New spumellarians (Radiolaria) from the Lower Miocene Toyohama Formation, Morozaki Group, central Japan

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下部中新統師崎層群豊浜累層産のSpumellaria目放散虫化石

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(要　　旨)

下部中新統師崎層群豊浜累層から得られる，十脚甲殻類化石を産する石灰質団塊中には，保存状態の良い放散虫化石が多数含まれている．今回はその中より，Spumellaria目に属する3新種を記載し，1新属を提唱した．それらは極めて特異な形態を持つものである．

(Abstract)

Three spumellarians are newly described from decapod-bearing calcareous nodules embedded within the Lower Miocene Toyohama Formation, Morozaki Group, Aichi Prefecture. One new genus *Enalomelon* is also proposed herein.

Introduction

More than 150 species of radiolarians have been obtained from decapod-bearing calcareous nodules embedded within the Lower Miocene Toyohama Formation, Morozaki Group, Aichi Prefecture. To clarify and discuss the faunal character, it is first of all necessary to describe all the component species, but it is impossible to do at the same time because there are so many unknown taxa. This study thus focuses to describe only new spumellarians with rather preculiar aspect. Samples used in this study are named TH-1, 2 and 4, respectively, whose detailed information is given by Sugiyama (1992; in press).

Systematic Description

All described specimens are deposited in the Department of Earth and Planetary Sciences, School of Science, Nagoya University.

Family Actinommidae Haeckel, 1862, emend. Riedel, 1967

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Received August 31, 1992

Genus *Drymosphaera* Haeckel, 1881

Type species: *D. hexagonalis* Haeckel, 1887.

Drymosphaera (?) *pseudosagenoscena* Sugiyama sp. nov.

Pl. 9, figs. 1a-4b

Description: Central sphere single, small, latticed by cylindrical bars generally forming triclade, rarely diclade corners and polygonally shaped pores. The radial spines arising from the corners, generally more than 15 in number, very long, having three or four verticils disposed nearly at the same intervals, proximally cylindrical, distally becoming thick and changing into three-bladed beyond the first verticils. From each verticil arise cylindrical and straight bars, which are thinner than ones forming the central sphere and perpendicular to the radial spine. This type of radiation resulting in forming three or four lattice-plates with large, triangular meshes. Moreover, some bars developed obliquely from a verticil to preceding and following ones on neighboring spines. All bar is not hollow.

Remarks: The generic assignment is quite tentative. This species may belong to a new genus but the proposal is reserved in this time. It differs from other actinommids in its shell structure, particularly the presence of the characteristic lattice-plates described above. The construction of the lattice-plates is similar to that of phaeodarian genus *Sagenoscena* Haeckel, 1887. The abundance is very rare in the samples TH-1, 2 and 4.

Dimensions (in μm): Based on seven specimens. Diameter of central sphere; 22-40. Length of radial spine; up to 330.

Holotype: ESN 146851 (Pl. 9, figs. 1a, 1b) from TH-2.

Etymology: From the Greek *pseudes*, false, and the generic name *Sagenoscena* Haeckel.

Family Collosphaeridae Müller, 1858

Genus *Collosphaera* Müller, 1855

Type species: *C. huxleyi* Müller, 1855.

Collosphaera (?) *solenochira* Sugiyama sp. nov.

Pl. 9, figs. 5-7 ; Pl. 10, figs. 1a-4

Description: Shell single, thin walled with wide frames, pierced by large, irregularly shaped pores. From the surface of the shell arise long, thin, fiber-like rays. The rays forming one to four, hollow tubes bundled by numerous, transverse and oblique, delicate connector bars. In some specimens, possibly representing gerontic forms, the tubes are double or triple and the connector bars become nodose and densely develop between the primary rays (Pl. 10, fig. 1c). This looks like forming another, rough, somewhat spongy sphere outside the shell (Pl. 10, fig. 1b). Each tube variable in length, generally tapering distally, open or closed at the tip, sometimes again increasing the diameter in the distal part after the tapering (Pl. 9, fig. 5). The tubes usually making obtuse angles, but the angles are unstable.

Remarks: The generic and possibly family assignments remain tentative, and further investigations are necessary to determine them. However, the characteristic thin wall seems to permit of the provisional family assignment to Collosphaeridae. Then one can consider that the tubes formed of fiber-like rays, the diagnostic feature of this species, are traces of reproduction by multiple fission. I cannot say for sure about biological meanings of such a peculiar structure since the biology of radiolarians is still very poorly understood. However, it can be said that the structure is rather different from similar one suggesting relatively well-known binary fission, because in those specimens (Pl. 10, figs. 5-6b) fiber-like rays never develop all around the shell, and the shell is more or less distorted as stated by Kling (1971). The abundance is common to rare in the samples TH-1, 2 and 4.
Dimensions (in μm): Based on 30 specimens. Diameter of shell; 130-170. Length of tube; up to 450.
Holotype: ESN 146864 (Pl. 10, figs. 1a-1c) from TH-4.
Etymology: From the Greek *solen*, pipe, and *cheir*, hand.

Family Spongodiscidae Haeckel, 1881, emend. Riedel, 1967

Genus *Enalomelon* Sugiyama gen. nov.

Etymology: From the Greek *enalos*, marine, and *melon*, an apple, neuter gender.
Type species: *E. inemmestum* Sugiyama sp. nov. (by monotypy).
Diagnosis: Test composed of a large cortical shell and a small, spongy, spherical to discoidal medullary one. A distinct pylome present on the former shell. Between both the shells spongy framework, which looks like a gather of fibers and is much more delicate than that of an actinommid genera *Spongoplegma* Haeckel, 1881, is arranged without regularity. Distinct radial skeletal element missing except the spongy framework.
Remarks: The present new genus is distinguished from the genera *Lithocarpium* Stöhr, 1880, and *Prunopyle* Dreyer, 1889, both have definite pylome and somewhat similar externality to this genus, by lacking concentric layers and radial skeletal elements. The spongy framework is similar to that of *Plegmosphaera* Haeckel, 1881, from which this genus differs in having a distinct medullary shell. The generic diagnosis probably requires further emendation in future since it is based only on the type species.

Enalomelon inemmestum Sugiyama sp. nov.

Pl. 11, figs. 1-6

Description: Cortical shell spherical, very large, thick, consisting of two layers, having a small pylome surrounded by well-developed, imperforate peristome. The outer layer is smooth and looks imperforated under a binocular at a glance but, as a matter of fact, is pierced by numerous, very small pores of uniform size all around. The inner layer somewhat spongy, with relatively large pores. Considerably delicate spongy framework filled in the shell. The framework is rather sparse in the peripheral part where the radial elements, extending to pore frames of the inner layer of the cortical shell, are generally pronounced. However, there are no distinct concentric or spiral layers in the cortical shell.

Near the center of the shell, which is ill-preserved and occupied by a certain secondary growth of silica in most examined specimens (Pl. 11, figs. 4a, 4b), there is a much denser, somewhat discoidal part corresponding to a spongy medullary shell (Pl. 11, figs. 5a, 5b) whose details are uncertain.

Remarks: This species resembles the late Eocene species *Lithocarpium monikae* (Petrushevskaya, 1975, pl. 4, figs. 6-10, pl. 30, figs. 1-7) but differs from it in having much larger and thicker cortical shell composed of two layers, and lacking radial spines in the cortical shell. It is also similar to the Oligocene species *Prunopyle frakesi* (Chen, 1974, pl. 1, figs. 3-6) from which it is distinguished by having a spherical cortical shell rather than pyriform and lacking a spiral medullary shell. The features of pores and pylome also differs between *E. inemmestum* and *P. frakesi*. However, above mentioned two species, both are known only from the antarctic region, are possibly related to this new species, but the further examinations are difficult to do in the present state of knowledge. The abundance is rare in the sample TH-4.

Dimension (in μm): Based on 15 specimens. Diameter of cortical shell; 290-430. Diameter of pylome; 15-35.

Holotype: ESN 146872 (Pl. 11, figs. 2a, 2b) from TH-4.

Etymology: From the Greek *is* (genit. *inos*), fiber, and *emmestos*, filled.

Acknowledgments

I express my deep gratitude for Junji Itoigawa and Akiko Nishimura for their critical reviews of the manuscript and valuable comments. I am also much indebted to Tomowo Ozawa, Shinobu Mori and Hiroshi Furutani for their encouragements during the study.

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Plate 9

Figs. 1 a-4 b: *Drymosphaera* (?) *pseudosagenoscena* Sugiyama sp. nov.

1 : Holotype, ESN 146851, TH-2. 1 b is an enlargement of the center.

2 : Paratype, ESN 146855, TH-4. 2 b is an enlargement of the center.

3 : Paratype, ESN 146853, TH-2.

4 : Paratype, ESN 146852, TH-2. 4 b is an enlargement of the center.

Figs. 5-7 : *Collosphaera* (?) *solenochira* Sugiyama sp. nov.

5 : Paratype, ESN 146854, TH-4.

6 : Paratype, ESN 146863, TH-4.

7 : Paratype, ESN 146862, TH-1, broken specimen.

Scale bars: 1 b, 2 b and 4 b = 20 μm; 1 a, 3 and 4 a = 50 μm; others = 100 μm.

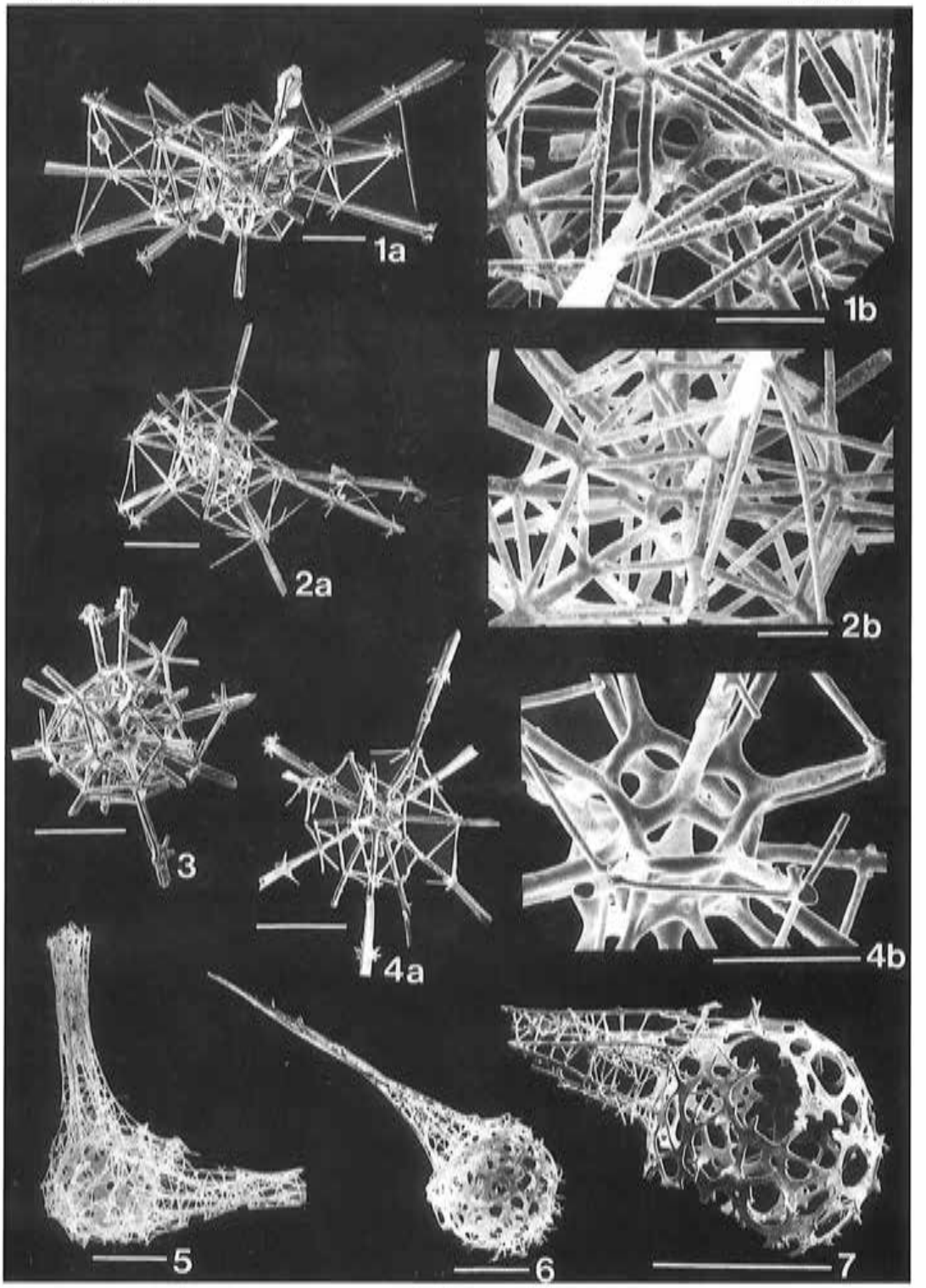

1a
1b
2a
2b
3
4a
4b
5
6
7

Plate 10

Figs. 1 a-4 : *Collosphaera* (?) *solenochira* Sugiyama sp. nov.

1 : Holotype, ESN 146864, TH-4. 1 b and 1 c are enlargements of the shell and tube, respectively.

2 : Paratype, ESN 146865, TH-4.

3 : Paratype, ESN 146861, TH-4.

4 : Paratype, ESN 146866, TH-4.

Figs. 5-6 b: Collosphaeridae gen. et sp. indet.

5 : ESN 146867, TH-4.

6 : ESN 146868, TH-4. 6 b is an enlargement of the connectiong part.

Scale bars: 1 b, 1 c and 6 b = 20 μm; others = 100 μm.

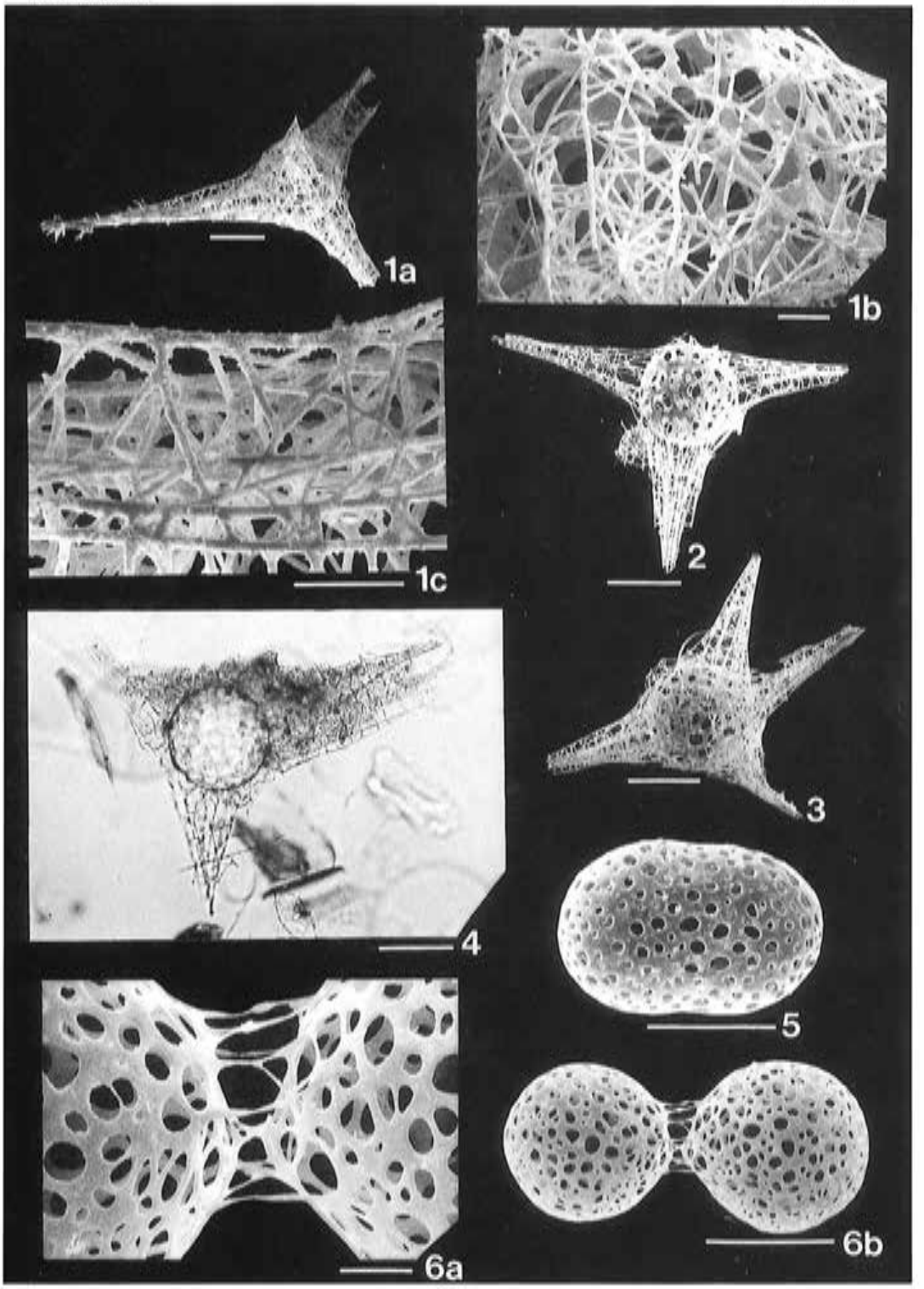

1a
1b
1c
2
3
4
5
6a
6b

Plate 11

Figs. 1–6 : *Enalomelon inemmestum* Sugiyama gen. et sp. nov.

1 : Paratype, ESN 146871, TH-4.

2 : Holotype, ESN 146872, TH-4. 2 b is an enlargement of the pylome.

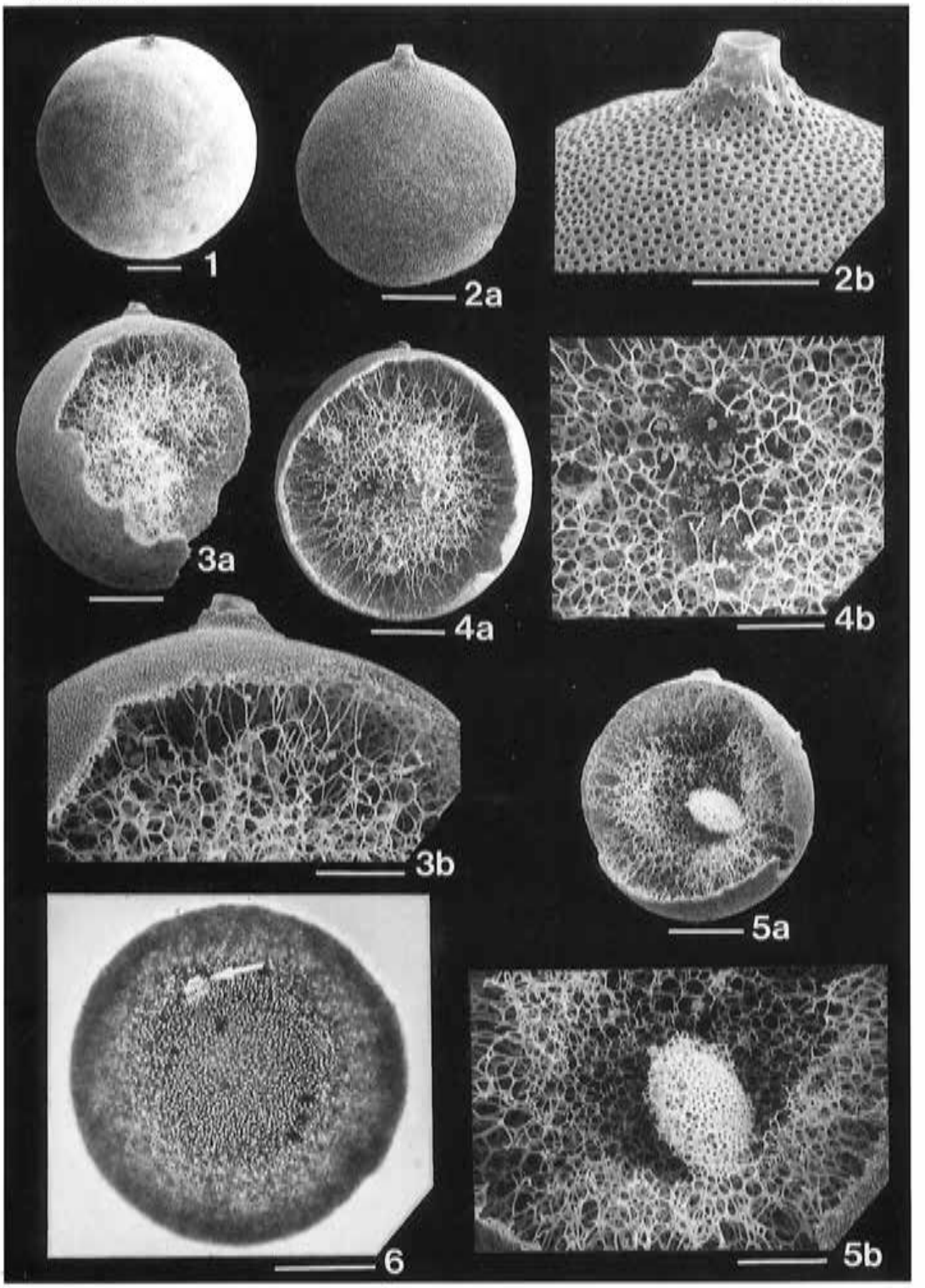
3 : Paratype, ESN 146873, TH-4, sectioned specimen. 3 b shows details of the double cortical shell and internal shell structure.

4 : Paratype, ESN 146874, TH-4, sectioned specimen. The center of this specimen is occupied by secondary growth of silica. 4 b is an enlargement of the center.

5 : Paratype, ESN 146875, TH-4, sectioned specimen. 5 b is an enlargement of the center, showing details of the medullary shell.

6 : Paratype, ESN 146876, TH-4, sectioned specimen. Arrow points a pylome.

Scale bars: 2 b, 3 b, 4 b and 5 b = 50 μm; others = 100 μm.


1
2a
2b
3a
4a
4b
3b
5a
6
5b