Diagnosis. Middle Triassic dicyrtid shell of campanulate shape consisting of a hemispherical cephalis with a long conical and robust apical horn, a very short ventral spine and a short cylindrical thorax separated from cephalis by a circumferential ridge. Initial spicule without dorsal spine and with primary and secondary lateral rays not extended outside.
Etymology. Arbitrary combination of letters, masculine gender.
Remarks. By its general shape and initial spicular structure, this genus resembles the genus *Silicotintinnabulum* n. gen., from which it differs by having a conical apical horn, instead of a three-bladed one, a very small ventral spine and a perforated distal segment below the thoracic circumferential ring. If it is really a member of this family, it represents a lateral branch and cannot be included in the evolutionary lineage of the genus *Pseudosaturniforma*.
Stratigraphic range. Lower Ladinian so far as known.

***Colpotrelus campanuliformis* n. sp.**
Figs. 2f, g

Diagnosis. Shell very small, dicyrtid. Cephalis with a robust and long conical apical horn with pointed distal end. Cephalis globular with smooth surface and partly poreless or with small pores on its basal part. Initial spicule without dorsal ray. Ventral spine very small and conical. Collar boundary not marked by a constriction; it could be situated at the level where the shell starts becoming conical and where the pores increase in size and frequency. Thorax conical in the proximal part, with a well-marked circumferential ridge. Beyond it, shell is very short and cylindrical or inverted conical. Its pores are circular or oval, sparse and of various sizes.
Studied material. Two specimens in Rc4.
Holotype. The specimen from the sample Rc4, fig. 2g, coll. MGL.110271.
Dimensions. Total length with apical horn 100-115 µm, without horn 53-75 µm, diameter of cephalis 38-39 µm, of the circumferential ridge 69-77 µm, of distal segment 62-66 µm.
Etymology. From the campanulate shape of its shell.
Remarks. This species differs from the species of the other genera herein described by the very small size of its ventral spine, the absence of a three-bladed morphology of the apical horn, and its massive structure.
Stratigraphic range. Lower Ladinian.

Family **GORISPELIDAE** n. fam.
Type genus. *Gorispela* n. gen.

Diagnosis. Bell-shaped Middle Triassic Nassellaria without dorsal ray in the initial spicule and apical and ventral spines or horns partly conical and hollow on the proximal portions and conical or three-bladed on the distal one.
Etymology. The family is dedicated to Dr. Špela Goričan.
Remarks. The founding members of this family have some characters similar to those of the family Goestlingellidae Dumitrica 2017 as, for example, the absence of the dorsal ray in the initial spicule and hollow conical apical horn, from which they differ by having also a long and equally hollow ventral spine that becomes a real horn, and also by having, usually, the distal ends of these horns three-bladed. It is also possible that this new family should be considered a subfamily of the family Goestlingellidae Dumitrică 2017.
Stratigraphic range. Middle Anisian (Pelsonian) to lower Ladinian (Fassanian).

Genus ***Gorispela*** n. gen.
Type species. *Gorispela fenestrata* n. sp.

Diagnosis. Shell dicyrtid with apical and ventral rays of the initial spicule prolonged into practically equal and robust horns originating on the apex or lateral parts of cephalis. They are usually conical with proximal part conical or cylindrical and hollow, and distal part three-bladed or conical. Initial spicule without dorsal ray, and primary and secondary lateral rays (L and l) not extended outside shell. Thorax usually conical with one or more circumferential rings on the surface and separated from cephalis by a slightly marked constriction, or none.
Etymology. The genus is dedicated to Dr. Špela Goričan, Ljubljana, for her contribution to the knowledge of Mesozoic radiolarians and for her friendship. Feminine gender.
Remarks. By its initial spicule without the dorsal ray, the shape of shell and hollow structure of the A horn, this genus resembles the coeval genus *Goestlingella* Kozur & Mostler, 1979, from which it differs by having the ventral spine changed usually into a long horn with a hollow structure, and size and even shape rather similar to those of the apical horn.
Range. Tethyan middle Anisian (Pelsonian) to lower Ladinian (Fassanian) so far as known.

***Gorispela cornubovis* n. sp.**
Figs. 3a, a1

Diagnosis. Shell dicyrtid and very short with blunt apex and long, very divergent and apically curved apical and ventral horns resembling the horns of an ox. Cephalis smooth-surfaced, with blunt and imperforate apex, its distal part, at the contact with the thorax, with sparse and very small pores. Initial spicule without dorsal ray. Primary and secondary lateral rays not extend outside. Apical and ventral spines very divergent, practically symmetrical and extended outside into two long and curved horns. Both horns hollow and straight on their proximal halves, then curved in apical direction and three-bladed, with an apically directed blade and two laterally directed blades. At the base of the laterally directed blades a well visible spur or nudge is developed. Thorax very short and divided into two parts by a well-marked and thin protruding circumferential ring: a truncate cone-shaped proximal part with sparse and circular or oval pores of variable sizes and irregularly disposed, and a distal and very short cylindrical part with larger, circular or oval pores. Distal end irregularly terminated as if the skeleton was not yet finished.
Studied material. A single specimen in sample Rc4.
Holotype. The illustrated specimen, Rc4, coll. MGL.110272.
Dimensions. Length of shell without spines 73 µm, of cephalothorax 56 µm, of distal part of thorax 17 µm, of A and V horns 80 µm, diameter of cephalis 35 µm, of circular ring 62 µm, of distal cylindrical part of thorax 56 µm.
Etymology. From the Latin *corn* – horn and *bos, bovis* – ox, due to its resemblance with the horns of an ox.
Remarks. This species differs from all the other species of the genus *Gorispela* by having the A and V horns very divergent and curved in apical direction on their distal halves.
Stratigraphic range. Lower Ladinian (Fassanian), Recoaro, Vicentinian Alps, North Italy.

***Gorispela fenestrata* n. sp.**
Fig. 3b

Diagonisis. Shell dicyrtid, campanulate. Cephalis practically imperforate except for a few small pores at the contact of the secondary lateral rays with the shell wall. Apical and ventral rays of the initial spicule forming two very robust horns diverging at about 90°, its bisectrice tilted at an angle of about 15° relative to the shell axis. Horns robust, conical on the proximal half or more and three-bladed and pyramidal on the distal portion. Apical horn tilted in dorsal direction, and apical ray prolonged along the inner side of the apical horn up to the base of the three-bladed portion. Ventral horn with proximal half conical and thick, and distal half three-bladed with pointed end and thin blades. Ventral ray of the initial spicule straight and very long inside shell, prolonged in the centre of the hollow conical half up to the base of the three-bladed portion. Collar boundary at the level of a circumferential row of small circular pores above the first circumferential ridge or, above it, at the level of MB that is marked at the surface by a constriction at the dorsal part of cephalis or a similar constriction at the base of the ventral horn. Thorax truncate-conical, with three circumferential ridges, the first one sometimes less marked. Each interval between two circumferential ridges with a row of very large oval pores forming a fenestrated structure. Distal end of shell with a thin circumferential band-like rings and, below it, a narrow girdle, both originated in the same place.
Studied material. Six specimens in the sample BV 85-70.
Holotype. Fig. 3b, BV 85-70, coll. MGL.110273.
Dimensions *(measured on holotype)*. Length of shell without apical horn, measured on holotype, 90 µm, of cephalis 57 µm, of thorax 34 µm, diameter of cephalis at its base 64 µm, of distal ring of thorax 127 µm, length of apical horn 65 µm, its diameter at base 27 µm, length of ventral horn 60 µm, its diameter at base 34 µm.
Etymology. From the Latin *fenestratus, -a, -um* – with windows.
Remarks. This species differs from the other species of the genus *Gorispela* by having a fenestrate thorax with three circumferential ridges and a very narrow distal cylindrical circle.
Stratigraphic range. Lower Ladinian of sample BV 85-70 from the Livinallongo Formation.

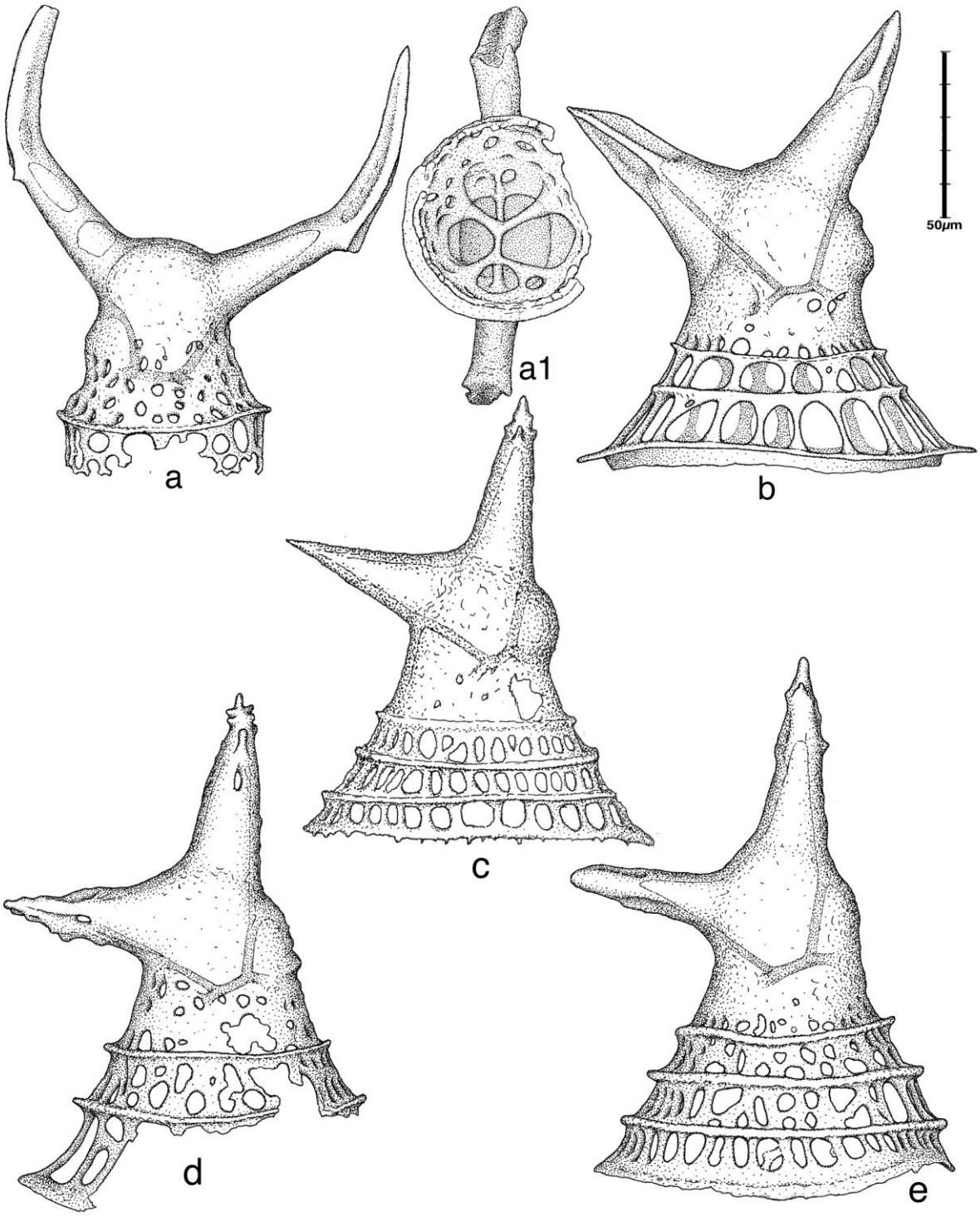

Fig. 3. **a**, **a1.** – *Gorispela cornubovis* n. sp., holotype in lateral and basal views, respectively, Rc4; **b.** – *Gorispela fenestrata* n. sp., holotype in lateral view, BV 85-70; **c**-**e**.– *Gorispela hungarica* n. sp., FÖ 87, **e**.– holotype. Scale bar of 50 µm is for all figures.

***Gorispela hungarica* n. sp.**

Figs. 3c-e

Diagnosis. Shell bell-shaped, conical bearing two or three circumferential ridges. Cephalis with robust and hollow conical apical and ventral horns. Its wall imperforated or with sparse rounded small pores of various sizes and irregular dispositions. Apical horn in axial position, its distal end with a few short spinules or irregular surface. Ventral horn in horizontal or subhorizontal position, its distal end three-bladed, blades thick or practically absent, and with irregular surface. Initial spicule with distal ends

of apical and ventral rays attached to the inner surface of horns. Thorax truncate conical, bearing two or three circumferential ridges, its wall with irregularly distributed pores of various forms, from circular to oval or triangular. Size of pores increases from the proximal to the distal part. Distal end represented by an imperforate band. Collar boundary not marked by a change in shape but considered to be above the level of the first circumferential ridge.

Studied material. Three illustrated specimens from the sample FÖ 87.

Holotype. Fig. 3e, coll. MGL.110274.

Dimensions. Length of shell with apical horn 155-160 µm, without horn 100 µm, of apical horn 50-60 µm, of ventral horn 40-45 µm; diameter of horns at base 20-25 µm, of base of thorax 108 µm.

Variability. The three illustrated specimens, the only ones found in the Felsőörs sample, prove that the variability of the species is visible especially in the number of circumferential rings and, depending on their number, the distance between them because the size of shell remains rather constant.

Etymology. From its occurrence in Hungary.

Remarks. *Gorispela hungarica* n. sp. resembles *Gorispela fenestrata* n. sp. by having a rather similar shape, but differs by having the apical horn in axial position, the ventral horn in horizontal position, and by not having two distal bands. It differs also by the position of the ventral ray of the initial spicule, that has not a central position in the ventral horn but it is connected to the lower side of its inner wall. It is interesting to mention that the same types of spinules present on the distal part of the apical horn of the three specimens have been remarked in the same position on the holotypes of the species *Gorispela mimetica* n. sp. (see below) and *Silicotinntinabulum formosum* n. sp., two species occurring in the same sample (case of horizontal gene transfer?).

Stratigraphic range. Late Anisian (Illyrian) of Hungary.

Gorispela victoria n. sp.

Fig. 4a

Diagnosis. Shell short conical with one circumferential ridge around the middle part of thorax. Initial spicule without dorsal ray. Apical and ventral rays prolonged outside into two equal, robust and straight horns situated practically symmetrical relative to the axis of shell and diverging from one another under an angle of 100°. Horns with proximal cylindrical portion short and hollow, and middle and distal portions three-bladed. Blades of apical horn bear a crown of small teeth, whereas the ventral horn bears only one tooth on the external blade. Both horns pyramidal beyond the level of the tooth. Cephalic cavity triangular in lateral view and poreless. Thorax truncate conical with about two circumferential rows of large pores on the distal end in an intercalary position. At its middle part there is a very well marked, thin and well-extending circumferential ring. Distal part of thorax below the circumferential ridge very short, inverted conical and with irregular distal border. It has large pores in the vicinity of the circumferential ridge and smaller ones and irregularly disposed on its distal part.

Studied material. A single specimen in the sample Rc4.

Holotype. Fig. 4a, coll. MGL.110275.

Dimensions. Length of shell without horns 72 µm, diameter of base of cephalis 40 µm, of circumferential ridge 87 µm.

Etymology. Due to the position of the two horns signifying victory, *victoria* – in Latin.

Remarks. Structurally, this species is close to *Gorispela cornubovis* n. sp., from which it differs especially by having straight horns and wide conical thorax with large pores.

Stratigraphic range. Buchenstein Formation, lower Ladinian.

Gorispela mimetica n. sp.

Fig. 4b

Diagnosis. Shell conical, bell-shaped with robust, conical and hollow apical and ventral horns. Apical horn practically axial bearing a few distal spinules on its distal end, whereas the ventral one has no spinules and is horizontally positioned. Both horns have also one or two large pores on the distal end of their hollow portion. Cephalis poreless except its distal part that has a series of small circular and irregularly disposed pores. Thorax truncate conical with pores that increase rapidly in diameter towards the distal end. This end has a protruding distal circumferential ring and a vertically positioned and thin distal girdle.

Studied material. A single specimen in sample FÖ 87, Felsőörs, Hungary.

Holotype. The specimen from Fig. 3b, coll. MGL.110276.

Dimensions. Length of shell with apical horn 138 µm, without apical horn 92 µm, diameter of cephalis 43 µm, of distal ridge 126 µm.

Etymology. Due to its thorax, the morphology of which resembles perfectly that of the thorax of *Silicotinntinabulum formosum* n. sp. occurring in the same sample**.**

Remarks. This species combines the morphology of two species assigned to two coeval genera: *Silicotinntinabulum formosum* n. sp. and species of the genus *Gorispela* due the presence of a robust and long ventral horn. From the former species it has the cephalis without dorsal (D) ray, and the ventral horn and thorax completely similar; from the genus *Gorispela* it has the same type of ventral horn. Moreover, its apical horn has short spinules at the distal end similar to the specimen of the species *Silicotinntinabulum formosum* n. sp. occurring in the same fauna of the sample FÖ 87 from Felsőörs (horizontal gene transfer?). What differs is the apical horn that is not three-bladed, as in *S. formosum*, but conical

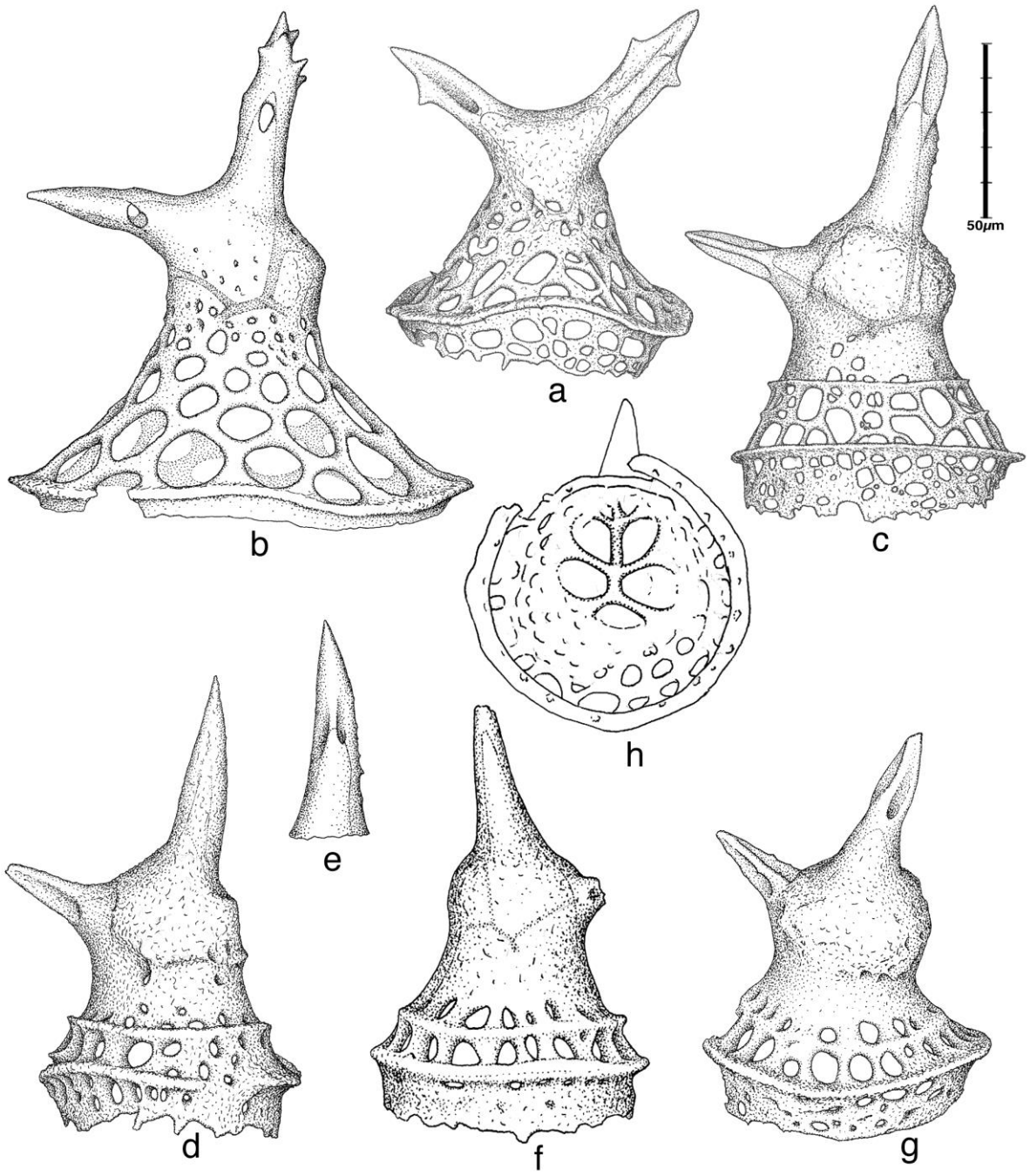

Fig. 4. **a.** – *Gorispela victoria* n. sp., holotype, Rc4; **b.** – *Gorispela mimetica* n. sp., holotype, FÖ 87; **c.** – *Gorispela haeckeli* n. sp., holotype, Rc4; **d**-**g.** – *Gorispela vicentiniana* n. sp.: **g**.- Rc4, **d.** – Rc2, holotype, **e.** – apical horn of another specimen, **f.** – Rc1d; **h.** – *Gorispela bragini* n. sp., holotype., basal view of fig. 4c; **f**, **g**.- Rc1. Scale bar of 50 µm is for all figures.

and hollow.

Stratigraphic range. Late Anisian (Illyrian).

***Gorispela haeckeli* n. sp.**

Fig. 4c

Diagnosis. Shell bell-shaped, poreless with a long and slightly subaxial apical horn and a shorter ventral horn. Apical horn long, cylindrical and hollow on more than half the proximal portion, and three-bladed and lanceolate on the distal portion. Apical ray prolonged along the inner dorsal side of its wall. Ventral horn approximately half shorter than the apical one, with a short and hollow

conical base and a much longer three-bladed and pointed distal portion. Ventral ray of the initial spicule straight, prolonged along the cavity of the conical proximal portion up to the base of the bladed portion. Distal part of cephalis conical with a few irregularly disposed pores towards the contact with the thorax. Thorax short, truncate conical with two thin circumferential ridges. The interval between these ridges has pores of very variable shape, size and arrangement resembling the *vitrails* of the medieval catholic churches. Distal part of thorax cylindrical to slightly inverted conical with irregular termination and irregularly disposed smaller pores than those of the proximal part.

Studied material. The holotype from the sample Rc4.

Holotype. Fig. 4c, sample Rc4, coll. MGL.110277.

Dimensions. Length of shell without apical horn 90 µm, of apical horn 70 µm, of cephalis 50 µm, of thorax 40 µm, of ventral horn 30 µm, diameter of cephalis 45 µm, of last circumferential ring 80 µm.

Etymology. Dedicated to Ernst Haeckel, the founder of the radiolarian taxonomy.

Remarks. *Gorispela haeckeliana* n. sp. differs from the other species of the genus by the very variable shapes and sizes of the thoracic pores and also by having only two circumferential rings and the distal end of thorax longer and worn out.

***Stratigraphic range*.** Very rare in the Buchenstein Formation, lower Ladinian.

***Gorispela bragini* n. sp.**

Figs. 4h, 5c

Diagnosis. Shell bell-shaped with practically poreles cephalis. Apical horn slightly tilted dorsally, pointed, hollow on the proximal portion and slightly three-bladed on the distal one. Ventral horn three-bladed and pyramidal arising directly from the cephalis without a conical intermediary portion. Ventral ray of initial spicule connected with the centre of the horn. Collar boundary marked by a slight constriction. Thorax thin-walled, truncate conical and bearing 2-3 circumferential ridges bearing in the interridge areas a row of circular, oval or rectangular windows. Distal end with a very narrow and vertically directed circumferential band.

Studied material. Three specimens in sample Rc4.

Holotype. The illustrated specimen, sample Rc4, coll. MGL.110278.

Dimensions (measured only on holotype). Length of shell with apical horn 130 µm, length of horn 60 µm, of cephalis 47 µm, of thorax 48 µm, diameter of cephalis 48 µm, of thorax 85 µm.

Etymology. The species is dedicated to Dr. Nikita Bragin for his contribution to the knowledge of Triassic radiolarians.

Remarks. By its morphology, this species resembles *Gorispela fenestrata* n. sp., from which it differs by being smaller and by not having the intermediary conical hollow portion between the distal three-bladed part of the ventral horn and the cephalic cavity.

Stratigraphic range. Buchenstein Formation, lower Ladinian (Fassanian).

***Gorispela vicentiniana* n. sp.**

Figs. 4d-g

Diagnosis. Shell dicyrtid bell-shaped with initial spicules without dorsal ray. Cephalis usually poreless except its distal part that can have several small circular pores in the vicinity of the thorax. Apical horn conical, usually slightly dorsally tilted, with distal part slightly three-bladed, interbladed grooves more or less visible and probably connected with the cavity of the horn (fig. 4e). Ventral horn in subhorizontal position, shorter than the apical horn and three-bladed, its basal part with a very short conical portion. Ventral ray directed to the axis of the horn. Thorax truncate conical, bearing two circumferential ridges, the last one better marked and the interval between them having usually a ring of larger pores. Distal end represented by a relatively short cylindrical body with a row of small pores below the last circumferential ridge or with small and irregularly disposed pores. Its distal end usually irregular.

Studied material. Four specimens of which one in Rc2 and three in Rc4.

Holotype. Fig. 4d, sample Rc2, coll. MGL.110279.

Dimensions. Length of shell with apical horn 110-130 µm, without apical horn 80-83 µm, of apical horn 40-50 µm, of ventral spine 28-30 µm; diameter of cephalis 43-45 µm, of thorax 73-82 µm.

Etymology. From its occurrence in the Vicentinian Alps, North Italy.

Remarks. *Gorispela vicentiniana* n. sp. differs from the other species above mentioned by having the unbladed proximal part of ventral horn very short or almost absent. It is very close to *Gorispela haeckeli* n. sp., from which it differs by having the pores in the space between the circumferential rings arranged usually in a single circumferential row and the circumferential rings narrower. Also, it is very close to *Gorispela fenestrata* n. sp. by having the pores between circumferential rings disposed in single rows, from which it differs by not having the ventral horn with a conical proximal portion, the pores between rows smaller and the rows closer to one another.

***Stratigraphic range*.** Buchenstein Formation of Recoaro, lower Ladinian.

***Gorispela tuba* n. sp.**

Figs. 5a, b

Diagnosis. Shell dicyrtid, conical, trumpet-shaped and smooth-surfaced with distal portion expanded. Apical horn conical, pointed and slightly dorsally tilted, its inner side partly hollow on half proximal portion. Ventral horn conical and pointed, with hollow proximal portion. Cephalis impossible to separate from thorax, most part of

its wall imperforated or with very small and sparse rounded pores. Pores start increasing in size and frequency from the level of the MB, where on consider that is the boundary between the cephalis and thorax. On thorax pores are larger but of different sizes and irregularly arranged.

Studied material. Three specimens of which two in FÖ 87, and one in Rc 4.

Holotype. Fig. 5b, FÖ 87, Hungary, coll. MGL.110280.

Dimensions. Total length of shell 128-143 µm, of shell without apical horn 80-90 µm, diameter of cephalis at the level of MB 40-48 µm, of distal end 80-103 µm.

Etymology. From the Latin *tuba* - trumpet.

Remarks. *Gorispela tuba* n. sp. has in common with the other species of this genus the general size of the shell and the hollow structure of the apical and ventral horns. It only differs by the absence of circumferential ridges and by the absence of three-bladed distal portions of the two horns.

Stratigraphic range. Upper Anisian (Illyrian) from Hungary, sample FÖ 87, to lower Ladinian (Fassanian) of the Buchenstein Formation from Recoaro, sample Rc4.

***Gorispela* (?) *triangulocephalis* n. sp.**

Figs. 6a, b

Diagnosis. Shell conical with long, straight and robust apical and ventral horns. Both horns massive but with cephalic cavity extended on a relatively short distance along them forming, in lateral view, a triangular cephalic cavity. Apical horn tilted dorsally, cylindrical in the proximal half and slightly three-bladed or with dorsal side with irregular outline on the distal half. Ventral horn subcylindrical on the proximal half and slightly three-bladed and conical on the distal half. Three-bladed morphology not expressed in forming blades but in the position of very short spines of the holotype. Initial spicule with dorsal ray prolonged outside into a very small spine. Cephalis imperforate on the upper part but with some sparse circular or oval pores on its distal half. In lateral view its cavity is practically triangular, a shape bordered by the top of the cephalis and the apical and ventral rays. Thorax subcylindrical with two or three circumferential ridges and irregularly distributed pores of circular or oval shapes in the interridged spaces.

Distal end with a narrow circumferential band.

Sudied material. Five specimens in the sample FÖ 87, Felsőörs, Hungary.

Holotype. Fig. 6b, coll. MGL.110281.

Paratype. Fig. 6a, coll. MGL.110282.

Dimensions. Length of shell without apical horn 90 µm, of apical horn 68-70 µm, of ventral horn 70-75, maximum diameter of thorax 70 µm.

Etymology. From the triangular shape of the cephalic cavity.

Remarks. Although the apical and ventral horns are very thick, which is a common character of the genus *Gorispela* n. gen., this species is questionably assigned to this genus due to the presence of the dorsal ray in the initial spicule and of the absence of a true hollow structure of the two horns (see also chapter 3b). As the images show, only the proximal parts of the two horns have a conical hollow portion, the result being the triangular shape of the cephalic cavity due to the prolongation of the cephalic cavity in the short conical hollow portion of the horns.

Stratigraphic range. Upper Anisian (Illyrian), Felsőörs, Balaton Highland, Hungary.

Genus ***Pozsvartia*** n. gen.

Type species. *Pozsvartia multicingulata* n. sp.

Diagnosis. Shell dicyrtid, conical with cephalis bearing a conical and robust apical horn in axial or subaxial position and a smaller conical ventral horn in oblique or subhorizontal position. Initial spicule with dorsal ray, and primary and secondary lateral rays not extended outside shell. Collar boundary indistinct outside by a constriction but considered to be at the level of MB or above the first circumferential ring. Thorax conical bearing several circumferential ridges with perforated inter-circumferential rings space.

Etymology. The genus is dedicated to Dr. Péter Ozsvárt, Budapest, for his contribution to the knowledge of Triassic Radiolaria. Feminine gender.

Remarks. By the morphology of its type species this genus is rather similar to the species *Gorispela tuba* n. sp. from which it differs by having a dorsal ray in the initial spicule.

Stratigraphic range. Middle Triassic (Pelsonian to Illyrian) so far as known.

***Pozsvartia multicingulata* n. sp.**

Figs. 5d-f

Diagnosis. Shell long conical with cephalis subglobular or conical and practically imperforate bearing a robust axial conical apical horn and a thinner and shorter ventral spine in an oblique position. Primary and secondary lateral rays not prolonged outside, but the dorsal ray can be prolonged into a very short and obliquely downward-directed spine.

Collar boundary not marked outside by a constriction; it can be established above the first circumferential ridge. Pores of thorax sparse, irregularly arranged and of variable sizes and shapes. Distal end straight.

***Studied material*.** Three specimens of which one from the Illyrian of FÖ 87, Hungary, and two from two levels of the Pelsonian of Cristian, samples CRH and CR25, all illustrated.

Holotype. Fig. 5d, sample FÖ 87, coll. MGL.110283.

Dimensions. Total length of shell 130-133 µm, of shell without apical horn 85-93 µm, diameter of cephalis 34-43 µm, maximum diameter of circumferential ridges

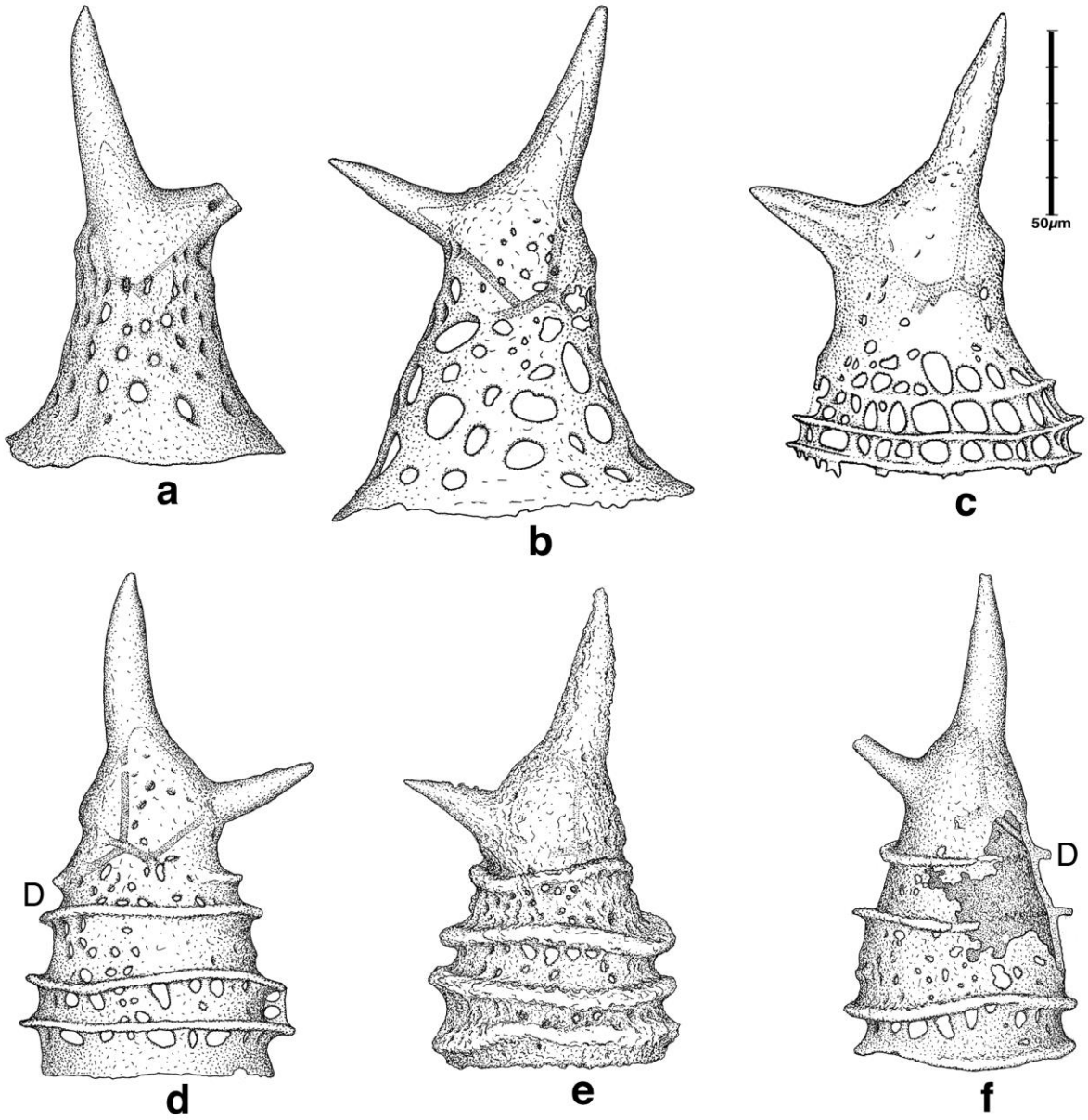

Fig. 5. **a**, **b**. – *Gorispela tuba* n. sp., **a.** – Rc4, **b.** – holotype, FÖ 87; **c.** – *Gorispela bragini* n. sp., holotype, Rc4 (see also fig. **3h**); **d-f.** – *Pozsvartia multicingulata* n. sp., **d.** – holotype, FÖ 87, **e.** – CRH, **f.** – CR25, D – dorsal spine. Scale bar of 50 µm is for all figures.

63-75 µm.

Etymology. From the Latin *multus* – many and *cingulata* – having belts.

Remarks. Although occurring at two different levels of the Anisian (Pelsonian and Illyrian) the morphology of the specimens is rather similar.

Stratigraphic range. Middle and Upper Anisian (Pelsonian to Illyrian).

Family **HUMEROCYRTIIDAE** n. fam.
Type genus: *Humerocyrtis* n. gen.

Diagnosis. Shell dicyrtid, bell-shaped with the proximal part of the thorax laterally expanded forming a kind of shoulder. Cephalis simple with initial spicule without dorsal ray, and primary and secondary lateral rays not extended outside shell surface. Apical and ventral rays extended outside into spines of different sizes and structures, usually three-bladed or conical and never hollow. Thorax latticed, perforated by circular or polygonal pores and usually wide open distally.

Remarks. The species of this new family differ from those of the family Gorispelidae n. fam. by not having hollow apical and ventral horns and by having the proximal part of the thorax laterally extended forming a kind of shoulder. It seems that, by some of its species such as *Humerocyrtis gracilis* n. sp. and others, this family, together with some species of the genus *Goestlingella* Kozur & Mostler (see Dumitrica 1917), marks the first appearance in the paleontological record of nassellarians with simple wall and circular pores arranged in a quincuncial manner, a type of arrangement common in many Jurassic, Cretaceous and especially Cenozoic species.

The species of this genus can be grouped in three subgroups:
1. Species with bigger skeletons, apical and ventral spines three-bladed and pores of the distal part of thorax disposed in circumferential rows: *Humerocyrtis superba* n. sp., *H. deweveri* n. sp., *H. lahmi* n. sp. and *H. avirostrum* n. sp., *Humerocyrtis* n. sp.
2. Species with smaller skeleton, apical horn three bladed and well developed, ventral spine very small, and thorax with pores arranged irregularly or quincuncially in oblique rows; *H. jekeli* n. sp., *H. contraria* n. sp., *H. conica* n. sp.
3. Species with apical horn conical and not hollow, and ventral spine three-bladed or conical.
Stratigraphic range. Middle Anisian (Pelsonian) to lower Ladinian so far as known.

Genus ***Humerocyrtis*** n. gen.
Type species. *Humerocyrtis superba* n. sp.

Diagnosis. Wide open dicyrtids with cephalis bearing well-developed three-bladed or conical apical and ventral horns. Thorax bell-shaped with proximal part well expanded laterally forming a kind of shoulder, distal part concave in outline and distal end flare-shaped. Initial spicule without dorsal ray, and primary and secondary lateral rays not expressed outside shell.
Etymology. From the Latin *humerus* – shoulder and the Greek *cyrtis* – basket, feminine gender.
Remarks. The species of this genus differ from the other Middle Triassic nassellarian species discussed in this paper by having massive conical or three-bladed apical and ventral horns and the thorax with a shoulder-like morphology. Such a morphology resembles that of some species of the genus *Goestlingella* Kozur & Mostler, 1979 as illustrated by Dumitrică (2017) and other authors, from which it differs by the absence of conical spines with hollow structure. Among the species published until present, *Goestlingella pseudoillyrica* Tekin & Mostler (2005, p. 7, figs. 13, 14) is the only Middle Triassic species that must be assigned to *Humerocyrtis* and can be considered as its youngest member. The position of blades in the shell follows usually the position of the arches AV, Alr and All (on the apical horn), and AV, VLr and VLl (on the ventral spine), arches that are common to most monocyrtid nassellarians.
The species are distinguished on the basis of morphology: shape and size of shell, type of apical and ventral spines or horns (conical or three-bladed) and their position on cephalis.
The species of this genus are very rare in the Middle Triassic by comparison with other species and can be grouped into three subgroups that could represent subgenera or even independent genera as follows:
1. Species with bigger skeleton, apical and ventral spines well developed and three-bladed, and pores of the distal part of thorax disposed in circumferential rows: *Humerocyrtis superba* n. sp., *H. deweveri* n. sp., *H. lahmi* n. sp., *H. avirostrum* n. sp. and *Humerocyrtis* sp. (n. sp.);
2. Species with smaller skeleton, apical and ventral spines three-bladed and of very different in size, ventral spine being small or very small by comparison with apical horn, and thorax with pores arranged irregularly or quincuncially in oblique rows: *Humerocyrtis jekeli* n. sp., *H. conica* n. sp., *H. undulata* n. sp., *H. gracilis* n. sp., *H. contraria* n. sp., *H. problematica* n.sp. and *H. pseudoillyrica* (Tekin & Mostler).
3. Species with apical horn conical and generally long and not hollow, and ventral spine three-bladed or conical: *Humerocyrtis brevithorax* n. sp., *H. infinita* n. sp., *H. asymmetrica* n. sp., *H. marmoladensis* n. sp., *H. mediotriassica* n. sp.
Stratigraphic range. Middle Triassic (middle Anisian to upper Ladinian) of Western Tethys so far as known.

***Humerocyrtis superba* n. sp.**
Fig. 6c

Diagnosis. Shell large, bell-shaped with the body divided into two parts by a median circumferential ridge corresponding to the maximum diameter of the shoulder: a proximal part and a distal part. Proximal part conical with concave lateral sides consisting of cephalis and the proximal part of the thorax. Cephalis hemisphaerical bearing two three-bladed horns: an apical horn and a ventral horn, both pointed and having thin but wide blades. Apical horn dorsally tilted. Cephalic wall perforated by very small circular or subcircular and irregularly arranged pores. Thorax of this part of shell wide conical with concave outline. It has much larger and irregularly arranged pores. Shoulder sharp and angular. Distal part of thorax much larger and longer than the proximal part, its outline concave and distal end flared. Pores of this part arranged in 6 circumferential intercalary rows of three types of shapes and sizes: first two rows consisting of smaller circular, oval or elliptical pores, following two rows consisting of very large rounded rectangular or oval pores with long axes longitudinally positioned, and last two rows with elliptical pores arranged with long axes transversally directed. Each row of such thoracic pores consisting of 10-11 pores on half the perimeter.
Studied material. One specimen in the sample BV 85-70.
Holotype. Fig. 6c, sample BV 85-70, coll. MGL.110284.
Dimensions. Length of shell without apical horn 155 µm, with apical horn 210 µm, length of shell up to the circumferential ring 70 µm, of distal part 85 µm, diameter of cephalis 50 µm, of shoulder or circumferential ring 110 µm, of distal end 160 µm.
Etymology. From the Latin *superbus*, *-a*, *-um* – superb.
Remarks. This species differs from other species of this genus by its great size and, especially, the different types and arrangement of pores on the distal part of thorax.

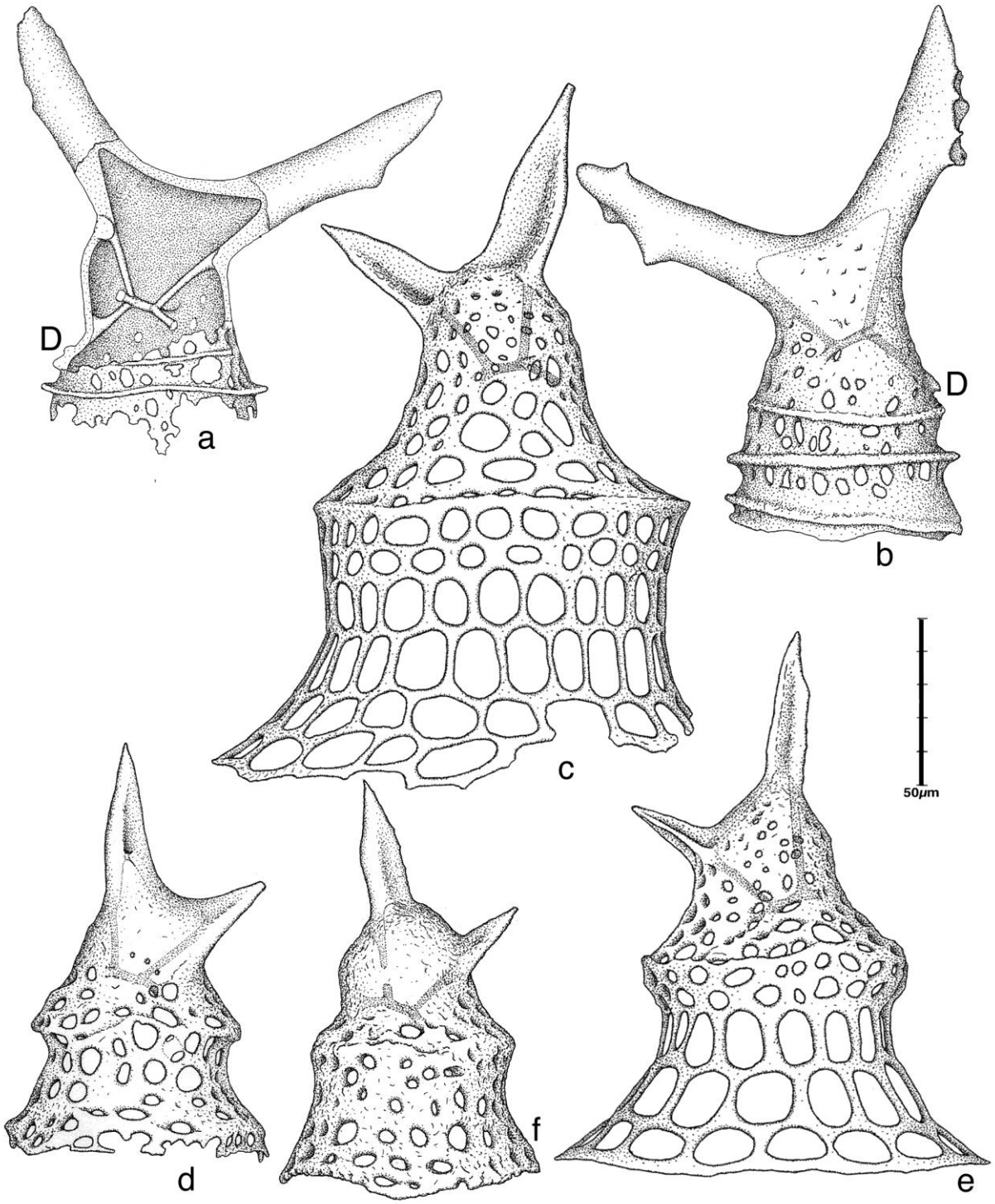

Fig. 6. **a**, **b.** – *Gorispela* (?) *triangulocephalis* n. sp., FÖ 87: **a.** – specimen showing internal structure, **b.** – holotype, D – dorsal ray. **c.** – *Humerocyrtis superba* n. sp., holotype, BV 85-70; **6d, 6c.** – *Humerocyrtis jekeli* n. sp., Rc4, **6c.** – holotype, **d.** - paratype; **e.** – *Humerocyrtis deweveri* n. sp., holotype, BW 85-70; **f.** – *Humerocyrtis problematica* n. sp., holotype, Rc4. Scale bar of 50 µm is for all figures.

Stratigraphic range. Livinallongo Formation, Marmolada Massif, North Italy, sample BV 85-70, lower Ladinian.

***Humerocyrtis deweveri* n. sp.**

Fig. 6e

Diagnosis. Shell relatively large, bell-shaped with rounded shoulder. Proximal part, consisting of cephalis and upper part of thorax, conical with concave lateral sides. Cephalis conical with two three-bladed horns: an apical horn in axial position and a smaller ventral horn, both pointed and having thin blades. Cephalic wall

perforated by small circular or subcircular and irregularly arranged pores. Thorax of this part of shell wide conical. It has much larger and irregularly disposed pores. Shoulder rounded and having small pores of variable sizes and irregular arrangement, especially on the proximal side. On distal side of thorax the shoulder has two circumferential rows of rounded pores of various sizes. Below them the thorax is constricted and distally flared, bearing three circumferential rows of large pores arranged into 3 circumferential intercalary rows of two types: the first two rows with very large rounded rectangular or oval pores with long axes longitudinally positioned, the last row with slightly smaller pores arranged with transversally directed long axes, each row containing 6-7 pores on half the perimeter.

Studied material. A single specimen in the sample BV 85-70.

Holotype. Fig. 6e, sample BV 85-70, coll. MGL.110285.

Dimensions. Length of shell without apical horn 114 µm, with apical horn 160 µm, length of shell up to the circumferential ring 50 µm, of distal part 65 µm, diameter of cephalis 40 µm, of shoulder or circumferential ring 74 µm, of distal end 120 µm.

Etymology. The species is dedicated to my friend Prof. Patrick De Wever for his contribution to the knowledge of Triassic radiolarians.

Remarks. This new species resembles very much the species *Humerocyrtis superba* n. sp. by having a rather similar morphology from which it differs by being smaller, by having smaller horns, shoulder with rounded outline and distal part of thorax with only three circumferential rows of large pores.

Stratigraphic range. Livinallongo Formation, Marmolada Massif, North Italy, sample BV85-70, lower Ladinian.

Humerocyrtis n. sp.

Fig. 7

Remarks. This new species, of which I have only the SEM image of a specimen from a residue of the sample Rc4 offered in 1975 to Emil Pessagno jr. during the 14 th European Micropaleontological Colloquium held in Romania, and illustrated by him later. This image shows very clearly the thorax with the circumferential ridge of the shoulder, the six rows of pores of the distal part of thorax, its concave outline, the proximal part of thorax and cephalis. Unfortunately, the details of the cephalic surface and its morphology are blur. What one can see is that the colar boundary is well marked and the apical horn is three-bladed but the ventral spine is invisible. One can also see that the proximal part of the thorax has pores arranged in circumferential rows as its distal part, a character that is not seen at other species of this genus, and also that the distal border of the thorax has a well-marked broad platy ring.

Studied material and Stratigraphic range. Sample Rc4, lower Ladinian, Buchenstein Limeston, Recoaro.

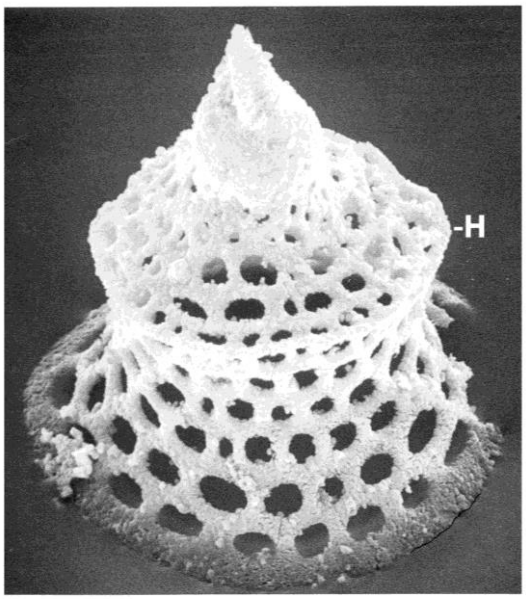

Fig. 7. - *Humerocyrtis* n. sp., H – shoulder, Rc4.

Humerocyrtis lahmi n. sp.

Figs. 8f

Diagnosis. Skeleton dicyrtid bell-shaped, relatively large with hemispherical cephalis and a robust axial three-bladed apical horn with well-developed thin blades. Ventral horn, broken off, but should be shorter than the apical horn. Thorax divided into two parts (proximal and distal) by a thin circumferential ridge. Its pores are rather wide and arranged intercalately in seven circumferential rows. Its proximal half wide cylindrical and distal half flared. It bears seven circumferential rows of rounded or elliptical pores of relatively equal sizes. Distal border probably straight and thin.

Studied material. One specimen in sample Rh03.

Holotype. Fig. 8f, lost.

Dimensions. Height of shell with apical horn 220 µm, of distal part of thorax 127 µm, diameter of cephalis 48 µm, of shoulder 109 µm, of distal end 156 µm.

Etymology. The species is dedicated to Dr. Berhard Lahm for his excellent study of the Middle and Upper Triassic radiolarians from Recoaro (Italy) and Grossreifling (Austria).

Remarks. By its general morphology and size and especially the presence of the circumferential ridge on the shoulder and the number of circumferential rows of pores, this species resembles very much *Humerocyrtis superba* n. sp., from which it differs by having the thoracic pores with practically similar shapes and sizes.

Stratigraphic range. Very rare in the lower Ladinian, Buchenstein Formation, Recoaro area.

***Humerocyrtis jekeli* n. sp.**
Figs. 6d, 8c

Diagnosis. Shell bell-shaped consisting of a small, pear-shaped cephalic cavity and practically poreles cephalis and a thorax with concave distal portion. Apical horn, long, three-bladed and pointed. Ventral spine small, three-bladed and pointed. Proximal part of thorax very short, wide-conical with rare small circular or oval pores. Shoulder relatively well remarked and rounded. Distal part of thorax subcylindrical with concave outline, its distal end simple or bearing a short and narrower thin-walled additional shell. Pores of thorax circular or oval, of variable sizes and arranged irregularly or in oblique rows.
Studied material. Two specimens in sample Rc4.
Holotype. Fig. 8c, sample Rc2, coll. MGL.110286.
Paratype. Fig. 6d, sample Rc4, coll. MGL.110287.
Dimensions. Maximum length of shell with apical horn 126-144 µm, without horn 87-96 µm, of cephalis 30-35 µm, of thorax 52-61 µm, diameter of cephalis 37-38 µm, of shoulder 57-58 µm, of distal end 95-106 µm.
Etymology. The species is dedicated to the geologist E. Jekelius who, at the beginning of the XXth century, studied the geology and Triassic fauna from the Braşov and Cristian areas.
Remarks. To this species I assigned provisionally two rather different specimens. The paratype differs from the holotype by having a longer and slightly pear-shaped cephalis, very irregularly arranged pores on thorax and distal border of thorax practically without the thin additional shell. There is just a beginning of such a shell in the left side of the distal border.
Stratigraphic range. Buchenstein Formation, Recoaro, lower Ladinian.

***Humerocyrtis problematica* n. sp.**
Fig. 6f

Diagnosis. Shell bell-shaped short with cephalis globular and practically imperforate with a strait, three-bladed and distally pointed apical horn and short three-bladed ventral spine. Shoulder rounded with a few small and iregularly arranged pores. Distal part with concave outline and circular or subcircular sparse pores Pores of thorax oval or circular, small, very variable in size and irregularly arranged. Distal border irregular, without an imperforate margin.
Studied material. A single specimen in sample Rc4.
Holotype. Fig. 6f, coll MGL.110288.
Dimensions. Length of shell 139 µm, of cephalis 39 µm, of thorax 86 µm, diameter of cephalis 49 µm, of should 68 µm, of distal end 87 µm.
Etymology. From the difficulty to classify it in one of the species of this genus.
Remarks. This species differs from the other lower Ladinian species illustrated on this occasion by having a straight apical spine with distal half pointed and the proximal one with parallel sides, rounded cephalis, irregular distal border, and very short proximal part of thorax.
Stratigraphic range. Very rare in the lower Ladinian, sample Rc4 from Recoaro.

***Humerocyrtis contraria* n. sp.**
Fig. 8a

Diagnosis. Test relatively short, bell-shaped with three-bladed, robust and pointed apical horn. Ventral horn pointed relatively long by comparison with other related species. Cephalis practically imperforated except a few very small pores at its lower part. Collar boundary difficult to distinguished but it could be considered to be under the level of the median bar where the pores become larger. Thorax with shoulder well marked by a rather acute angle in lateral view. Distal part of thorax very short, with a rather deep concavity under the shoulder followed by a flare-shaped outline. Distal border irregular, with a beginning of a thin additional wall developed in antapical direction.
Studied material. A single specimen in sample Rc4.
Holotype. Fig. 8a, sample Rc4, coll. MGL.110289.
Dimensions. Total length of shell 140 µm, of thorax 60 µm, diameter of shoulder 71 µm, of distal end of thorax 90 µm.
Etymology. From the Latin *contrarius*, *-ia* – contrary, because its ventral spine is longer than that of other species of the genus *Humerocyrtis* with similar morphology.
Remarks. This species resembles most of the small species of the genus *Humerocyrtis* with three-bladed apical horn by its general shape, but differs from them by having a longer and more robust ventral horn, thoracic pores with very variable sizes and irregular arrangement. It differs also by its irregular distal thoracic border.
Stratigraphic range. Very rare in the sample Rc4 from the Buchenstein Formation from Recoaro, North Italy.

***Humerocyrtis conica* n. sp.**
Fig. 8b

Diagnosis. Bell-shaped shell with apical horn three-bladed, pointed, practically axial but very slightly curbed in ventral direction. Cephalis conical with ventral horn very small and three-bladed and collar boundary very difficult to remark.
Studied material. A single specimen in sample Rc4.
Holotype. Fig. 8b, Rc4, coll. MGL.110290.
Dimensions. Length of shell 154 µm, of apical horn 50 µm, of thorax 78 µm, of distal part of thorax 60 µm, diameter of shoulder 60 µm, of distal end 110 µm, of additional shell 88 µm.
Etymology. From the rather perfect conical shape of the distal part of the thoracic shell.
Remarks. This species resembles *Humerocyrtis jekeli* n. sp., from which differs by having the distal part of thorax

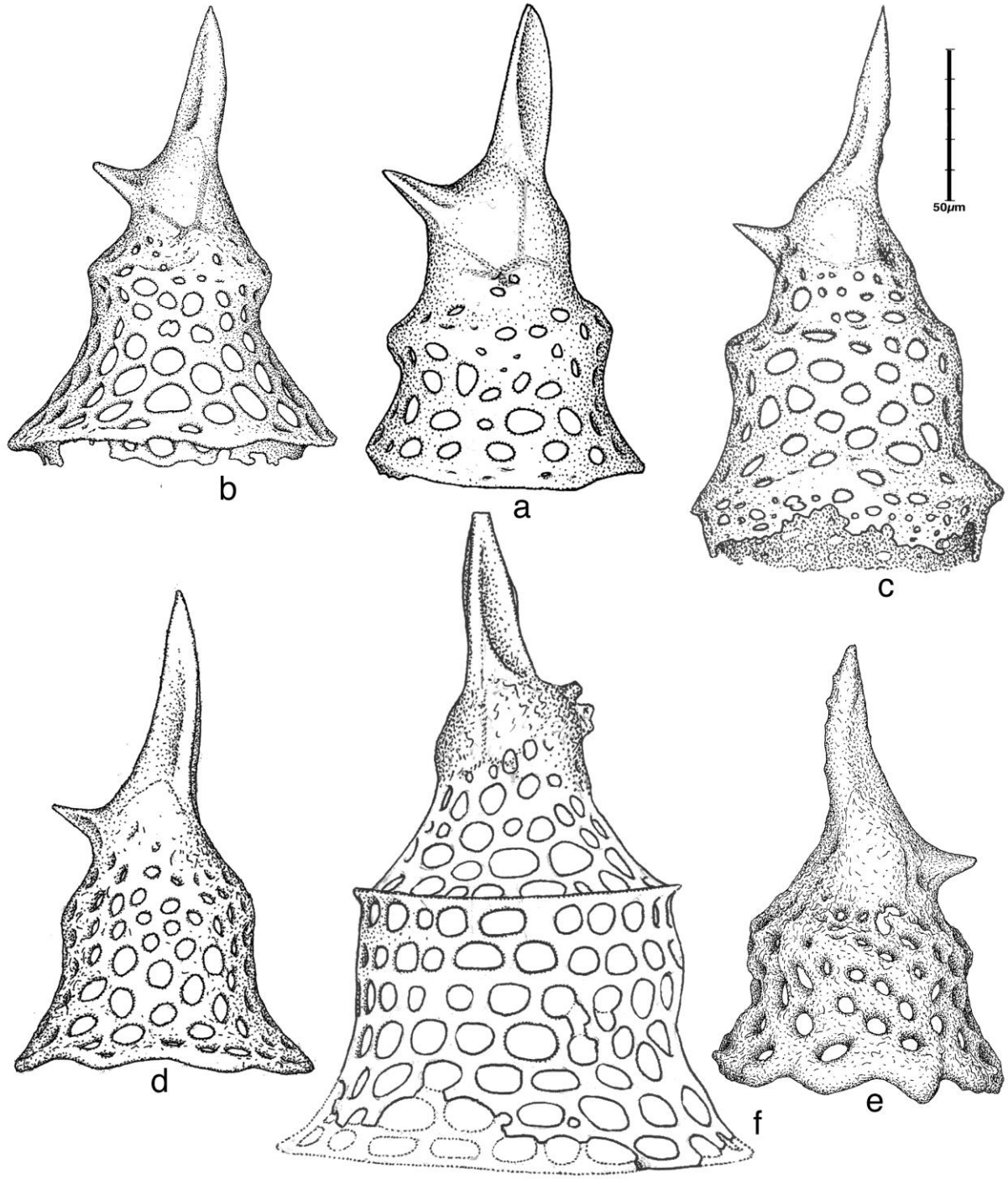

Fig. 8. **a.** – *Humerocyrtis contraria* n. sp., holotype, Rc4; **b.** – *Humerocyrtis conica* n. sp., holotype, Rc4. **c.** – *Humerocyrtis jekeli* n. sp., holotype, Rc2; **e**,?**d** .– *Humerocyrtis undulata* n. sp., Rc4: **e** – holotype. **f** – *Humerocyrtis lahmi* n. sp., holotype, Rc4. Scale bar of 50 µm is for all figures.

conical with straight sides and a very short post-thoracic additional shell under the distal end and originated on the inner side of thorax.

Stratigraphic range. Very rare in Buchenstein Formation from Recoaro, lower Ladinian.

***Humerocyrtis undulata* n. sp.**

Figs. 8e, ?8d

Diagnosis. Shell bell-shaped and thick-walled with a three-bladed, robust, pointed and slightly curved apical horn. One of its blades is in the plane of the ventral spine

and the other two are laterally directed. Ventral spine very short and pointed. Cephalis cavity pear-shaped with pointed end in apical direction and its wall practically poreless. Collar boundary marked by a slight constriction and by the appearance of pores. Thorax short, thick-walled, with evident shoulder but without a circumferential ring. Distal end thick with undulate border. Pores of thorax rounded, separated by wide intervening bars and relatively quincuncially arranged.

Studied material. Two specimens in sample Rc4.

Holotype. Fig. 8e, coll. MGL.110291.

Paratype. Fig. 8d, coll. MGL.110292.

Dimensions. Length of shell with apical horn 120-140 µm, of apical horn 40-65 µm, length of cephalis 25-30 µm, of thorax 50-55 µm, diameter of shoulder 60-64 µm, of distal end 72-?95 µm.

Etymology. From the Latin *undulatus*, *-a*, *-um* – winding due to its undulate distal border.

Remarks. This species differs from the other species of this genus herein described by the undulate distal border. The specimen illustrated in Fig. 8d is questionably included in this species because its thorax is less thick, the shoulder less marked and the distal end less undulated. By its overall morphology it seems to be intermediate between *H. undulata* and *H. gracilis* n. sp.

Stratigraphic range. Sparse in Buchenstein Formation, lower Ladinian, Recoaro.

Humerocyrtis avirostrum n. sp.

Fig. 9c

Diagnosis. Shell large bell-shaped, with well-developed and pointed three-bladed apical and ventral spines. Cephalis short and globular with a few very small pores. Collar boundary marked by a depression on the dorsal side and under the ventral spine that correspond to the position of MB. Proximal part of thorax tronconical and short with elliptical pores of various sizes and irregular arrangement. Shoulder rounded or slightly acute but without a circumferential ring. It corresponds to the boundary between the first two circumferential rows of pores. Distal part of thorax with concave outline and with the minimum diameter under the shoulder. Distal part of thorax conical with 4 or 5 circumferential rows of larger pores of oval, elliptical or rounded quadrangular shape. Distal end of thorax with a circular band a little broader and thicker than the bars between the circumferential rows of thoracic pores. Under this band there is a narrowing row of rounded quadrangular pores with thin intraporal bars.

Studied material. One specimen in sample Rc4.

Holotype. One specimen, coll. MGL.110293.

Dimensions. Length of shell with apical horn and post thoracic additional shell 270 µm, without post thoracic shell 255 µm, diameter of cephalis 55 µm, of shoulder 83 µm, of distal part of thorax 108 µm.

Etymology. From the Latin *avis* – bird and *rostrum* – beak, due to the resemblance between the ventral spine and the beak of birds.

Remarks. *Humerocyrtis avirostrum* n. sp. resembles generally *H. lahmi* n. sp. in size and the type of distal thoracic pores from which it differs by not having the shoulder with a circumferential ring and by having the distal part of thorax well constricted and the distal thoracic border with an additional post-thoracic narrowing row of pores with thin interporal bars.

Stratigraphic range. A single specimen in the lower Ladinian from the Buchenstein Formation.

Humerocyrtis gracilis n. sp.

Figs. 9a, b, f

Diagnosis. Two-segmented bell-shaped nassellarian without dorsal ray in the initial spicular system. Cephalis ovoidal with partly imperforate wall and pyriform cavity with the acute end in the base of the apical horn. Apical horn more or less three-bladed to almost conical, subaxially disposed and usually slightly curved in ventral direction. Ventral spine very small outside cephalis and pyramidal. Thorax bell-shaped with a well-marked rounded shoulder and a rather deep concavity of its distal part. Pores circular or subcircular, relatively large and usually quincuncially arranged and increasing in diameter in distal direction. Intervening bars of pores relatively thin. Distal end flared with or without a narrow circular and imperforate band.

Studied material. Six specimens of which two in the sample Rc4 and four in BV 85-70.

Holotype. Fig. 9b, sample BV 85-70, coll. MGL.110294.

Paratype. Fig. 9a, sample Rc4, coll. MGL.110295.

Dimensions. Total length of shell with apical horn 80-86 µm, of thorax 40-42 µm, diameter of cephalis 17-20 µm, of shoulder 37-38 µm, of distal end 57-59 µm.

Etymology. From the Latin adjectiv *gracilis* – delicate.

***Remark*s**. Morphologically, this new species is very close to the upper Longorbardian species *Humerocyrtis pseudoillyrica* (Tekin & Mostler, 2005) from which it differs by having the thoracic skeleton with larger pores, the apical horn much longer and slightly curved in ventral direction, the collar structure less marked, and the distal end of thorax without a broad imperforate zone, which is a general characteristic of many species of the genus *Goestlingella*. Although the ventral spine of *H. pseudoillyrica* is not mentioned in their description and not visible on their images, it must exist because it is a characteristic element of the cephalis of the genera *Goestlingella* and *Humerocyrtis*. Its absence must be due to the dorsal position of the illustrated shells. The shape of this species is also very similar to the coeval species *Goestlingella formosa* Dumitrică 2017, from which it only differs by having a three-bladed apical horn, and the distal border without a rather broad imperforate zone.

The specimen illustrated in Fig. 9f from the sample Rc4 is included in this species by its shape and disposition of pores, but difers from the holotype and all the other specimens from the sample BV 85-70 by having wider

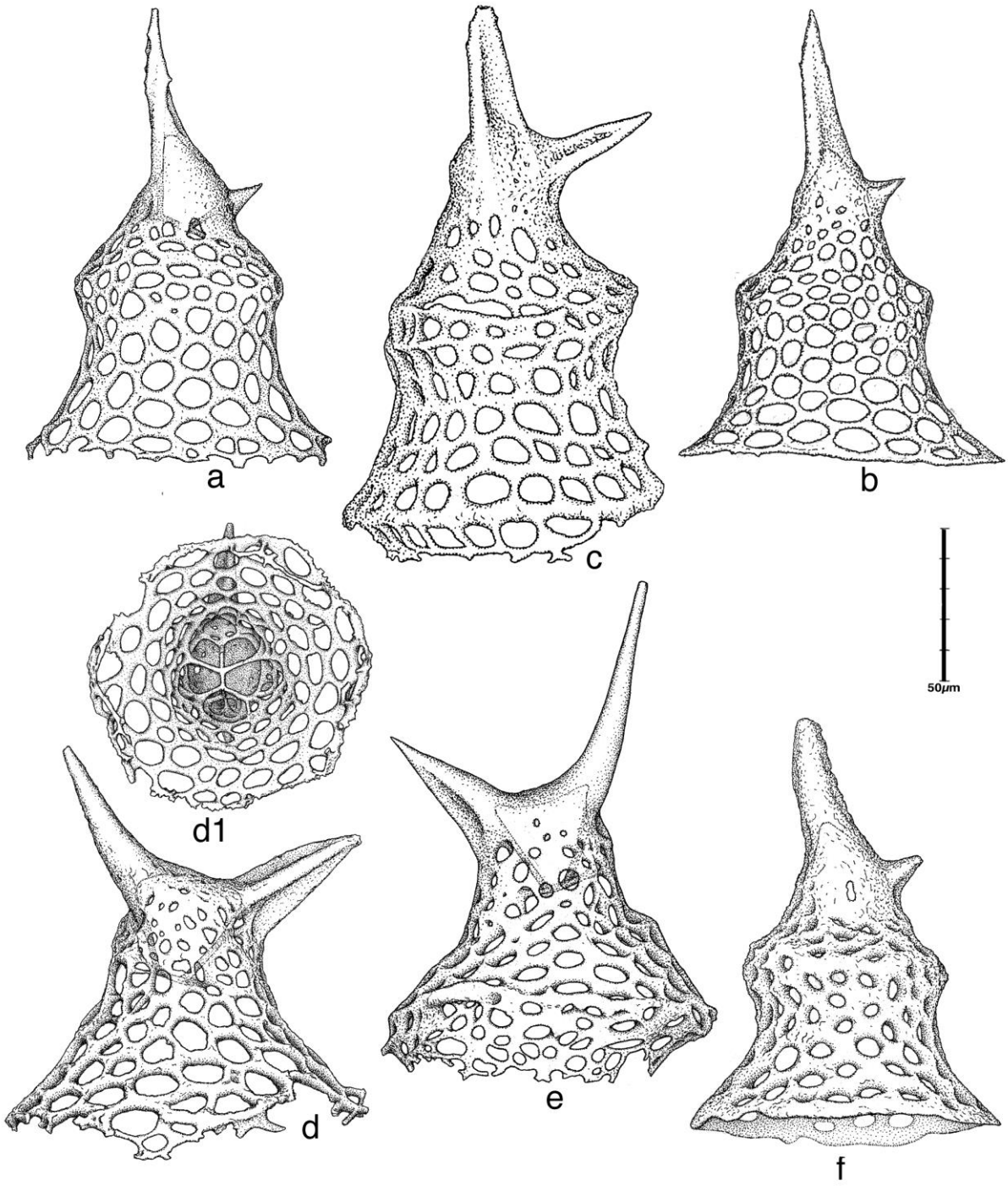

Fig. 9. **a**, **b**, **f.** – *Humerocyrtis gracilis* n. sp.: **a.** – paratype, Rc4; **b.** – holotype, BV 85-70, **f**.– Rc4. **c.** – *Humerocyrtis avirostrum* n. sp., Rc4; **d**, **d1**, **e.** – *Humerocyrtis brevithorax* n. sp., CRH: **d**, **d1.** – same specimen in lateral and basal view, respectively, showing the initial spicule without D ray, **e.** – holotype. Scale bar of 50 µm is for all figures, except fig. 7c for which the scale bar is of 75 µm.

intervening bars and smaller pores due probably to its robust skeleton.

***Stratigraphic range*.** Frequent in the lower Ladinian of the Livinallongo Formation, Marmolada Massif, sample BV 85-70, and rather rare in the Buchenstein Formation, Recoaro, sample Rc4.

***Humerocyrtis brevithorax* n. sp.**

Fig. 9d, d1, e; 10b, d

Diagnosis. Shell dicyrtid and very short consisting of cephalis, the shoulder plus a short portion of its narrowing distal segment. Cephalis with sparse small

pores of various shapes bearing a massive and slightly curved conical apical horn and a straight, three-bladed, and well-developed ventral horn. Thorax short, represented especially by its shoulder and a short narrowing distal part. Proximal part wide and short conical bearing large circular or oval pores separated by narrow and irregularly disposed intervening bars. Circumferential ring separating the two parts of the thorax is marked either by a protruding ring, an imperforate zone, or by no special structure. Distal part of thorax is thinner-walled, very short, narrowing very fast, and its pores are smaller and irregular in size, shape and arrangement. Its distal end is usually frayed, as if not finished.

Studied material. Four or five specimens, two in the Pelsonian, one in the lower Ladinian from sample R78/1, and one (poorly preserved), or two, in sample Rc4.

Holotype. Fig. 9e, CRH, Cristian, coll. MGL.110296.

Dimensions. Maximum length of shell without apical horn 80 µm, maximum diameter of thorax 97-112 µm.

Etymology. From the Latin *brevis* – short and *thorax* due to its short thorax.

Remarks. This species differs from the other species of this genus by having a very short and narrowing distal part of thorax, a conical apical horn and a three-bladed ventral horn.

Stratigraphic range. Samples CRH, R78/1 and Rc4, middle Anisian (Pelsonian) to lower Ladinian (Fassanian) of Eastern Carpathians and Buchenstein Formation, Recoaro area, North Italy.

Humerocyrtis infinita n. sp.

Fig. 10a

Diagnosis. Shell bell-shaped dicyrtid consisting of cephalis and proximal part of thorax represented by the shoulder. Cephalis smooth with some rare sparse rounded and irregularly distributed pores especially on its lower part. Apical and ventral horns conical and thin and of similar length. Apical horn dorsally tilted and slightly curved in ventral direction. Ventral horn straight and obliquely directed. Collar stricture not marked, but it could be approximately established at the level of MB where the pore start becoming larger. Thorax represented by the shoulder of thorax which is very much expanded in lateral direction and has a rounded outline. Its wall has large subcircular or rounded triangular or quadrangular pores of irregular arrangement and sizes. Distal part of shoulder is short, constricted and its end is marked by a thin linear border.

Studied material. A single specimen in Rc4.

Holotype. Fig. 10a, coll. MGL110297.

Dimensions. Length of shell without horns 88 µm, of thorax 55 µm, diameter of shoulder 96 µm, of its distal opening 74 µm.

Etymology. From the Latin *infinitus* – unfinished, because this species has no concave post shoulder part with flare-shaped end.

Remarks. *Humerocyrtis infinita* n. sp. resembles structurally *H. brevithorax* n. sp. by having the post-shoulder shell very short consisting of the narowing portion, but differs from it by missing the circumferential ring of the shoulder and by having a well-marked distal opening showing no possibility of developing a flare distal end.

Stratigraphic range. Very rare in the lower Ladinian sample Rc4 from the Buchenstein Formation from Recoaro, north Italy.

Humerocyrtis asymmetrica n. sp.

Fig. 10c.

Diagnosis. Shell bell-shaped with subrectangular cephalis in lateral view bearing a thin apical horn tilted dorsally and curved in ventral direction and a similar but straight ventral horn. Wall of cephalis perforated by a few circular or subcircular small and irregularly scattered pores. Collar boundary not marked externally but it seems to be below the ventral horn and at the contact of the secondary lateral rays with the shell, where an evident stricture is visible. Proximal part of thorax very short and wide conical, Shoulder asymmetrical, the ventral part more pronounced than in dorsal part. Pores of shoulder and proximal part of thorax relatively wide and divided into very small areas by a secondary network of very thin bars resembling a spider's web. This network is also present on the distal part of thorax but become less frequent in distal direction. Distal part of thorax subcylindrical with a more or less pronounced concave outline. Pores large, oval, subcircular or rounded quadrangular or triangular. Distal end with a narrowing circular and irregular row of rounded rectangular or oval pores.

Studied material. A single specimen in sample Rc4.

Holotype. Fig. 10c, coll. MGL.110298.

Dimensions. Length of shell without apical horn 101 µm, of thorax 78 µm, diameter of shoulder 78 µm, of distal end 90 µm.

Etymology. From the Latin *asymmetrica* – asymmetric, because its thorax is asymmetric in lateral view.

Remarks. This species differs from the other species of this genus with conical spines by the narrowing distal end of thorax and the frequency of the secondary network of thin spider's web inside the pores.

Stratigraphic range. Very rare in the sample Rc4 from the Buchenstein Limestone from Recoaro, North Italy.

Humerocyrtis mediotriassica n. sp.

Figs. 10e, g

Diagnosis. Shell bell-shaped relatively large. Cephalis with sparse, small and irregularly disposed pores. Apical and ventral horns thin, conical, relatively long and equal in length, the former displaced toward the dorsal side of the cephalis and slightly curved towards the axis of shell.

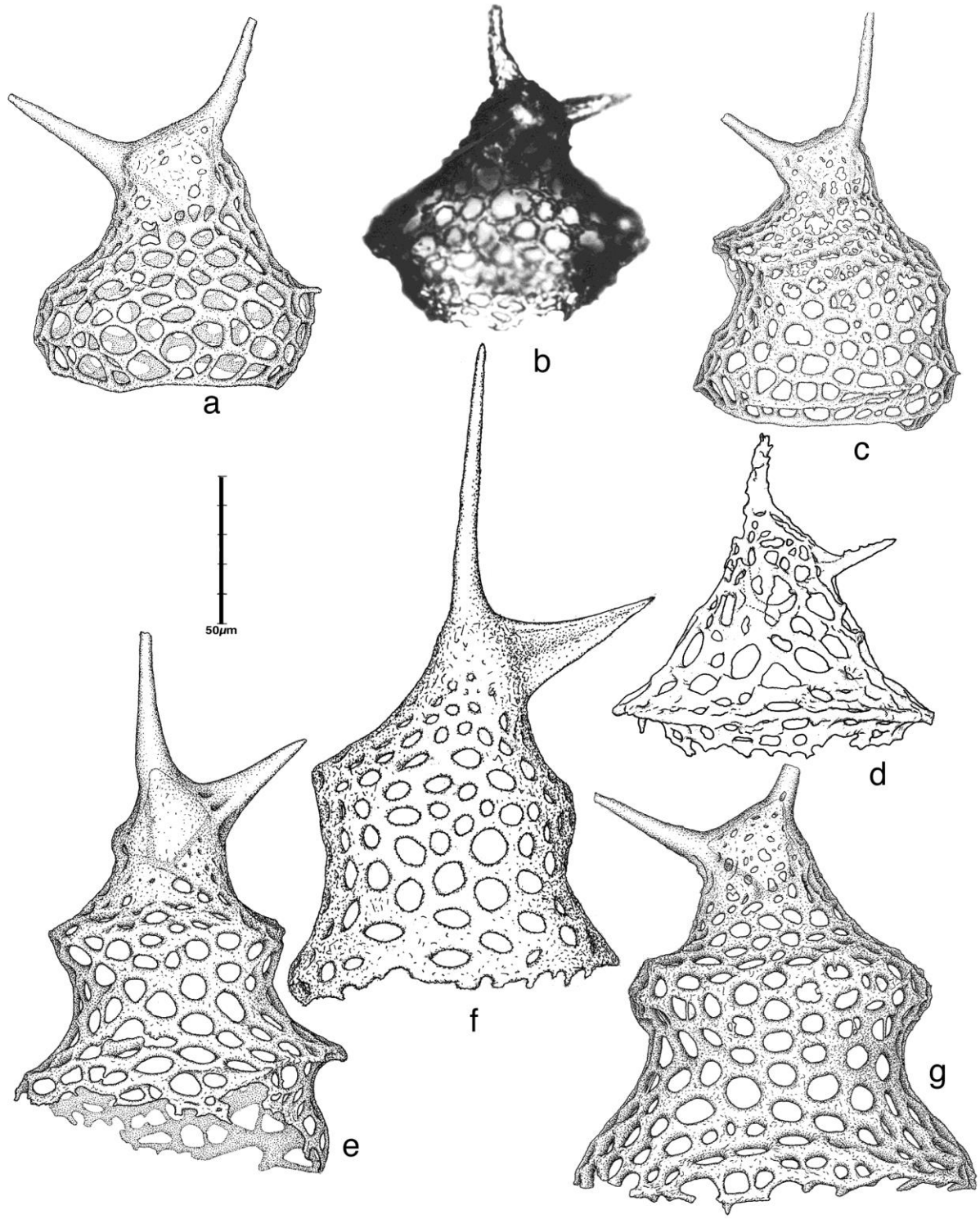

Fig. 10. **a** – *Humerocyrtis infinita* n. sp, Rc4. **b**, **d** – *Humerocyrtis brevithorax* n. sp.: **b** – R78/1b, **d** – poorly preserved specimen, Rc4. **c** – *Humerocyrtis asymmetrica* n. sp., Rc4. **f** – *Humerocyrtis marmoladensis* n. sp., BV 85-70. **e**, g – *Humerocyrtis mediotriassica* n. sp.: **e** – CR25, **g** – Rc4. Scale bar of 50 µm is for all figures.

Collar boundary weakly marked outside but considered to be at the level of the median bar, which corresponds to the appearance of larger pores. Shoulder well marked by the first lateral enlargement of shell, followed by its contraction and again enlargement so that the outline of post-shoulder thorax is concave.

Studied material. Two specimens, one in the sample CR 25 and another one in Rc4.

Holotype. Fig. 10e, CR 25, coll. MGL.110299.

Paratype. Fig. 10g, Rc4, coll. MGL.110300.

Dimensions. Length of shell without apical horn 120-145 µm, of cephalis 25-30 µm, of thorax 90-100 µm, diameter of cephalis 35-37 µm, of shoulder 78-90 µm, of distal end 105-120 µm.

Etymology. From its occurrence in the middle Triassic.

Remarks. *Humerocyrtis mediotriassica* n. sp. differs from the other species of the genus *Humerocyrtis* by having spines A and V conical and relatively thin, and the distal part of the thorax well developed.

Stratigraphic range. Middle Anisian (Pelsonian) of sample CR 25 and lower Ladinian (Fassanian) of sample Rc4.

***Humerocyrtis marmoladensis* n. sp.**

Fig. 10f

Diagnosis. Shell bell-shaped, wide opened distally with cephalis bearing a long, straight and thin conical apical horn in axial position and a three-bladed ventral spine with thin but very broad triangular blades. Cephalis elongate globular and practically imperforated except its distal part that contained small and irregularly disposed pores. Its distal end passes gradually to the short and wide conical proximal part of thorax. Shoulder rather angular but without a circumferential ridge. Distal part of thorax wide open, slightly concave; distal end of shell irregular and of diameter larger than that of the shoulder.

Studied material. The holotype from the sample BV 85-70.

Holotype. Figure 10f, coll. MGL.110301.

Dimensions. Length of shell without apical horn 108 µm, of apical horn 67 µm, of ventral horn 42 µm, diameter of shoulder 75 µm, of distal end 97 µm.

Etymology. From the Marmolada Massif, north Italy.

Remarks. The shape of the shell of *Humerocyrtis marmoladensis* n. sp. resembles very well that of the species *Humerocyrtis gracilis* n. sp., from which it differs by having larger and irregularly arranged pores, a very long and thin conical apical horn and the ventral horn thick, three-bladed and much longer.

Stratigraphic range. Very rare in the lower Ladinian of the Livinallongo Formation, Marmolada Massif, North Italy.

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