

CRUSTOSE CORALLINACEOUS ALGAE (RHODOPHYTA) OF THE NEW ZEALAND AND UNITED STATES SCIENTIFIC EXPEDITION TO THE ROSS SEA, BALLENY ISLANDS, AND MACQUARIE RIDGE, 1965

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SUMMARY

Fourteen taxa of crustose *Corallinaceae* are described from a collection of marine algae picked up in Antarctic and sub-Antarctic waters along a Ross Sea — Balleny Islands — Macquarie Island tract aboard the USS *Glacier* in 1965. Three of these taxa are newly described, i.e. *Lithothamnium macquariensis*, *L. zaneveldii* and *Phymatolithon lenormandii* f. *macquariensis*. Two of the taxa recognized (*Lithothamnium foecundum* and *L. laeve*) appear to have a bipolar distribution. The remainder of the taxa collected are restricted to the southern hemisphere. The observed depth distribution of these crustose corallines shows that only one of the fourteen taxa is steno-eulittoral and four taxa are steno-elittoral. The remainder of the taxa cover a wide vertical range, i.e. from the eulittoral or sublittoral down into elittoral depths.

INTRODUCTION

Ever since macroscopic benthic marine algae have been collected in Antarctic waters, collections of crustose *Corallinaceae* in the region south of the Antarctic Convergence (map 1) remained very rare; according to Papenfuss (1964) no more than eight taxa. The first known epilithic coralline species was collected by Scott's *Discovery* Expedition (1901–1904). The species was shortly mentioned by Foslie in 1905 as *Lithothamnium coulmanicum*, and fully described by the same author in 1907. Adey (1970a) transferred the specimen to the genus *Leptophytum*. The pebbles with the algal incrustations came from a depth of 33 meters and were collected off Cape Wadworth on Coulman Island in the Ross Sea.

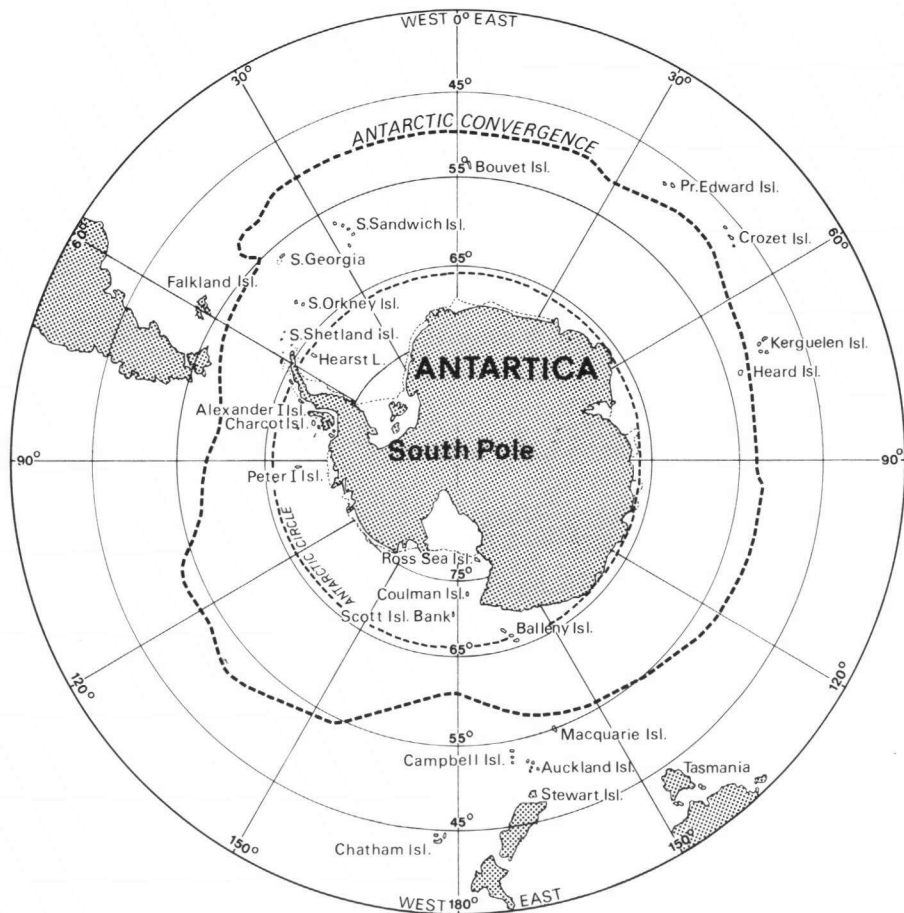
The present study consists of a systematic evaluation of the crustose coralline portion of the Antarctic benthic marine algae, collected by the senior author, while partaking in the combined New Zealand-United States Expedition to the Ross Sea, the Balleny Islands, and Macquarie Ridge, aboard the USS icebreaker *Glacier* from January 10 to March 4, 1965, covering 8,100 miles (Seelig, 1965; Polard Record, 1966; Map 2).

C l a s s i f i c a t i o n — The taxonomic classification in the present paper is based on the concepts of Adey (1970a), Adey and Johansen (1972), Johansen (1976) and Lebednik (1977).

T e c h n i q u e s — Identification in each case was based largely on the characteristics of the reproductive organs and the thallus as seen in vertical cross sections. Sectioning was conducted by a method developed by the junior author, which

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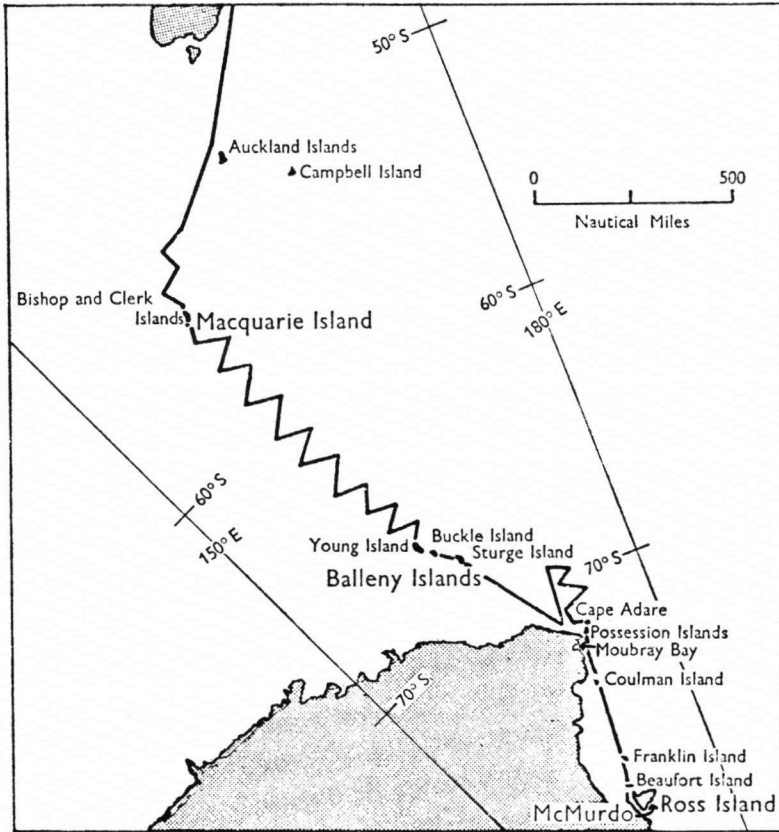
** U.S. Environmental Protection Agency, Water Safety Department, Washington, U.S.A.



Map 1. Location of the Antarctic Convergence on February 19th, 1965.

consisted of decalcification with 0.5% HCl, freezing with electronic circuit cooler, and hand sectioning with a razor blade under a dissecting microscope. Specimens were kept moist at all times, stained in multiple polychrome EA-65 (Ortho), and mounted in water soluble 'clearcol' for permanent filing. Occasionally holomounts were made of monostromatic or distromatic specimens. The color mentioned in each of the specimens is that of the alga in dried form.

Habitat conditions — Physical conditions within the Ross Sea such as salinity, temperature, light intensity, and tidal amplitude were described by Zaneveld (1966a, b). For those of the Balleny Islands one should consult Quatermain (1964) and for Macquarie Island Kenny and Hayson (1962). Many useful data are also contained in the U. S. Navy Hydrographic Office Sailing Directions for Antarctica (1960). As border region between Antarctic and sub-Antarctic waters is taken the Antarctic Convergence (map 1) which was identified



Map 2. Track of USS icebreaker *Glacier* during the western Ross Sea. Balleny Islands and Macquarie Ridge New Zealand and United States Scientific Expedition, 1965.

during the track on February 19, 1965 at latitude $61^{\circ} 28' S$, longitude $158^{\circ} 06' E$ and latitude $60^{\circ} 29' S$, longitude $158^{\circ} 52' E$. At this date, during a period of eight hours, the surface water showed a rise in temperature from 2.5° to $4.4^{\circ} C$, and in salinity from 32.0‰ to 33.4‰ . Hence, the Antarctic convergence runs just south of Macquarie Island, the Falkland Islands, and the Kerguelen Islands, but north of South Georgia and Bouvet Island. However, hydrologically South Georgia lies within the Antarctic zone, but from a phycogeographical viewpoint South Georgia belongs to the sub-Antarctic zone, Bouvet Island to the Antarctic (Deacon, 1937; Skottsberg, 1941). The surface 0° isotherm forms the northern limit of the Antarctic algal flora. Macquarie Island lies between the surface isotherms of 2° and 8° , the Falkland Islands between 5° and 6° , South Georgia between 0° and 2° , the easterly South Shetland Islands and the northernmost South Sandwich Islands between 0° and -1° ; all the other Antarctic Islands fall south of -1° . Some seaweed species are good indicators of the temperature zones; the giant phaeophyte *Durvillea* is unable to live under Antarctic conditions, but it forms thick submarine forests around

Species	Victoriand, Ross Sea Is.	Smith I., Balleny Is.	Macquarie I.	Campbell Is., Auckland Is. New Zealand, Australia	Antarctic Peninsula offshore Is., S. Shetland Is., S. Orkney Is.	Kerguelen Is.	South Georgia Is.	Falkland Is.	Magellaen Str., Fuegia	North America	Europe, Asia	Arctic region
<i>Lithophyllum atalayense</i>	-	-	+	-	-	-	-	-	+	-	-	-
<i>Heteroderma leptura</i>	-	-	+	+	-	-	-	-	-	-	-	-
<i>Pseudolithophyllum</i>												
<i>aequabile</i>	-	-	+	-	+	-	+	-	-	-	-	-
<i>almanense</i>	-	-	+	-	-	-	+	-	+	-	-	-
<i>discoideum</i>	-	-	+	-	-	-	+	+	+	-	-	-
<i>Lithothamnium</i>												
<i>macquariensis</i>	-	-	+	-	-	-	-	-	-	-	-	-
<i>neglectum</i>	-	-	+	+	-	+	-	+	+	-	-	-
<i>schmitzii</i>	+	-	+	-	+	-	+	+	+	-	-	-
<i>zaneveldii</i>	-	-	+	-	-	-	-	-	-	-	-	-
<i>Phymatolithon lenormandii</i> f. <i>macquariensis</i>	-	-	+	-	-	-	-	-	-	-	-	-
<i>Leptophyllum asperulum</i>	-	-	+	+	-	-	-	-	-	-	-	-
<i>coulmanicum</i>	+	-	+	-	-	-	-	-	-	-	-	-
<i>foecundum</i>	+	+	+	-	-	-	-	-	-	-	+	+
<i>laeve</i>	+	-	-	-	-	-	-	-	-	+	+	+

Table 1

Geographical distribution of the crustose *Corallimaceae* of the western Ross Sea, Balleny Islands, Macquarie Island traject, 1965.

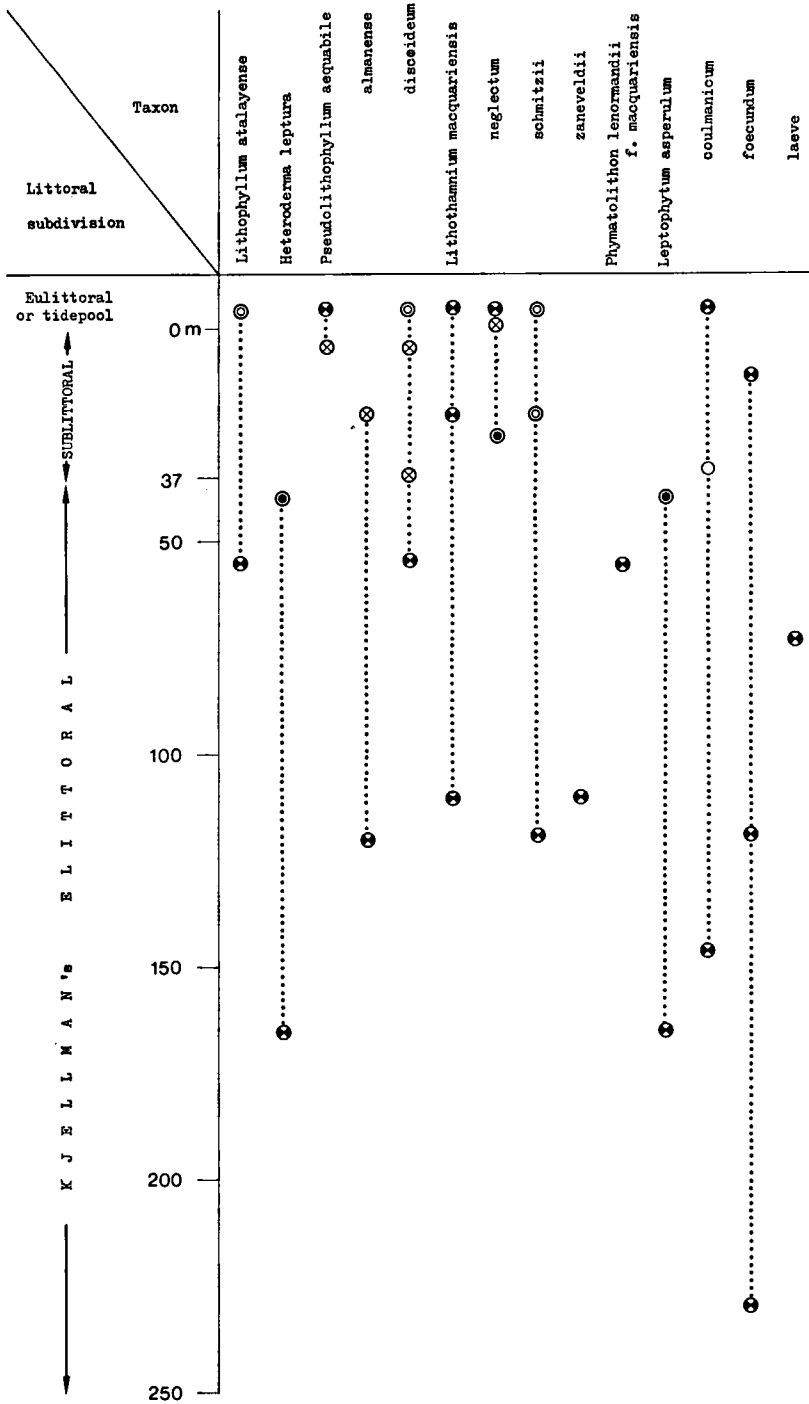
Macquarie Island. On the other hand, another giant phaeophyte, *Phyllogigas grandifolius* luxuriates in the northern part of the Ross Sea, and is therefore Antarctic, but it is absent from the sub-Antarctic (Zaneveld, 1966a, b; 1968a). Thus, out of the 14 marine crustose coralline taxa described in the present paper only 4 are endemic of Antarctic waters.

Geographical distribution—The worldwide distribution of the taxa mentioned in the present paper can be seen in Table 1. According to this data two

Table 2. Vertical distribution in Antarctic waters of the crustose corallines collected along the western Ross Sea, Balleny Islands, Macquarie Island traject, 1965

The depth record symbols refer to the following papers:

○ Foslie 1905, 1907a; ⊙ Lemoine 1913, 1920, 1940; ● Levring 1945, 1960; ⊗ Skottsberg 1923, 1941, 1953; ⊕ Zaneveld and Sanford, 1980.



out of the 14 crustose corallines, *Lithothamnium foecundum* and *L. laeve*, appear to have a bipolar occurrence. The remainder of the taxa are restricted to the southern hemisphere.

Vertical distribution — While collecting algae in Antarctic and sub-Antarctic waters, particular attention was given to the exact depths of their occurrence. This was done either by scuba diving or by checking the ship's echo sounder (Zaneveld 1966a, b; 1968b). These depths, and those recorded in literature for the same taxa, are shown in Table 2. This data confirm earlier published findings (Zaneveld 1966a, b, c) of the existence of marine benthic algae with either stenobathic or eurybathic, sublittoral and elittoral distribution patterns. Among the 14 taxa mentioned only one is steno-elittoral and four are steno-elittoral. The remainder of the taxa are distributed from either the elittoral or sublittoral down into elittoral depths. The depth distribution of other species of crustose corallines is reported by Lemoine (1940), Johnson (1962), Johnson and Adey (1965), Adey (1970c), and Adey and MacIntyre (1973).

Ecology — The present collection was found to show certain general characteristics. Most of the algae form quite thin crusts, that is in only two cases were thalli over one mm thick. The incrustations generally tend to be without excrescences, though occasionally this characteristic was obscure, due to considerable elevation and folding at points of confluence of different specimens of the same species. Such space competition frequently involves sporophytic as well as carposporophytic specimens. In some cases confluence of the same species resulted in overgrowth or upturning of edges and in other cases to a possible cellular fusion: specimens 65-02-332c and 65-02-332d both identified as *Lithothamnium neglectum* (Foslie) Foslie. This fusion or non-fusion lead to uncertainty at times as to the possibility of two types of conceptacles on the same thallus. In only one case, though, was such a condition definitely confirmed (specimen 65-02-0578, identified as *Leptophytum foecundum* (Kjellman) Adey). According to Adey (1970b) space competition among crustose corallines seems to be regulated by marginal growth, and thus under influence of light intensity and temperature.

Collection . — All specimens, including holotypes and isotypes of new taxa, are in the Zaneveld collection at the Rijksherbarium, Leiden, The Netherlands. The collections were made by Jacques S. Zaneveld, Jim M. Curtis, and Jack K. Fletcher, indicated as (Z, C, F).

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Family CORALLINACEAE Lamouroux, 1812

KEY TO THE SUBFAMILIES, TRIBES AND GENERA MENTIONED IN THE PRESENT PAPER

- 1a. Roof of tetrasporangial conceptacles pierced by a single, large pore 2
- b. Roof of tetrasporangial conceptacles pierced by a few to many pores (Subfamily *Melobesioideae*). 4
- 2a Hypothallium multilayered (polystromatic); hypothallial cells markedly

elongate and parallel to the substrate; perithallium with secondary pit connections (Subfamily *Lithophylloideae*, Tribe *Lithophylleae*)

Genus *Lithophyllum*

- b. Hypothallium single layered (monostromatic); hypothallial cells not markedly elongate and parallel to the substrate; secondary pit connections absent (Subfamily *Mastophoroideae*, Tribe *Mastophoreae*) 3

- 3a. Perithallium weakly developed or absent in the vegetative alga

Genus *Heteroderma*

- b. Perithallium well-developed Genus *Pseudolithophyllum*

- 4a. Meristem cells large, growth by perithallial-epithallial meristem elongation; epithallial cells distinctive angular in section and thick walled ('*Lithothamnium* type cover cells'); hypothallial cells parallel to the substrate, not arranged in arched rows (non-coaxial); perithallial cells generally layered; conceptacle roofs level with surrounding surface or only slightly raised (30–40 μm) (Tribe *Lithothamnieae*) Genus *Lithothamnium*

- b. Meristem cells short, exhibiting progressive perithallial growth by elongation; epithallial cells weakly developed, rounded, and thin walled (not '*Lithothamnium* type'); hypothallial cells arranged in arched rows (coaxial); perithallial cells not layered; conceptacle roofs elevated above surrounding surface (Tribe *Phymatolitheae*) 5

- 5a. Perithallial cells more or less angular in shape, mean < 7 μm in diam.; conceptacle roofs sunken or slightly raised (< 40 μm) Genus *Phymatolithon*

- b. Perithallial cells rounded, mean > 7 μm diam.; conceptacle roofs strongly raised (ca. 90 μm) Genus *Leptophyllum*

Subfamily LITHOPHYLLOIDEAE Setchell, 1943

Type genus: *Lithophyllum* Philippi, 1837

Tribe LITHOPHYLLEAE Zanardini, 1844

Type genus: *Lithophyllum* Philippi, 1837

Genus LITHOPHYLLUM Philippi, 1837

Lectotype species (Foslie, 1898): *L. incrustans* Philippi, 1837

Lithophyllum atalayense Lemoine. — Fig. 1.

L. atalayense Lemoine, 1920: 13, pl. 1, f. 1; De Toni 1924: 677; Skottsberg 1923: 65; 1941: 12, 64, 79; Levring 1960: 39; Papenfuss 1964: 29.

Type locality: Atalaya I. Fuegia.

Thallus pink, 100–150 μm or 19–25 cells thick, epilithic, partly adnate, surface essentially smooth with exception of occasional concentric growth lines, elevated ridges where plants are confluent; edges flat. *Hypothallium* between one and three cells thick, with an occasional tendency for the few oval or rectangular shaped cells to lie with long axis parallel to the substrate and create a slight tendency toward upward curving hypothallial filaments, generally the cells are round and with little or no distinction between the cells of the hypothallium and perithallium, (2)3–7(8) \times 3–8(11) μm . *Perithallium*, in general, offers no perceptible transition from hypothallium, filamentous, generally a slight decrease in cell sizes towards surface; cells generally round and 4–7 \times 4–8 μm . *Sporangial conceptacles* monoporous, hemispherical with slight indication of a central depression in some cases, 200–250

μm diameter; both bispores and tetraspores found in same conceptacles, 19–35 \times 46–70 μm .

Collections examined: Macquarie I. (53°55' S, 158°47' E), on small rocks at 55 m depth collected by cone shaped dredge, 27 Feb. 1965, Z, C, F 65-02-0438b (Z).

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: Fuegia, Atalaya I.

Remarks: The type locality of this species is incorrectly cited by Papenfuss (1964) as being the Antarctic Peninsula. The material used by Lemoine (1920) was collected by the Swedish Magellanic Expedition to Patagonia and Fuegia on May 25, 1908 in the 'Queen Adelaide Archipelago', Fuegia and not near Adelaide Island, Antarctic Peninsula.

A distributional map of the genus *Lithophyllum* was given by Adey (1970a, fig. 2) and by Adey and MacIntyre (1973, fig. 33).

Subfamily MASTOPHOROIDEAE Setchell, 1943

Type genus: *Mastophora* Decaisne, 1842

Tribe MASTOPHOREAE Svedelius in Engler and Prantl, 1911

Type genus: *Mastophora* Decaisne, 1842

I. Genus HETERODERMA Foslíe, 1909

Lectotype species (Setchell and Mason, 1943): *H. subtilissima* (Weber-van Bosse et Foslíe, 1904) Foslíe, 1909

Heteroderma leptura (Foslíe) Foslíe. — **Fig. 6, 7.**

H. leptura Foslíe, 1909: 56; Adey 1970a: 16; South 1976b: 42. — *Melobesia leptura* Foslíe, 1906: 16; De-Toni 1924: 648; Levring 1945: 15; Papenfuss 1964: 32; Adams 1972: 74; Chapman and Parkinson 1974: 188.

Type locality: Island Bay, New Zealand.

Thallus reddish-brown, 5–30 μm thick, epizoid on shells of molluscs, monostromatic or oligostromatic, entirely adnate, smooth but with many concentric growth lines, very fragile: filament direction very obvious on vertical view, edges flat and scalloped. *Hypothallium* in vertical view monostromatic in some areas and distromatic or oligostromatic in others, cells in vertical view in monostromatic areas (4)5–16(18) \times (11)12–23(24) μm , 10% with lateral fusion; in distromatic areas superficial cells 5–10(17) \times 7–12(17) μm ; in cross section hypothallium consists of a single row of large oval or irregular cells, with long axes almost entirely parallel to substrate (occasionally long axis is perpendicular to substrate), cells (5)7–14 \times (6)9–21 μm . In areas where a *perithallium* exists, transition from hypothallium is abrupt, with perithallial cells considerably smaller or with long axis approximately perpendicular to substrate, occasional fusion; the perithallium one cell thick in sterile areas to five cells thick in vicinity of conceptacles; cells varying from round to subrectangular or irregular, with long axis perpendicular to hypothallium in approximately 25% of cases, cells 4–7(11) \times 5–18 μm . *Epithallium* one to several cells thick when present, cells 4 \times 4–9 μm . *Sporangial conceptacles* monoporus, partly immersed, hemispherical to conical and irregular in shape, 180–300 μm diameter, bispores 27–40 \times 50–70 μm . *Cystocarpic conceptacles* 200–370 μm diameter.

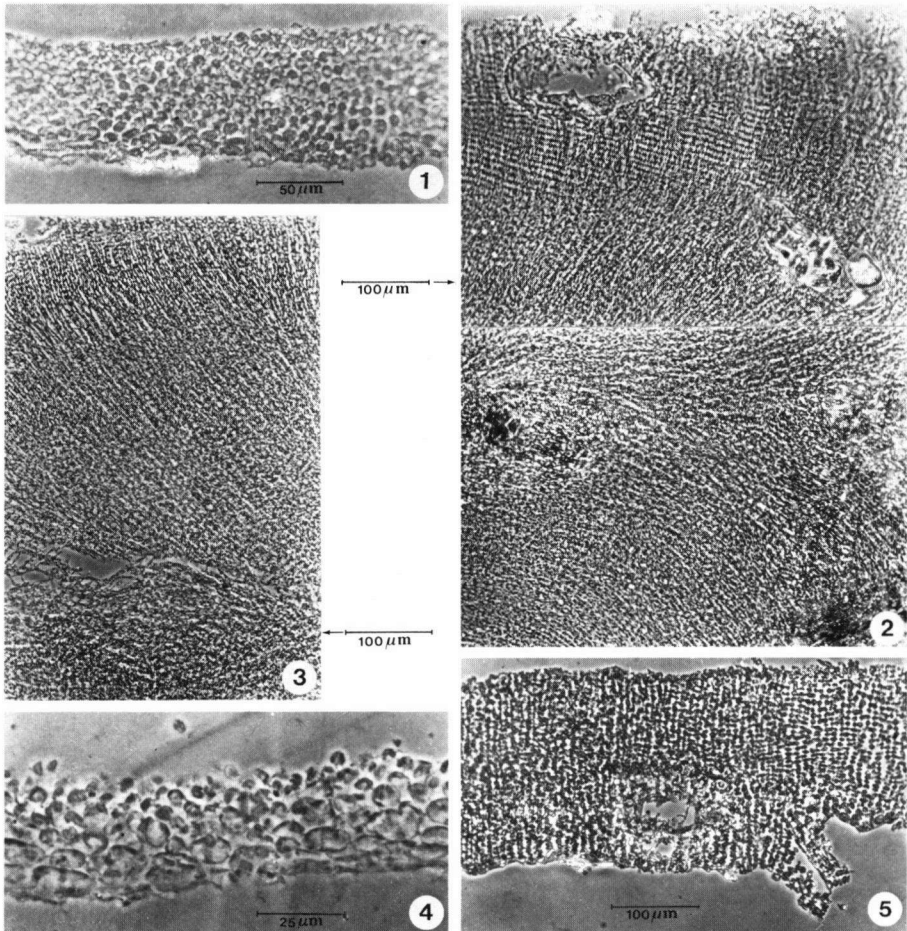


Plate I. Fig. 1. *Lithophyllum atalayense*, vertical section, No. 65-02-0438b. — Fig. 2, 3. *Pseudolithophyllum aequabile*, vertical sections, Nos. 65-02-0332a and 65-02-0340b. — Fig. 4. *Pseudolithophyllum almanense*, vertical section, No. 65-02-0428a2. — Fig. 5. *Pseudolithophyllum discoideum*, vertical section, No. 65-02-0437b.

Collections examined: Macquarie I., off NE. side ($53^{\circ}46' S$, $159^{\circ}05' E$), collected with cone shaped dredge at 165 m depth, on pebbles, and particularly abundant on shells of *Pecten*, 27 Feb. 1965, Z, C, F 65-02-0442 (Z); *ibidem*, 65-02-446 (Z).

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: New Zealand, Stewart I., Campbell I.

Remarks: The Macquarie Island specimens belong to the group of closely related, southern hemisphere *Heteroderma* species, i.e. *H. caulerpae*, *H. cymodoceae* and *H. explanata*. Since a detailed characterization of these species has not been given, it may not be possible to maintain all of them whenever these data become

available. Our specimens are differentiated from the other epizoic and epilithic crustose *Corallinaceae* by the thin, semitransparent thallus with distinctly bulging conceptacles. The algae were collected from a depth hitherto not yet recorded for a *Heteroderma* species.

II. Genus *PSEUDOLITHOPHYLLUM* Lemoine, 1913

Lectotype species (Hamel *et* Lemoine): *P. discoideum* (Foslie, 1900) Lemoine, 1913: 46

1. *Pseudolithophyllum aequabile* (Foslie) Adey. — Fig. 2, 3.

P. aequabile Adey, 1970a: 12. — *Lithophyllum aequabile* Foslie, 1906: 22; Hariot 1907: 9; Gain 1912: 77, 100, 104, 112; Lemoine 1913: 39, f. 11; De-Toni 1924: 675; Skottsberg 1941: 37, 45, 64, 79; 1953: 554; Papenfuss 1964: 29.

Lithophyllum aequabile Foslie f. *typica* Foslie, 1906: 22; 1907a: 12, pl. 2, figs. 6–9; 1929: 31; pl. 59, figs. 12–14; Delépine, Lamb and Zimmermann 1966: 107, 110, 114.

Lithophyllum aequabile Foslie f. *wandelica* Foslie, 1906: 22; 1929: 32, pl. 59, figs. 15–19.

Lithophyllum discoideum Foslie f. *aequabilis* Foslie, 1905a: 3; 1912: 91; 1929: 31, pl. 59, figs. 15–19; Holmes 1905: 198; 1912: 88; Hariot 1907: 9; De-Toni 1924: 676.

Lithophyllum discoideum Foslie f. *wandelica* Foslie in Hariot 1907: 9; De-Toni 1924: 676

Type locality: South Orkney Is.

Thallus pale pink, 1 to 2 mm thick, epilithic and epibiotic, adnate; surface containing fine, squamous markings and convoluted ridge formation at edges of confluent plants, with resulting plicate and verrucose surface, much overgrowth. *Hypothallium* 1/2 to 2/3 of thallial thickness, fibers plumose, polystromatic with cells in all parts of approximately the same size, cells 4–11 × (8)11–26 μm; cell walls very thin and frequently collapsed; transition to perithallium gradual. *Perithallium* somewhat zonate, 1/2 to 1/3 of thallial thickness; cells 4–7(14) × 4–20 μm. *Tetrasporic conceptacles* very numerous (covering entire plant), completely submerged (roof flush with surface or slightly depressed below surface), also old conceptacles at various depths in perithallium, monoporous, roof white and sloughing in many cases, 200–280 μm diameter. *Tetraspores* zonate, very numerous, and in every conceptacle, 30–50 × 50–75 μm.

Collections examined: Macquarie I., Garden Cove (54° 29' S, 158° 58' E), coating the rocks of the walls of tide pools down to about 30 cm and on mollusk shells, particularly on those of *Patella*, 25 Feb. 1965, Z, C, F 65-02-0332a (Z), 65-02-0340b (Z).

Antarctic and sub-Antarctic distribution: Antarctic Peninsula: Cape Roquemaurel; Petermann I.; Wiencke I.; Booth-Wandel I.; S. Shetland Is.; S. Orkney Is.; South Georgia; Macquarie I.

Other distribution: none.

Remarks: *Pseudolithophyllum aequabile*, restricted in its distribution to the sub-Antarctic region of the Southern Ocean, occurs mainly in tide pools in the upper part of the sublittoral where the localities are protected from moving ice. At Macquarie Island the specimens form an almost continuous horizontal zone in the upper part of tide pools, indicating the upper level of the sublittoral zone. In this zone the alga grows also on other larger algae and on mollusk shells.

The authors do not think that there are enough characteristics to distinguish a separate form *wandelica*.

A distributional map of the genus *Pseudolithophyllum* was given by Adey (1970a, f. 6) and reprinted by Adey and MacIntyre (1973, f. 37).

2. *Pseudolithophyllum almanense* (Lemoine) Zaneveld et Sanford, *comb. nov.*, — Fig. 4.

P. almanense Zaneveld et Sanford. — *Lithophyllum almanense* Lemoine, 1920: 8, pl. 1, figs. 4, 7. De-Toni 1924: 677. Skottsberg 1923: 65; 1941: 13, 64, 79. Levring 1960: 38.

Type locality: Chiloe I.

Thallus pink, oligostromatic, basically smooth except for concentric growth lines, almost entirely adnate, epilithic. *Hypothallium* 2/3 entire thallial thickness or 10–13 cells thick, plumose, cells oblong and larger at base of hypothallium than at top, 8–12 × 14–27(49) μm , fairly abrupt transition to perithallium. *Perithallium* filamentous, about 6 cells thick, cells oval or round, 2–5 × (2)4–9 μm . *Conceptacles* monoporous, conical, 300–320 μm diameter; spores absent.

Collections examined: Macquarie I., NE. side (54°43' S, 159°04' E), collected with small Agassiz trawl at 120 meters depth, on small rocks and shell fragments, 27 Feb. 1965, Z, C, F 65-02-0428a2 (Z).

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: S. Chile: Gulf of Corcovado, Cape Alman.

Remarks: The Macquarie Island specimens were collected at a depth of 120 meters, adherent to small rocks. The specimens recorded in literature were vertically distributed from the lower part of the eulittoral zone down to a depth of 20 meters. The present collection forms an extension of the southern range of the species.

Lemoine (1920, p. 7) remarked already that the present species as well as *Lithophyllum skottsbergii* are closely related to *Lithophyllum fetum* Foslie. Adey (1970a, p. 12), after having studied the type material, transferred *L. fetum* to the genus *Pseudolithophyllum*. Accordingly, the present authors are of the opinion that *L. almanense* and *L. skottsbergii* should be included in the genus *Pseudolithophyllum*. See also the remarks under *P. discoideum*.

3. *Pseudolithophyllum discoideum* (Foslie) Lemoine. — Fig. 5.

P. discoideum Lemoine, 1913: 46, f. 13; 1915: 198, pl. 10, figs. 1–2; 1920: 12, 16; Skottsberg 1923: 8; Papenfuss 1964: 32; Adey 1970: 12. — *Lithophyllum discoideum* Foslie 1900b: 73; 1906: 22; 1907a: 10, pl. 2, figs. 2–4; 1929: 33, pl. 59, figs. 1–11; Skottsberg 1941: 16, 17, 29, 30, 31, 64, 79, 88; Levring 1943a: 754.

Lithophyllum fuegianum Heydrich 1901: 533, pl. 11, figs. 1–3.

Crodelia discoidea (Foslie) Levring 1960: 40.

Type locality: Fuegia.

Thallus pink, smooth, except for a patchy surface configuration, epilithic, 150 μ thick, very brittle. *Hypothallium* monostromatic, cells occasionally round or isodiametric, but sometimes oval with long axes parallel to substrate, (4)5–8(11) × 8–14(16) μm . *Perithallium* often filamentous, but in several areas presenting only slight layering, due to irregularity of filaments and cells; secondary pitconnections absent. However, the basal parts of adjacent meristem cells form horizontal clusters of large oval cells which fuse with one another but do not show secondary pits; in general, perithallial cells are round or oval with extensive lateral fusion, long axis of

oval cells parallel to substrate; cells 4–8(11) × 5–11(14) μm . *Epithallium* one to two cells thick, 3 × 5 μm . *Tetrasporic conceptacles* are monoporous, completely flush with thallial surface, and with no indication of their presence other than a pore and/or white patch of dead cells where no pore can be seen; outside conceptacle diameter 150–210 μm , inside conceptacle diameter (100)170–200(250) μm . *Tetraspores* zonate, reddish, located peripherally in conceptacles, (16)14–35(39) × (38)46–70(81) μm .

Collections examined: Macquarie I., NE. side (53° 55' S, 158° 47' E), collected with cone shaped dredge at 55 m depth, on pebbles and small rocks, 26 Feb. 1965, Z, C, F 65-02-0437b (Z).

Antarctic and sub-Antarctic distribution: Macquarie I., South Georgia.

Other distribution: Fuegia, Strait of Magellan, Observatory I., Falkland Is., Juan Fernandez Is.

Remarks: A most important characteristic of this genus is the lack of cellular layering in the perithallium (Lemoine, 1913). However, Adey (1966a) showed that such a layering is present in *Pseudolithophyllum orbiculatum*. Such a not well-marked layer was also observed in the specimens from Macquarie Island. In naming this species we use the generic name given by Lemoine (1913) for reasons explained by Johnson and Adey (1965: 80) and Adey (1966a: 480). Our specimens came from a depth of 55 meters, compared to the specimens from Fuegia which occurred down to 36 meters. Both, in Fuegia and in the Falkland Islands the species is very common in tide pools washed by surf.

Subfamily MELOBESIOIDEAE (Areschoug, 1852) Yendo, 1902

Type genus *Melobesia* Lamouroux, 1812

Tribe LITHOTHAMNIEAE Foslie, 1908

Type genus *Lithothamnium* Philippi, 1837

Genus LITHOTHAMNIUM Philippi, 1837, *emend.* Adey, 1966

Lectotype species (Mason, 1953): *Lithothamnium ramulosum* Philippi, 1837

1. *Lithothamnium macquariensis* Sanford, *spec. nov.* — Fig. 9, 10.

Thallus semi-rubicundus sive albus, generaliter tenuis et superficiem adnatus, praeter pannicas irregularitates levis, oligostromatus, epilithicus, marginibus irregularibus ad lobatis, parvus, crassus, thalli crassitudine 68–122 μm , cellulis 14 ad 26. *Hypothallus* ex ordine singulare cellularum constans, quae circulares, ovaes, sive irregulares sunt, membranibus crassis instructae, 5–10(11) × (5)7–12(14) μm , axibus longis e filis directe a base ascendentibus, cellulis basalibus generaliter ovalibus axibus longis ad basem parallelis, cellulis superioribus frequenter circularibus et generaliter minoribus cellularum perithalliarum magnitudine variationis 3–8 × 4–11 μm . *Conceptacula tetrasporangialia* poris multis, immersa, centrale depressa, crista peripherale subelevata laminae fistularum diametro 100–130 μm , fistulis 18–29, diametro interno 150–190 μm , externo 250–350 μm ; sporae non repertae. *Conceptacula cystocarpica* monopora urcei similis, circum peripheriam basalem canaliculo, diametro 200–400 μm .

Typus: Z, C, F, 65-02-0439 (Z), sporophytus, Z, C, F, 65-02-0428b2 (Z), gametophytus, Macquarie I.

Thallus light pink to white, generally thin and adnate, surface smooth, except for slight, patchy irregularities, oligostromatic, epilithic, edges irregular to lobate and

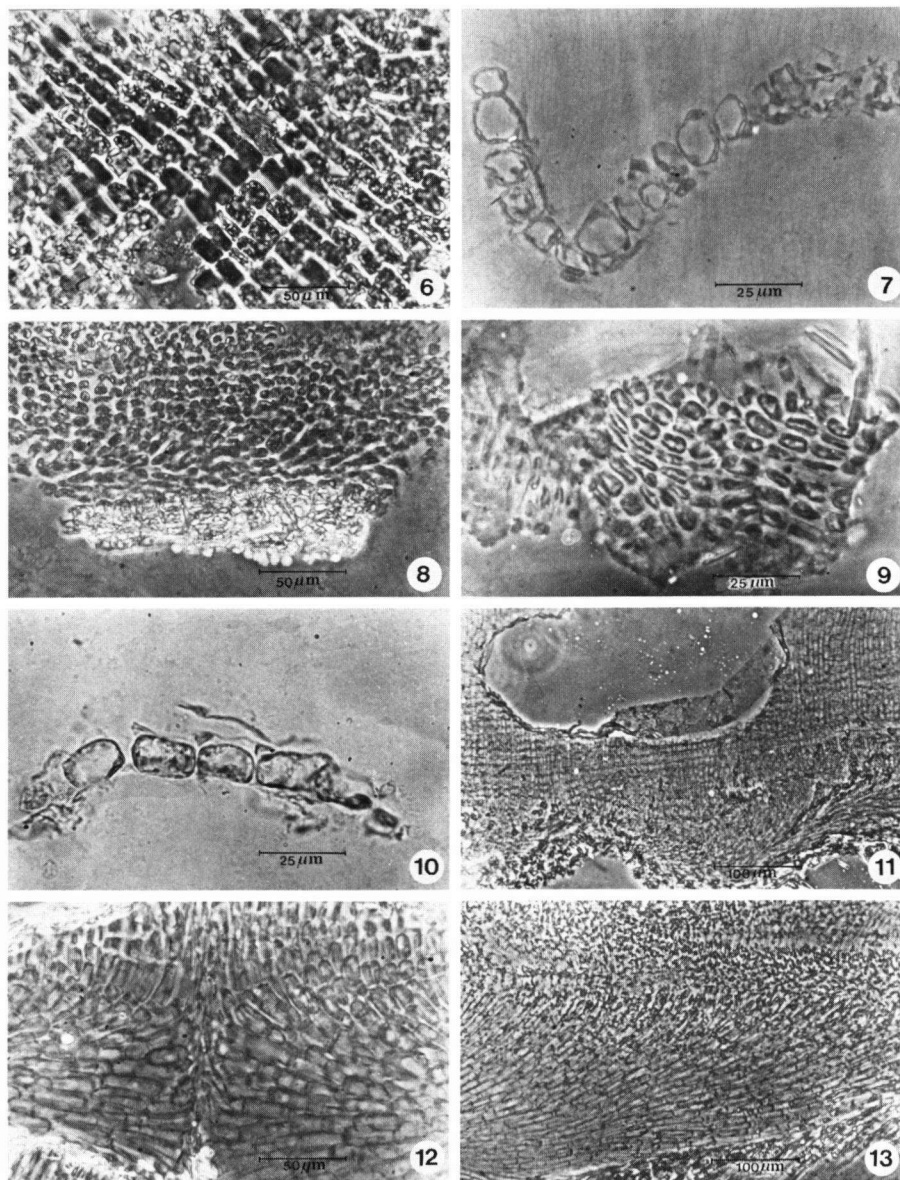


Plate II. Fig. 6, 7. *Heteroderma leptura*, surface view, No. 65-02-0442; vertical section, No. 65-02-0446. — Fig. 8. *Phymatolithon lenormandii* f. *macquariensis*, vertical section, No. 65-02-0437. — Fig. 9, 10. *Lithothamnium macquariensis*, surface view, and vertical section respectively, No. 65-02-0428a. — Fig. 11, 12, 13. *Lithothamnium neglectum*, vertical sections, Nos. 65-02-0332b, c, and d respectively.

slightly thickened, thallial thickness 68–122 μm , 14 to 26 cells. *Hypothallium* consists of single rows of thick walled, round, oval, or irregular cells with an occasional rectangular one, 5–10(11) \times (5)7–12(14) μm , long axes of cells parallel to substrate (non-coaxial). *Perithallium* composed of filaments growing directly upward from base; cells near base generally oval with long axes parallel to base, upper cells frequently round and generally smaller, entire perithallial cell range 3–8 \times 4–11 μm . *Tetrasporangial conceptacles* multiporous, largely immersed, centrally depressed with slightly elevated peripheral ridge, pore plate diameter 100–130 μm with 18–29 pores, internal diameter 150–190 μm , external diameter 250–350 μm , no spores found. *Cystocarpic conceptacles* monoporous, jug-shaped with groove around periphery of base, 200–400 μm diameter.

Collections examined: Macquarie I., NE. side (54°55' S, 158°47' E), collected with cone shaped dredge at 55 m depth, on small rocks, 27 Feb. 1965, Z, C, F 65-02-0439 (Z) — holotype of sporophyte; ibidem, at 110 m depth (54°09' S, 158°54' E), collected with small Agassiz trawl, on small rocks, 27 Feb. 1965, Z, C, F 65-02-0428b2 (Z) — holotype of gametophyte.

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: None.

Remarks: The asexual specimen appears to have sustained considerable abrasion and consists of spotty growth on a small rock approximately 3 cm in diameter. The characteristics of this new species have much in common with those of *Lithothamnium mangini* Lemoine *et* Rosenvinge, in that the hypothalli are composed of single or at most double layers of oval or subrectangular cells with perithallial filaments growing upward from the basal layer. However, *L. mangini* has a much reduced hypothallium of obliquely slanted, oval cells of almost equal size (7–9 \times 7–10 μm) and asexual conceptacles entirely depressed in the surface of the thallus (Lemoine 1913: 6–8).

2. *Lithothamnium neglectum* (Foslie) Foslie. — Fig. 11, 12, 13.

L. neglectum Foslie 1902: 19; 1929: 55; Lemoine 1913: 14; 1915: 196–198, pl. 9, f. 2; pl. 10, figs. 3–6; 1920: 12, 15; Skottsberg 1923: 65; 1941: 64, 79. De-Toni 1924: 632; Taylor 1939: 143; Levring 1960: 36; Papenfuss 1964: 31.

Lithothamnium neglectum (Foslie) Foslie f. *fragilis* Foslie 1905a: 2; 1908: 207; 1929: 43, pl. 9, figs. 1–3.

Lithothamnium neglectum (Foslie) Foslie f. *typica* Foslie 1908: 207, pl. 20, figs. 4–7; 1929: 43, pl. 9, f. 4.

Lithothamnium muelleri Lenormand; Lucas and Perrin 1947: 390.

Lithothamnium muelleri Lenormand f. *neglecta* Foslie 1900b: 16; 1900c: 17.

Lithothamnium variabile Foslie 1906: 10; 1907a: 6, pl. 1, figs. 7–9; 1929: 47, 53, pl. 5, figs. 15–17;

Lemoine 1913: 14, 30; Skottsberg 1941: 30, 64, 79.

Lithophyllum lichenoides Philippi sensu Hariot 1895: 98.

Melobesia lichenoides Ellis sensu Dickie 1876: 200; 1879: 58; Hemsley 1884: 241.

Melobesia neglectum (Foslie) Adey 1970a: 25.

Type locality: Kerguelen Islands.

Thallus pink to white, crustose, generally smooth but with occasional wart-like excrescences probably due to rough substrate and concentric growth lines, much folding of edges of confluent plants, considerable overgrowth with resulting loosely attached, superimposed crusts, approximately 135–250 μm thick per individual growth, epizoic on shells. *Hypothallium* 8 to 11 cells thick (approximately 2/3 of the thallial thickness), non-coaxial; filaments slightly upward bending but some down

bending; cells thin walled and oblong, $4-9(12) \times (7)11-33 \mu\text{m}$; gradual transition to perithallium. *Perithallium* less developed, up to approximately 1/3 of thallial thickness, filamentous, very regular in conformation; cells thin walled, square or rectangular, $4-7(14) \times (4)5-22 \mu\text{m}$. *Epithallium* reduced, approximately 10μ thick (2 cells); cells $5-8 \times 5-8 \mu\text{m}$. Both monoporous and multiporous *conceptacles* observed on either same or adjacent plants (this distinction not determined). *Cystocarpic conceptacles* subhemispherical, partly submerged, $(250)306-663 \mu\text{m}$; multiporous, tetrasporangial-like conceptacles flat roofed, slightly elevated above surface, no pores evident, $500-600 \mu\text{m}$ diameter. Five zonate *tetraspores* found with zonate partitions and exterior walls, irregular, $33-92 \times 103-162 \mu\text{m}$.

Collections examined: Macquarie I., Garden Cove ($54^{\circ}29' \text{S}$, $158^{\circ}58' \text{E}$), in tide pool, on shells of *Patella*, at 30 cm depth, 25 Feb. 1965, Z, C, F 65-02-0332b, 65-02-0332c, and 65-02-0332d (Z).

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: Fuegia, Falkland Is., Kerguelen Is., S. Australia.

Remarks: Lemoine, in 1915, pointed out that *Lithothamnium neglectum* and *L. variable* Foslie, 1906 are synonyms. This opinion, however, is not shared by Adey (1970a, p. 26) who transferred the latter species to the genus *Mesophyllum*. Another possible synonymy is discussed by Dawson, suggesting that *L. neglectum* and *L. lamellatum* Setchell *et* Foslie, 1903, may represent widely separated forms of the same species, i.e. *L. lamellatum*, adapted now to different temperature ranges. The 'nouvelles formations cellulaires' which are formed inside the empty sexual conceptacles which are characteristic for *L. neglectum* are, according to our point of view, reminiscent of spermatia. A most interesting feature of *L. neglectum* is the occurrence of cystocarpic and tetrasporic conceptacles in the same thallus. This fact was also observed by Lucas and Perrin (1947, p. 390) in Australian plants from Lyall Bay, which were identified as *Lithothamnium muelleri*. Adey (1970a, p. 25) transferred *L. muelleri* f. *neglecta* to the genus *Mesophyllum*, although the hypothallium lacks a coaxial structure. Because of the absence of this type of structure characteristic for the genus *Lithothamnium*, the present authors have retained the original name of this taxon.

A further characteristic about the internal structure of the Macquarie Island material is that the hypothallial cells are much more developed than the perithallial ones. Approximately 2/3 of the perithallial cells are isodiametric or approximately so, but the remaining 1/3 has a vertical dimension approximately twice that of the horizontal dimension. Externally the Macquarie Island plants look like Foslie's picture of *M. variable*, showing superimposed, small crusts (1929, pl. 5, figs. 15-17) not exceeding 2 cm diameter.

Similar to the type specimens from the Kerguelen Islands and to the Falkland Islands material, the Macquarie Island specimens are epizoid on *Patella* species indicating their occurrence around the low water line. All specimens found thus far are inhabitants of tide pools. The distribution of the species is circum-Antarctic.

3. *Lithothamnium schmitzii* (Hariot) Heydrich. — Fig. 14, 15, 16, 17.

L. schmitzii Heydrich, 1901: 541; Foslie 1907b: 8; 1929: 45, 53, pl. 5, f. 11; Lemoine 1913: 25, figs. 5, 6, pl. 1, f. 3; 1915: 195; 1920: 11; Skottsberg 1923: 64; 1941: 16, 18, 64, 79; De-Toni 1924: 619; Levring 1960: 36; Papenfuss 1964: 32. — *Lithophyllum schmitzii* Hariot 1895: 98, p.p.; Foslie 1907b: 8.

Lithothamnium scutelloides Heydrich, in: De Wildeman 1900: 563; 1935: 41.
Lithothamnium magellanicum Foslie 1895a: 8, f. 8; 1900b: 71; 1907a: 4, pl. 1, fig. 1–3; 1929: 43, pl. 2, figs 1–3; De-Toni 1905: 1739; Skottsberg 1941: 17, 29, 30, 64, 79; Levring 1960: 36.
 Type locality: Orange Bay, Fuegia.

Thallus pink or chalky white, 1/3 to 1/2 mm thick, easily scratched (relatively soft), epilithic and epizoic on shells, adnate, surface essentially smooth but with irregularities due to substrate contours, elevated confluences of adjacent plants, and occasional superficial, patchy, configurations, edges slightly thickened and rounded; hypothallial fibers plumose, non-coaxial, oligostromatic, with lower cells oblong and upper ones almost round, $5-14 \times (14)16-32(43) \mu\text{m}$, fairly abrupt transition to perithallium. *Perithallium* primarily filamentous but with slight evidence of layering, from transition zone upward cells are isodiametric to round to oval to oblong, $4-11 \times 5-16 \mu\text{m}$. *Epithallium* 1 to 3 cells thick or $8-25 \mu\text{m}$, and $2-5 \mu\text{m}$ in diameter. *Bisporic conceptacles* polyporous, slightly elevated above surface, flat without central depression, $350-610(700) \mu\text{m}$ diameter; bispores red, $33-108 \times 100-207 \mu\text{m}$. *Cystocarpic conceptacles* subhemispherical, partly submerged, $350-600(900) \mu\text{m}$ diameter.

Collections examined: Moubray Bay off Cape Hallett, Victoria Land ($72^{\circ}18'S$, $170^{\circ}11'E$), collected with cone shaped dredge at 119 m, on small rocks, 19 Jan. 1965, Z. C. F 65-01-0180 (Z). Macquarie I. ($54^{\circ}29'S$, $158^{\circ}58'E$), Garden Cove, along beach, on shells of *Patella* and washed ashore material, 25 Feb. 1965, Z. C. F 65-02-0338c, 65-02-0338d, and 65-02-0338f (Z).

Antarctic and sub-Antarctic distribution: Moubray Bay, Macquarie I., South Orkney Is., South Georgia.

Other distribution: Fuegia, Strait of Magellan, Falkland Is.

Remarks: The cystocarpic conceptacles of this species are among the largest of the genus; in some specimens they can be seen with the naked eye. *Lithothamnium schmitzii* has a wide adaptability range as it occurs in tide pools and in sublittoral and littoral depths between 15 and 119 meters.

4. *Lithothamnium zaneveldii* Sanford, spec. nov. — Fig. 18, 19.

Thallus albus, laete rubicundus sive laete purpureus colorem seu texturam substrati secundus, monostromatus seu distromatus margine introrsum sinuoso a vertice aspectu cellulae contiguae in conformatione lineare concentrica, magnitudine $3-13 \times 5-18(21) \mu\text{m}$; cellulae in sectione transversali ovalae seu subrectangulae areis monostromatis et distromatis eadem magnitudine, $(5)8-14(16) \times (8)10-19(22) \mu\text{m}$, axis longis ad substratum parallelis; cellulae triangulae parvae superiores frequenter videantur, $3 \times 5 \mu\text{m}$. *Conceptacula tetrasporangiala* incerte multiporosa, certe haemispherica, superficialia, certe prominente, diametro $180-300 \mu\text{m}$. *Tetrasporae* zonatae circumferentia irregulari sive sinuosa, $22-41 \times 35-70 \mu\text{m}$. *Conceptacula cystocarpica* certe conica monoporosa, diametro $170-330 \mu\text{m}$.

Type: Z. C. F. 65-02-0428a (Z), Macquarie I.

Thallus white, light pink, or light purple depending on color or texture of substrate, monostromatic or distromatic, flat, scalloped edges; in vertical view cells of adjacent hypo- and perithallial filaments are in concentric line conformation, $3-13 \times 5-18(21) \mu\text{m}$; in cross section these cells are oval or subrectangular and of approximately the same size in both monostromatic and distromatic areas, $(5)8-14(16) \times (8)10-19(22) \mu\text{m}$, with long axes parallel to substrate; small,

triangular cover-cells frequently seen, $3 \times 5 \mu\text{m}$. *Tetrasporangial conceptacles*, because of mosaic glass appearance, give vague evidence of being multiporous, but with 8–20 tiny pores found on very close examination, are decidedly hemispherical, superficial, and very prominent, $180\text{--}300 \mu\text{m}$ diameter. *Tetraspores* zonate with irregular or crenated outline, $22\text{--}41 \times 35\text{--}70 \mu\text{m}$. *Cystocarpic conceptacles* decidedly conical, monoporous, $170\text{--}330 \mu\text{m}$ diameter.

Collections examined: Macquarie Island, N. E. side ($54^{\circ}09' \text{S}$, $158^{\circ}54' \text{E}$), collected with cone shaped dredge at 110 m depth, on pebbles and small rocks, Feb. 1965, Z, C, F 65-02-0428a (Z) — holotype.

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: None.

Remarks: This species is known from several specimens found on a single rock. The most striking characteristics which differentiate it from other members of this genus are its perfectly hemispherical, asexual conceptacles and its decidedly conical, cystocarpic conceptacles. The sporangial conceptacles, though smaller, are strikingly similar in gross appearance to those of *Mesophyllum lichenoides* (Ellis) Lemoine (Hamel and Lemoine, 1952), in which the roofs, however, are multipored. No description pertaining to this alga can be found in the synoptical key of Foslie, 1929, primarily because of the peculiar, hemispherical asexual conceptacles.

Tribe *PHYMATOLITHEAE* Adey et Johansen, 1972

Type genus: *Phymatolithon* Foslie, 1898

Genus *PHYMATOLITHON* Foslie, 1898

Type species: *P. polymorphum* (Linné, 1767) Foslie, 1898.

***Phymatolithon lenormandii* (Areschoug in J. Agardh, 1852) Adey, 1966 forma *maquariensis* forma nov.**

Thallus atrorubicundus, adnatus, praeter irregularitates minores pannosas praecipue levis, ergo hebes, ellipticus, $130\text{--}140 \mu\text{m}$ crassus. *Hypothallium* quinque ad novum cellulae crassus, cellulis ovalis et rectangularibus, $5\text{--}7 \times 11\text{--}24 \mu\text{m}$, filis generaliter a base ascendentibus sed aliquando plumosis, $1/4\text{--}1/6$ thalli crassitudine. *Perithallium* filis generaliter verticalibus, irregularibus, indistinctis, cellulis circularibus sive ovalibus, axe longo ad substratum parallelo, $3\text{--}5 \times 4\text{--}8(10) \mu\text{m}$. *Epithallium* cellulis uno, duabus seu tribus pariete tenui complanatis $2 \times 6 \mu\text{m}$ grandis. *Conceptacula* tetrasporangiala conspicua crateriforma laminarum fistularum diametro $100\text{--}130 \mu\text{m}$, fistulis $8\text{--}25$, centris profunde depressis. *Sporae* rubrae zonatae duas, tres vel quattor partes partitae.

Typus: Z, C, F, 65-02-0436 (Z); **isotypus:** Z, C, F, 65-02-0437 (Z), Macquarie I.

Thallus dark pink, adnate, essentially smooth except for very slight irregularities of a patchy nature, surface therefore somewhat dull, epilithic, $130\text{--}240 \mu\text{m}$ thick. *Hypothallium* between five and nine cells thick, cells oval and rectangular $5\text{--}7 \times 11\text{--}24 \mu\text{m}$; filaments generally upward curving but in some cases plumose and $1/4\text{--}1/6$ of thallial thickness. *Perithallium* of generally vertical but irregular and indistinct filaments; cells round or oval with the long axis parallel to the substrate, $3\text{--}5 \times 4\text{--}8(10) \mu\text{m}$. *Epithallium* consisting of one to three thin-walled, periclinally flattened cells, $2 \times 6 \mu\text{m}$. *Tetrasporangial* conceptacles very conspicuous, crater-shaped with pore plates $100\text{--}130 \mu\text{m}$ diameter, $8\text{--}25$ pores, and centers deeply depressed below rims of conceptacles. *Spores* red colored, zonate, and two, three, and four parted.

Collections examined: Macquarie I., off NE. side (53° 55' S, 158° 47' E), collected with cone shaped dredge at 55 m, on pebbles and small rocks, 27 Feb. 1965. Z, C, F 65-02-0436 (Z) — holotype; ibidem, Z, C, F 65-02-0437 (Z) — isotype.

Antarctic and sub-Antarctic distribution: Macquarie I.

Other distribution: None. (The species itself has a bipolar distribution; it has been recorded in the southern hemisphere for the Antarctic Peninsula, the Kerguelen Is., S. Chile, and Fuegia, and in the northern hemisphere from the Mediterranean to the Arctic, the Japan Sea and along the Pacific coast of Mexico and the U.S.A.)

Remarks: The distinguishing feature of this new form is the presence of oval perithallial cells with their long axes parallel rather than perpendicular to the substrate as is the case in the type specimen of *Phymatoliton lenormandii* (consult Adey, 1966b). Other Antarctic species containing conceptacles which are depressed in the center with a resulting annular border are *Lithothamnium schmitzii* and *Leptophytum foecundum*.

Genus LEPTOPHYTUM Adey, 1966

Type species: *L. leave* (Strömfelt, 1966) Adey, 1966.

1. *Leptophytum asperulum* (Foslie) Adey. — Fig. 20

L. asperulum Adey, 1970a: 29.

Lithothamnium asperulum Foslie 1907b: 6; 1929: 39, 50, pl. 1, figs. 4–6; De-Toni 1925: 625; Levring 1945: 15; Papenfuss 1964: 30; Chapman and Parkinson 1974: 195, pl. 66, f. B; Adams 1972: 74.

Lithothamnium repandum Foslie f. *asperula* Foslie 1906: 5, 6.

Type locality: New Zealand.

Thallus pink, 20–50 μm thick, epilithic, adnate, smooth, shiny, edges rounded but not elevated or thickened. *Hypothallium* almost entire thickness of plant and consisting of rather indistinct, upward-curving filaments with bottom and central cells primarily oval shaped and upper cells more rounded, four or five cells thick, (4)5–7 \times 12–16(18) μm . *Perithallium* consisting of upper two or three layers of cells generally round in shape, 5.4 \times 5.4 μm , or feebly elongated, 4 \times 7 μm , no transition to be seen between hypothallium and perithallium. *Multiporous conceptacles* with centrally depressed roofs, but no spores seen, approximately 210 μm diameter. *Monoporous conceptacles* dome-shaped, empty, presumably cystocarpic, 150–280 μm diameter.

Collections examined: Macquarie I., off N. E. side (53° 55' S, 158° 47' E), collected with cone shaped dredge off north east side of island at 165 m, forms a red crust on shells, small rocks, and pebbles, 27 Feb. 1965, Z, C, F 65-02-0441 (Z).

Antarctic and sub-Antarctic distribution: Macquarie I., Campbell I.

Other distribution: New Zealand.

Remarks: *Leptophytum asperulum* is one of the crustose corallines characterized by a well developed hypothallium and a reduced perithallium. Moreover, the diameter of the presumably cystocarpic conceptacles covers the total range mentioned by Foslie in his monograph (1929) for both *L. asperulum* and *L. repandum*, i.e. 150–300 μm . The species inhabits deep water, e.g. the elittoral region.

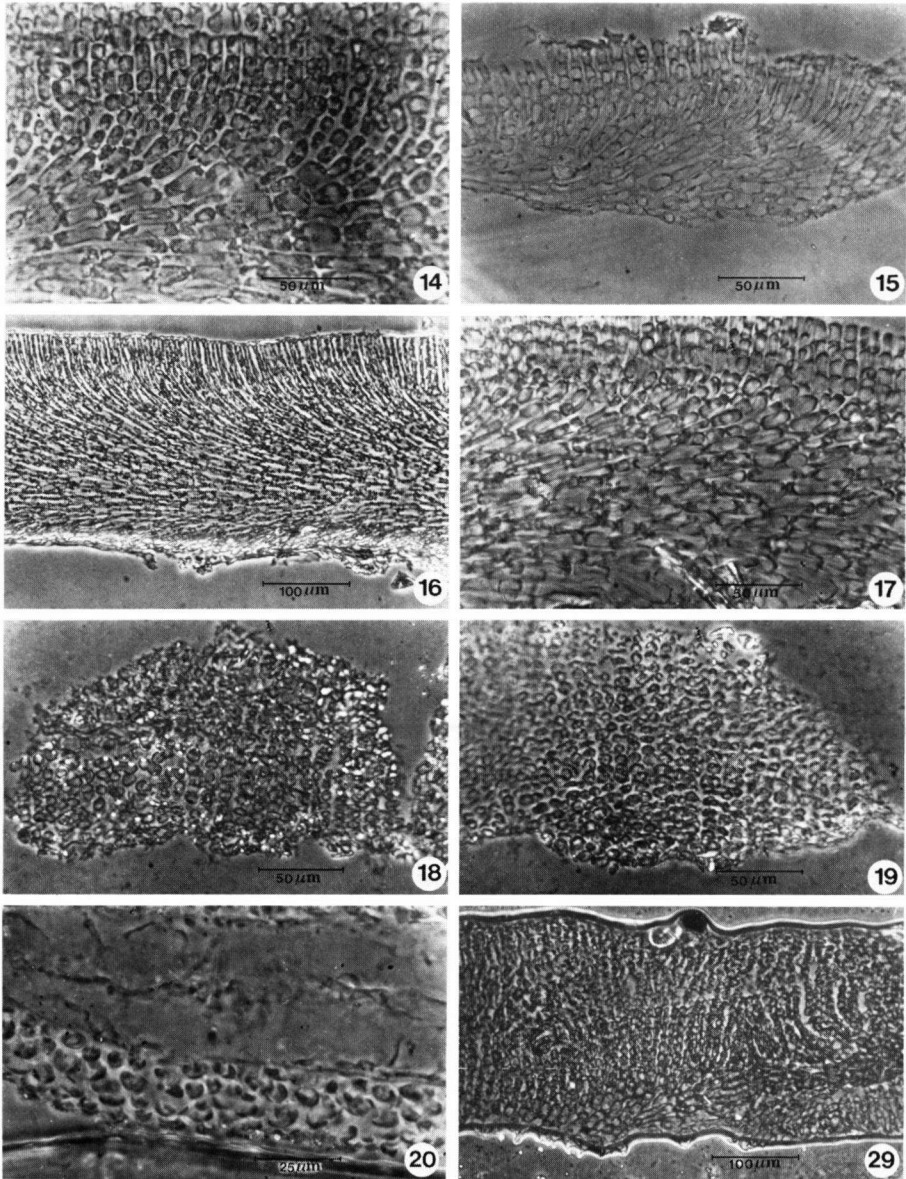


Plate III. Fig. 14, 15, 16, and 17. *Lithothamnium schmitzii*, vertical sections Nos. 65-01-0180, 65-02-0338c, 65-02-0338d, and 65-02-0338f respectively. — Fig. 18, 19. *Lithothamnium zaneveldii*, vertical sections, Nos. 65-02-0439 and 65-02-0428b2 respectively. — Fig. 20. *Leptophytum asperum*, vertical section, No. 65-02-0441. Fig. 29. *Leptophytum laeve*, vertical section, No. 65-01-0101.

A distributional map of the genus *Leptophytum* was given by Adey (1970a, f. 13) and by Adey and MacIntyre (1973, f. 44).

Dawson's remark (1960, p. 22) that *L. asperulum* is a synonym of *Lithothamnium lenormandii* could not be substantiated after Adey (1966c) showed that *L. lenormandii* needs to be transferred to the genus *Phymatolithon*.

2. *Leptophytum coulmanicum* (Foslie) Adey. — Fig. 21, 22, 23.

L. coulmanicum Adey, 1970a: 31; 1970b: 6; Adey and MacIntyre 1973: 891, 892, 897; Adey and Adey 1973: 376.

Lithothamnium coulmanicum Foslie 1905a: 2 (16); 1907a: 1, f. 1; 1929: 40, 51, pl. 2, figs. 8–9; Lemoine 1911: 52; 1913: 13; De-Toni 1924: 616; Papenfuss 1964: 31.

Type locality: Coulman I., Ross Sea.

Thallus chalky white with minute irregularities, due mainly to substrate but also to patchiness, sloughing, and some concentric growth ridges, epilithic, approximately 1/5 mm thick, entirely adnate, occasional a slight ridge where plants are confluent. *Hypothallium* six to ten cells thick (1/3 total thallial thickness); filaments curving upward but not downward, fragile and easily torn; cells (4)5–9 × 5–22 μm, generally thicker walled than those in perithallium. *Perithallium* showing gradual transition from hypothallium, filamentous, in some areas about 2/3 total thallial thickness; cells round, oval, rectangular, or collapsed, 4–9 × 5–14 μm. *Conceptacles* both multiporous and monoporous; sporangial conceptacles multiporous, 25–30 pores, largely immersed, indistinct boundaries, slightly depressed in center, 400–550 μm in diameter; one bispore found, 39 × 89 μm; monoporous conceptacles pyramidal, indistinct outlines, sub-immersed, empty, pore either nonexistent or in form of small depression, conceptacles 120–484 μm in diameter.

Collections examined: Macquarie I., off NE. side (53°39' S, 159°12' E), collected with small Agassiz trawl at 146 meters depth on small rocks, 28 Feb. 1965, Z, C, F 65-02-0454 (Z), 65-02-0450a (Z); ibidem, Sandy Beach (54°29' S, 158°58' E), on rocks in wash zone, 24 Feb. 1965, Z, C, F 65-02-0449a (Z), Z, C, F 65-02-0449b (Z).

Antarctic and sub-Antarctic distribution: Coulman I., Macquarie I.

Other distribution: None.

Remarks: The presence of bispores and the lack of tetraspores in the Macquarie Island material is inconsistent with Foslie's original description. Stratification of specimen 65-02-0454 as seen in figure 23 is indicative of growth layers. The type specimen was collected at a depth of 33 m, whereas the Macquarie Island specimens occurred from the littoral down to 146 m. Geographically, the new collections form an important extension of the known range of one of the earliest known epilithic crustose Ross Sea species.

3. *Leptophytum foecundum* (Kjellman) Adey. — Fig. 24, 25, 26, 27, 28.

L. foecundum Adey, 1966b: 325, figs. 23, 24, 38, 42, 96–98; 1966c: 53, fig. 9; 1970c: 226, 227; South 1976a: 11.

Lithothamnium foecundum Kjellman 1883: 99, pl. 5, figs. 11–19; Foslie 1895b: 109; 1905b: 21; 1929: 40, pl. 2, figs. 12–14; Rosenvinge 1898: 12; 1910: 100; 1926: 37; De-Toni 1905: 1739; Lemoine 1911: 49; Zinova 1955: 85; Taylor 1957: 246; Lund 1959 (1): 198; 1959 (2): 31, 39.

Lithothamnium polymorphum Kjellman 1877: 15 [non *Lithothamnium polymorphum* (L.) Areschoug].

Type locality: Actinia Bay, Arctic Ocean.

Thallus pink or white, surface smooth except for occasional concentric growth ridges; individual plants 1–4 mm in diameter and up to 0.5 mm thick, edges rounded and thickened; thalli clinging tightly to rocks, shells or algae, sometimes covering them completely, forming hard irregular nodules. Hypothallus fibers both upward bending, 6 to 12 cells thick, including approximately 1/2 to 1/5 of thallic thickness; cells rectangular in shape with long dimension along fiber axis, 5–14 × 14–43(54) μm ; moderately abrupt transition to perithallium. *Perithallium* regular and approximately 1/2 to 4/5 of thallic thickness; lower cells rectangular, upper ones both rectangular and isodiametric, 4–14 × 4–30(33) μm . *Epithallium* 1–5 cells thick; cells flat with long axis parallel to thallic surface, 2 × 8 μm . *Tetrasporangial conceptacles* very numerous and frequently confluent, slightly elevated or almost flush with thallic surface, some flat on top and others depressed in center with resulting ridge around periphery, 360–550(800) μm in diameter; 19–118 pores; bisporangia and tetrasporangia zonate, granular 40–60–108 × 130–190 μm . *Cystocarpic conceptacles* subhemispherical; some with single round pores and some with single but elongated pores, (250)380–450 μm in diameter. *Carpospores* numerous.

Collections examined: Cape Hallett, 150 meters off north beach, by diving at 14 m depth, on small rocks and pebbles, 7 Jan. 1965, *Z. C. F 65-01-0039 (Z)*, *65-01-0042 (Z)*. Moubray Bay off Victorialand (72° 18' S, 170° 11' E), collected with cone shaped dredge at 119 m depth, on pebbles and algae, 19 Jan. 1965, *Z. C. F 65-01-0182 (Z)*. Balleny Is., off west side of Young I. (66° 34' S, 162° 08' E), collected with Blake trawl at 220–229 m depth, on small rocks, 12 Feb. 1965, *Z. C. F 65-02-0181 (Z)*. Macquarie I, Bauer Bay (54° 31' S, 158° 57' E), washed ashore on pebbles and algae, 24 Feb. 1965, *Z. C. F 65-02-0578 (Z)*.

Antarctic and sub-Antarctic distribution: Cape Hallett, Moubray Bay, Balleny Is., Macquarie I.

Other distribution: Iceland, Norway, Ellesmere I., Greenland, Arctic Ocean.

Remarks: This is one of the more common species in the area under consideration, occurring on shells and stones at depths between 14 and 219 meters. Lund (1959, 2: 39) reports for the northern hemisphere that it occurs between 9 and 120 meters. The species is characterized by the numerous, immersed or slightly elevated, tetrasporangial conceptacles, often provided with a ring shaped border.

4. *Leptophytum laeve* (Strömfelt) Adey. — Fig. 29, 30.

L. laeve Adey, 1966b: 32; figs. 60–90; 1966c: 52, f. 8; 1970a: 29; 1970b: 272, f. 4; 1971: 47; Adey and Adey 1973: 349, 377–379, figs. 46, 47; South 1976a: 11.

Lithothamnium laeve Foslie in Rosenvinge 1898: 14. Foslie 1898: 7; 1901: 16; 1905b: 16, 131; 1906: 3; 1908: 6; 1929: 43; 51, pl. 3, figs. 4–9; Jonsson 1901: 153; Saunders 1901: 396, 442; De-Toni 1905: 1757; 1924: 611; Rosenvinge 1910: 100, f. 1; 1917: 215, figs. 129–132; Lemoine 1911: 74, pl. 3, f. 1; Taylor 1957: 256; Lund 1959 (1): 198; (2): 31, 39; Dawson 1960: 18, pl. 12, figs. 1–2; 1961: 414; Adey 1965: 549, pl. 2, figs. 30, 31.

Lithophyllum laeve Strömfelt 1886: 21, pl. 1, figs. 11–12.

Lithophyllum lenormandi Rosanoff f. *laevis* Foslie 1891: 11.

Lithothamnium tenue Rosenvinge 1893: 778, figs. 6, 7 *p.p.*; 1894: 58, figs. 4–6.

Lithothamnium strömfeltii Foslie f. *macrospora* Foslie 1895b: 173, pl. 22, f. 12.

Lithothamnium strömfeltii Foslie f. *tenuissima* Foslie 1895b: 173, pl. 22, f. 12.

Type locality: Iceland.

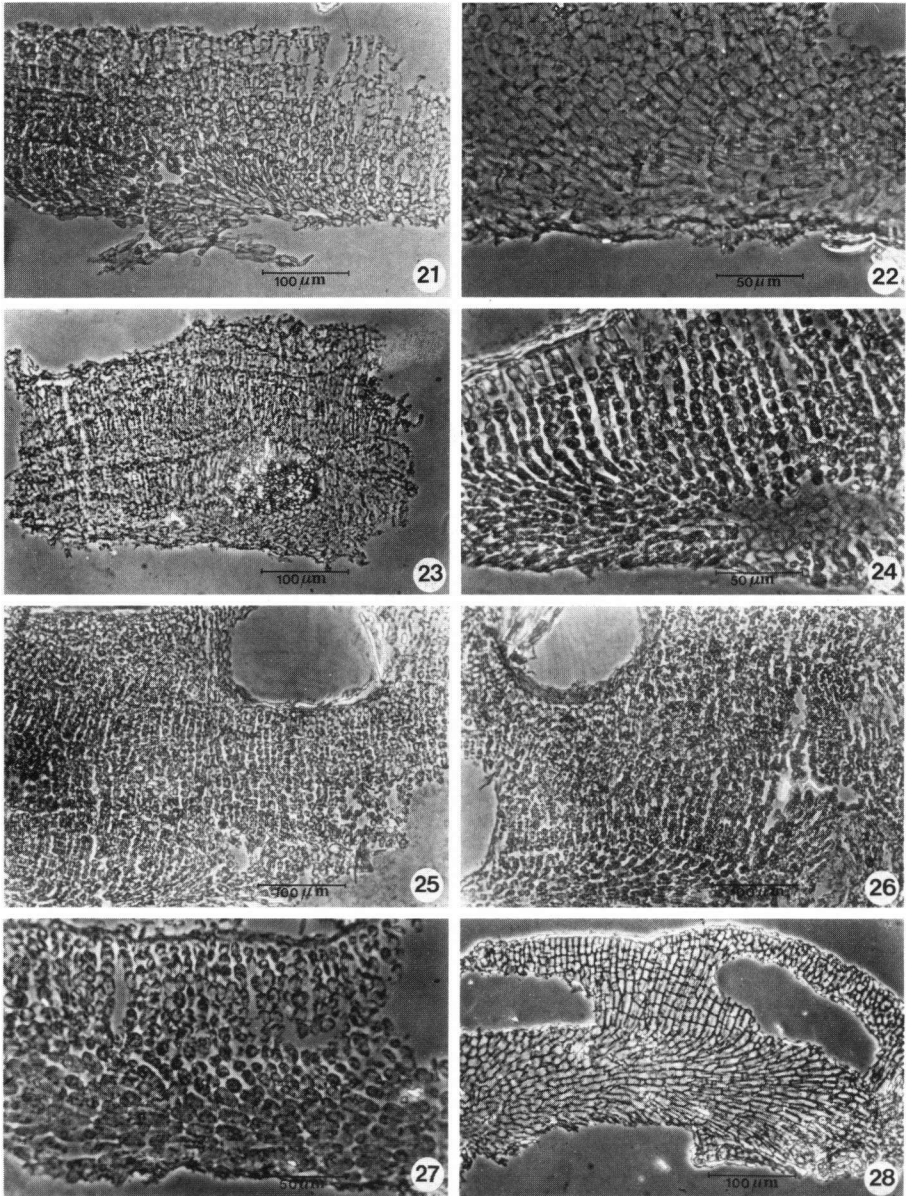


Plate IV. Fig. 21, 22, and 23. *Leptophytum coulmanicum*, vertical sections, Nos. 65-02-0449b, 65-02-0450a, and 65-02-0454 respectively. — Fig. 24, 25, 26, 27, and 28. *Leptophytum foecundum*, vertical sections, Nos. 65-01-0039, 65-01-0182, 65-02-0181, and 65-02-0578 respectively.

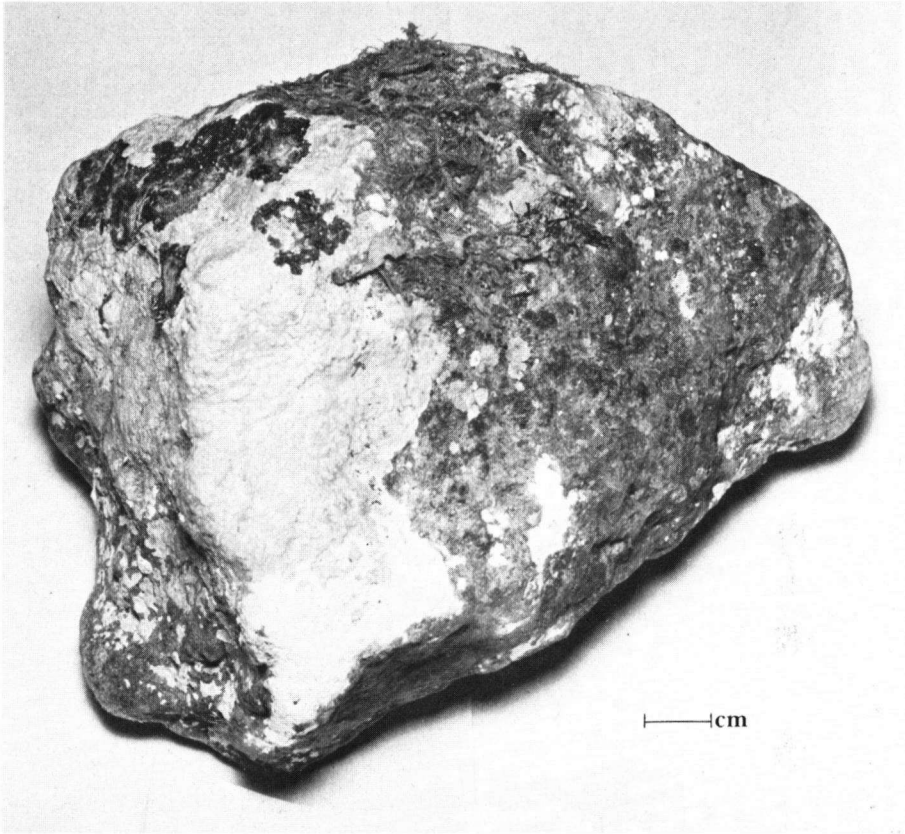


Fig. 30. Fully developed specimen attached to a pebble: *Leptophytum laeve*, picked up off Franklin I. at 73 meters, No. 65-01-0101.

Thallus white, smooth or almost so with small patchy elevations which in some cases may be due to irregular substrate, epilithic, convoluted where confluent with other specimens, adnate, edges thickened, numerous partly adnate growth layers. *Hypothallium filaments* curving upward, polystromatic with gradual transition to perithallium; cells thick walled, rectangular or oval in shape, (5)7–12(14) × (10)14–24 μm . *Perithallium* moderately layered due to regularity of cells in adjacent filaments; decrease in cell size from bottom to top; cells (4)5–11 × (5)7–14 μm . *Epithallium* composed of nondiscrete layer of cells with total thickness of about 8 μm . Bisporic, multiporous *conceptacles* flush with thallial surface or slightly elevated, 29–39 pores; pore plates 173–204 μm diameter; inside diameter of conceptacle 280–510 μm ; outside diameter of conceptacle 500–750 μm . *Spores* bipartite, 31–41 × 132–142 μm .

Collections examined: Franklin I., off west side (76°05' S, 168°09' W), collected with small Agassiz trawl at 73 m depth on small rocks, 12 Jan. 1965, Z, C, F 65-01-0101 (Z).

Antarctic and sub-Antarctic distribution: Ross Sea; Franklin I.

Other distribution: Mexico: Baja California; U.S.A.: Massachusetts, Pacific Coast Alaska; North Sea; Skagerrak; Norway; Faeroer Is.; Iceland; Ellesmere I.; Greenland; Jan Mayen I.; White Sea; Spitsbergen.

Remarks: This species is widely distributed in deep waters of the high latitudes of the northern hemisphere, but in 1960 it was reported by Dawson from 'deep bottoms' of Baja California, Mexico. The present record of the species in the southern hemisphere indicates that *Leptophytum laeve* may be a cosmopolite. Although out of its common range, the specimens are well characterized by the very large tetrasporangial conceptacles, the dimensions of the hypothallial cells, and its adherent smooth surface. Its occurrence at low temperatures and low light intensities of deep waters may explain the wide geographical distribution.

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