Marine Algae of Cheju Island –The Leathesiaceae–

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ABSTRACT

Morphotaxonomic study was made on the Leathesiaceae of Cheju Island. One species of *Petrospongium*, *P. rugosum*, and three of *Leathesia*, *L. difformis*, *L. sphaerocephala*, and *L. verruculiformis*, were found in Cheju Island. *Myriactula* species was not found in the locality. *L. verruculiformis* was described as a new species of the genus *Leathesia*. *L. verruculiformis* was characterized by the less compact cortical layer, clavate assimilating filaments, and plurilocular sporangia born in tufts.

INTRODUCTION

In Korea it has been known five taxa of *Leathesia* Gray, one taxon of *Petrospongium* Nägeli, and one taxon of *Myriactula* Kuntze in the Leathesiaceae Setchell et Gardner (Lee and Kang 1986). However, taxonomic studies on the family have not been made. This study is for a taxonomic consideration with the collections from Cheju Island during the period from July 1987 to June 1988.

A species, *Petrospongium rugosum* (Okamura) Setchell et Gardner is growing on rocks with smooth surface in the upper to middle tidal zone. *Leathesia difformis* (L.) Areschoug occurs on articulate corralline algae or rocks and forms intermittent mats in the middle to lower tidal zone. The other taxa of *Leathesia* are of small thalli and usually epiphytic on brown algae in this locality. *Myriactula* species was not found in Cheju Island during this investigation.

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DESCRIPTION OF TAXA

PETROSPONGIUM Nägeli ex Kützing (1858, tab. 3 fig. II)

Korean name: 바위주름속

Kützing 1858, band 8, tab. 3. Setchell and Gardner 1925, p. 508. Hamel 1931–1939, p. 144 as *Cylindrocarpus*. Okamura 1936, p. 186. Smith 1944, p. 115. Inagaki 1958, p. 96. Womersley 1987, p. 98. Fletcher 1987, p. 160. Hauck 1885, p. 357.

Type species: *Petrospongium berkeleyi* (Greville) Nägeli.

Plants are fleshy, gelatinous, somewhat rigid, with a smooth or sometimes rugose surface, and usually appear circular in shape by marginal growth. The plants show three layers in their internal structure; basal, medullary, and cortical layers. The basal layer is composed of entwined rhizoidal filaments and attached to the substratum. The medullary layer is located between the basal and the cortical layers and composed of erecting and dichotomously branched filaments, which consist of barrel-shaped to fusiform cells. The cortical layer is composed of assimilating filaments, hairs, and reproductive structures. The assimilating filaments which arise from upper medullary cells and consist of 4–10 cells with determinate growth, are rather compact in palisade-like arrangement, simple or branched dichotomously or subdichotomously. The plants of *Petrospongium* contain discoid chloroplasts in the cells of assimilating filaments.

Only two species have been known in this genus; *P. berkeleyi* (Grev.) Nägeli from the North Atlantic and *P. rugosum* (Okamura) Setchell et Gardner from northern to southern Pacific Coast (Okamura 1907, Setchell and Gardner 1925, Hamel 1939, Womersley 1987). *Petrospongium* is characterized by cylindrical and branched assimilating filaments without an inflated apical cell, more compact medullary filaments, rather cartilagenous, and dark brown color.

Nägeli (*in* Kützing 1858, tab.3) proposed *Petrospongium* with *P. berkeleyi* (Greville) Nägeli. The species was previously described by Greville as *Chaetophora berkeleyi* Greville (cf. Kützing 1858). On the other hand, *Cylindrocarpus* was established by Crouan and Crouan (1851, cf. Setchell and Gardner 1925) in which *C. microscopicus* Crouan and *C. berkeleyi* (Greville) Crouan were mentioned. Upon the examination of *Petrospongium berkeleyi* (Greville) Nägeli and *Cylindrocarpus microscopicus* Crouan, Setchell and Gardner (1925) concluded the former to be regarded in the Leathesiaceae and the latter in the Ectocarpaceae (cf. Hamel 1931–1939, Womersley 1987, Fletcher 1987). This conclusion has been generally accepted (e.g., Okamura

1936, Newton 1931, Smith 1944, etc.). However, Abbott and Hollenberg (1976) insisted on Crouan's opinion. If *C. berkeleyi* was mentioned as the type of *Cylindrocarpus*, *Petrospongium* might be superfluous. In this paper, *Petrospongium* is adopted, based on the Setchell and Gardner's conclusion, because the original description of Crouan and Crouan (1851) was not consulted yet.

Petrospongium rugosum (Okamura) Setchell et Gardner (1924, p. 12)
(Text Figs 1–11.)
Basionym: *Cylindrocarpus rugosa* Okamura 1907, p. 20.
Korean name: 바위주름

Setchell and Gardner 1925, p. 509. Okamura 1936, p. 186. Smith 1944, p. 116. Inagaki 1958, p. 97. Lindauer *et al.* 1961, p. 222. Abbott and Hollenberg 1976, p. 177 as *C. rugosus*. Scagel *et al.* 1986, p. 81 as *C. rugosus*. Womersley 1987, p. 100. Fletcher 1987, p. 169. Kang 1968, p. 123.

Plants are crustose, expanded by marginal growth, appearing more or less circular in outline. Thalli are fleshy, with a smooth and lubricous surface when young, or a radially or irregularly wrinkled surface and becoming hollow at center when mature. The basal part is composed of entangled rhizoidal filaments. The rhizoidal filaments arise from lower medullary cells. Occasionally, the upper to middle cells of medullary filaments also give rise to rhizoidal filaments. The cells of rhizoidal filaments are cylindrical, more or less contorted, 10–12 μm wide and 80–160 μm long. The medullary layer is 1200–1800 μm thick and composed of hyaline filaments which are erect, branched di- or trichotomously, and compact without lateral connection. The cells of medullary filaments are fusiform to barrel-shaped or moniliform, 30–50 μm wide and 120–350 μm long. Agglutinated brown granules appear in the cells of medullary filaments. Frequently, the medullary cells near cortical layers give rise to short and small-celled projections laterally. The cortical layer is composed of assimilating filaments, phaeophycean hairs and reproductive structures. The assimilating filaments arise from the outermost medullary cells and are simple or subdichotomously branched, or frequently forked at the base, composed of 5–9 cells and 70–100 μm long. The cells of assimilating filaments are cylindrical to long barrel-shaped, 6–9 μm wide and 10–16 μm long. Phaeophycean hairs are born in groups on the outer medullary cells.

Unilocular sporangia are born on outer medullary cells, usually sessile, ellipsoid to fusiform, 25–35 μm wide and 70–80 μm long. The unilocular sporangia attach to the subtending cell with their bases when young, and elongate thereafter by anterial and posterial extension in maturity. Thus, the sporangia appear to be attached laterally when mature. Plurilocular sporangia were known to be born on ectocarpacean thalli, of multiseriate loculi and fusiform or conical in shape (Arasaki 1948, cf. Ajisaka 1984).

Type locality: Shima Idju, Japan (Okamura 1907).

Type: SAP (cf. Womersley 1987)

Distribution: British Columbia to Baja California of North America, New Zealand, Australia, Japan, Korea.

Local distribution: Pusan, Bijindo, Cheju Islands.

Collections examined: LYP 764, Seongsan, Cheju, 1988-Ⅵ-12. LYP 765, Hengwon, Cheju, 1988-Ⅵ-13 (leg. K.J. Lee).

The plants of *P. rugosum* are common in the upper to middle intertidal zone of Cheju Island in spring. The plants are crustose, expanding marginally and showing a rather circular plate. The thallus surface is smooth when young, but rugose radially or irregularly when old. Thereafter, the center of thallus becomes hollow. The plant is easily distinguished from *Ralfsia* species in dark reddish brown, rather thick and fleshy, soft and lubricous nature of thallus.

LEATHESIA Gray (1821, p. 301)

Korean name: 바위두둑속

Areschoug 1847, p. 376. Oltmanns 1922, p. 26. Setchell and Gardner 1925, p. 510. Smith 1944, p. 114. Takamatsu 1939, p. 2. Inagaki 1958, p. 100. Abbott and Hollenberg 1976, p. 176. Fletcher 1987, p. 141. Womersley 1987, p. 100. Kützing 1843, p. 331.

Type species: *Leathesia tuberiformis* (J.E. Smith) Gray 1821, pl. 1, p. 301.

Plants are lumpy or globose, lubricous but rigid, occasionally hollow, epilithic or epiphytic, and composed of two discernible layers; medulla and cortex. The basal part of thallus is composed of hyaline, small cells or rhizoidal filaments. Medullary layers are composed of long, fusiform to clavate, or short barrel-shaped to moniliform cells, or cells with various shape. The cells of medulla are hyaline, occasionally containing agglutinated brown granules, developing anastomoses with laterally adjacent cells with or without lacunae between them. The cortical layer is composed of assimilating filaments, hairs, and reproductive structures; uni- and/or plurilocular sporangia. The assimilating filaments arise from the outer medullary cells and form a compact palisade-like stratum, showing determinate growth, clavate to spatulate in shape with a rather inflated apical cell. Phaeophycean hairs are born in groups on the outer medullary cells. Discoid or parietal laminate chloroplasts are present in the cell of assimilating filaments.

Plurilocular sporangia are of uniseriate or partially biseriate loculi, born solitarily or in corymbose groups on the outer medullary cells. Unilocular sporangia are born on the basal cells of assimilating filaments. Ajisaka (1984) reported that the macrothallic phase of *Leathesia japonica* Inagaki alternated with a filamentous microthallic phase in the life cycle.

There is no consensus in discrimination of *Corynophlaea* from *Leathesia*. Kützing (1843) established *Corynophlaea* on the basis of *C. haltica* Kützing and *C. umbellata* (Agardh) Kützing.

Corynophlaea was characterized in the original description by small, globose and gelatinous thallus, clavate and moniliform-celled assimilating filaments, and loosely anastomosing medullary filaments. Hamel (1931–1939) recognized *Corynophlaea* in having rather long assimilating filaments and without anastomosis of medullary filaments. Lindauer *et al.* (1961) characterized *Corynophlaea* by soft and lubricous thallus nature with long assimilating filaments, while *Leathesia* by firm, globose and glabrous thallus with short assimilating filaments. Womersley (1987) circumscribed *Corynophlaea* on the basis of long, simple and arcuate assimilating filaments, and without anastomosis of medullary filaments, while *Leathesia* on the basis of short and simple assimilating filaments with an inflated terminal cell, and anastomosing medullary filaments. Womersley (1987) suspected some Japanese taxa of *Leathesia* credited by Inagaki (1958). Setchell and Gardner (1925), however, regarded *Corynophlaea* to be same genus as *Leathesia* because the hollow or solid nature of adult thallus was useless to circumscribe to two genus. Takamatsu (1939) and Inagaki (1958) followed Setchell and Gardner's opinion.

Upon the examination of the collections from Cheju Island, interspecific variation in the cell shape of assimilating filaments appeared in *Leathesia*. The lateral lacunae of anastomosing medullary filaments were observed in the plants of *Leathesia difformis* (L.) Areschoug but *Leathesia sphaerocephala* Yamada and *Leathesia verruculiformis* sp. nov. In this paper *Corynophlaea* is regarded as same genus as *Leathesia* pending further knowledge on *Leathesia-Corynophlaea* complex. Thus, *Leathesia* is to be characterized by simple, clavate to spatulate assimilating filaments with an inflated terminal cell.

Leathesia difformis (L.) Areschoug (1847, p. 376)

(Text Figs 12–31.)

Korean name: 바위두둑

Basionym: *Tremella difformis* Linneaus (1755, p. 429. cf. Smith 1944).

Synonym: *Leathesia saxicola* Takamatsu (1939, p. 17).

Areschoug 1847, p. 376. Hauck 1885, p. 355. Okamura 1907, p. 80. Kylin 1933, p. 64. Okamura 1936, p. 187. Takamatsu 1939, p. 12. Smith 1944, p. 114. Inagaki 1958, p. 101. Kang 1968, p. 122. Womersley 1987, p. 102. Fletcher, 1987, p. 143.

Plants are epiphytic or epilithic, solitary in globose shape or gregarious in various shape and size, rugged or wrinkled, becoming hollow at the center of thallus in age. Rhizoidal filaments are profuse at the base of thallus, with an obtuse or somewhat inflated terminal cell. The cells of rhizoidal filaments are hyaline, more or less contorted, cylindrical, 6–8 μm wide and about 120 μm long. Medullary cells except for outer ones are polygonal or polymorphic, forming a loosely parenchymatous reticulum, and including agglutinated brown granules. The outer medullary cells are globose to subglobose, issuing cells in forked or trident mode, and 200–300 μm in diameter. The outermost medullary cells are small, globose to cylindrical, and giving rise to assimilating filaments, phaeophycean hairs, or reproductive stuctures. Assimilating filaments are born singly to in triplets on a medullary cell, composed of 2–4 cells, shortly clavate with an inflated terminal cell, 30–70 μm long. The intercalary cells of assimilating

filaments are oblong to barrel-shaped, 4–6 μm wide and 8–18 μm long. The terminal cell of assimilating filaments are inflated, pyriform or obovoid to globose, 12–16 μm wide and 12–24 μm long. Phaeophycean hairs are born solitarily on the outermost medullary cells and about 8 μm thick. Discoid chloroplasts are present in the cells of assimilating filaments.

Unilocular sporangia are born on the basal cell of assimilating filaments, attached basally or sublaterally, sessile, ellipsoid to ovoid, 18–22 μm wide and 30–40 μm long. Plurilocular sporangia are born on the outermost medullary cells, with uniseriate loculi, 4–8 μm wide and 20–28 μm long.

Type locality: Sweden (cf. Smith 1944).

Type: LINN (?) (cf. Womersley 1987).

Distribution: cosmopolitan.

Local distribution: whole coast of Korean peninsula.

Collections examined: LYP 750, Aewol, Cheju, 1988–V–30 (leg. K.J. Lee). LYP 762, Seongsan, Cheju, 1988–VI–12, LYP 763, Hengwon, Cheju, 1988–VI–12 (leg. K.J. Lee). LYP 767, Hengwon, Cheju, 1988–VI–13 (leg. K.J. Lee). LYP 769, Seongsan, Cheju, 1988–VI–12. LYP 770, Hengwon, Cheju, 1988–VI–13 (leg. K.J. Lee).

L. difformis is one of the common algae in Cheju Island. The species usually occur in association with articulate coralline algae in the middle to lower tidal zone during winter and spring. The plants are gregarious in an intermittently broad mat or solitary in subglobose or globose forms.

The assimilating filaments of some collections (LYP 750, LYP 762, LYP 763, LYP 767) are more or less shorter (18–24 μm long) than those of other collections (LYP 769, LYP 770). The plants of the former collections are bearing only plurilocular sporangia. The assimilating filaments of the plants bearing plurilocular sporangia of the latter collections are also shorter (30–40 μm long) than those of unilocular sporangial plants. The plants of the former collections are closely related to *Leathesia saxicola* Takamatsu and also to the plants of *L. difformis* from British Isles in terms of the shape of assimilating filaments and thallus forms (Takamatsu 1939, Inagaki 1958, Fletcher 1987). The unilocular sporangial plants of the latter collections have assimilating filaments similar to the plants of *L. difformis* from Japan (Okamura 1936, Takamatsu 1939, Inagaki 1958). The two forms, with short or long assimilating filaments, share the habitat in Cheju Island. Takamatsu (1939) advocated that the thallus of *L. difformis* was more fragile, thinner, and showing more irregular lobes on the surface than that of *L. saxicola*. However, the characters used by Takamatsu (1939) are not useful to distinguish the both taxa, *L. difformis* and *L. saxicola*, in field. Therefore, *L. saxicola* seems to us best to be synonymous with *L. difformis*.

L. difformis was regarded to be the same taxon as *L. tuberiformis* which was the type of the genus *Leathesia* (cf. Fletcher 1987, Womersley 1987). However, the two taxa are remaining here separately because no comparison of the type collections of the two taxa has been attempted.

Leathesia sphaerocephala Yamada (1932, p. 269)
(Text Figs 32–41.)
Korean name: 구슬머리바위두둑
Okamura 1936, p. 188. Tokida 1954, p. 87. Inagaki 1958, p. 115.

Plants are epiphytic, globose to pulvinate showing elongate ridges, 300–500 μm high. The basal part of the plants have small and irregular shaped cells on which long clavate medullary cells are issued. Medullary layers are composed of 2–5 celled erect filaments. The medullary filaments are more or less anastomosing laterally and branched di- or trichotomously from the distal part of the component cells. The cells of medullary filaments are longish clavate, 20–50 μm wide and 100–200 μm long at the lower part and fusiform to cylindrical, 14–40 μm wide and 20–60 μm long at the upper part of medullary filaments. Assimilating filaments arise in pairs or triplets from the outermost cell of a medullary filaments, composed of 4–6 cells, spatulate, with an inflated terminal cell, 40–100 μm long. The intercalary cells of assimilating filaments are cylindrical to barrel-shaped, containing a parietal laminate chloroplast, 4–8 μm wide and 10–40 μm long. The terminal cell of assimilating filaments is inflated, ellipsoid to globose, containing a cap-like chloroplast, 14–18 μm wide and 20–30 μm long. Phaeophycean hairs are born in tufts from outer medullary cells, and 6–10 μm thick.

Plurilocular sporangia born in tufts on the outermost medullary cells are of uniseriate or partially biseriate loculi, 7–10 μm wide and 30–56 μm long. Unilocular sporangia born on the outermost medullary cells are sessile or with a small-celled stalk, associated with plurilocular sporangia, usually including oil-like droplets near sporangial wall, ellipsoid to pyriform or globose, 20–42 μm wide and 45–60 μm long.

Type locality: Saruru, Kitami Prov. Japan.
Type: SAP (?)
Distribution: Japan, Korea.
Collections examined: LYP 662, Seongsan, Cheju, 1988–Ⅳ–18. LYP 748, Sagye, Cheju, 1988–Ⅳ–7. LYP 751, Kosan, Cheju, 1988–V–29.

The plants examined in this study are growing on the upper part of the thallus of *Myagropsis myagroides* Fensholt in the subtidal zone or tide pools of Cheju Island. The plants are globose or occasionally expanding in long ridge-like forms which cause the supporting part of host to be bent oppositely. The medullary filaments are forked or more frequently trident at the upper part than the lower part. The medullary cell bearing a phaeophycean hair does not give rise to other cortical components; assimilating filaments or reproductive structures. Assimilating filaments are born singly to in triplets on the outermost medullary cell, straight, of same width from base to subterminal cells. The intercalary cells of assimilating filament are cylindrical and containing a laminate chloroplast. The chloroplast of the terminal cell of assimilating filaments is cap-like and occupying distal end of the cell.

Unilocular sporangia usually include oil-like droplets near sporangial wall when mature. In the plants collected at Sagye, mature unilocular sporangia appear among empty plurilocular

sporangia. Thus, the plurilocular sporangia of the plants from Sagye seem to be produced earlier than unilocular sporangia.

The plants at hand agree well with the description given by Yamada (1932) except for the cell number of assimilating filaments. The plants examined by Yamada had assimilating filaments with 7–13 cells, while those examined by Inagaki (1958) had assimilating filaments with 5–9 cells. Thus, the cell number of assimilating filaments seems to be somewhat variable in this taxon. Takamatsu (1939) distinguished her new species, *Leathesia pulvinata* Takamatsu, from *L. sphaerocephala* by pulvinate nature of thallus and the cell number of assimilating filaments (5–6 cells). Inagaki (1958) distinguished the taxa, *L. sphaerocephala* and *L. pulvinata*, by thallus form and the shape of the basal cell of assimilating filaments; slender or barrel-shaped. The plants from Cheju Island show either subglobose or pulvinate nature of thallus, and have either slender or barrel-shaped basal cell of assimilating filaments (see also Inagaki 1958, p. 117). Thus, the characters used by Takamatsu and Inagaki are to be less useful for discrimination of the two taxa. However, the two taxa are separated in this paper pending more informations on *L. sphaerocephala-L. pulvinata* complex.

Leathesia verruculiformis Lee, Y.P. et I.K. Lee sp. nov.
(Text Figs 42–51.)
Korean name: 작은혹바위두둑 (nom. nov.)

Thalli epiphytici, hemispherici vel spherici, 150–200 μm alti, 250–600 μm diametro; medulla hyalinae parvae; fila medullarum 2–4 cellulis composita, ramificantia dichotome vel trichotome; cellulae filorum medullarum cylindricae in superioribus vel fusiformes ad moniliformes in inferioribus medullis, 15–25 μm latae et 30–40 μm longae; fila assumentium orientia e extima medullas, 8–11 cellulis composita, clavata cum cellula terminali tumida subspherica, vesicaria gradatim versus apicem; sporangia plurilocularia filamentosa, caespitosa, 5–10 μm latae et 50–60 μm longae; sporangia unilocularia pyriformes ad spatulata cum gracilibus fundis, 20–38 μm latae et 50–90 μm longae.

Type locality: Intertidal zone of Sagye, Cheju, Korea (126°18′50″ E, 33°11′75″ N).
Holotype: LYP 646 (Text Fig. 43 upper one, CNU; The Herbarium of the Department of Biology, Cheju National University, Korea).

Thalli epiphytic, lubricous, spherical to hemispherical, 150–200 μm high, 250–600 μm in diameter; medullae hyaline, composed of 2–4 celled erect filaments branching dichotomously or trichotomously; cells of medullary filaments cylindrical at upper parts or fusiform to moniliform with acute terminals at basal parts of medulla, 15–25 μm wide and 30–40 μm long; assimilating filaments born on the outermost medullary cells, composed of 8–11 cells, longish-clavate with subglobose terminal cells, gradually inflated towards apices, occasionally arcuate, 80–170 μm long; cells of assimilating filaments containing discoid chloroplasts, globose through moniliform or fusiform to cylindrical in shape from apices to bases, 6–7 μm wide and 10–30 μm long at bases, 22–25 μm wide and 18–26 μm long at apices of

assimilating filaments; phaeophycean hairs born solitarily from outer medullary cells, 12–13 μm thick.

Plurilocular sporangia filamentous, tufted with 3–5 sporangial filaments, born on basal cells of assimilating filaments, usually of uniseriate loculi, sometimes of partially biseriate loculi here and there in sporangia, 5–10 μm wide and 50–60 μm long; unilocular sporangia rare, born on outer medullary cells, associated with plurilocular sporangia, pyriform to spatulate with finely short neck-like bases, 20–38 μm wide and 50–90 μm long.

Collections examined: LYP 646, Sagye, Cheju, 1988–Ⅳ–17.

The plants of *L. verruculiformis* appear as tiny lumps on the surface of blades or vesicles of *Sargassum thunbergii* (Mertens) O. Kuntze collected in the intertidal zone of Sagye, Cheju, Korea. The medullary filaments of *L. verruculiformis* are short, composed of 2–4 cells, branched di- or trichotomously, and anastomosing laterally near base. However, no lacuna was observed at anastomosing parts between medullary filaments. The cells of medullary filaments are longish fusiform to cylindrical at upper parts and moniliform at basal parts of medullary filaments. The basal cells of medullary filaments have a short and acute projection towards the substratum. The assimilating filaments are longish clavate with an inflated and subglobose terminal cell. Occasionally, the subterminal or upper cells of assimilating filaments appear in moniliform.

Several taxa of *Leathesia* having a tiny thallus were previously reported; *L. umbellata* (Agardh) Meneghini, *L. nana* Setchell et Gardner, *L. crassipilosa* Takamatsu, *L. sadoensis* Inagaki, and *L. yezoensis* Inagaki (Kützing 1858, Setchell and Gardner 1924, Takamatsu 1939, Inagaki 1958). *L. verruculiformis* is distinguished from *L. nana* by long assimilating filaments with 8–11 cells. *L. verruculiformis*is also distinguished from *L. crassipilosa* by straight assimilating filaments with rather cylindrical in shape of intercalary cells. *L. verruculiformis* also differs from *L. sadoensis* in the shape of plurilocular sporangia and assimilating filaments. *L. yezoensis* is rather related to *L. crassipilosa* than *L. verruculiformis* in terms of the shape of component cells of assimilating filaments. *L. umbellata* also differs from *L. verruculiformis* in the construction of medullary layers and the assimilating filaments without inflated terminal cells.

L. verruculiformis is characterized by the less compact cortical layers, clavate assimilating filaments with an inflated terminal cell, and plurilocular sporangia with uniseriate loculi born in tufts on the basal cell of assimilating filaments. It is described as a new species because no taxon with the above characters was known.

적 요

제주도산 바위두둑과 식물 2속 4종 즉 바위주름속의 바위주름, 그리고 바위두둑속의 바위두둑, 구슬머리바위두둑, 작은혹바위두둑이 발견되어 이들의 형태분류학적 연구를 수행하였으며 모자반털사촌속의 식물은 발견되지않았다. 작은혹바위두둑은 성긴 피층조직과 방망이 모양의 동화사 그리고 다발로 형성되는 복자낭 등의 특징을 가지고 있어서 신종으로 보고한다.

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Explanation of Figures

Figs 1–11. *Petrospongium rugosum*.

1. Thallus shape (scale 10 mm). 2. Hairs (scale 50 μm). 3. Branching mode of assimilating filaments (scale 50 μm). 4. Small projections (scale 20 μm). 5. Young unilocular sporangium (scale 20 μm). 6. Mature unilocular sporangium (scale 20 μm). 7. Empty unilocular sporangium (scale 20 μm). 8. Assimilating filaments (scale 20 μm). 9. Medullary and cortical layers (scale 50 μm). 10. Medullary filaments(scale 50 μm). 11. Rhizoidal filament(scale 50 μm).

Figs 12–21. *Leathesia difformis* (LYP 769, LYP 770).

12. Thallus shape (scale 5 mm). 13. Assimilating filaments in development (scale 30 μm). 14 and 16. Assimilating filaments and unilocular sporangia (scale 14=20 μm, 16=30 μm). 15. Hair of unilocular sporangial plant(scale 30 μm). 17 and 20. Plurilocular sporangia (scale 30 μm). 18. Medullary filaments(scale 100 μm). 19. Hair of unilocular sporangial plant(scale 30 μm). 21. Rhizoidal filaments(scale 100 μm).

Figs 22–31. *Leathesia difformis* (LYP 750, LYP 762, LYP 763, LYP 767).

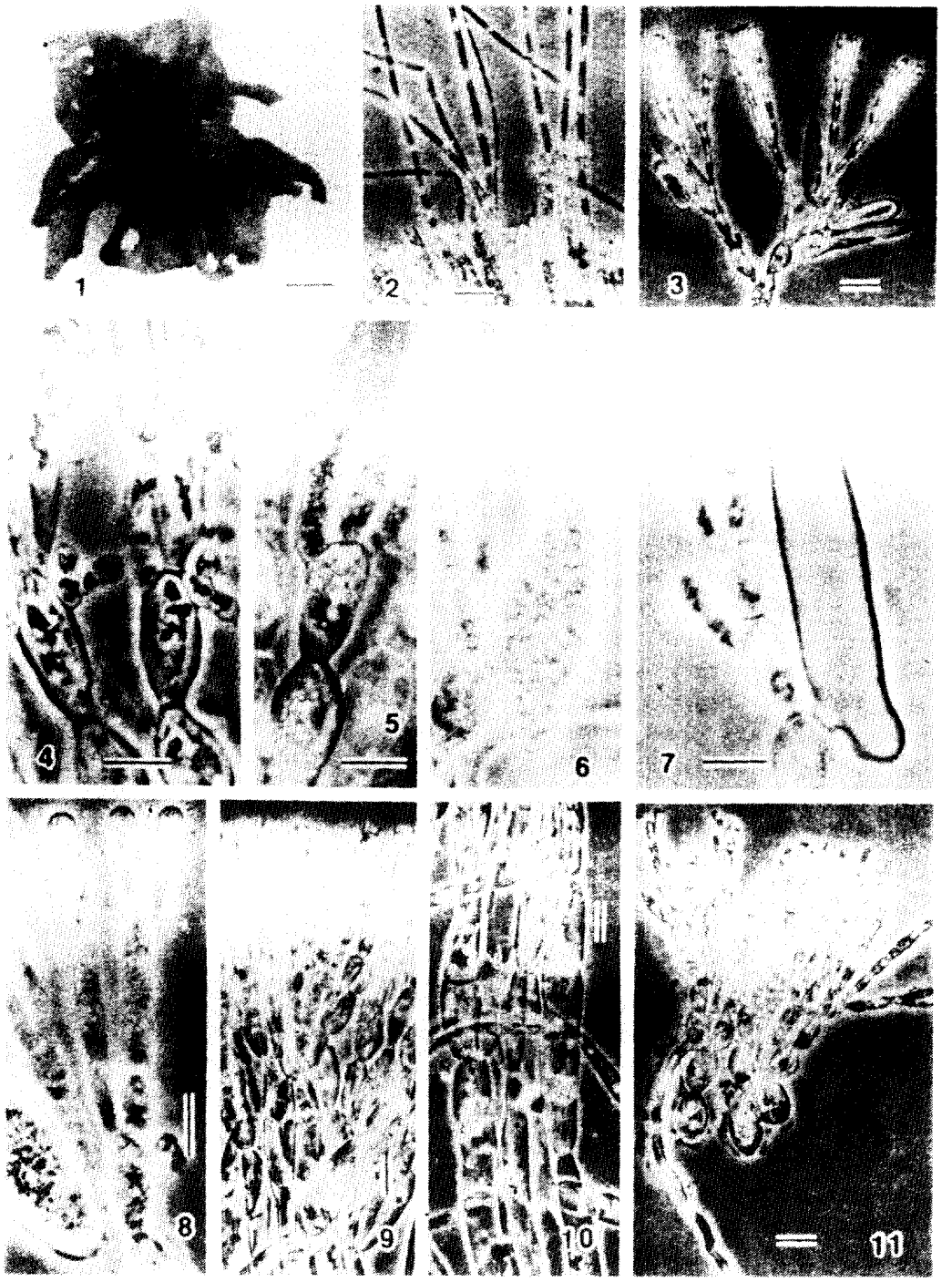
22 and 25. Thallus shapes (scale 5 μm). 23 and 24. Assimilating filaments (scale 20 μm). 26 and 29. Hairs (scale 30 μm). 27. Plurilocular sporangia (scale 20 μm). 28. Cross section of thallus showing anastomosis of medullary filaments (scale 30 μm). 30. outer medullary cells (scale 30 μm). 31. Medullary filaments(scale 100 μm).

Figs 32–41. *Leathesia sphaerocephala*.

32. Thallus shapes (scale 3 mm). 33. Plurilocular sporangia (scale 30 μm). 34. Assimilating filaments and unilocular sporangium including oil-like droplets (scale 30 μm). 35. Internal structure of thallus (scale 100 μm). 36. Empty plurilocular sporangia (scale 30 μm). 37. Assimilating filaments and hair (scale 30 μm). 38. Thallus shape (scale 500 mm). 39 and 40. Medullary filaments (scale 30 μm). 41. Outer medullary cells (scale 30 μm).

Figs 42–51. *Leathesia verruculiformis*.

42 and 43. Thallus shapes, 43 upper one being **Holotype** (scale 42=200 μm, 43=150 μm). 44. Arcuate assimilating filament (scale 30 μm). 45 and 46. Outer medullary cells (scale 30 μm). 47. Unilocular sporangium (scale 30 μm). 48 and 49. Plurilocular sporangia (scale 30 μm). 50. Assimilating filaments (scale 30 μm). 51. Medullary filaments (scale 30 μm).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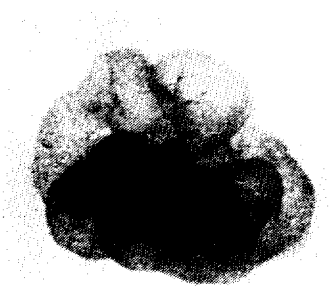
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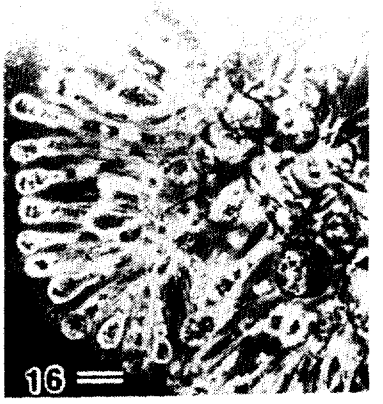
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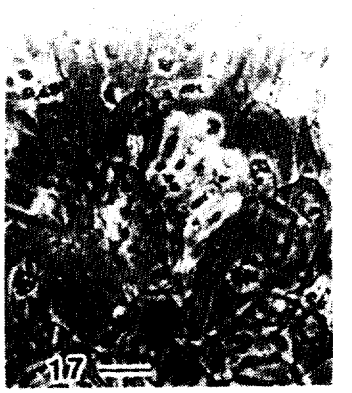
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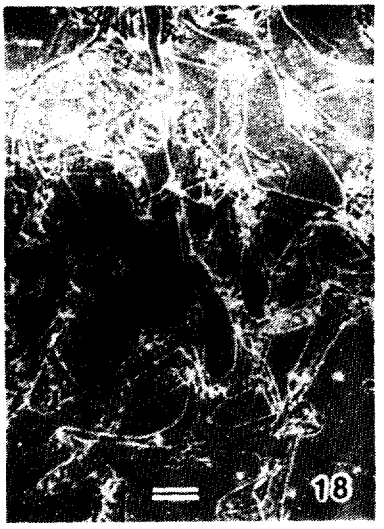
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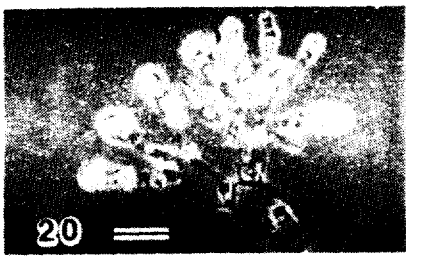
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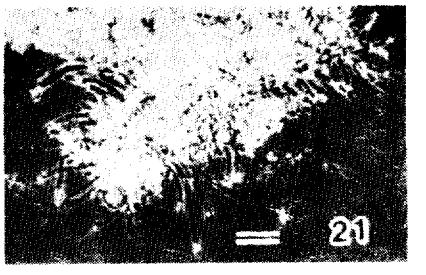
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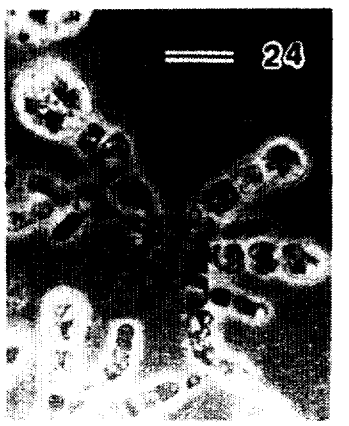
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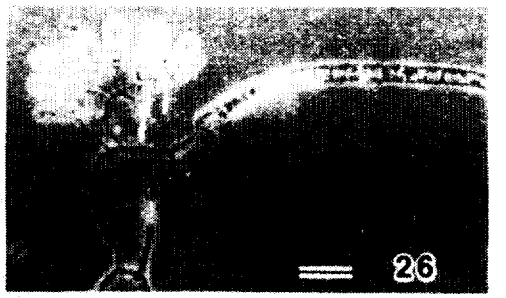
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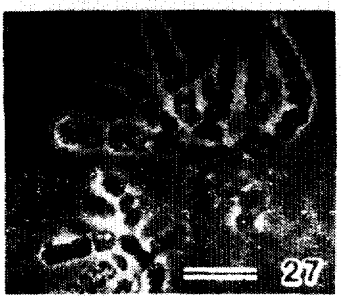
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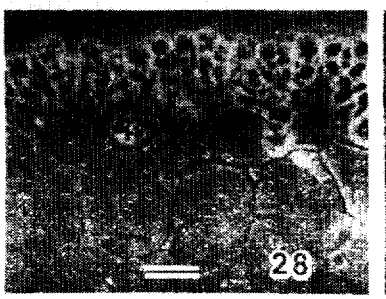
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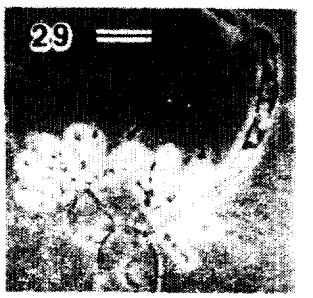
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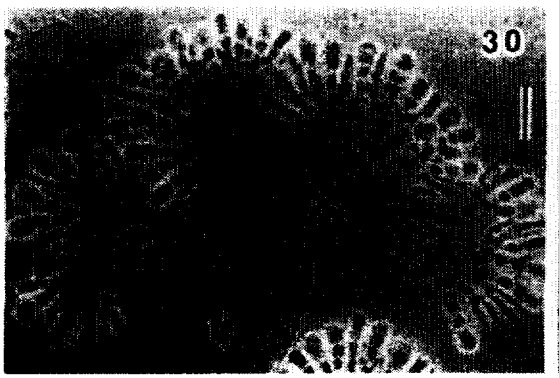
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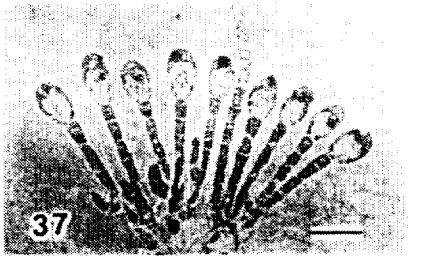
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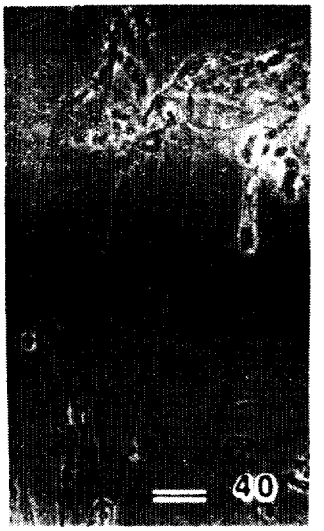
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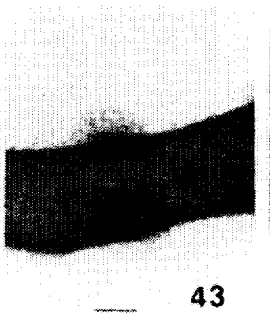
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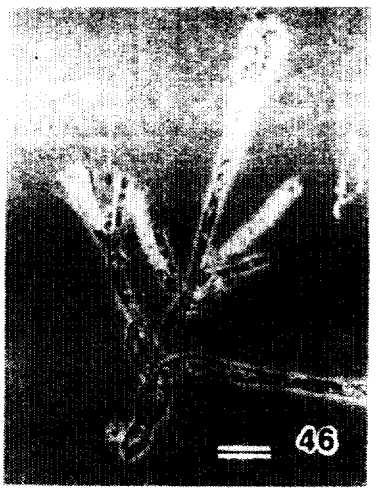
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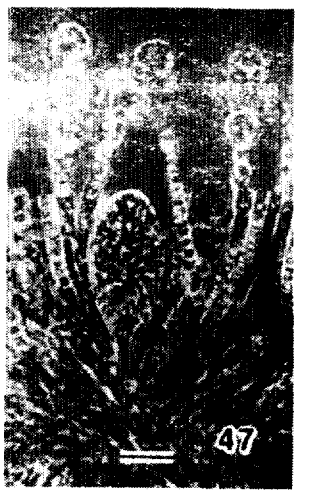
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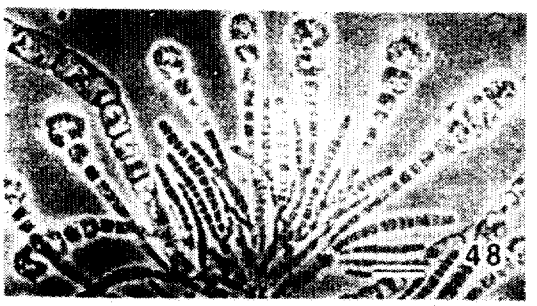
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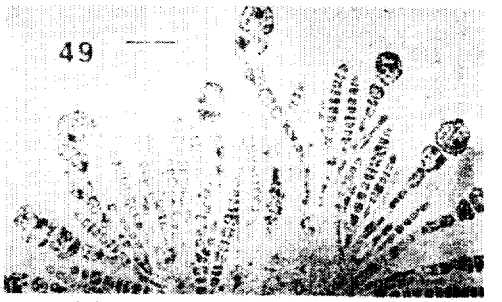
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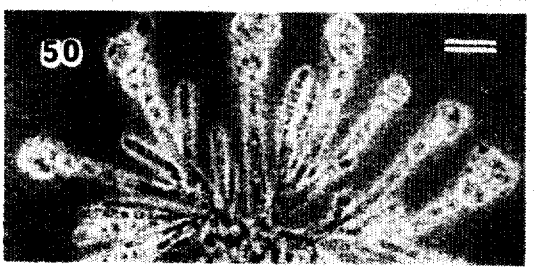
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