

A systematic Study of Marine Sponges in Korea **11. Sponges of Islets near the coast of Cheju Island**

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ABSTRACT

Among areas in Korea, Cheju Island and its vicinity are inhabited by the most diverse sponges, and a number of species have been recorded as new to science or new to Korean fauna. Forty species of sponges belonging to 29 genera in 21 families were identified as a result of research based on the materials deposited in the Department of Biology, Hannam University and the Department of Biology, Ehwa Woman's University. These species had been collected in Cheju Island and its vicinity. Three species are known to be new to science, and nine other species discovered for the first time from Korea. The new species are described with detailed illustrations, and for the new records for Korea the remarks and illustrations are prepared.

Key words: systematics, marine sponges, Cheju Island, Korea.

INTRODUCTION

The present study on marine sponges is based on the materials from Cheju Island, Korea. Systematic surveys of the sponges in this island were reported by Sim (1982a,b, 1985), Sim & Byeon (1989), and Sim *et al.* (1992).

The materials used were collected from fishing net or with SCUBA from seven localities (Fig. 1) near Cheju Island and adjacent areas from 1969 to 1993. Forty species in 29 genera and 21 families were identified, of which three species were recognized as new species and nine species being new to Korea.

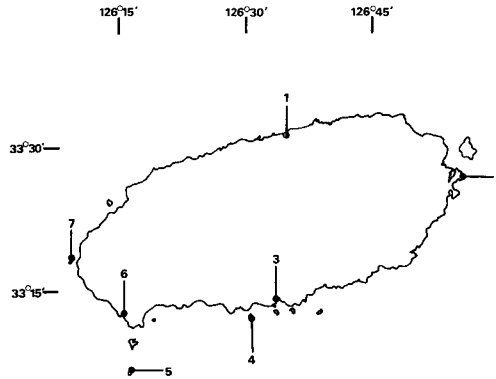


Fig. 1. Localities where the examined materials were collected. 1, Samyang 1 dong; 2, Songsanp'o; 3, Sogwip'o; 4, Pomsom; 5, Marado; 6, Mosulp'o; 7, Ch'agwido.

SYSTEMATIC ACCOUNT

The species marked with an asterisk (*) indicate new records in Korea and double asterisks (**) indicate new species.

- Phylum Porifera
- Class Demospongiae
- Subclass Tetractinomorpha
- Order Astrophorida
- Family Stellettidae

1. *Myriastra purpurea (Ridley, 1884) 보라다성해면 (신칭) (Pl. 1, Figs. 1-5)

Stelletta purpurea Ridley, 1884; Burton, 1926, p.45.

Pilochrota purpurea: Sollas, 1886, p.190

Myriastra purpurea: De Laubenfels, 1954, p.239, fig.164; Levi, 1967, p.231, fig.3; Begquist, 1961, p.201, fig.19; 1968, p.45, Pl.7, fig.16.

Material examined. Pomsom (SCUBA, 20-25m), 22 Oct. 1991.

Remarks. This sponge is small, approximately 10 × 8 × 5 mm. The surface is hard and rough because of protruding spicules. The colour is externally purple, and internally pale yellow.

Spicules- Megascleres:

Oxeas	450-950 × 10-30 μm
Plagiotriaenes.....	rhabds 350-750 × 20-30 μm
	clads 40-100 × 10-20 μm
Anatriaenes	rhabds 200-700 × 10-20 μm
	clads 15- 30 × 5-20 μm

Microscleres:

hiasters	6-10 μm
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Chiaster is rare in Laubenfel's (1954) collection but common in our specimen.

Distribution. Korea (Cheju Island); Indian Ocean; Australia; Indo-Pacific; Japan; New Zealand and Antarctic Ocean.

Family Geodiidae

2. *Erylus bahamensis Finali, 1986 바하마꼭지해면 (신칭)(Pl.2, Figs. 1, 2, Pl. 3, Figs. 1-6)

Erylus bahamensis Finali, 1986 (pp.78-80, figs.12-13).

Material examined. Ch'agwido (SCUBA; 20-25m), 23 Oct.1991.

Remarks. This sponge is small and mass, up to 25 × 20 × 7mm. The surface is smooth and hard with many sterraster. The ectosome can easily be separated from the endosome. The colour is brownish black externally; internally beige. Inside, the texture is soft. Two oscules are visible on the top of the sponge.

Spicules- Megascleres:

Oxeas 479-800 × 11-16 μm
 Orthotriaenes rhabds 450-610 × 30 μm
 clads 220-300 × 30 μm

Microscleres:

Sterrasters..... 120-250 × 40-70 μm
 Microxeas 32-65 × 3 μm
 Oxyasters 20-100 μm

Distribution. Korea (Cheju Island); West Indies (Bahamas, Dominican Republic).

Family Jaspidae

****3. *Asteropus plumos***, n. sp. 깃털별해면 (신칭)(Pl. 4, Figs. 1-4)

Holotype. Por.14, Deposited in The Natural History Museum of Han Nam University

Material examined. Samyang 1 dong (Cheju Sea woman), 9 July 1991.

Description. This sponge is massive, up to 55 × 30 × 20 mm. The texture is compressible and soft. The surface of the body is rough owing to the presence of large oxea lying tangentially beneath the surface. The colour in life is brown; dirty beige in alcohol.

Spicules- Megascleres:

Oxeas 675-1875 × 13-55 μm
 Small oxeas 80-180 μm

Microscleres;

Sanidasters (spined) 12.5-25 μm
 Oxyasters (spined) 25-55 μm

Remarks. This new species is similar to *Asteropus haeckeli* Dendy, 1905 in shape. Dendy's specimen has one size of sanidaster, but this new species has two sizes.

Distribution. Korea (Cheju-Island).

Etymology. The specific name plumos (L: feather) is based upon feather shape of the new species.

Order Lithistida
 Suborder Triaenosina
 Family Theonellidae

4. *Discodermia discifurca Sollas, 1888 갈래가죽해면 (신칭)(Pl. 5, Figs. 1-3)

Discodermia discifurca Sollas, 1888, p. 292, Pl. 32, figs.1-11.

Material examined. Songsanp'o (SCUBA, 20-25m), 24 Oct. 1991.

Remarks. This sponge is a cup shape, with the wall of the cup thick, the cavity shallow, and the margins rounded. The size up to 50 × 50 × 9 mm. The Outside of the cup is rough. The texture is hard like a stone. The colour in alcohol is pale yellow.

Spicules- Megascleres:

Oxeas 1200-1600 × 10-15 μm

Desmas 340-570 μm

Phyllostriaenes 300-570 μm

Microscleres:

Microstrongyles 9-17.5 × 3-7 μm

Microxeas 60-75 × 3-5 μm

Distribution. Korea (Cheju Island); Australia (Port Jackson).

Order Hadromerida
 Family Suberitidae

5. *Terpios fugax Duchassing & Michelotti, 1864 터피오즈해면 (신칭)(Pl. 6, Figs. 1-6)

Terpios fugax Duchassing & Michelotti, 1864, p. 102.

Terpios fugax: Hentschel, 1912, p. 326; Arndt, 1920, p. 139, Taf. 3, fig. 6, text-fig. 2; De Laubenfels, 1950, p.103; 1954, p. 209, text-fig. 142).

Material examined. Marado (SCUBA, 10-15m), 25 Oct. 1991.

Remarks. This sponge is usually an incrustation on an oyster shell, the size is indefinite. The surface is smooth with a soft texture. The colour in life is red; yellow in alcohol.

Spicules- Megascleres:

Tylostyles 130-629 × 2-11 μm

Distribution. Korea (Cheju Island); West Central Pacific (Marshall Islands, Ponape Island); Caribbean Sea (Caragao Island, Carcas Bay); Bermuda (Bermudas).

****6. *Suberites mammilaris***, n.sp. 유두코르크해면 (신칭)(Pl.7, Figs. 1, 2)

Material examined. One specimen, Seogwipo, Oct. 1992.

Holotype. Por.15, Deposited in The Natural History Museum of Han Nam University.

Description. This sponge is mammilates with a size up to 40 × 50 × 20mm. At the top it has oscules of 1mm in diameter. The texture is hard and elastic. The colour in life is reddish brown; dark brown in alcohol.

Spicule- Megascleres:

Large tylostyles 500-1000 × 13-40 μm

Small tylostyles 220-470 × 9-14 μm

Remarks. This new species is similar to *Suberites mollis* in spicules, but it is different in shape.

Distribution. Korea (Cheju Island).

Etymology. The specific name *mammilaris* (L: mamma) is based upon mammilla shape of the species.

****7. *Laxosuberites nestus*, n. sp.** 등지큰코르크해면 (신칭)(Pl.7, Figs. 3-4)

Material examined. Mosulp'o, 9 Sept. 1993.

Holotype. One specimen, Por.16, Deposited in The Natural History Museum of Han Nam University.

Description. This sponge is attached to coral branches, like a bird nest. The size is up to 20 × 35mm. The surface is rough with hispidating spicular brushes and a texture hard. The colour in life is redish orange.

Spicules- Megascleres:

Large tylostyles	24-1150 × 20-30 μm
Small tylostyles	238-758 × 7-13 μm
Slender tylostyles	200-811 × 2-4 μm

Remarks. This new species is similar to *Laxosuberites psammophilus* Finali 1986 in spicules, but the large tylostyles are thicker than in Finali's spicules.

Distribution. Korea (Cheju Island).

Etymology. The specific name *nestus* is based upon nest shape of the new species.

Order Axinellida

Family Axinellidae

8. *Axinella convexa Hoshino, 1981 불록축해면 (신칭)(Pl. 11, Figs. 1, 2)

Axinella convexa Hoshino, 1981, p. 207, text-fig. 1, Pl.1, Fig.1.

Material examined. Sogwip'o, Nov. 1992.

Remarks. This sponge is massive; up to 55 × 40 × 30mm. The surface is rough owing to projecting spicules. The texture is compressible. The colour in life is green; dirty grey in alcohol.

Spicules- Megascleres:

Oxeas	320-1300 × 3-15-30 μm
Sinuous oxeas	320-550 × 9-12 μm

Distribution. Korea (Cheju Island), Japan (Ariake Sea).

Subclass Ceratinomorpha

Order Poecilosclerina

Family Mycalidae

9. *Paresperella macrosigma (Lidgren, 1897) 큰시그마해면 (신칭)(Pl. 8, Figs. 1-4)

Esperella macrosigma Lindgren, 1897, p. 482; 1898, p. 301, Pl. 19, figs. 12a-e, d', d").

Esperella macrosigma: Tanita, 1961, p. 135, Pl. IV, figs. 8, 9, text-fig. 5).

Material examined. Pomsom, 15 Nov. 1969.

Description. This sponge is erect and attached to a small shell at the base. The size is up to 85mm in length and 12mm in maximam breadth. The surface is uneven with a soft dermal membrane. The

colour in alcohol is white. The texture is soft and friable.

Spicules- Megascleres:

Styles 380-460 × 5-12 μm

Microscleres:

Large sigmas 310-520 × 20-24 μm

Small sigmas 90-145 × 5-7 μm

Large anisochelas 40-45 μm

Small anisochelas 20-30 μm

Remarks. The present material agrees closely with Tanita's descriptions of shape and spicules. He states that Lindgren described this species under the name of *Esperella macrosigma* in 1897, based on the specimens from the strait of Korea, but Lindgren (1897) reported his material from China Meere.

Family Clathriidae

*10. *Antho brathesardi* Soest, 1986 나무꽃해면 (신칭) (Pl. 9, Figs. 1-4)

Antho brathesardi Soest, 1986, p. 42, Figs. 1-3.

Material examined: Seogwip^o, 7 Sept. 1985.

Remarks. This sponge is erect, with branches like a tree. The size is up to 210 × 50mm, with branch diameters of 4mm. It is attached to a stone at the base. The surface of the branches feels like velvet. The texture is elastic. The colour in alcohol is yellowish brown.

Spicules- Megascleres:

Subtylostyles 250-500 × 3-5 μm

Smooth choanosomal styles 350-600 × 7-16 μm

Reinforcing acanthostyles 190-230 × 8-11 μm

Acanthostyles 135-190 × 7-10 μm

Acanthostrongyles 140-150 × 7-12 μm

Microscleres:

Large toxa 140-220 μm

Small toxa 35-85 μm

J-shaped spicules (crocae) 11-20 μm

Palmate isochelae 15-20 μm

Family Tedaniidae

*11. *Tedania oligostyla* De Laubenfels, 1954 빈침태다니해면 (신칭) (Pl. 10, Figs. 1-6)

Tedania oligostyla De Laubenfels, 1954, p. 127, fig. 8.

Material examined. Marado (SCUBA, 10-15m), 25 Oct. 1991.

Remarks. This is an encrusting sponge on rock, with a size up to 75 × 50 × 17mm. The surface has many pores, like the inside of bread. The texture is soft and easily broken. The colour in life is red; in alcohol pale yellow.

Spicules- Megascleres:

Styles 120-250 × 3-7 μm

Tylotes 230-275 × 2.5-6 μm

Raphids 75-200 × 0.5-2 μm

Styles are rare in Laubenfel's specimens, but our specimen has many styles.

Distribution. Korea (Cheju Island); West Central Pacific (Ebon Island).

Class Calcarea

Subclass Calthrinida

Order Leucettida

Family Leucettidae

12. *Leucetta antarctica Dendy, 1918 남극섬해면(신칭)(Pl. 11, Figs. 3-4)

Leucetta antarctica Dendy, 1918, p. 8, Pl. I, figs. 2-7.

Material examined. Pomsom, 29 Dec. 1986.

Remarks. Massive, with a thin dermal membrane. The size is up to 50 × 25mm. The surface is smooth, with a soft and compressible texture. The colour in alcohol is pale yellow.

Spicules- Megascleres:

Triradiates 40-110 μm

Small triradiates 10-20 μm

Distribution. Korea (Cheju Island), Antarctic.

RESULTS

One hundred sixty three species of sponges were identified from around Cheju Island and its adjacent waters. These represent 80% of the total 202 species of sponges collected from the three coastal seas around Korea. Ninety nine species are only known so far from Cheju Island. Cheju Island is considered to have unusual oceanographic conditions and to contain an extra-ordinarily high diversity of sponges. This area deserves special protection from rapidly encroaching human development.

REFERENCES

- Arndt, W., 1920. Kalk und Kieselschwämme von Curacao. *Bijd. Kenn. Fau. Curacao.*, **3**: 17-158.
- Bergquist, P.R., 1961. Demospongiae (Porifera) of the Chatham Islands and Chatham Rise, collected by the Chatham Island 1954 Expedition. *N. Z. Dept. Sci. Ind. Res. Bull.*, **139**(5): 169-206.
- Bergquist, P.R., 1968. Demospongiae of New Zealand, 1. Tetractinomorpha and Lithistida. *Mem. N. Z. Oceanogr. Inst.*, **37**: 1-105.
- Burton, M., 1926. *Stelletta purpurea* Ridley, and its variations. *Ann. Mag. Nat. Hist. London.*, **9**(18): 44-49.
- Dendy, A., 1905. Report on the sponges collected by professor Heedman at Ceylon in 1902. *Rep. Pearl Oyster Fish Guig of manaar*, 3, suppl., **18**: 57-246.
- Dendy, A., 1918. Calcareous sponges. Australasian Antarctic Expedition. *Sci. Rep. Ser. C. Zool. 2 Bot.*, **19**(4): 11-14.
- Duchassing, F.P. De. and G. Michelotti, 1864. Spongiaires de la cer Caraibe. *Natuurk. Verh. Holl. Mij. Wetensch.*

- Harrlem(2), **21**(3): 1-124.
- Finali, P.G., 1986. A collection of West Indian Demospongiae (Porifera). In appendix, a List the Demospongiae Hitherto recorded from the West Indies. Estratto dagli Annali del Museo Civico di Storia Naturale di Genova., vol. LXXXVI-18. Luglio 1986, pp. 65-216.
- Hentschel, E., 1912. Kiesel und Hoynschwamme der Aru und Kei-Insln: Abh Senckenb. Naturf. Kes., **34**: 291-448.
- Hoshino, T., 1981. Shallow-water Demosponges of Western Japan; I.J.Sci. Hishoshima Univ. Ser. B, Div., 1, **29**(2): 207-283.
- Laubenfels, M.W. De., 1950. The porifera of the Bermuda Archipelago. Trans. Zool. Soc. London; **27**(1): 1-306.
- Laubenfels, M.W. De., 1954. The sponges of the West Central Pacific. Ore. St. Monogr. Stud. Zool., **7**: 1-306.
- Levi, C., 1967. Spongiaires d'Afrique du Sud(3) Tetractinellides. Trans. Roy. Soc. S. Afr., **37**(3): 227-256.
- Lindgren, N.G., 1897. Beitrag zur kenntniss der Spongien-fauna des Malaiischen Archipels und der Chinesischen Meere. Zool. Anz., **20**: 480-489.
- Ridley, S.O., 1884. Spongiida. Report on zoological collections made in the Indo-Pacific Ocean during the Voyage of N.M.S. "Alert" 1881-1882. London, 336-482, 582-630.
- Sim, C.J., 1982a. A systematic study on the Marine sponges from Cheju Island. Soong Jun Univ., Essays & Papers, **12**: 187-210.
- Sim, C.J., 1982b. A taxonomic study on the Marine sponges in Korea, 4. Choristida (Geodiidae) Kor. J. Zool., **25**(1): 1-8.
- Sim, C.J. and M.H. Kim, 1988. A systematic study on the Marine sponges in Korea, 7. Demospongiae and Hexactinellida. Kor. J. Zool., **4**(1): 21-42.
- Sim, C.J. and H.S. Byeon, 1989. A systematic study on the Marine sponges in Korea. 9. Ceractinomorpha. Kor. J. Zool., **5**(1): 33-57.
- Sim, C.J., Y.S. Kim and Y.H. Kim., 1992. Systematic study on Marine sponges in Korea. 10. Demosponges of Cheju Island. Kor. J. Syst. Zool., **8**(2): 301-324.
- Sollas, W.J., 1886. Preliminary account of the Tetractinellida sponges dredged by H.M.S. challenger, 1873-1876. Part 1. The Choristida. Sci. R. Proc. Dublin Soc., **5**: 177-199.
- Sollas, W.J., 1888. Report on the Tetractinellida collected by H.M.S. challenger during the year 1873-1876. Rep. Sci. Res. Voy. Chall. Zool., **25**: 1-458.
- Soest, R.W.N. Van. and W.H. De Weerd., 1986. Marine shallow - water Haplosclerida (Porifera) from the South Eastern part of the North Atlantic Ocean. Zool. Ver., **225**: 1-49.
- Tanita, S., 1961. Report on the Non-Calcareous sponges in the Museum of the Biological Institute of the Tohoku University; part 1. Sci. Rep. Tohoku Univ., Ser.4, Biol., **27**(2): 131-140.

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한국산 해산 해면류의 계통분류학적 연구 11. 제주 부근 섬의 해산 해면동물

심 정 자 · 김 영 혜
(한남대학교 이과대학 생물학과)

요 약

제주도 연안과 부근섬에서는 다른 무척추동물에 비해 해면동물이 다양하게 분포하고 있으며 많은 미기록종과 신종이 나오고 있다. 본 연구는 1992년 6월부터 1993년 6월까지 제주도 연안과 부근섬에서 채집된 재료와 그동안 한남대학교 생물학과와 이화여자 대학교 생물학과에 보관되어 있던 표본들을 동정·분류한 결과 21과 29속 40종이 밝혀졌으며, 그 중 3종은 신종이었으며 9종이 한국 미기록종이었다. 여기에서는 3종의 신종에 관하여서는 자세한 기재와 도판을 첨가하였으며 미기록종은 특기와 도판을 첨가하였다.

Explanation of Plates

Plate 1. *Myriastra purpurea* (Ridley): 1, Entire animal; 2, Surface of skeletal framework (SEM, $\times 200$); 3, Megascleres (A, Oxea; B, Plagiotriaene; C, Anatriaene); 4, Microscleres (Chiaster, SEM, $\times 3000$); 5, Spicules (SEM, $\times 100$).

Plate 2. *Erylus bahamensis* Finali: 1, Entire animal; 2, Megascleres (A, Oxea; B, Sterraster; C, Orthotriaene); 3, Microscleres; D, Large oxyaster; E, Small oxyaster; F, Microstrongyle).

Plate 3. *Erylus bahamensis* Finali: 1, Surface of skeletal framework (SEM, $\times 100$); 2, Sterraster (SEM, $\times 350$); 3, 4, Fully developed steraster (SEM, $\times 1500$, $\times 6000$); 5, Spicules (SEM, $\times 1500$); 6, Oxyaster (SEM, $\times 1500$).

Plate 4. *Asteropus plumos*, n. sp.: 1, Entire animal; 2, Megascleres (Oxea); 3, Microscleres (A, Oxyaster, SEM, $\times 900$, $\times 1500$); B, Small sanidaster (SEM, $\times 1800$); C, Large sanidaster (SEM, $\times 1800$); D, Large sanidaster (SEM, $\times 3000$).

Plate 5. *Discodermia discifurca* Sollas: 1, Entire animal; 2, Surface of skeletal framework (SEM, $\times 100$); 3, Megascleres (A, Oxea; B, Phyllotriaene; C, Desma); 4, Microscleres (D, Microxea; E, Microstrongyle).

Plate 6. *Terpios fugax* Duchassing & Michelotti: 1, Entire animal; 2, Surface of skeletal framework (SEM, 200); 3, Megascleres (A, Tylostyle); 4, Spicules (SEM, $\times 183$); 5, 6, Head of tylostyle (SEM, $\times 1100$, $\times 2200$).

Plate 7. *Suberites mammilaris*, n. sp.: 1, Entire animal; 2, Megascleres (A, Slender tylostyle; B, Small tylostyle; C, Large tylostyle). *Laxosuberites nestus*, n. sp.: 3, Entire animal; 4, Megascleres (A, Tylostyle; B, Slender tylostyle; C, Slender tylostyle).

Plate 8. *Paresperella macrosigma* (Lindgren): 1, Entire animal; 2, Megascleres (Style); 3, Microscleres (A, Large sigma; B, Small sigma, SEM, $\times 1100$; C, Large anisochela, SEM, $\times 1200$; D, Small anisochela, SEM, $\times 1200$).

Plate 9. *Antho brathesardi* Soest: 1, Entire animal; 2, Surface of skeletal framework; 3, Megascleres (A, Slender style B, Head of slender style (SEM, $\times 5000$); C, Acanthostyle; D, Acanthostrongyle); 4, Microscleres (A, Large toxa; B, Small toxa; C, Isochela).

Plate 10. *Tedania oligostyla* De Laubenfels: 1, Entire animal; 2, Surface of skeletal framework (SEM, $\times 200$); 3, Megascleres (A, Style; B, Tylole Microscleres; C, Raphid); 4, Spicule showing spined body of a raphid (SEM, $\times 3500$); 5, 6, Spicule showing spined head of a tylostyle (SEM, $\times 1300$, $\times 10000$).

Plate 11. *Axinella convexa* Hoshino: 1, Entire animal; 2, Megascleres (A, Style; B, Sinuous style). *Leucetta antarctica* Dendy: 3, Entire animal; 4, Megascleres (A, Large triradiate; B, Small triradiate).

PLATE 1

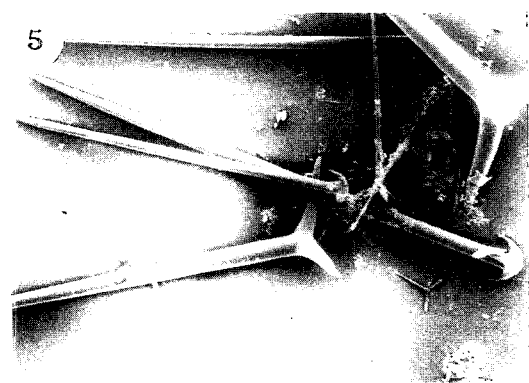
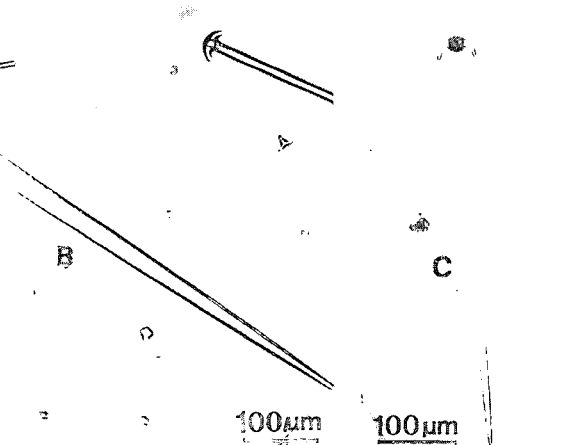
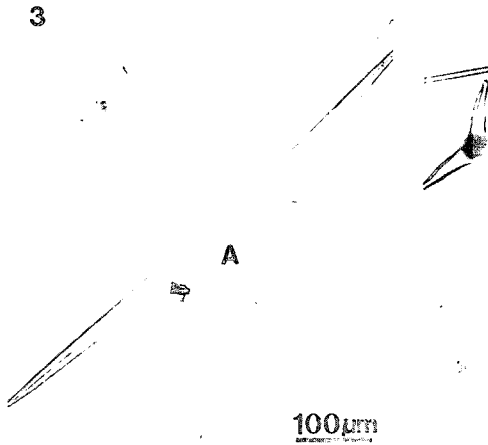
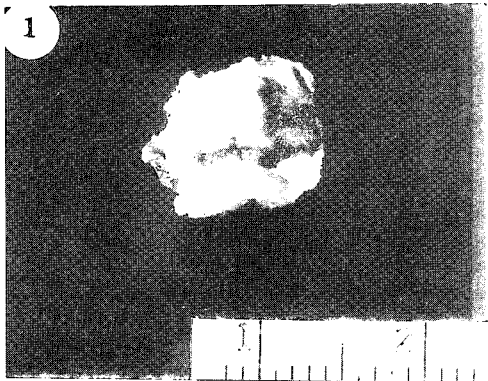


PLATE 2

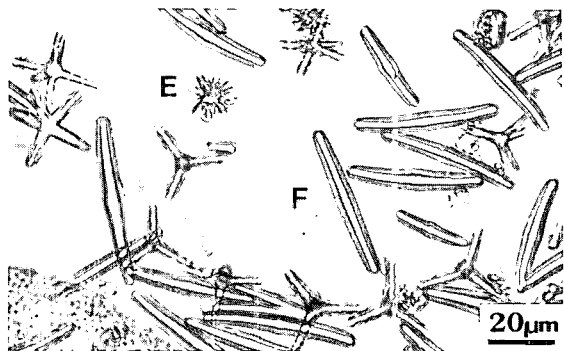
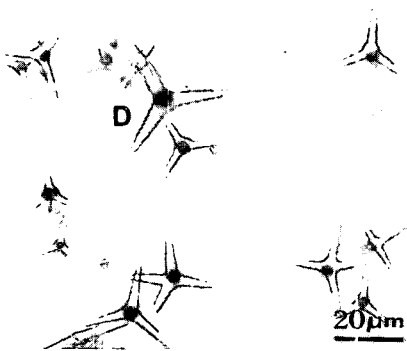
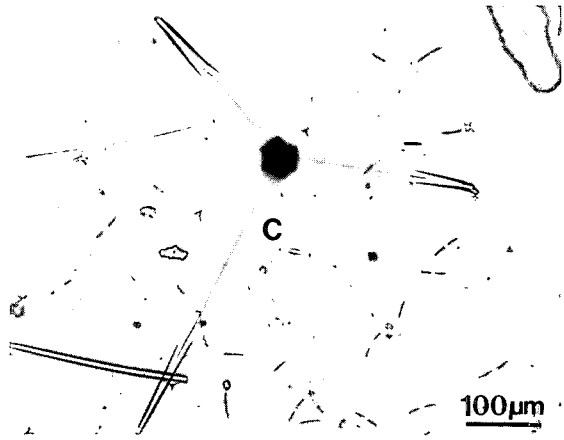
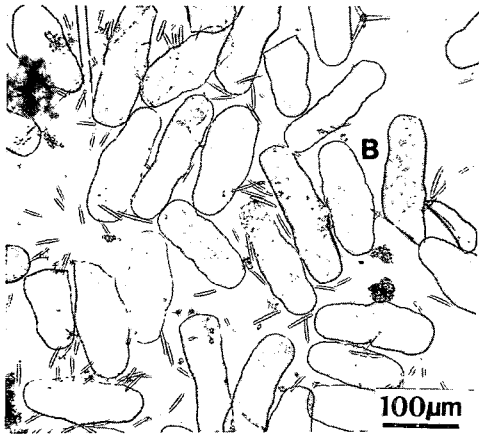
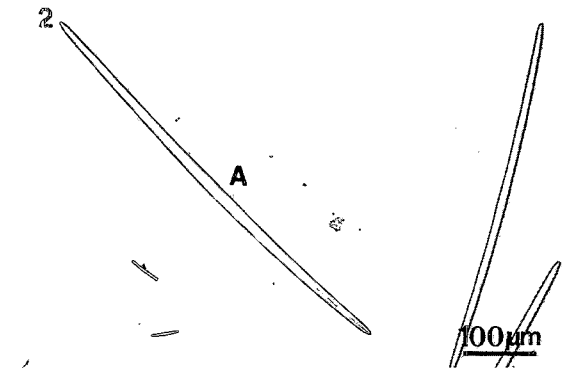
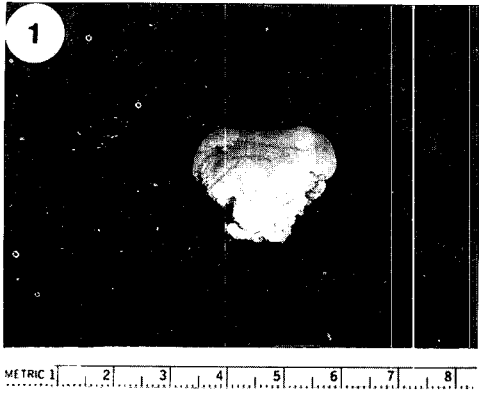


PLATE 3

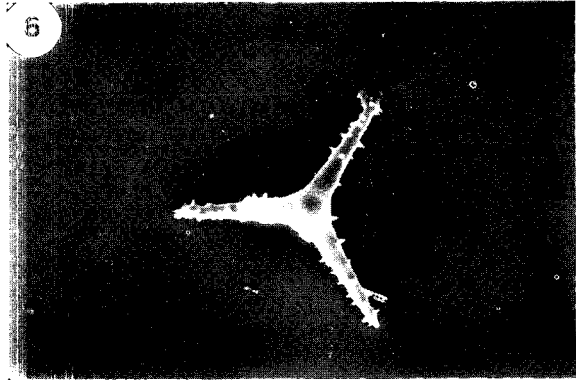
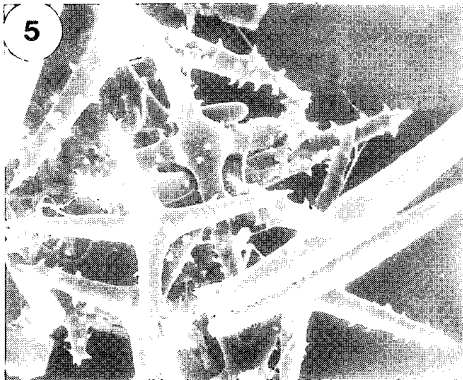
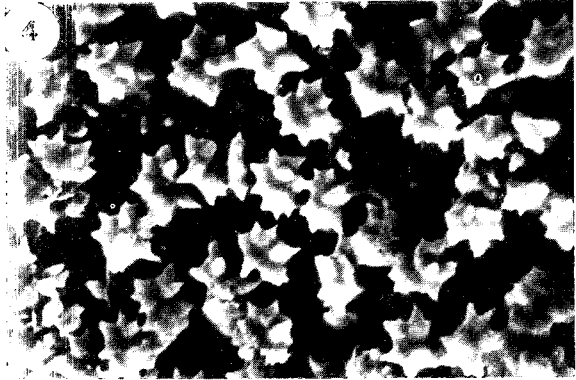
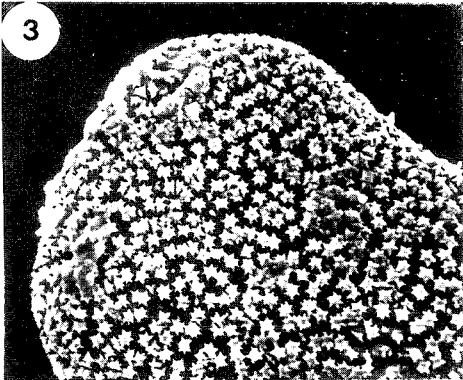
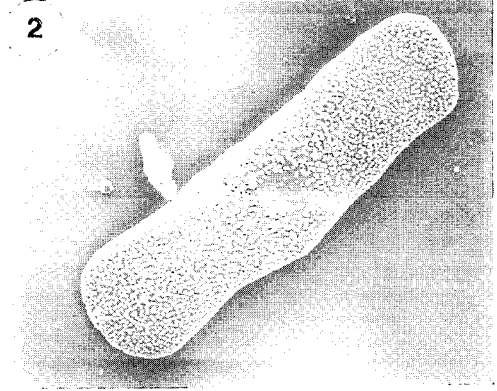


PLATE 4

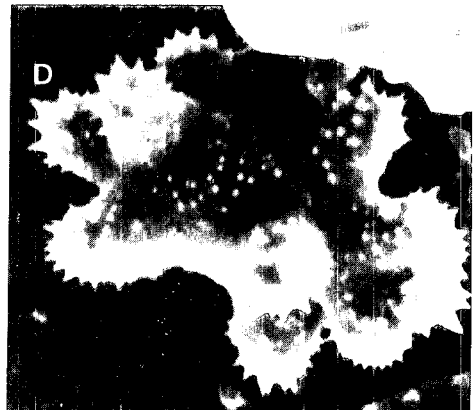
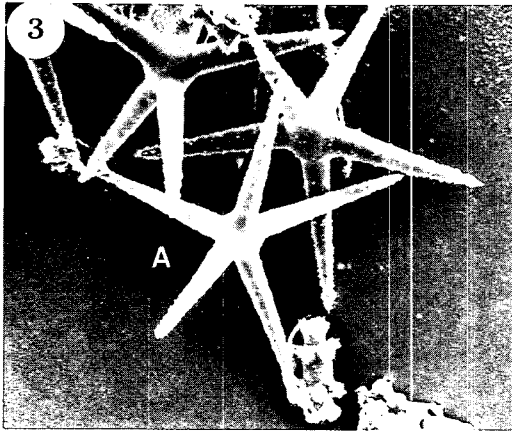
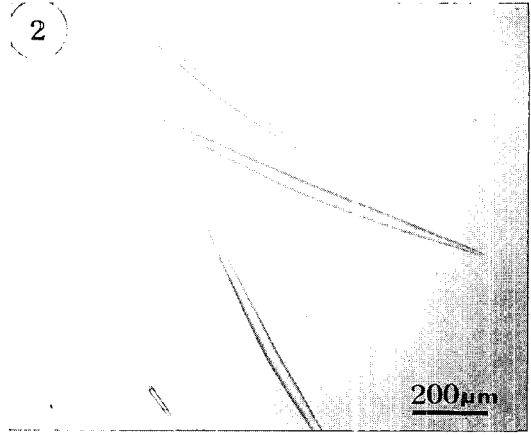
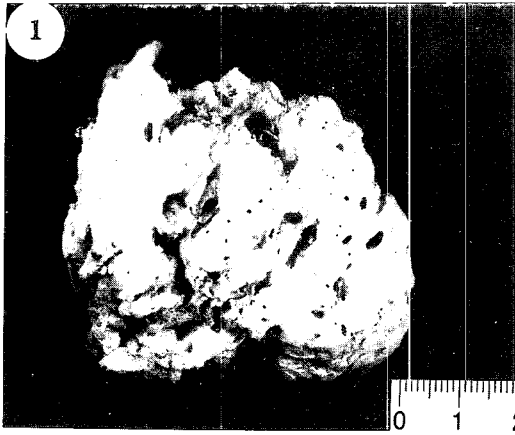


PLATE 5

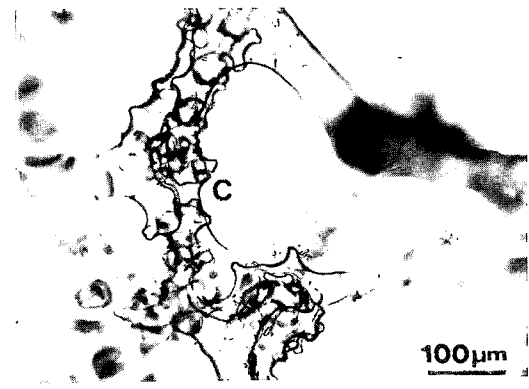
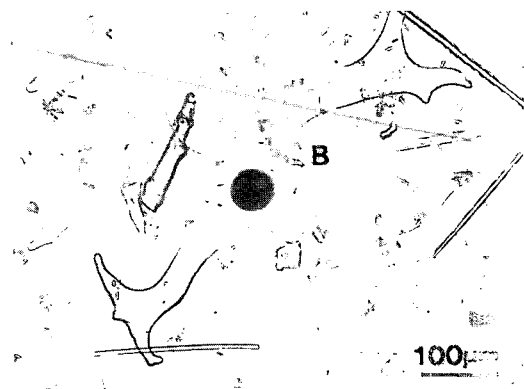
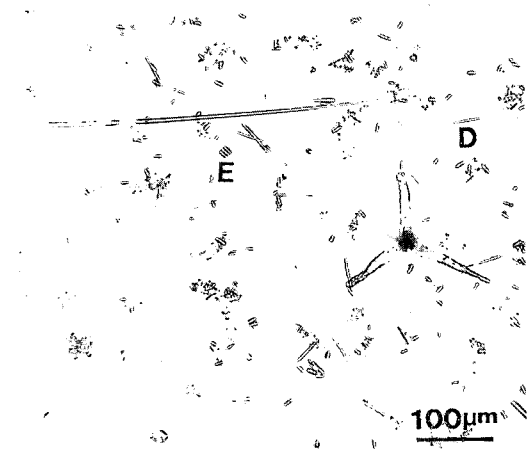
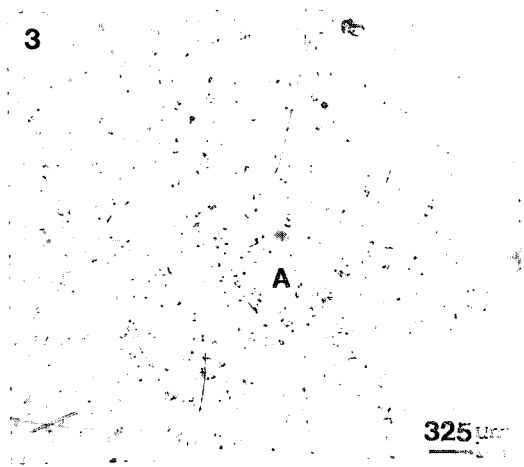
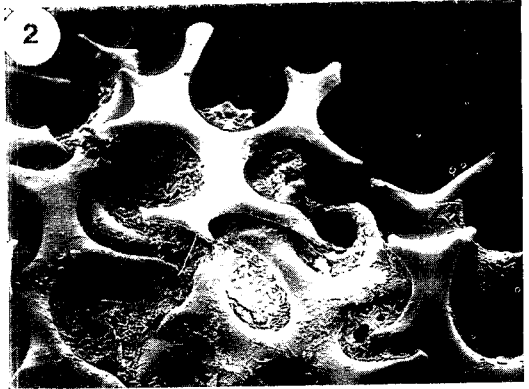
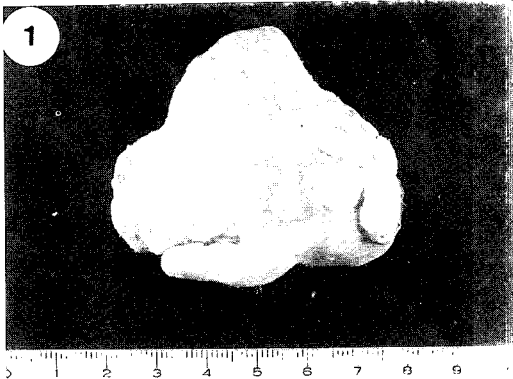


PLATE 6

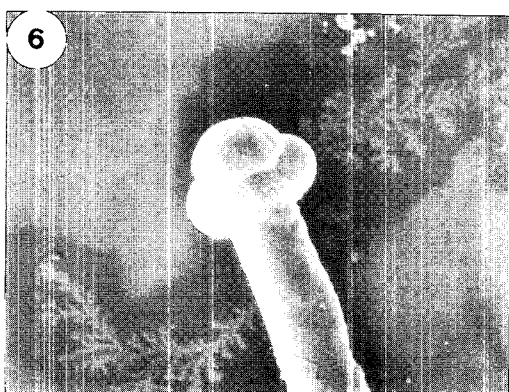
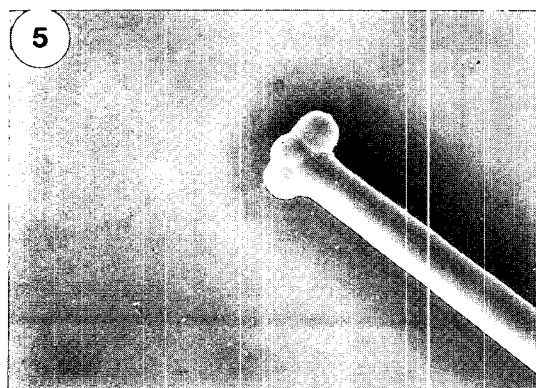
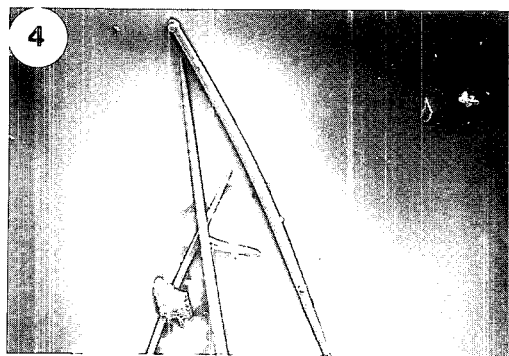
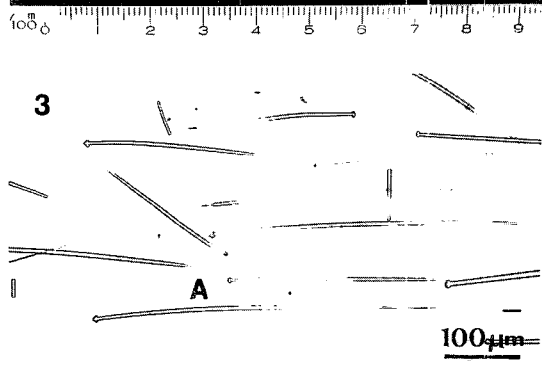
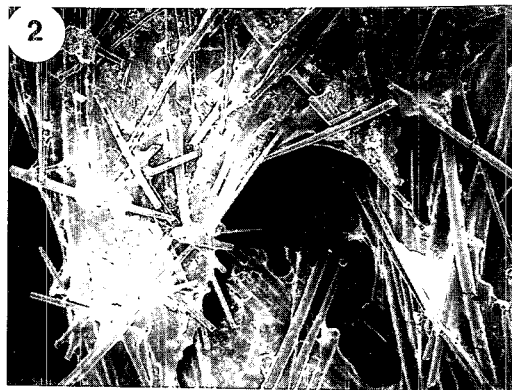


PLATE 7

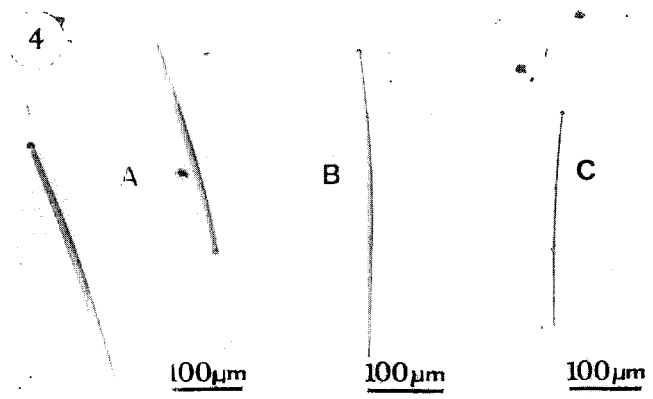
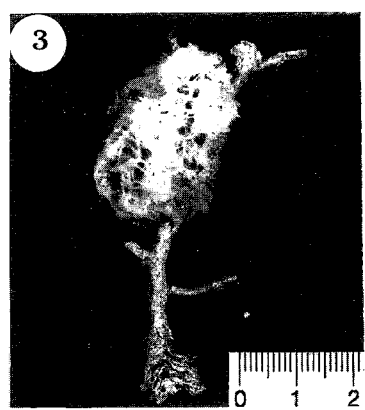
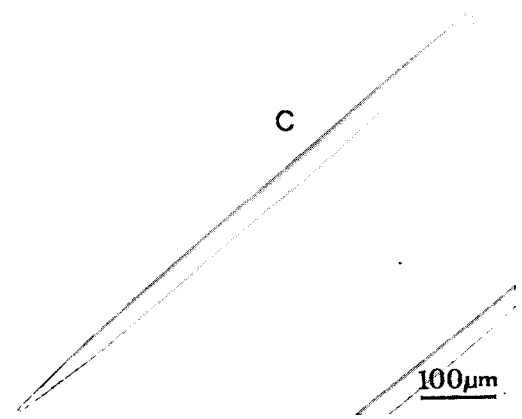
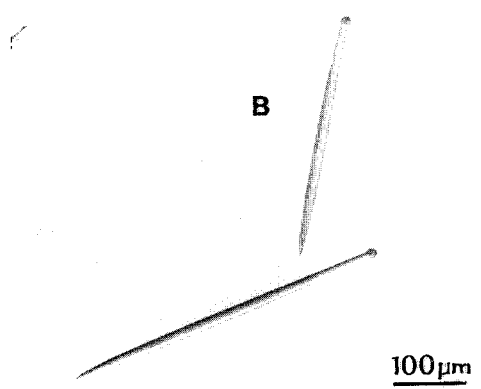
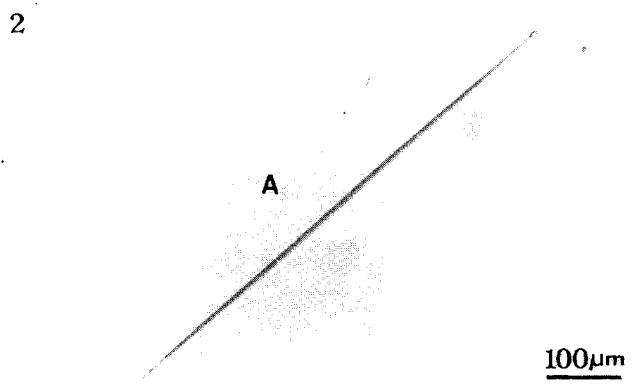
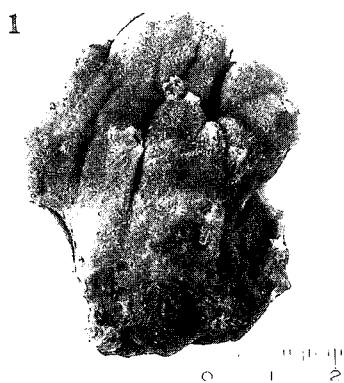


PLATE 8

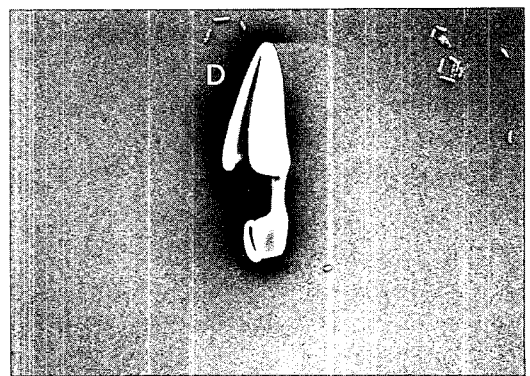
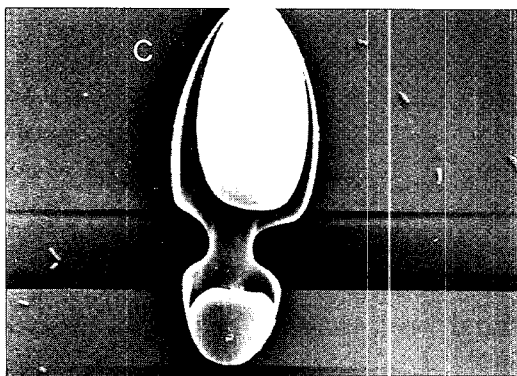
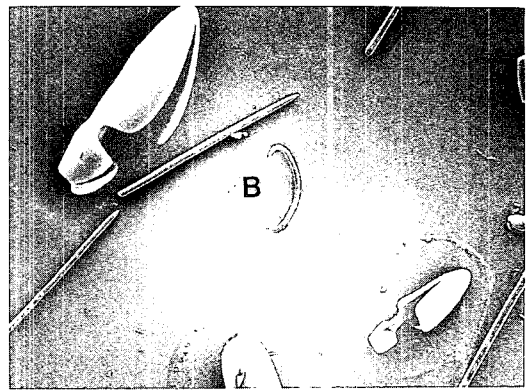
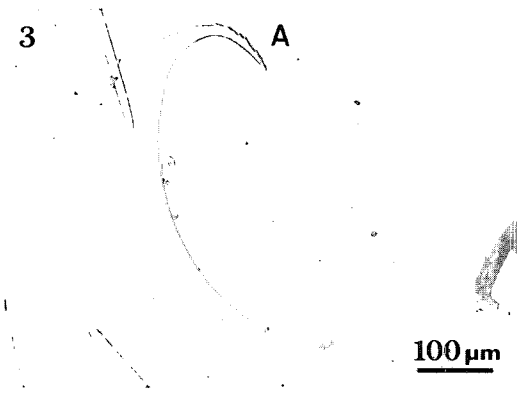
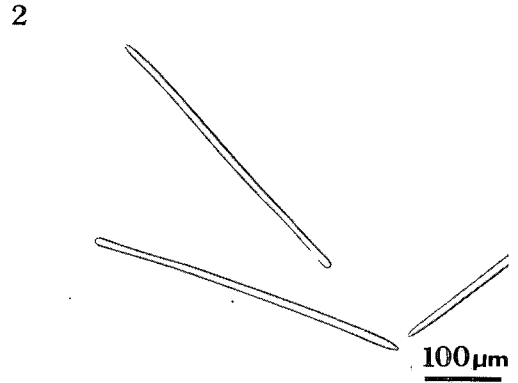
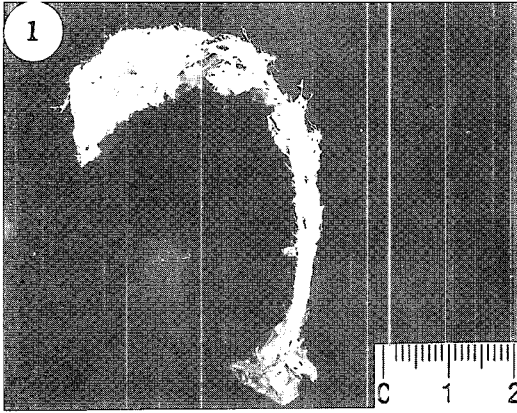


PLATE 9

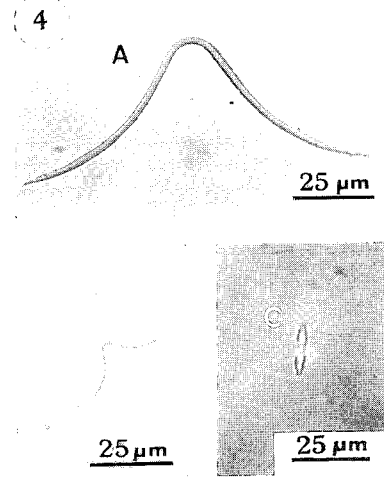
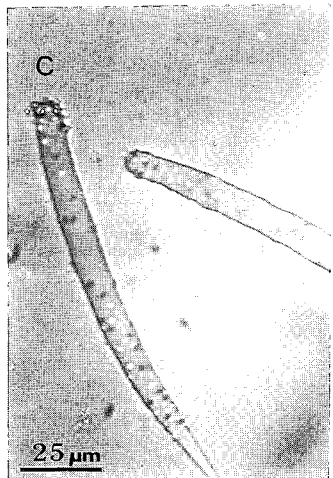
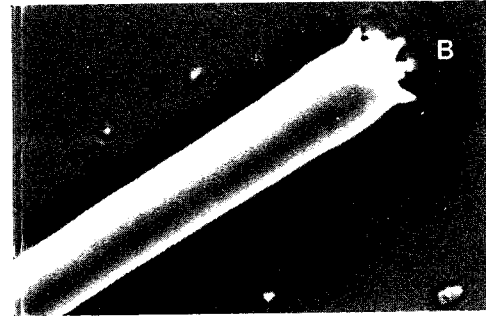
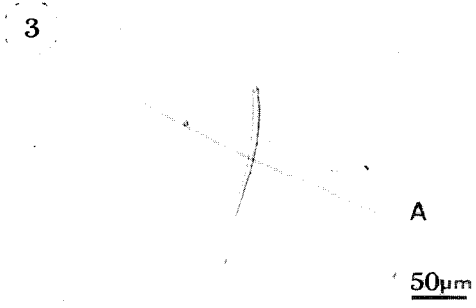
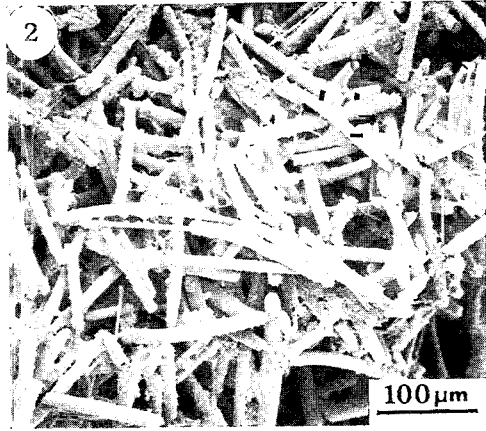
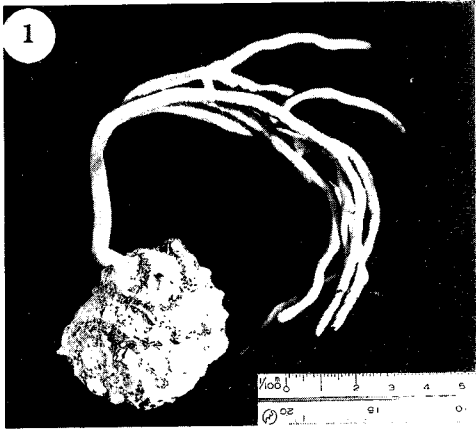


PLATE 11

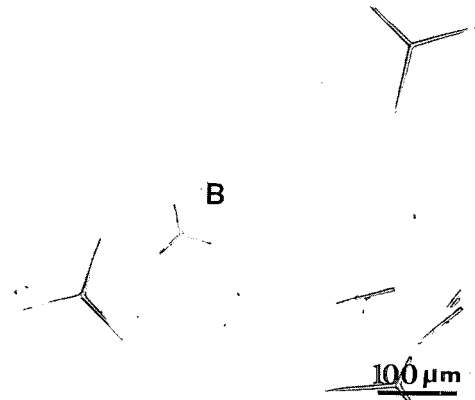
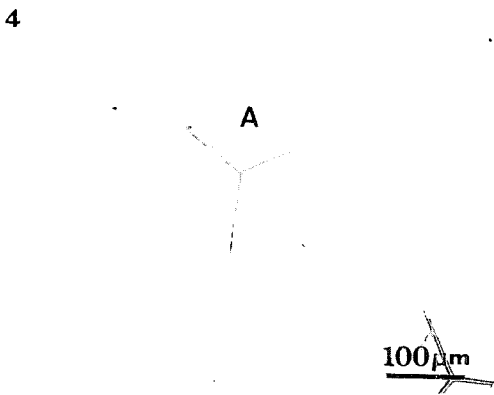
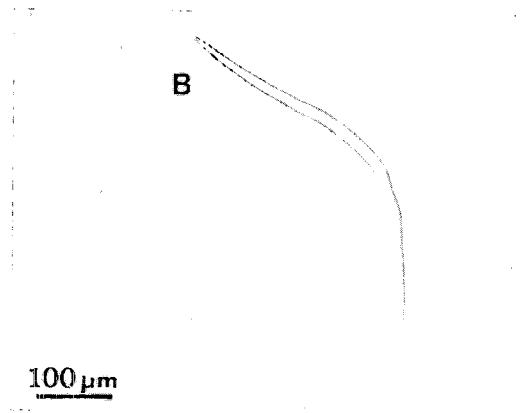
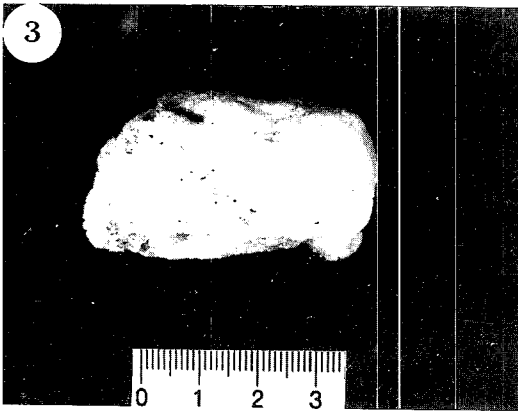
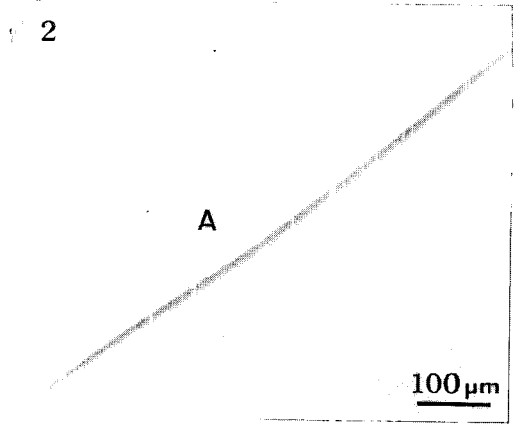
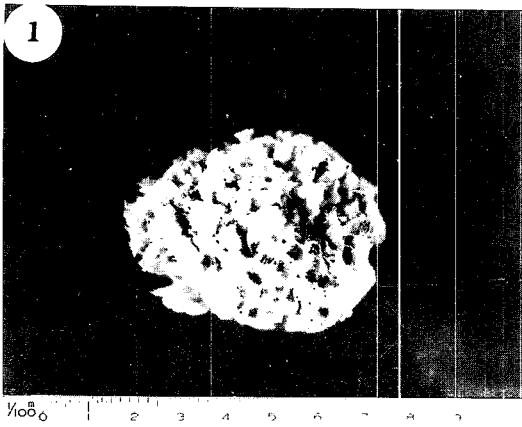


PLATE 10

