STUDIES ON THE MELOBESIOIDEAE OF JAPAN. V

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8. **Clathromorphum compactum** (Kjellman) Foslie

Pl. I, Figs. 1 & 2; Pl. II, Figs. 1–5; Pl. III

Foslie, 1898, p. 4; 1898*a*, p. 8; 1900*a*, p. 10; 1908, p. 11; 1929, p. 29, pl. 41, figs. 1–4; De Toni, 1905, p. 1726; Mason, 1953, p. 331, pl. 37, fig. c; Segawa, 1956, p. 70, pl. 40, fig. 309; Kawabata, 1959, p. 292.

Syn. *Lithothamnium compactum* Kjellman, 1883, p. 101, pl. 6, figs. 8–12; Foslie, 1895, p. 103, pl. 19, figs. 1–4; Lemoine, 1911, p. 98; Zinova, 1955, p. 78, fig. 67. *Phymatolithon compactum* (Kjellm.) Foslie, 1905, p. 88; Taylor, 1937, p. 260; 1957, p. 243. *Ph. compactum* f. *typicum* Foslie, 1905, p. 88.

Japanese name. Kita-ishimo (Segawa).

Habit and distribution, in literature. On rocks, stones and shells, and epiphytic on *Lithothamnium*, in sublittoral belt to 40 meters depth. Shirikishinai, Prov. Oshima, Hokkaido, and eastern coast of Hokkaido, Japan; Kurile Islands; Behring Sea; Alaska; northeastern coast of North America; Greenland; Ellesmere Island; Spitsbergen; Novaya Zemlya; Norway.

Specimens collected. On stones and shells, and epiphytic on *Lithothamnium lenormandii*. Akkeshi, Prov. Kushiro, Hokkaido, 5 November 1958, F. Iwata; 29 April 1960, H. Yamamoto; Erimo-misaki, 24 August 1961, T. Kaneko.

Thallus in the form of crusts firmly adherent to substratum, nearly orbicular in outline, 2–5 cm diam., often overgrowing one another in old specimens, surface usually smooth and plain, but sometimes more or less uneven owing to the shape of substratum, upheaved at border lines of confluent individuals, surface becoming coarse in the greater part of old crusts, being provided with numerous minute concave holes visible to the naked eye, especially in tetrasporic individuals which have a honeycomb-like appearance under a magnifying glass after the spores have been liberated; single crust 1–1.5 mm thick in tetrasporic, 0.5–0.7 mm thick in female, and 0.3–0.7 mm thick in male individuals; hypothallium poorly developed, consisting of 1–5 layers of cells which are elongated parallel to substratum, 12–43 μ long by 5–9 μ diam.; perithallium abruptly arising from hypothallium, cells rectangular, 5–11 μ long by 5–12 μ diam., often shorter than diameter; cell-fusion frequently occurring between adjacent cell-rows; epithallium conspicuous, consisting of 3–8 layers of subquadrate cells which are 5 μ in diam.; sporangial conceptacles crowded, immersed, subspherical or elliptical in section, 190–313 μ

diam., 168–230 μ high, roof 42–63 μ thick, nearly flat or slightly elevated on surface, but at maturity becoming sunken as a result of decortication, intersected by 10–20 muciferous canals; sporangia tetrasporic, 92–147 μ long, 42–80 μ diam., four sporangia standing in section on the central part of floor in each conceptacle; procarpic conceptacles flat, 84–105 μ high, 126–168 μ diam., carpogonial branches and their supporting cells stained deeply with haematoxylin and anilin blue; cystocarpic conceptacles flat, 168–230 μ high, 210–292 μ diam., ostiole narrow, fusion-cell discontinuous in section, supporting cell of carpogonial branch fused or not after fertilization with fusion-cell, carpospores arising from periphery of fusion-cell; spermatangial conceptacles flat, 55–70 μ high, (126–) 168–230 μ diam., roof 25–34 μ thick, orifice narrow and short without a spout, spermatangia globular, 2 μ diam.

Foslie established *Clathromorphum* in 1898, but in 1905 he reduced it to the rank of subgenus in *Phymatolithon* because its sporangia appeared to have a close resemblance to those of the latter genus. However, in 1908 he treated *Clathromorphum* as a genus again. Lemoine (1911) pointed out that there was no difference between *Clathromorphum* and *Lithothamnium* so far as the number of muciferous canals and the form of sporangial conceptacles were concerned.

Procarpic, cystocarpic and spermatangial plants have been unknown to this genus to date. The writers fortunately could observe all of them besides the hitherto known sporangial plants in the specimens referable to the present species collected at Akkeshi on November 5, 1958, by Dr. Fumio Iwata of the Faculty of Science, Hokkaido University, to whom the writers are much obliged for his kindness in sending the specimens to them. The sexual conceptacles of these specimens have been proved to show characters different from those of *Phymatolithon polymorphum*, the type of the genus. The spermatangia in *Phymatolithon* and *Lithothamnium* are produced in dendroid clusters (cf. Suneson, 1943, fig. 11) while those of the specimens under consideration are of simple type as shown in Pl. III, Fig. 7. The procarpic and cystocarpic conceptacles of the writers' specimens have a strong resemblance to those of *Polyporolithon reclinatum* (cf. Masaki & Tokida, 1961) and *Mesophyllum lichenoides* rather than those of *Phymatolithon polymorphum*. From these facts, the writers conclude that the validity of recognition of *Clathromorphum* as an independent genus is now more fully established.

Of the three species enumerated by Mason (1953) under *Clathromorphum*, *C. compactum* is that to which the writers' specimens are referable as learnt from the above description. However, as compared with the descriptions of the species given by previous authors, the writers' specimens do not exactly coincide with

them in that they have a somewhat thinner single crust, a slightly thicker epithallium, and the sporangia divided always into four spores. In Pl. III, Fig. 2 is shown the epithallium 5–6 layers of cells thick. The stipple in this figure indicates the cell-cavities of the epithallium cells faintly stained with haematoxylin and anilin blue, while the dark shading shows the terminal cells of the perithallium cell-rows deeply colored with the same stains.

Clathromorphum is characterized as having a deeply sunken, concave roof in mature sporangial conceptacles. The roof which is at first nearly flat or slightly elevated becomes concave as a result of decortication, as shown in Pl. III, Fig. 4 and in Pl. III, Fig. 3 at early and final stages respectively.

9. **Lithothamnium lenormandii** (Areschoug) Foslie

Pl. I, Figs. 3–5; Pl. II, Figs. 6–9; Pl. IV

Zinova, 1955, p. 83, fig. 72; Dawson, 1960, p. 20, pl. 11, fiigs. 4–6, pl. 14, fig. 2. *Lithothamnium lenormandi* (Aresch.) Foslie, 1895, p. 150; 1895*a*, p. 178; 1905, p. 12; 1929, p. 43, pl. 3, figs. 14–20; Heydrich, 1897, p. 53; 1897*a*, p. 413; 1900, p. 78, pl. 2, figs. 23–25; De Toni, 1905, p. 1756; 1924, p. 620; Lemoine, 1911, p. 81; Rosenvinge, 1917, p. 216, figs. 133–135; Suneson, 1943, p. 5, pl. 1, figs. 1–4, pl. 8, fig. 36, text-figs. 1–3; Hamel & Lemoine, 1953, p. 89, figs. 49–50, pl. 16, 17, 18, fig. 1; Taylor, 1937, p. 262; 1957, p. 245; Skottsberg, 1953, p. 554.

Syn. *Melobesia lenormandi* Areschoug, *in* J. Agardh, 1852, p. 514. *Lithophyllum lenormandi* (Aresch.) Rosanoff, 1866, p. 85, pl. 5, figs. 16–17, pl. 6, figs. 1–3, 5; Hauck, 1885, p. 267, pl 3, fig. 4.

Japanese name. Akkeshi-ishimo (n.n.).

Habit and distribution, in literature. On rocks, stones, shells of molluscs (e. g. *Littorina, Modiola, Mytilus* and *Trochus*), lime tubes of a worm (*Pomatoceros triqueter*), and other calcareous algae. From tide-pools and lower sublittoral to 14–36 meters. Pacific and Atlantic coasts of North America; Pacific coast of Mexico; Iceland; Faeröes; British Isles; Norway; Sweden; Denmark; Germany; France; Australia; Mediterranean; Adriatic; Arctic; Antarctic.

Specimens collected. On stones and pebbles. Akkeshi, Hokkaido, 29 May 1960, H. Yamamoto.

Thallus in the form of firmly adherent thin crusts, 100–200 μ thick, 2–5 cm diam., confluent with each other, surface smooth but microscopically rough, peripheral portion forming rounded, zonate lobes with whitish margins; hypothallium 40–85 μ thick, consisting of 5–8 layers of cells, cells rectangular, 12–25 (–34) μ long, 7–12 μ diam.; perithallium arising abruptly from hypothallium, cells subspherical and 9 μ diam., or subrectangular to elliptical or ovoid and 7–12 μ long by 4–7 μ

diam., coalescence of cells occurs; epithallium consisting of 1–2 layers of cells, cells rectangular, 4 μ high by 9 μ diam.; sporangial conceptacles crowded, depressed-hemispherical, often subprominent with floor at the same level as the crust surface, but sometimes immersed, 200–350 μ diam., 84–160 μ high, roof 21–42 μ thick, perforated by numerous muciferous canals up to 80 in number, ultimately decorticate, leaving a large depression visible from surface (Pl. I, Fig. 4), sporangia quadrinucleate before division, producing usually binucleate bispores or rarely also tetraspores, both kinds of spores produced in one and the same conceptacle, bi- and tetrasporangia of similar size, 80–145 μ long, 20–75 μ diam.; procarpic conceptacles hemispherical to subconical, 100–190 μ in inner diam., ca. 170 μ high, roof about 50 μ thick, cystocarpic conceptacles hemispherical to subconical, 190–380 μ in inner diam., 125–230 μ high, roof 42–63 μ thick, carpospores arising from the whole surface of the conceptacle floor, no fusion-cell developed after fertilization, ripe carpospores 97–105 μ long, 30–55 μ diam.; spermatangial conceptacles subhemispherical or subconical, 105–210 μ in inner diam., 63–105 μ high, roof ca. 42 μ thick, spermatangia globular, 3 μ diam., produced on dendroid systems of filaments developed from the whole inner surface of conceptacle; dioecious.

The writers' specimens from Akkeshi here described are in general referable to the present species which is widely distributed in the world but not reported to date from Japan. However, as compared with the descriptions of this species given by previous authors, the writers' specimens show some differences in certain respects, namely in rather smaller size of the sexual conceptacles, in larger number of pores* in the roof of a sporangial conceptacle, and in the production of usually binucleate bispores or rarely also tetraspores in one and the same conceptacle instead of producing generally tetraspores but also uninucleate bispores in different crusts (cf. Suneson, 1943, p. 6, fig. 2 B). The spermatangia in this species are described by Suneson (1943, p. 7) as being produced in dendroid clusters developed only from the bottom of the conceptacle, while those of the writers' specimens in dendroid clusters developed not only from the bottom of the conceptacle but also from the inside of its roof (Pl. IV, Fig. 8). In Pl. II, Fig. 7 is shown a section of a crust bearing both male and female conceptacles. However, there can be seen a clear boundary of tissues beneath the female conceptacle disclosing the fact that such an apparent monoecious crust is no other than a product of overlapping growth of two crusts differing in sex from each other.

Summary

1. In this paper are described and illustrated the following two crustaceous

* 45–50 in smaller conceptacles but up to 80 or more in larger ones.

corallines collected at Akkeshi, Prov. Kushiro, Hokkaido.

2. *Clathromorphum compactum* (Kjellm.) Foslie is not new to Hokkaido, but sexual reproductive organs are described herein for the first time not only in this species but also in this genus.

3. *Lithothamnium lenormandii* (Aresch.) Foslie is reported herein to be new to Japan, though there are some differences between the characters of the writers' specimens and the descriptions of the species given by previous authors.

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(For further references: see the preceding reports, I–IV)

EXPLANATION OF PLATES

PLATE I

Clathromorphum compactum (Kjellman) Foslie

Fig. 1. Habit of plant ×1

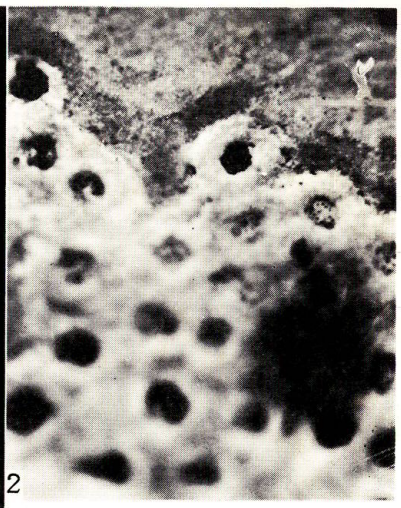
Fig. 2. Surface detail of a sporangial plant showing conceptacles and muciferous canals visible on the conceptacle roof as minute black dots ×50

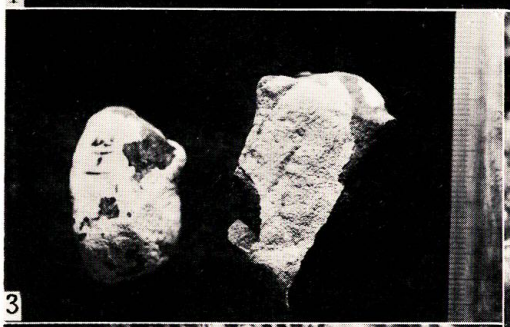
Lithothamnium lenormandii (Areschoug) Foslie

Fig. 3. Habit of plant ×0.7

Fig. 4. Surface detail of a sporangial plant ×3.5

Fig. 5. Detail of the surface showing hemispherical tetrasporangial conceptacles and muciferous canals visible in the shade of the conceptacle roof as minute black dots ×50





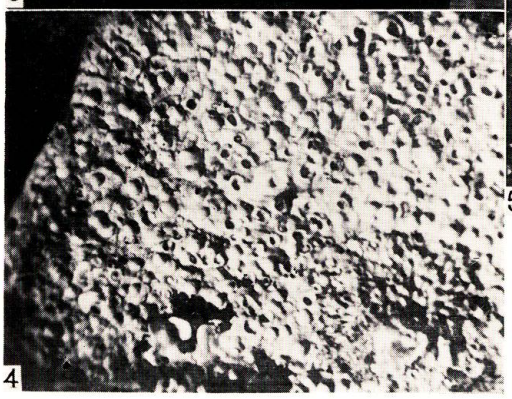


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PLATE II

Clathromorphum compactum (Kjellman) Foslie

Photomicrographs of vertical sections of plant

Fig. 1. Tetrasporangial crust ×44

Fig. 2. Emptied tetrasporangia with a decorticated concave roof ×72

Fig. 3. Spermatangial crust ×72

Fig. 4. Procarpic crust ×72

Fig. 5. Cystocarpic crust ×72

Lithothamnium lenormandii (Areschoug) Foslie

Photomicrographs of vertical sections of plant

Fig. 6. Tetrasporangial crust ×72

Fig. 7. Apparently monoecious crust with spermatangial and cystocarpic conceptacles ×44

Fig. 8. Procarpic conceptacle ×104

Fig. 9. Cystocarpic conceptacle ×104

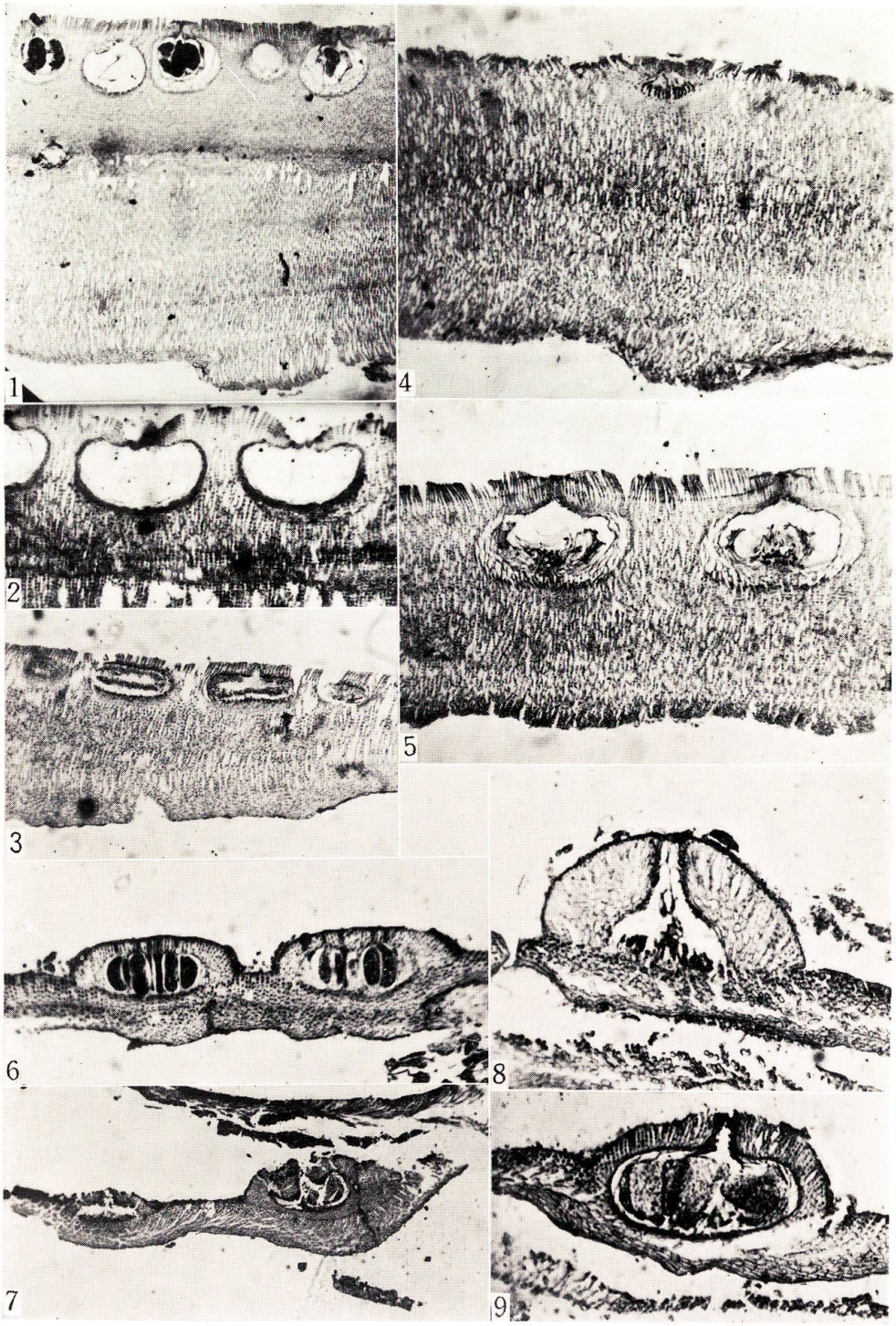

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PLATE III

Clathromorphum compactum (Kjellman) Foslie

Fig. 1. Part of vertical section through hypothallium and perithallium

Fig. 2. Part of vertical section through perithallium and epithallium

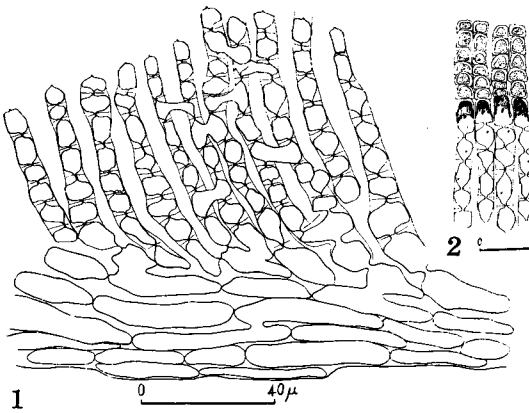
Fig. 3. Tetrasporangial conceptacle with the decorticated roof

Fig. 4. Tetrasporangial conceptacle in an early process of decortication

Fig. 5. Procarpic conceptacle

Fig. 6. Cystocarpic conceptacle

Fig. 7. Spermatangial conceptacle



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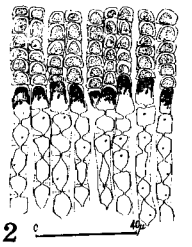

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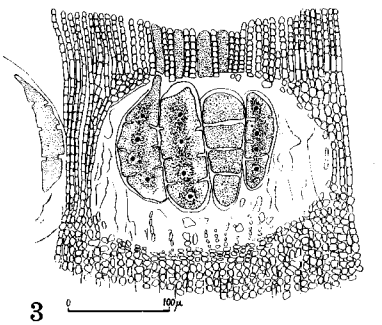

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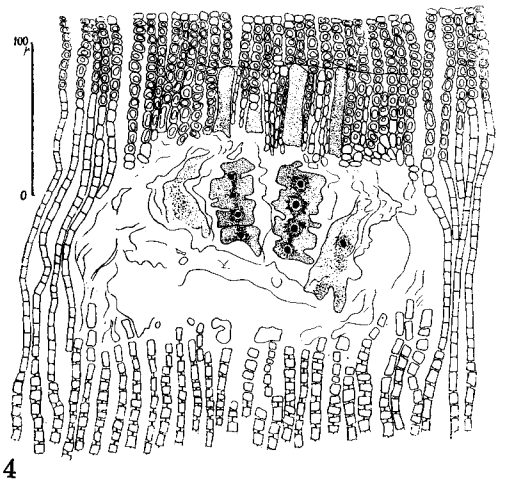

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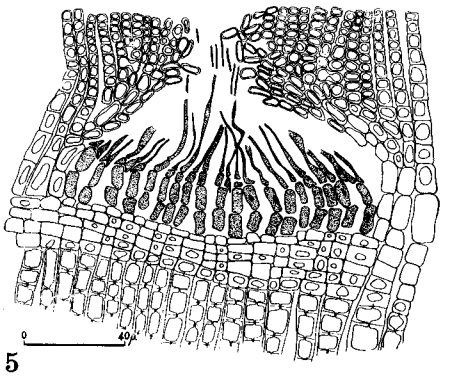

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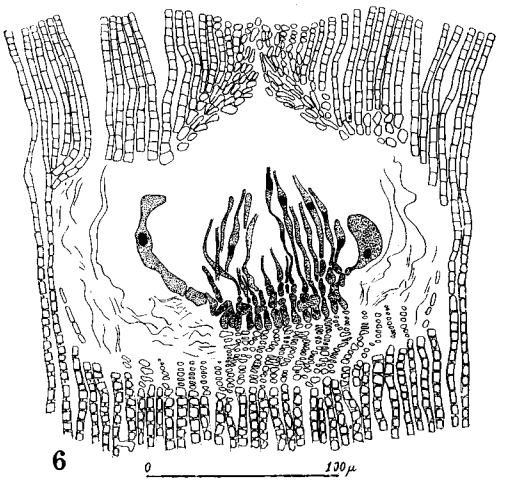

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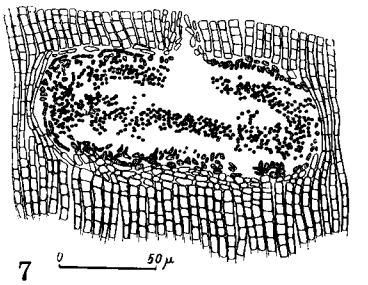

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PLATE IV

Lithothamnium lenormandii (Areschoug) Foslie

Fig. 1. Vertical section through marginal portion of a crust

Fig. 2. & 3. Vertical section through vegetative part of a crust

Fig. 4. Sporangial conceptacle with binucleate bispores

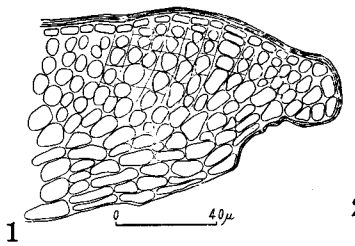
Fig. 5. Sporangial conceptacle with two still undivided tetranucleate sporangia, six bisporangia and a young tetrasporangium in an early stage of the second cell division

Fig. 6. Procarpic conceptacle

Fig. 7. Cystocarpic conceptacle

Fig. 8. Spermatangial conceptacle with dendroid clusters developed from both the bottom of conceptacle and the inside of conceptacle roof

Fig. 9. Spermatangial conceptacle with dendroid clusters developed from the bottom of conceptacle



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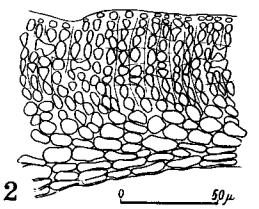

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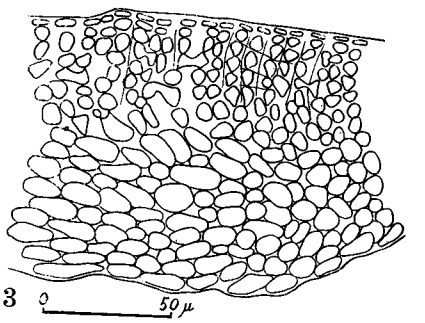

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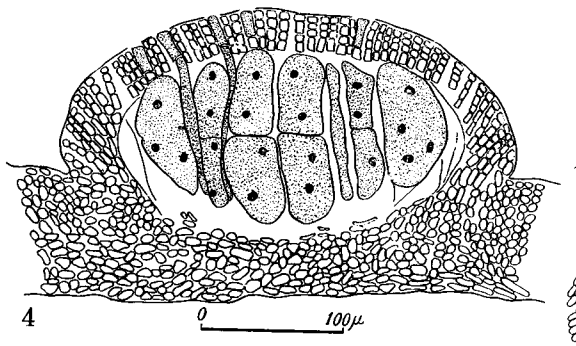

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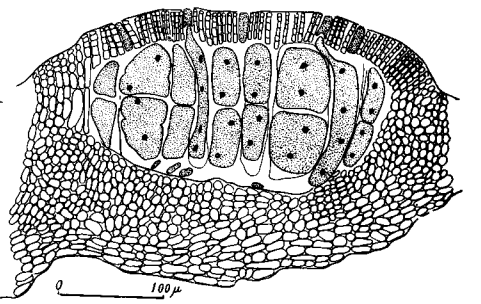

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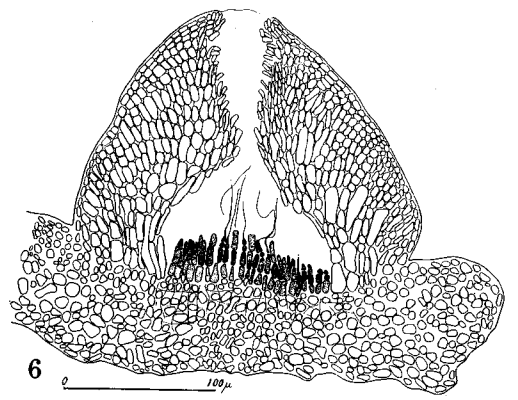

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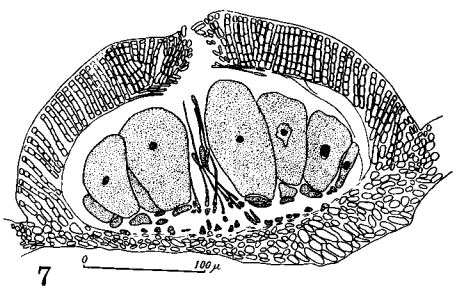

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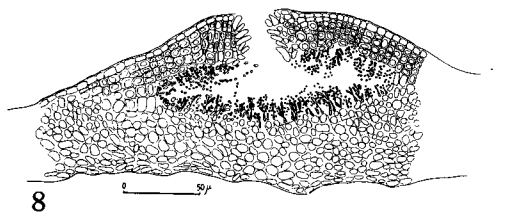

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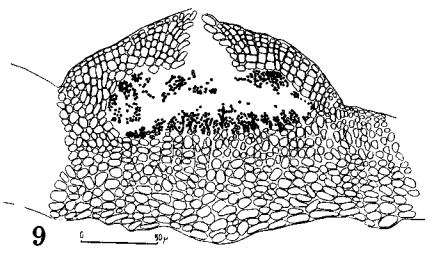

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