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THE DISCOVERY OF A CALLOVIAN RADIOLARIAN ASSOCIATION IN THE UPPER POSIDONIA BEDS OF THE PIENINY SUCCESSION OF THE KLIPPEN BELT (WESTERN CARPATHIANS)

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Abstract: The first contribution dealing with the study of Middle Jurassic radiolarians in the Western Carpathians presents the composition of radiolarian associations in the Upper Posidonia beds of the Pieniny succession (s.1.) in the Klippen Belt at Trstená in Orava. The assemblages have been assigned to the Lower to Middle Callovian. For comparison, the composition of an assemblage from the overlying radiolarite horizon of Upper Callovian to Upper Oxfordian age has been included.

Key words: Western Carpathians, Klippen Belt, Upper Posidonia beds, radiolarian.

Introduction

The Middle Jurassic age of the Posidonia and Upper Posidonia beds of the Pieniny (s.1.) succession of the Klippen Belt was already known in the past (Andrusov 1945; Birkenmajer 1977 and others). This stratigraphical assignment was supported by finds of macrofauna, especially ammonites. Microfauna, suitable for biostratigraphic purposes, is represented in these strata by radiolarians, which are so numerous, that in some places they produce a radiolarian or radiolarian-sponge microfacies (Began & Samuel 1987). However, the analysis of this radiolarian microfauna, has not yet been achieved, either in the Posidonia or in the Upper Posidonia beds. This article is the first contribution to microfaunal research in these beds.

Geological and stratigraphical-lithological characteristics profile studied

Samples were obtained from a profile in the Orava section of the Klippen Belt, in an old quarry south-west of Trstená, on the south-east slope of Halečková (k.743.0) (Fig. 1). Upper Posidonia beds and radiolarites occur in inverted order in the quarry (Fig. 2). In the highest part of the quarry, light, clayey- calcareous shales are found, with a high content of silicisponge spicules (in places it goes up to spiculites), and a rich admixture of pyrite pigments, which often fill the relatively rare radiolarian tests (M. Mišík - pers. com). About 7 *m* below the top of the quarry, hard dark calcareous-clayey shales appear. According to microscopic analysis by M. Mišík (pers. com.), a sub-parallel texture, formed by the parallel orientation of plant detritus, may be observed in the shale. The basic material is argillous, with the presence of a larger quantity of small calcite grains, and pyrite pigment. Chalcedon, silt quartz from clastic material, flakes of clastic illite, and occasionally muscovite are present in lesser quantities. From the fossil remains, the presence of abundant meroleims of plant web, and less abundant radiolarian tests, of small size can be observed. Sponge spicules of chalcedon, individually filled with calcite, phosphatized fish scales, and ostracods are rarely found. Fossilized macroflora - *Otozamites pterophylloides* Brongn., was found in the shales (J. Jablonský, pers. com.).

This part of the profile belongs to the Upper Posidonia beds of the Pieniny (s.l.) succession of the Klippen Belt. According to Birkenmajer (1953) the Upper Posidonia beds are formed by dark, spotted, slightly siliceous limestone and marls, and also shale of similar character to the shale of the underlying Posidonia beds. However, the silicious content increases in an upward direction. A sponge and sponge-radiolarian microfacies is typical of these beds. The fauna of ammonites is dated to the Middle Bajocian, Bathonian and probably also to the Lower Callovian.

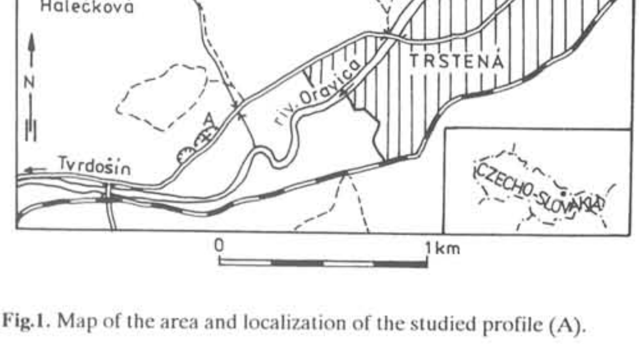


Fig.1. Map of the area and localization of the studied profile (A).

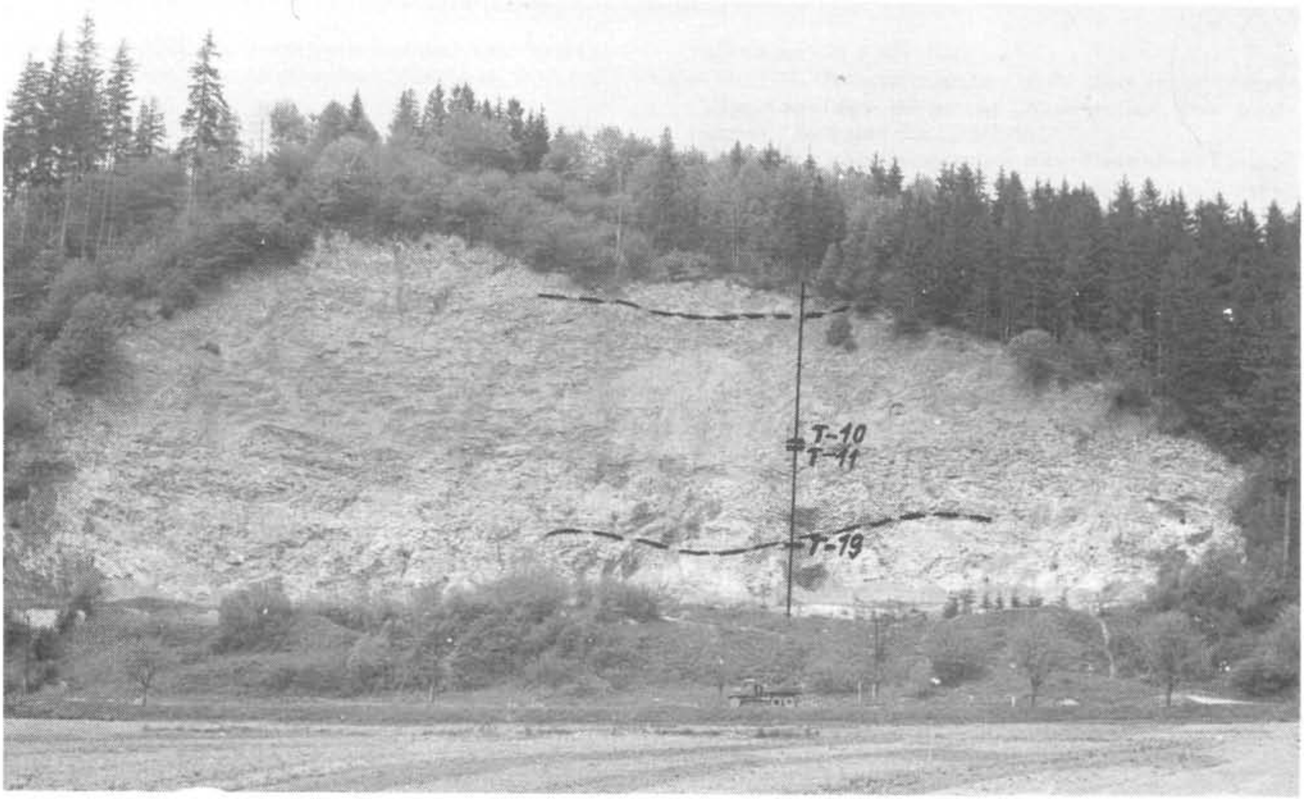


Fig.2. View of the profile with the positions from which the positive samples were taken marked.

Green-grey radiolarites, which appear in the lower part of the quarry, are a further member of the succession. The radiolarite horizon is dated by its superposed position to the Upper Callovian to Oxfordian (Began & Samuel 1987). For comparison, a radiolarian association from a radiolarite layer in close contact with the Upper Posidonia beds (T-19) was studied. A sample of radiolarite (T-26) was obtained from the foot of a neighbouring quarry, with an association representing a stratigraphically higher part of the horizon.

Evaluation of the radiolarian associations

Samples T-11 and T-10, from the Upper Posidonia beds, in approximately the middle part of the quarry, contained a rich association of radiolarians (Fig. 2). The microfauna was separated by dissolution of the samples with acetic and hydrofluoric acid. In sample T-11 the forms were of small size and signs of grading appeared. Nassellaria without apophyses or spines formed the greater part of the association. Spumellaria was found in negligible quantities in the form of fragments. In sample T-10 spiny and rayed spumellaria were represented in basically greater quantities, and their sizes dominated over the small tests of Nassellaria.

The composition of the associations were as follows:

Sample T-10: *Acanthocircus suboblongus* (Yao), *Crucella theokaftensis* Baumgartner, *Emiluvia cf. splendida* Carter, *Eoxitus hungaricus* Kozur, *Halesium* sp., *Homoeoparonaella argolidensis* Baumgartner, *Hsuum maxwelli* Pessagno, *Hsuum mirabundum* Pessagno et Whalen, *Paronaella* sp. A, *Pseudodictyomitrella* cf. *hexagonata* (Heitzer), *Striatojaponocapsa plicarum* (Yao), *Tetraditryma pseudoplena* Baumgartner, *Triactoma jonesi* (Pessagno), *Triactoma tithonianum* Rüst, *Tritrabs* cf. *ewingi* (Pessagno), *Tritrabs hayi* (Pessagno), *Tritrabs rhododactylus* Baumgartner.

Sample T-11 (2 *m* below sample T-10): *Acanthocircus suboblongus* (Yao), *Archaeodictyomitra exigua* Blome, *Archaeo-dictyomitra rigida* Pessagno, *Archaeodictyomitra primigena* Pessagno et Whalen, *Archaeospongoprunum imlayi Pessagno*, *Dictyomitrella kamoensis* Mizutani et Kido, *Emiluvia premyogii* Baumgartner, *Eoxitus hungaricus* Kozur, *Eucyrtidiellum* sp., *Hsuum* sp. B, *Monosera unumaensis* (Yao), *Obesacapsula* sp., *Parahsuum* sp., *Paronaella* sp. B, *Praezhamoidellum convexum* (Yao), *Praezhamoidellum japonicum* (Yao), *Praezhamoidellum yaoi* Kozur, *Praezhamoidellum* sp., *Protunuma ochiensis* Matsuoka, *Protunuma turbo* Matsuoka, *Spongocapsula palmerae* Pessagno, *Stichocapsa* sp., *Striato-japonocapsa plicarum* (Yao), *Tricolocapsa ruesti* Tan Sin Hok, *Tricolocapsa* cf. *undulata* (Heitzer), *Tricolocapsa* sp. A, *Tricolocapsa* sp. B, *Unuma* sp., ?*Theocapsomma* sp. Both associations represent the Lower to Middle Callovian. Although they are rich associations, the species *Unuma echinatus* Ichikawa et Yao, characteristic of older Middle Jurassic associations, is not found in it. Species which appear in the Upper Callovian - *Acaeniotyle diaphorogona* Foreman, *Paronaella broennimanni* Pessagno, *Ristola procera (*Pessagno), *Tritrabs exotica (*Pessagno) and others - are also not present. These species already appear in the stratigraphically overlying Upper Posidonia strata - in the radiolarites (sample T-19).

Our association probably correspond to the stratigraphic range of the *Tricolocapsa tetragona, Guexella nudata* and ?*Archaeodictyomitra mirabilis* zones (Aita 1987), or to the lower and middle parts of the *Tricolocapsa conexa* zone (Matsuoka & Yao 1986).

The positive sample T-19 was taken from the radiolarites, 9.5 *m* below sample T-11, and 2 *m* below the boundary between the Upper Posidonia beds and the radiolarites. The radiolarian association, contained the following genera and species: *Acaeniotyle diaphorogona* Foreman, *Andromeda podbielensis* (Ožvoldová), *Angulobracchia digitata* Baumgartner, *Archaeodictyomitra* sp., *Archaeospongoprunum imlayi* Pessagno, *Bernoullius dicera* (Baumgartner), *Cingulotürris carpatica* Dumitrica, *Emiluvia sedecimporata salensis* Pessagno, *Higumastra imbricata* (Ožvoldová), *Higumastra* aff. *inflata*

Baumgartner, *Homoeoparonaella argolidensis* Baumgartner, *Hsuum brevicostatum* (Ožvoldová), *Hsuum* maxwelli Pessagno, *Mirifusus guadalupensis* Pessagno, *Mirifusus mediodilatatus mediodilatatus* (Rüst), *Obesacapsula morroensis* Pessagno, *Orbiculiforma* sp., *Paronaella broennimanni* Pessagno, *Paronaella kotura* Baumgartner, *Paronaella mulleri* Pessagno, *Podobursa triacantha* (Fischli), *Ristola procera* (Pessagno), *Spongocapsula palmerae* (Pessagno), *Staurosphaera antiqua* Rüst, *Staurosphaera tympanica* (Ožvoldová), *Tetraditryma pseudoplena* Baumgartner, *Tetratrabs zealis* (Ožvoldová), *Triactoma blakei* (Pessagno), *Triactoma cornuta* Baumgartner, *Triactoma jonesi* (Pessagno), *Tritrabs casmaliaensis* (Pessagno), *Tritrabs ewingi* (Pessagno), *Tritrabs exotica* (Pessagno), *Tritrabs hayi* (Pessagno).

The presence of the species *Acaeniotyle diaphorogona* Foreman, *Paronaella broennimanni* Pessagno, *Ristola procera* (Pessagno) and *Tritrabs exotica* (Pessagno), the occurrence of which begins in U.A.5, and the presence of the species *Higumastra imbricata* (Ožvoldová), the occurrence of which ends in U.A.5-6, shows that the association may be correlated with U.A.5-6, which is equivalent to the stratigraphical range of the Upper Callovian to the lower part of the Lower Oxfordian (Baumgartner 1984, 1987).

Sample T-26 was taken from the radiolarites at the foot of the neighbouring quarry. A rich association of radiolarians was found in it: *Angulobracchia biordinale* Ožvoldová, *Acanthocircus variabilis* (Squinabol), *Emiluvia ordinaria* Ožvoldová, *Emiluvia orea* Baumgartner, *Emiluvia pessagnoi* Foreman, *Emiluvia sedecimporata elegans* (Wisniowski), *Emiluvia sedecimporata salensis* Pessagno, *Homoeoparonaella argolidensis* Baumgartner, *Hsuum brevicostatum* (Ožvoldová), *Mirifusus guadalupensis* Pessagno, *Mirifusus mediodilatatus baileyi* Pessagno, *Podobursa spinosa* (Ožvoldová), *Podobursa triacantha* (Fischli), *Staurosphaera antiqua* Rüst, *Tetratrabs bulbosa* Baumgartner, *Triactoma blakei* (Pessagno), *Triactoma jonesi* (Pessagno), *Tritrabs exotica* (Pessagno), *Tritrabs hayi* (Pessagno).

The composition of the whole association, and especially the presence of the species *Emiluvia orea* and *Tritrabs exotica*, point to a stratigraphical range of U.A.7 to U.A.8, that is from the upper part of the Lower Oxfordian to the Upper Oxfordian (Baumgartner 1984, 1987).

Conclusion

Analysis of the radiolarian microfauna from the dark, grey-calcareous-clayey shales indicates an age of Lower to Middle Callovian. In the highest part of the quarry, a narrow band of light clayey-calcareous shales with a high content of silicisponge spicules (in places already spiculites), did not contain a separable radiolarian microfauna. An association, which may be correlated with U.A.5 to U.A.6, that corresponds in stratigraphic range from the Upper Callovian to the lower part of the Lower Oxfordian, was found in the radiolarite horizon in the lower part of the quarry (Baumgartner 1984, 1987). In the neighbouring quarry an association was also found, in the radiolarite horizon, representing the highest part of this horizon, that is the upper part of the Lower Oxfordian to the Upper Oxfordian (U.A.7 - U.A.8 - Baumgartner 1984, 1987).

Systematic part

The chapter includes only those forms, whose specific identification was problematic, or which did not correspond well with to the diagnosis of a species.

Genus: *Emiluvia* Foreman 1973; emended Foreman 1975
Typical species: *Emiluvia chica* Foreman 1973
Emiluvia cf. *splendida* Carter 1988
Pl. I, Fig. 1

1988 *Emiluvia splendida* n.sp. - E.S. Carter, B.E.B. Cameron & P.L. Smith, p. 35, Pl. 16, Figs. 6, 11.

Remark: The preserved forms do not allow a certain identification.
Stratigraphic range: The species *E. splendida* was described in the Bajocian of N. America.
Occurrence: T-10.

Genus: *Eucyrtidiellum* Baumgartner 1984
Typical species: *Eucyrtidium (?) unumaensis* Yao 1979
Eucyrtidiellum sp.
Pl. III, Fig. 15

Description: The test is made up of 4 segments. The cephalis is small, semicircular and poreless. A large pore is found in the collar strictum. The thorax of dome-like shape is poreless, but covered with so called closed pores. One or two rows of circular, middle sized pores, arranged diagonally, are found at the junction of the thorax and abdomen. The abdomen is ring-like, convex, poreless, with longitudinal lamelae (c.12 on one half of the test) on its upper part. The fourth segment is cylindrical, and covered with three horizontal rows of circular pores, placed diagonally, the size of which increases distally.

Remarks: Kido et al. (1982) (in Nagai 1986) consider this form to be a transition between the species *Monosera unumaensis* (Yao) and *Eucyrtidiellum ptyctum* (Riedel et Sanfilippo).
Occurrence: T-11.

Genus: *Halesium* Pessagno 1971; sensu Baumgartner 1980
Typical species: *Halesium sexangulum* Pessagno 1971
?*Halesium* sp.
Pl. I, Fig. 3

Description: A three rayed test, with rays of tetragonal cross-section. The corners of the tetragon are pointed and noticeably raised. The ray meshwork is composed of tetragonal to polygonal pore frames, irregularly arranged.
The middle of the central area is noticeably raised.
Occurrence: T-10.

Genus: *Higumastra* Baumgartner 1980
Typical species: *Higumastra inflata* Baumgartner 1980
Higumastra aff. *inflata* Baumgartner 1980
Pl. V, Fig. 5

1980 *Higumastra* sp. aff. *H. inflata* Baumgartner n.sp. - P.O. Baumgartner, p. 290, Pl. 3, Fig. 4.

Remarks: Our forms are equivalent to the form *H.* sp. aff. *H. inflata* (Baumgartner 1980), which is distinguished from the species *H. inflata* by its smaller size and shorter rays.
Stratigraphic range: According to Baumgartner(1980) - ?Callovian, Oxfordian - Kimmeridgian to Tithonian.
Occurrence: T-19.

Genus: *Hsuum* Pessagno 1977
Typical species: *Hsuum cuestaensis* Pessagno 1977
Hsuum sp. A
Pl. IV, Fig. 3

Description: The conical test has a poreless cephalis without an apical horn. The thorax is covered with irregularly arranged costae, between which large pores of irregular form are found in the grooves. On the abdomen and postabdominal segment to 2/3 of the height of the test, there is a meshwork formed mostly by longitudinally arranged pore frames, tetragonal to polygonal in shape, with large pores. The last third of the test has a regular meshwork, formed by longitudinal costae, between which two rows of pores, of smaller size than on the preceding segments, are found in the grooves.
Occurrence: T-11.

Hsuum sp. B
Pl. IV, Fig. 6

Description: The conical test has a large, poreless, semicircular cephalis, without an apical horn. The other segments, up to about 2/5 of the height of the test, have a meshwork composed of two horizontal rows of tetragonal pore frames, with diagonally arranged pores only in the proximal part. The parts with pores are separated by relatively convex poreless belts. A further part of the test has a meshwork like that of the species *H. maxwelli* Pessagno.
Occurrence: T-11.

Genus: *Obesacapsula* Pessagno 1977
Typical species: *Obesacapsula morroensis* Pessagno 1977
Obesacapsula sp.
Pl. III, Figs. 7, 9, 10

Description: The test is composed of 5 - 6 segments. The cephalis is circular and poreless. It forms a wide cone with three further segments. The meshwork of these segments is formed by two horizontal rows of diagonally arranged pores, the size of which increases distally. The last segment is large and globular. Its meshwork is composed of noticeably raised hexagonal pore frames, in the middle of which, in the hollow, a small circular pore is found. The aperture of the test is small and circular.
Occurrence: T-11.

Genus: *Parahsuum* Yao 1982
Typical species: *Parahsuum simplum* Yao 1982
Parahsuum sp.
Pl. IV, Fig. 4

Description: A wide conical test. The cephalis is poreless, circular, and without an apical horn. The thorax of trapezoidal form is finely pored. The meshwork of the remaining segments, except the last, is formed mainly by continuous longitudinal costae, between which one row of tetragonal pore frames are found. The last segment has a meshwork composed of three horizontal rows of hexagonal to polygonal pore frames, arranged diagonally.
Occurrence: T-11.

Genus: *Paronaella* Pessagno 1971; emend. Baumgartner 1980
Typical species: *Paronaella solanoensis* Pessagno 1971
Paronaella sp. A
Pl. I, Fig. 5

Description: The test is composed of three short, wide rays with rounded but not bulbous ends, and with one stout, short, central spine. The meshwork of the rays is formed mainly by longitudinal beams, irregularly connected by bars.
Occurrence: T-10.

Paronaella sp. B
Pl. II, Fig. 1

1988 *Paronaella* sp. A - E.S. Carter, B.E.B. Cameron & P.L. Smith, p. 42, Pl. 4, Fig. 10.

Description: The test is three rayed with wide, short rays, which have extend bulbously for about half their length. The ray tips have a single, short, stout, central spine. The meshwork of the rays is composed of large triangular or tetragonal, to polygonal pore frames. The nodes of the meshwork are noticeably thickened.
Stratigraphic range: E.S. Carter, B.E.B. Cameron & P.L. Smith (1988) show this form in the Upper Pliensbach of the Queen Charlotte Islands in British Columbia.
Occurrence: T-11.

Genus: *Praezhamoidellum* Kozur 1984
Typical species: *Praezhamoidellum yaoi* Kozur 1984
Praezhamoidellum sp.
Pl. II, Figs. 10, 11

Description: The test has three segments, and is of wide drop shaped form. The cephalis is poreless, and partly depressed to the thorax. The thorax is high and poreless. The abdomen is large, of wide oval form, and covered with relatively thinly placed pores. The aperture is small and round.
Occurrence: T-11.

Genus: *Pseudodictyomitrella* Kozur 1986
Pseudodictyomitrella cf. *hexagonata* (Heitzer 1930)
Pl. I, Fig. 10

1930 *Cyrtocalpis hexagonata* spec.n. - I. Heitzer p. 391, Pl. 28, Fig. 26.

Remarks: H. Kozur (in: Grill & Kozur 1986) placed the species *C. hexagonata* in the new genus *Pseudodictyomitrella*. Our forms are distinguished from the holotype by the wide conical form of the test.
Stratigraphic range: The species was described from the Middle Jurassic.
Occurrence: T-10.

Genus: *Stichocapsa* Haeckel 1881
Typical species: *Stichocapsa jaspidea* Rüst 1885
Stichocapsa sp.
Pl. III, Fig. 1

Description: The four segmented test is of drop shaped form. The cephalis is round and poreless. The thorax, together with the abdomen are of trapezoidal cross section, and covered with closely spaced circular pores, of medium size. The fourth segment has a wide oval form, and is covered with pores in the same way as the preceding segment. The joining of the segments was not observed on the surface. The aperture is circular, and occurs in a poreless hollow.
Occurrence: T-11.

Genus: *Theocapsomma* Haeckel 1887
Typical species: *Theocapsa linnaei* Haeckel 1887
?Theocapsomma sp.
Pl. IV, Fig. 1

1982 *Tricolocapsa* sp. B - S. Kido, I. Kawaguchi, M. Adachi & S. Mizutani, p. 204, Pl. 5, Fig. 6.

Description: The test is drop shaped, and composed of three segments. The cephalis is round and poreless. The abdomen is 1.5 x higher than the thorax. The meshwork of both is composed of raised hexagonal to polygonal pore frames, in the hollow of which, a single, small, round pore is found. The aperture was not observed.
Occurrence: T-11.

Genus: *Tricolocapsa* Haeckel 1881
Typical species: *Tricolocapsa theophrasti* Haeckel 1887
Tricolocapsa cf. undulata (Heitzer 1930)
Pl. III, Fig. 13

1930 *Lithobotrys undulata* sp.n. - I. Heitzer p. 390, Pl. 28, Fig. 22.

Remark: Our forms may not be reliably identified as this species. They are distinguished from the holotype by the shape of their apertures.
Stratigraphic range: The species was described from an association of the Middle Jurassic.
Occurrence: T-11.

Tricolocapsa sp. A
Pl. II, Figs. 6, 7

Description: The test is composed of three segments. The cephalis is semicircular and poreless. The thorax, of trapezoidal cross-section, has so called closed pores. The abdomen is round, noticeably flattened along the main axis, and with a funnel shaped aperture. The opening is small and circular.
Occurrence: T-11.

Tricolocapsa sp. B
Pl. II, Fig. 9

1982 *Tricolocapsa* sp. I - A. Matsuoka, p. 253, Pl. 3, Fig. 14.

Description: The test is composed of three segments. The large cephalis is semicircular, and poreless, with a single row of large pores in the colar structure. The height of the thorax is equivalent to only 2/3 of the height of the cephalis. The meshwork of the thorax is indistinct. The abdomen is large, and round, with a small, raised, round aperture. The meshwork of the abdomen is composed of hexagonal pore frames, the nodes of which are thickened and raised.
Remarks: It is distinguished from the species *Tricolocapsa ruesti* Tan Sin Hok by the character of the proximal and distal parts of the test (the cephalis and the character of the aperture).
Stratigraphic range: Matsuoka (1982) identify this form from an association, which represents the *Guexella nudata* zone and the *Gongylothorax sakawaensis* - *Stichocapsa* sp. C zone (Upper Callovian to Oxfordian).
Occurrence: T-11.

Genus: *Tritrabs* Baumgartner 1950
Typical species: *Paronaella* (?) *casmaliaensis* Pessagno 1977
Tritrabs cf. *ewingi* (Pessagno 1971)
Pl. I, Fig. 8

1971 *?Paronaella ewingi*, n. sp. - E.A. Pessagno, p. 47, pl. 19, Figs. 2-5.
1980 *Tritrabs ewingi* (Pessagno) - P.O. Baumgartner, p. 293, Pl. 4, Figs. 5, 7, 17, 18.
1982 *Tritrabs* sp. A cf. *T. ewingi* (Pessagno) - K. Wakita, p. 164, Pl. 5, Fig. 1.

Remarks: The forms are distinguished from the species *T.* ewingi, by their shorter rays, and their relatively less noticeably bulbous ends.
Stratigraphic range: Wakita (1982) illustrates this form from an association of the Middle Jurassic.
Occurrence: T-10.

Genus: *Unuma* Ichikava et Yao 1976
Typical species: *Unuma typicus* Ichikawa et Yao 1976
Unuma sp.
Pl. IV, Fig. 10

Description: The test is spindle shaped, with a small, round, poreless cephalis. The thorax has large pores, of irregular form. Longitudinal, irregularly arranged, lamellae, are found on the following segments. Between the lamellae are 2 - 3 elongated rows of large oval pores. The last segment is narrower, and ended by a funnel shaped appendix, with pores of larger size than on the other segments.
Occurrence: T-11.

Translated by M.C. Styan

Plate I: Sample T-10.
Fig.1 - *Emiluvia* cf. *splendida* Carter - 8881, 235x magn.; Fig.2 - *Tetraditryma pseudoplena* Baumgartner - 8862, 130x magn.; Fig.3 - *?Halesium* sp. - 8848, 195x magn.; Fig.4 - *Tritrabs rhododactylus* Baumgartner - 8842, 140x magn.; Fig.5 - *Paronaella* sp. A - 8876, 195x magn.; Fig.6 - *Crucella theokaftensis* Baumgartner - 8883, 195x magn.; Fig.7 - *Triactoma tithonianum* Rüst - 8856, 110x magn.; Fig.8 - *Tritrabs* cf. *ewingi* (Pessagno) - 8857, 140x magn.; Fig.9 - *Tritrabs hayi* (Pessagno) - 8872, 105x magn.; Fig.10 - *Pseudodictyomitrella* cf. *hexagonata* (Heitzer) - 8880, 400x magn.
Sample T-11.
Fig.11 - *Striatojaponocapsa plicarum* (Yao) - 7158, 390x magn.; Antapical view from Fig.12. Fig.12 - *Striatojaponocapsa plicarum* (Yao) - 7157, 400x magn.; Fig.13 - *Hsuum maxwelli* Pessagno - 8851, 290x magn.; Fig.14 - *Eoxitus hungaricus* Kozur - 5254, 400x magn.; Fig.15 - *Hsuum mirabundum* Pessagno et Whalen - 6307, 400x magn.

Plate II: Sample T-11.
Fig.1 - *Paronaella* sp. B - 5495, 280x magn.; Fig.2 - *Acanthocircus suboblongus* (Yao) - 5240, 300x magn.; Fig.3 - *Archaeospongoprunum imlayi* Pessagno - 7127, 350x magn.; Fig.4 - *Emiluvia premyogii* Baumgartner - 8839, 290x magn.; Fig.5 - *Praezhamoidellum yaoi* Kozur - 7116, 400x magn.; Fig.6 - *Tricolocapsa* sp. A - 7123, 450x magn.; Fig.7 - *Tricolocapsa* sp. A - 7122, 400x magn.; antapical view from Fig.6; Fig.8 - *Praezhamoidellum yaoi* Kozur - 5258, 400x magn.; antapical view from Fig.5; Fig.9 - *Tricolocapsa* sp. B - 7132, 400x magn.; Fig.10 - *Praezhamoidellum* sp. - 6329, 500x magn. antapical view from Fig.11; Fig.11 - *Praezhamoidellum* sp. - 6328, 510x magn.; Fig.12 - *Tricolocapsa ruesti* Tan Sin Hok - 8890, 380x magn.; Fig.13 - *Tricolocapsa ruesti* Tan Sin Hok - 8891, 390x magn.; anatapical view from Fig.12; Fig.14 - *Praezhamoidellum japonicum* (Yao) - 5235, 400x magn.

Plate III: Sample T-11.
Fig.1 - *Stichocapsa* sp. - 7149, 370x magn.; Fig.2 - *Stichocapsa* sp. - 7148, 350x magn.; antapical view from Fig.1; Fig.3 - *Protunuma turbo* Matsuoka - 5570, 360x magn.; Fig.4 - *Hsuum brevicostatum* (Ožvoldová) - 5556, 190x magn.; Fig.5 - *Praezhamoidellum convexum* (Yao) - 6327, 400x magn.; Fig.6 - *Praezhamoidellum convexum* (Yao) - 6321, 400x magn.; antapical view from Fig.5; Fig.7 - *Obesacapsula* sp. - 5277, 380x magn.; Fig.8 - *Hsuum fuchsi* Kozur - 5245, 250x magn.; Fig.9 - *Obesacapsula* sp. - 5271, 370x magn.; antapical view from Fig.7; Fig.10 - *Obesacapsula* sp. - 5554, 400x magn.; Fig.11 - *?Protunuma ochiensis* Matsuoka - 7138, 320x magn.; Fig.12 - *?Dictyomitrella kamoensis* Mizutani et Kido - 7173, 380x magn.; Fig.13 - *Tricolocapsa* cf. *undulata* (Heitzer) - 5272, 390x magn.; Fig.14 - *Monosera unumaensis* (Yao) - 5491, 420x magn.; Fig.15 - *Eucyrtidiellum* sp. - 5241, 490x magn.

Plate IV: Sample T-11.
Fig.1 - *?Theocapsomma* sp. - 5252, 540x magn.; Fig.2 - *Archaeodictyomitra exigua* Blome - 7133, 390x magn.; Fig.3 - *Hsuum* sp. A - 7128, 320x magn.; Fig.4 - *Parahsuum* sp. - 7171, 300x magn.; Fig.5 - *Archaeodictyomitra rigida* Pessagno - 1159, 290x magn.; Fig.6 - *Hsuum* sp. B - 5262, 510x magn.; Fig.7 - *Archaeodictyomitra primigena* Pessagno et Whalen - 5262, 510x magn.; Fig.8 - *Eoxitus hungaricus* Kozur - 7135, 290x magn.; Fig.9 - *Spongocapsula palmerae* Pessagno - 3128, 320x magn.; Fig.10 - *Unuma* sp. - 5255, 390x magn.; Sample T-19: Fig.11 - *Tritrabs exotica* (Pessagno) - 1911, 100x magn.; Fig.12 - *Acaeniotyle diaphorogona* Foreman - 4155, 120x magn.; Fig.13 - *Paronaella broennimanni* Pessagno - 4177, 120x magn.; Fig.14 - *Andromeda podbielensis* (Ožvoldová) - 1966, 145x magn.; Fig.15 - *Mirifusus guadalupensis* Pessagno - 4074, 125x magn.

Plate V: Sample T-19.
Fig.1 - *Obesacapsula morroensis* Pessagno - 4183, 145x magn.; Fig.2 - *Ristola procera* (Pessagno) - 4158, 235x magn.
Sample T-26.
Fig.3 - *Emiluvia orea* Baumgartner - 5170, 115x magn.
Sample T-19.
Fig.4 - *Triactoma cornuta* Baumgartner - 1945, 140x magn.; Fig.5 - *Higumastra* aff. *inflata* Baumgartner - 4168, 115x magn.; Fig.6 - *Homoeoparonaella argolidensis* Baumgartner - 4181, 95x magn.; Fig.7 - *Triactoma jonesi* (Pessagno) - 4171, 130x magn.; Fig.8 - *Tetratrabs zealis* (Ožvoldová) - 1937, 100x magn.
Sample T-26.
Fig.9 - *Emiluvia pessagnoi* Foreman - 5168, 135x magn.; Fig.10 - *Podobursa spinosa* (Ožvoldová) - 150x magn.;
Sample T-19.
Fig.11 - *Angulobracchia digitata* Baumgartner - 4153, 120x magn.; Fig.12 - *Staurosphaera tympanica* Ožvoldová - 4077, 140x magn.; Fig.13 - *Paronaella mulleri* Pessagno - 4088, 110x magn.; Fig.14 - *Mirifusus mediodilatatus mediodilatatus* (Rüst) - *4156, 105x magn.*

Plate I

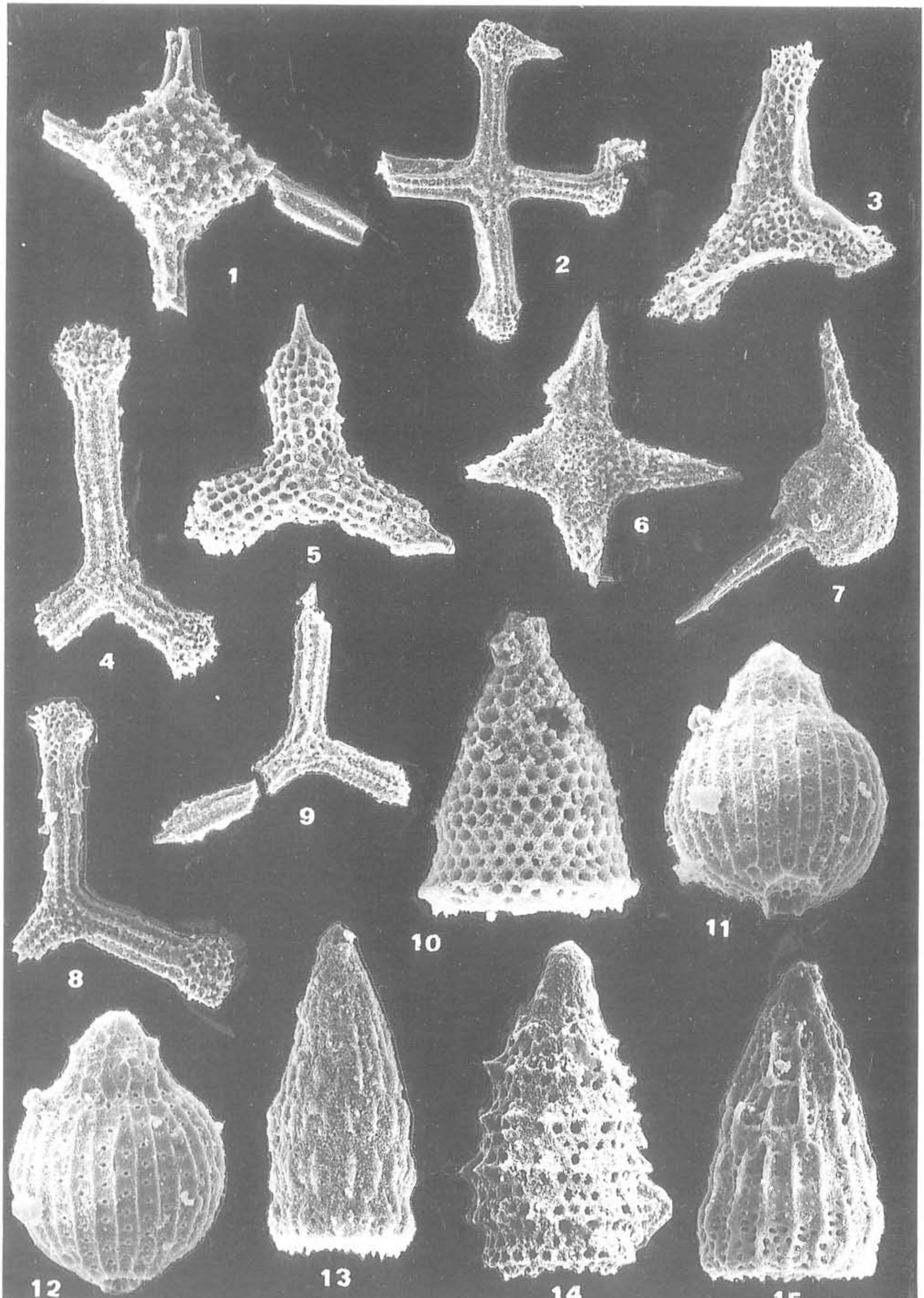


Plate II

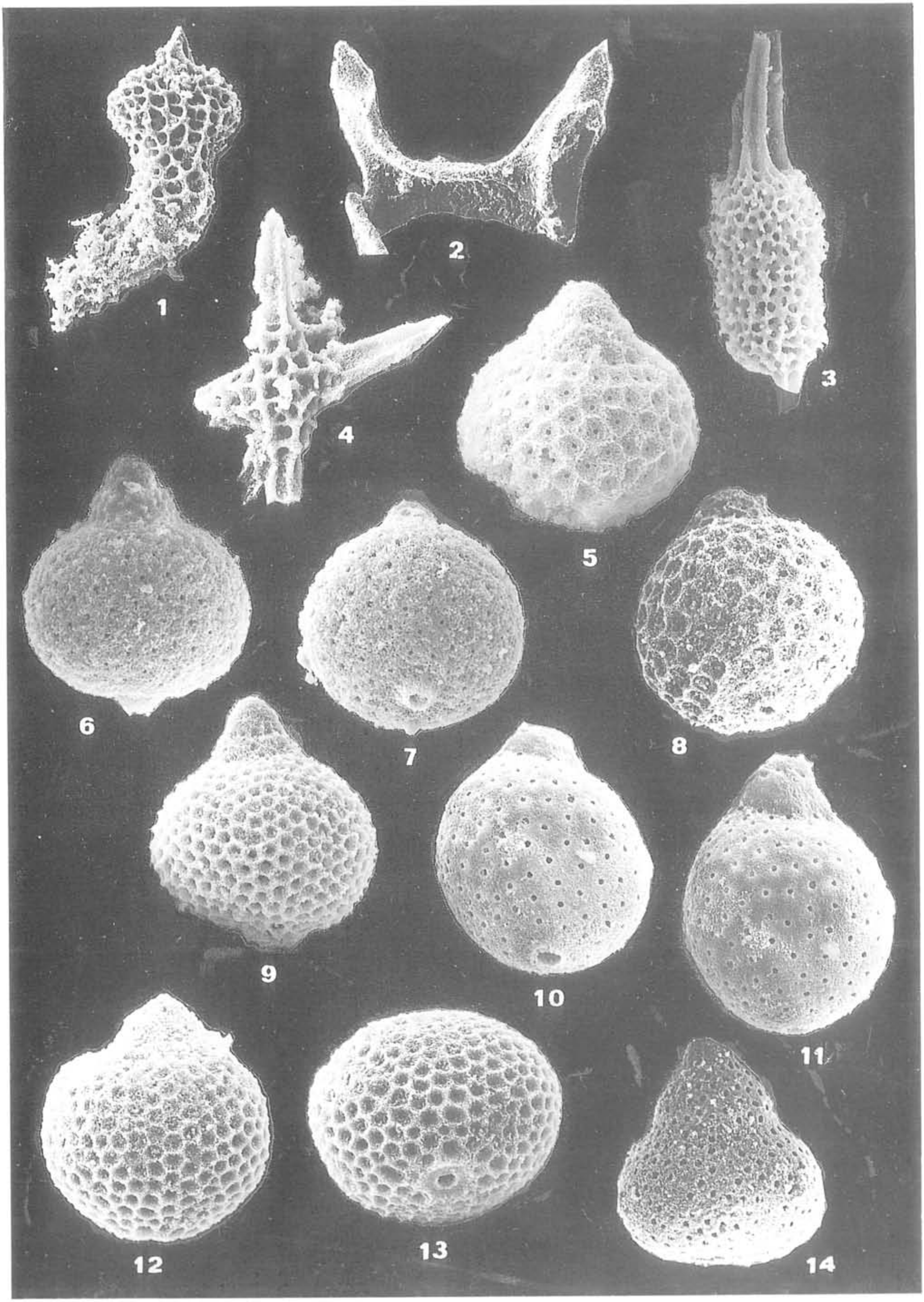


Plate III

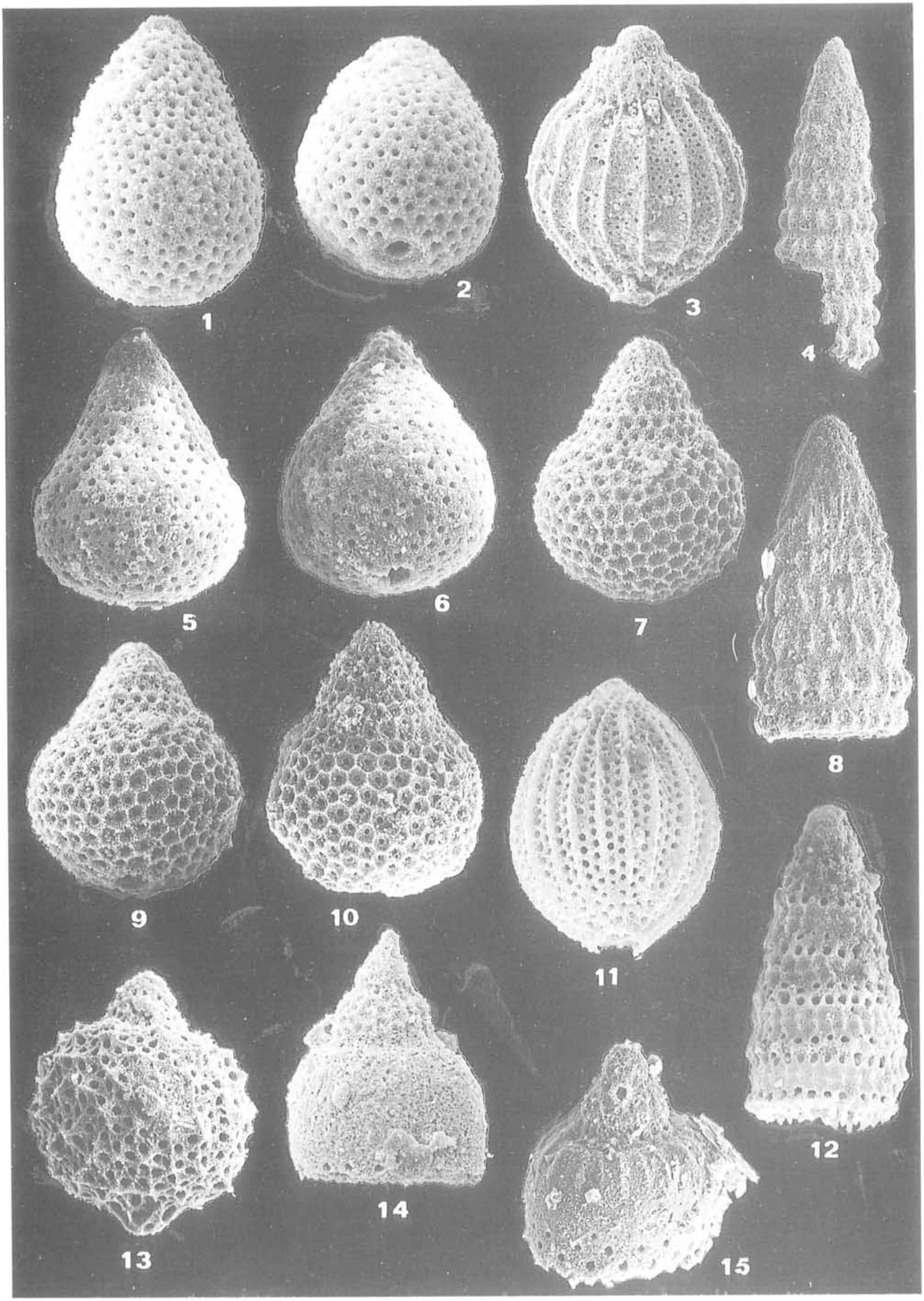


Plate IV

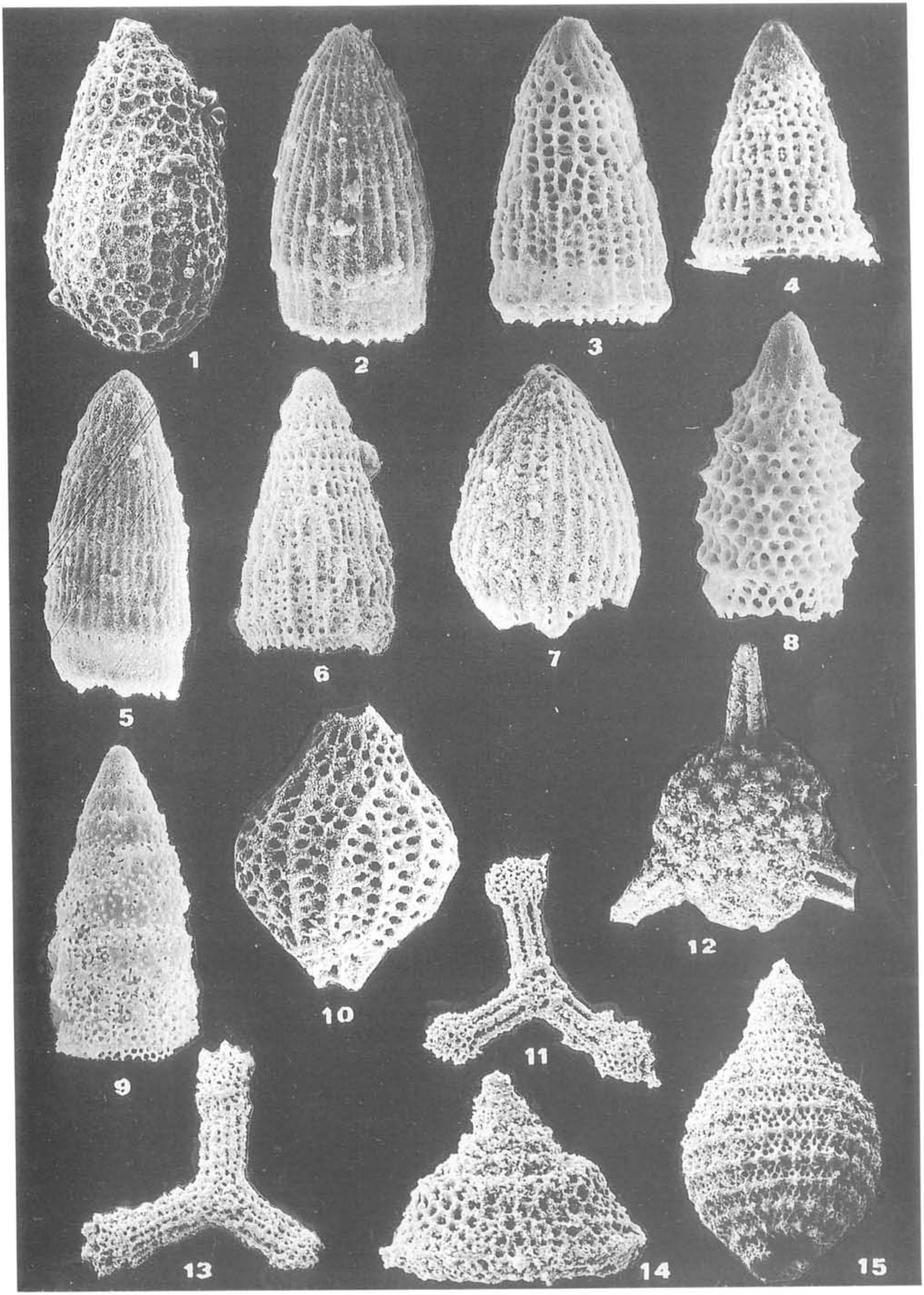
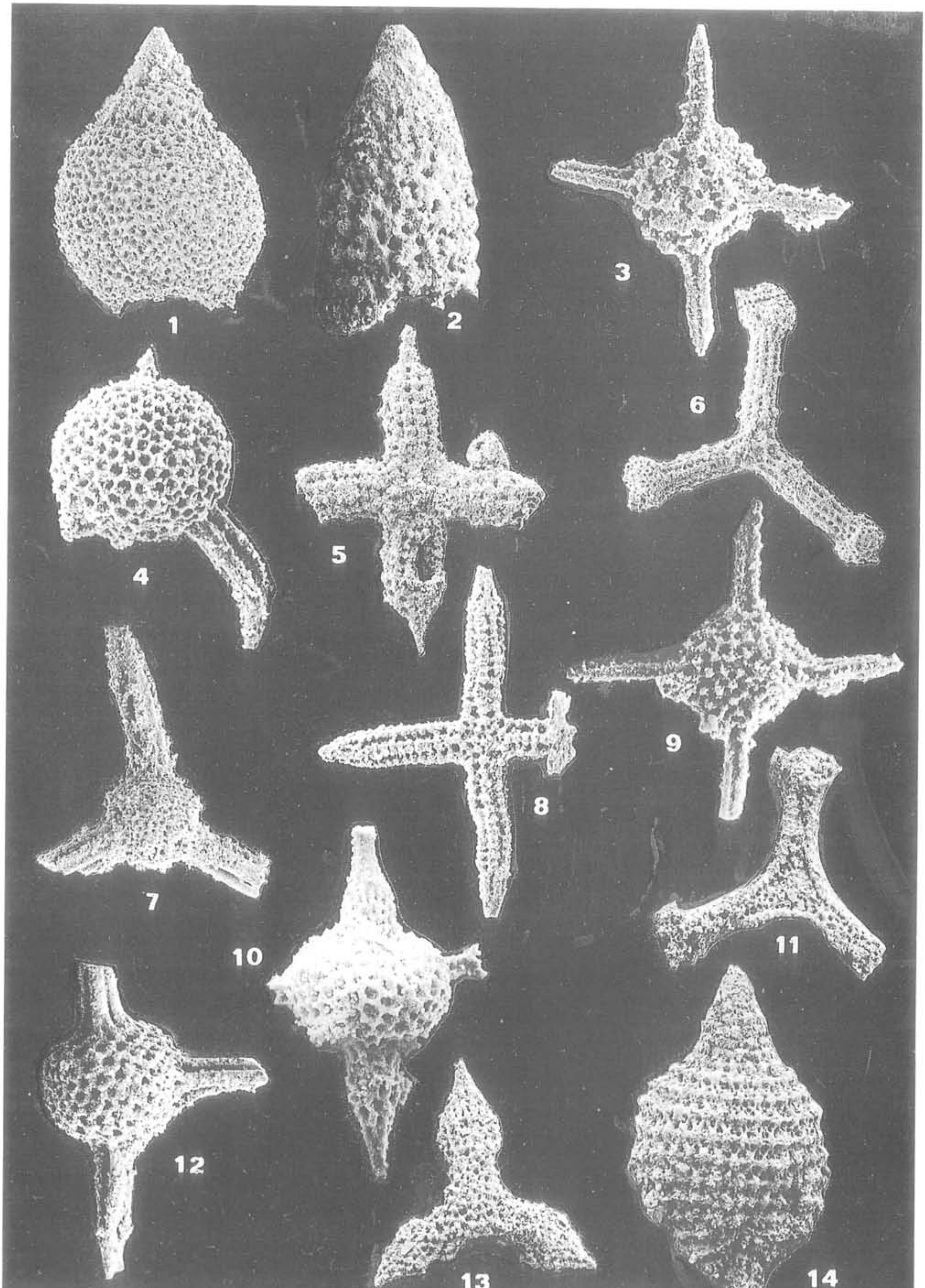


Plate V



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