Tohoku Univ., Sci. Rep., 2nd ser. (Geol.), v. 47, no. 1,
p. 1~5, 1 table, 2 figs, 2 pls, March 15, 1977

A Calcitic Sclerosponge from the Ishigaki-shima Coast, Ryukyu Islands, Japan

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Abstract

A new Recent calcitic sclerosponge, *Tabulospongia japonica*, n. sp. is described. The skeleton is composed of high magnesium calcite, organic material and siliceous spicules (megascleres) of dichotriaene type. Additional discussions to the previous paper (Mori, 1976) on relationships among calcitic sclerosponges, fossil acanthochaetetids and stromatoporoids are presented.

INTRODUCTION

Four beach cast specimens of Recent calcitic sclerosponges have been found on the coast of Yarabu Peninsula, Ishigaki-shima, Ryukyu Islands, Japan. They are well rounded and were ashore associated with fragmental hermatypic scleractinian corals such as *Acropora*, *Favia* and *Goniastrea*. This discovery of sclerosponges is first in the Japanese Islands and indicates that living calcitic sclerosponges are widely distributed in the shallow water of the Western Pacific, as shown by Hartman and Goreau (1975). Four specimens belong to the same species, *Tabulospongia japonica*, n. sp. which is the third species of the calcitic sclerosponges reported in the Pacific, following *T. wellsi* (Hartman and Goreau) and *T. horiguchii* Mori. No specimens show their original shapes and surface structures because they are waterworn. Thus there are no signs showing stellate pattern of depressions serving as exhalant canals in the specimens. Chemical analyses indicate that the skeletons are composed of high magnesium calcite. Siliceous spicules have also been found.

The purpose of the present paper is to describe the new species of the sclerosponge found in Japan and to discuss the relationships among the calcitic sclerosponges, fossil acanthochaetetids and stromatoporoids.

ACKNOWLEDGEMENTS

The present author is indebted to Professor Ivar Hessland and Dr. David Rickard, Department of Geology, University of Stockholm, for the critical reading of the manuscript. He is also indebted to Dr. Yuzo Kato, Institute of Petrology, Mineralogy and Economic Geology, Tohoku University, for the X-ray powder diffraction and the chemical analyses of the specimens, and to Dr. Toyosaburo Sakai, Institute of Geology and Paleontology, Tohoku University, for taking the scanning electron micrographs. Thanks are due to Dr. Krister Brood, Riksmuseet, Stockholm and Dr. Jean-Claude Fischer, Institute of Paleontology, Museum of Natural History, Paris for their comments. The writer wishes to extend his thanks to Mr. Kimiji Kumagai, Institute of Geology and Paleontology, Tohoku University, for his photographic assistance; to Mr. Akio Ishikawa of the same Institute for making thin sections; to Mrs. Inger Arnström, Department of Geology, University of Stockholm for drawing text-figures.

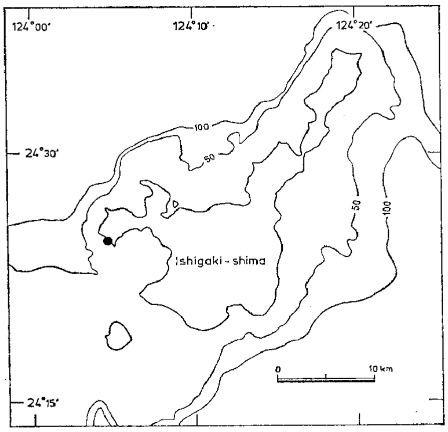

Fig. 1. Calcitic sclerosponge collection locality (black circle). Depth contours are in meters.

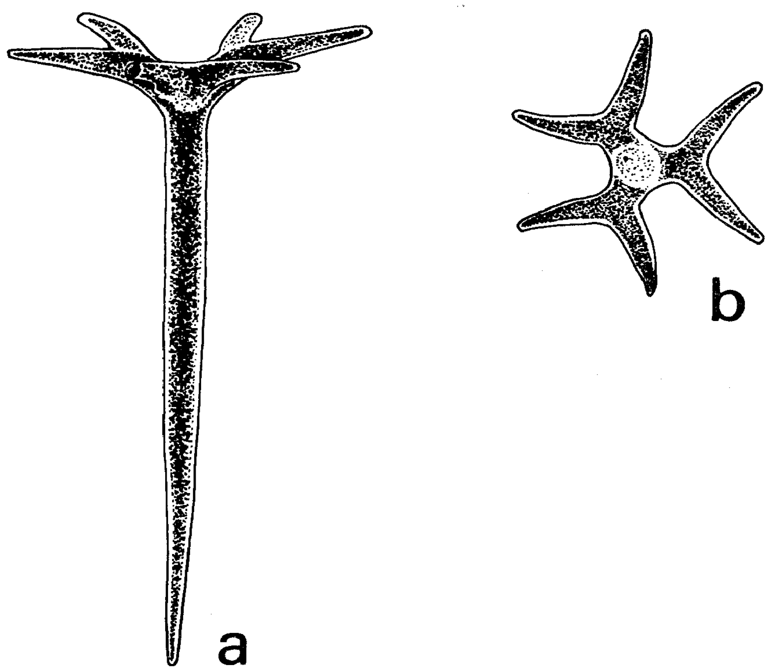

Fig. 2. Siliceous spicules of the dichotriaeneous type, occurring abundantly in the calcitic skeleton. × 200. a: Whole specimen, b: Frontal view showing forked clads.

THE MORPHOLOGY OF *TABULOSPONGIA JAPONICA* MORI, N. SP.

Original sizes and shapes of the sclerosponges here studied are unknown because they are worn beach cast specimens. The holotype specimen is 2.0×5.7×8.6 cm, but the paratype specimens are smaller (Pl. 1, Figs. 1–4). No surface structures are preserved. Stellate patterns of depressions serving as exhalant canals are not morphologically recognized in the specimens or in thin sections. The skeleton is composed of honeycomb like structures. Very small pits are circular to polygonal in shape. The lumens of the pits are 514 μ in diameter on average, measured in 50 larger pits, generally falling in the range of 450–550 μ. The maximum diameter of the lumen is 650 μ. Smaller pits, the diameters of which are less than 450 μ, are also common. New pits appear by intramural offsets. The pits are separated by a common wall which is generally 25–70 μ thick measured in 50 parts of the wall. The maximum thickness of the wall is 90 μ. The pits are preserved as cavities as in other calcitic sclerosponges. Many irregularly distributed spines protrude inwards from the pit wall. In the pits the tabulae are well developed. They are mostly horizontal, but some are slightly concave or convex. The tabulae occur at almost the same level, numbering 2–5 tabulae per 2 mm. The distance between two tabulae in a pit varies from 0.1 to 1.2 mm. The thickness of the tabulae is 20–50 μ. Siliceous spicules (megascleres) are of the dichotriaene type (Fig. 2; Pl. 2, Figs. 3–5). The length of the megascleres varies from 300 μ to 355 μ. The diameter of forked clads are from 140 μ to 190 μ, measured from tip of one clad to that of its opposite clad. On the surface of the megascleres there are many small circular holes which are 1.5 μ in diameter (Pl. 2, Fig. 6). They are randomly distributed and some are interconnected. The depth of each hole is not known precisely, but the holes seem to be very shallow. No microscleres have been found in the skeleton. As in the case of other calcitic sclerosponges, the siliceous spicules are not incorporated in the calcitic skeleton. The microstructure is lamellar. The chemical compositions of the skeletons of the specimens are shown in Table 1.

Table 1. Chemical composition of the skeleton of *Tabulospongia japonica* Mori, n. sp.

Spec. No.	95420 (Holotype)	95421	95422	95423
CaO	48. 35	48. 16	48. 26	48. 48
MgO	5. 79	5. 68	5. 86	5. 73
MnO	tr	tr	tr	tr
FeO*	0. 04	0. 03	0. 02	0. 02
SiO_2	tr	tr	tr	tr
Na_2O	0. 31	0. 41	0. 25	0. 20
K_2O	0. 03	0. 04	0. 03	0. 03
P_2O_5	0. 07	0. 06	0. 06	nd
H_2O^-	0. 38	0. 47	0. 37	0. 28
Ign. Loss	44. 77	45. 14	44. 95	44. 96
Total	99. 74	99. 99	99. 80	99. 70

* FeO may include some Fe_2O_3.

RERATIONSHIPS AMONG CALCITIC SCLEROSPONGES, ACANTHOCHAETETIDS AND STROMATOPOROIDS

The present author (1976) discussed briefly the relationships among the calcitic sclerosponges, the fossil acanthochaetetids and the stromatoporoids. In this section additional notes on these relationships are presented.

The species here described is very similar to *Tabulospongia wellsi* (Hartman and Goreau) and *T. horiguchii* Mori in general skeletal structure. The chemical composition of the skeleton of *T. japonica*, n. sp. (Table 1) shows also close resemblance to that of *T. horiguchii*. It can be distinguished from *wellsi* and *horiguchii* by having a different type of megascleres (tylostyles in *T. wellsi* and fusiform type in *T. horiguchii*), while the dichotriaene type occurs in *T. japonica*. There is no possibility that the megascleres found in the skeleton came from other sponges, because only dichotriaenes with similar sizes occur abundantly in the skeleton.

Hartman and Goreau (1975) are of the opinion that the Recent calcitic sclerosponge described by them is identical with fossil acanthochaetetids at the generic level. They (*op. cit.*, p. 10) noted that "the absence of siliceous spicules (or their pseudomorphs) embedded in the calcareous skeleton does not gainsay poriferan affinities for fossils with otherwise suggestive characteristics." Contrary to this opinion, the present author (Mori, 1976) mentioned that the fossil acanthochaetetids are distinguished from the Recent calcitic sclerosponges by lacking siliceous spicules. Although it is not strictly confirmed whether the fossil acanthochaetetids originally possessed siliceous spicules, which might have been dissolved or otherwise not preserved after deposition, spicules have not as yet been reported in the chaetetid group. Lack of any positive reliable evidence for the presence of spicules in the fossil group is here considered to imply that the fossil acanthochaetetids did not have spicules originally. The fact that siliceous spicules have been found even in waterworn calcitic sclerosponge specimens does not contradict this view. In addition, the hypothesis that the stellate exhalant canals of sclerosponges are identical with astrorhizae of fossil acanthochaetetids and stromatoporoids is doubtful. Stearn (1975) mentioned that all stromatoporoids must have had a stellate excurrent system, and that astrorhizae are traces of an excurrent system that interfered with the secretion of the skeleton in some stromatoporoids but was entirely above the hard tissue in others. But stellate patterns of canals of the Recent calcitic sclerosponges can be observed only in the outer surface where living tissue is present, while astrorhizae are recognized through the astogenetic development of the stromatoporoid skeleton in many genera and species. The astrorhizae of the fossil acanthochaetetids which ascend from the depths of skeleton resemble those of the stromatoporoids in their morphological growth patterns. It seems unlikely that the soft canals found in the Recent sclerosponges can leave distinct traces in the skeleton, such as are well observed in the stromatoporoids (see also Kaźmierczak, 1974). It is speculative to consider that stromatoporoid genera and species which lack morphologic evidence of astrorhizae have had stellate exhalant canals which have not interfered with skeleton. Hartman and Goreau (1975) noted that one of the astrorhizal patterns developed in the fossil acanthochaetetids (Cuif *et al*, 1973, Pl. 1, Fig. 4) is different from the star-shaped exhalant canals of the calcitic sclerosponges. They (*op. cit.*, p. 6) mentioned that it either represents another species or has resulted from diagenetic processes. Although it is controversial whether two different types of astrorhizae occur in a single "species", it is considered that such a clear structure intimately related to other skeletal structures cannot result from diagenetic processes. Hartman and Goreau (op. cit.) noted also that the picture of the astrorhizae of *Acanthochaetetes seunesi* Fischer (Cuif *et al*, Fig. 6) records several developmental abnormalities that occurred during the growth of the calcareous skeleton. However, it does not seem likely that these structures have been caused in such a way, because the astrorhizal structures mentioned above are similar to those of stromatoporoids which cannot be explained simply by abnormal development. It is highly probable that this difference is based on different functions of stellate patterns of depression serving as exhalant canals in calcitic sclerosponges and astrorhizae in fossil acanthochaetetids and stromatoporoids. The similarity between them is thus considered to be superficial. However similarities of gross- and microstructures of the skeleton between the Recent calcitic sclerosponges and the fossil acanthochaetetids and dissimilarities of gross structures between the acanthochaetetids and stromatoporoids further complicate the problem of phylogenetic relationship among these three groups.

SUMMARY OF SYSTEMATICS

Phylum Porifera Grant, 1872
Class Sclerospongiae Hartman and Goreau, 1970
Order Tabulospongida Hartman and Goreau, 1975
Family Tabulospongiidae Mori, 1976
Genus *Tabulospongia* Mori, 1976

Type species: *Acanthochaetetes wellsi* Hartman and Goreau, 1975
Species included: *Tabulospongia wellsi* (Hartman and Goreau)
T. horiguchii Mori
T. japonica Mori, n. sp.
Geographical distribution: At present known only from the Western Pacific.
Geological range: Known at present only as Recent.

Tabulospongia japonica Mori, n. sp.

Pl. 1, figs. 1–8; pl. 2, figs. 1–6.

Derivation of name: The specific name is based on the first discovery of the calcitic sclerosponge in Japan.

Type species: Holotype, IGPS Coll. Cat. No. 95420; Paratypes, IGPS Coll. Cat. No. 95421, 95422 and 95423.
Repository: The type specimens are stored in the Institute of Geology and Paleontology, Tohoku University, Sendai.
Description: See the text.
Remarks and comparison: See the text.
Geographical distribution: At present known only from Ishigaki-shima, Ryukyu Islands, Japan.

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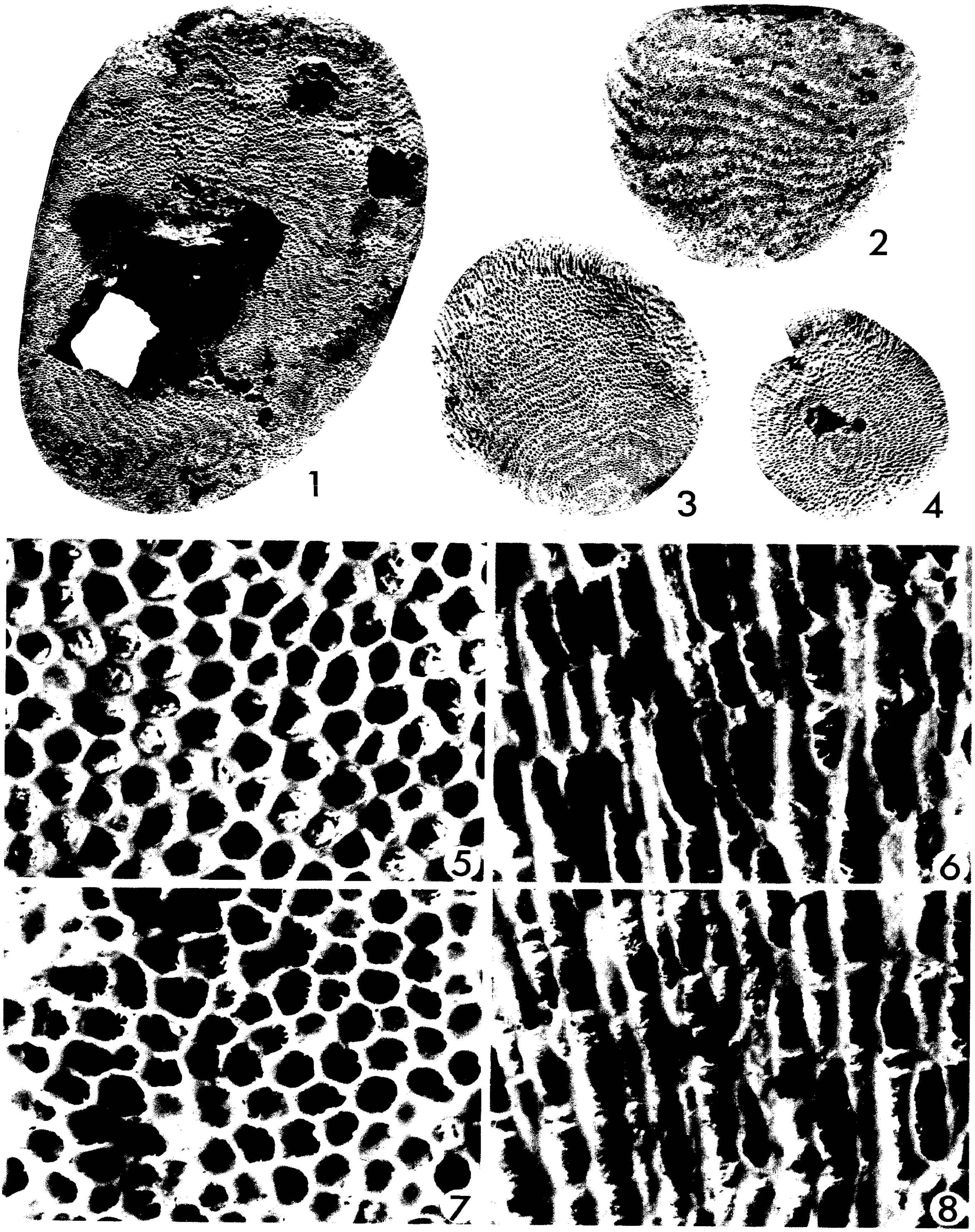
Plate 1

Figs. 1–4. Beach cast specimens of *Tabulospongia japonica* Mori, n. sp. × 1.
- Fig. 1: Holotype (IGPS Coll. Cat. No. 95420)
- Figs. 2–4: Paratypes (IGPS Coll. Cat. No. 95421, 95422 and 95423 respectively)

Figs. 5–8. Waterworn surfaces of *Tabulospongia japonica* Mori, n. sp. × 10.
- Fig. 5: Tangential view of holotype (IGPS Coll. Cat. No. 95420)
- Fig. 6: Vertical view of the holotype
- Fig. 7: Tangential view of paratype (IGPS Coll. Cat. No. 95421)
- Fig. 8: Vertical view of the paratype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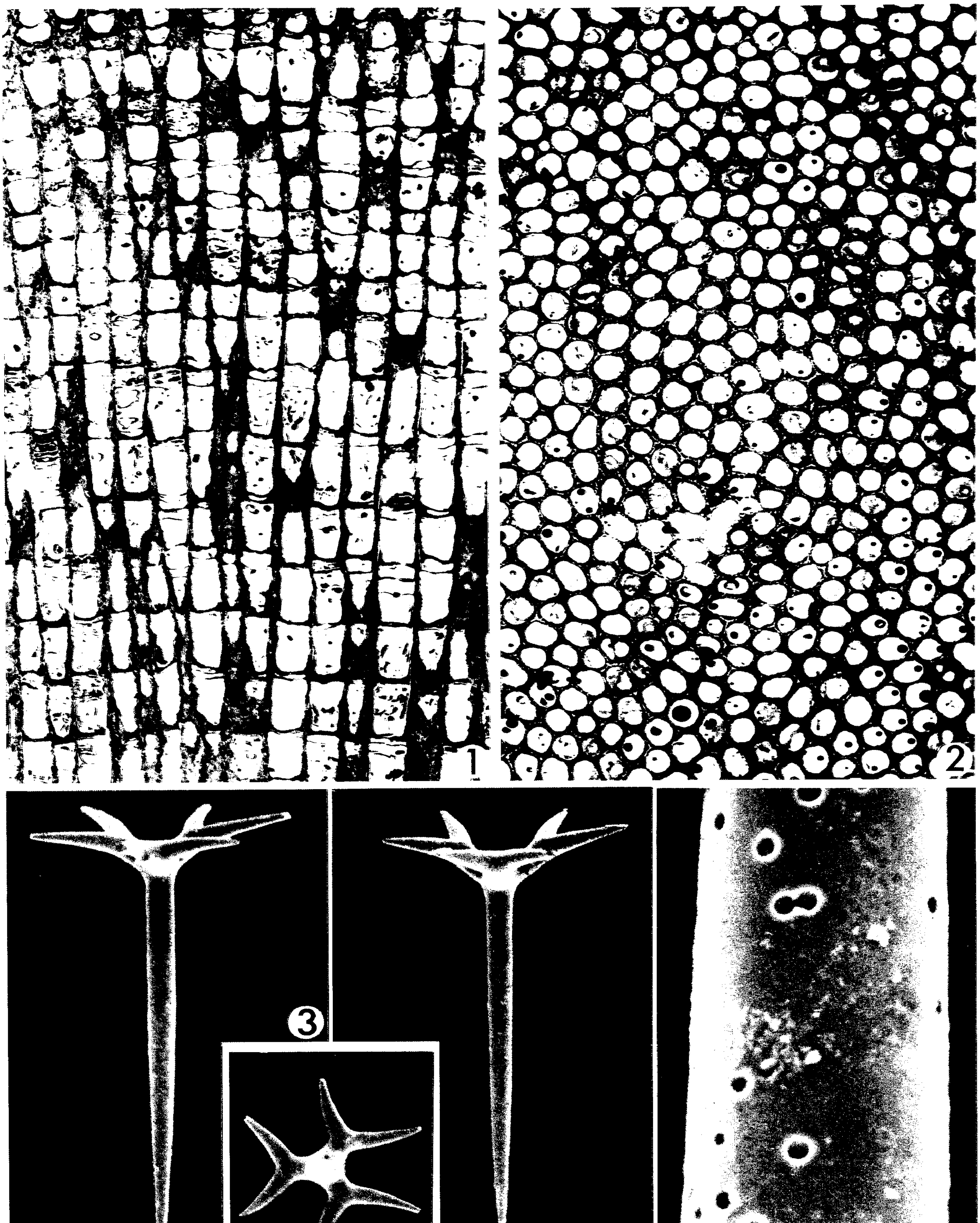
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Plate 2

Figs. 1, 2. Thin section of *Tabulospongia japonica* Mori, n. sp. Holotype (IGPS Coll. Cat. No. 95420), × 10.

Fig. 1: Vertical section; Fig. 2: Tangential section

Figs. 3–6. Scanning electron micrographs of siliceous spicules (megascleres) of *Tabulospongia japonica* Mori, n. sp. Holotype (IGPS Coll. Cat. No. 95420).

Figs. 3, 4: Spicules of dichotriaene type, × 200.

Fig. 5: Frontal view of a spicule showing triaene with forked clads, × 200.

Fig. 6: Enlarged view of a spicule showing many small holes on the surface, × 2000.