

**Morphological observation on a brown alga,
Delamarea attenuata (KJELLMAN) ROSENVINGE
(Dictyosiphonales), new to Japan¹⁾**

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Delamarea attenuata belonging to the order Dictyosiphonales (Phaeophyta) is reported from Abashiri on the Okhotsk coast of Hokkaido. Previously known from the North Atlantic and eastern North Pacific, this is the first record from the western Pacific. The species is characterized by having an unbranched cylindrical habit similar to that of *Scytosiphon lomentaria*, and by having large vesicular paraphyses and by the occurrence of ovate unilocular and lanceolate plurilocular sporangia on separate (rarely on the same) thalli.

Key Index Words: *Delamarea*; *Dictyosiphonales*; *geographical distribution*; *morphology*; *Phaeophyta*; *systematics*; *taxonomy*.

A brown alga, *Delamarea attenuata* (KJELLMAN) ROSENVINGE belonging to the Dictyosiphonales has been reported from cold waters of Novaya Zemlya (FLOROV & KORSAKOVA 1932, A. D. ZINOVA 1954), Spitsbergen (KJELLMAN 1883), Greenland (ROSENVINGE 1893, LUND 1959), Iceland (CARAM & JÓNSSON 1972), Norway (JAASUND 1965), Denmark (ROSENVINGE & LUND 1947), Helgoland (KUCKUCK 1894), Miquelon Isl. (HARIOT 1889) and southern Massachusetts (DOTY 1948, TAYLOR 1937, 1957) of North Atlantic Ocean. It is also known from Alaska (JOHANSEN 1971) of the eastern North Pacific Ocean, but not from the western Pacific.

The alga referable to this species was first collected from the Okhotsk Sea coast of Hokkaido on the west side of the Pacific. Morphological observations on the Japanese population are described here.

Materials

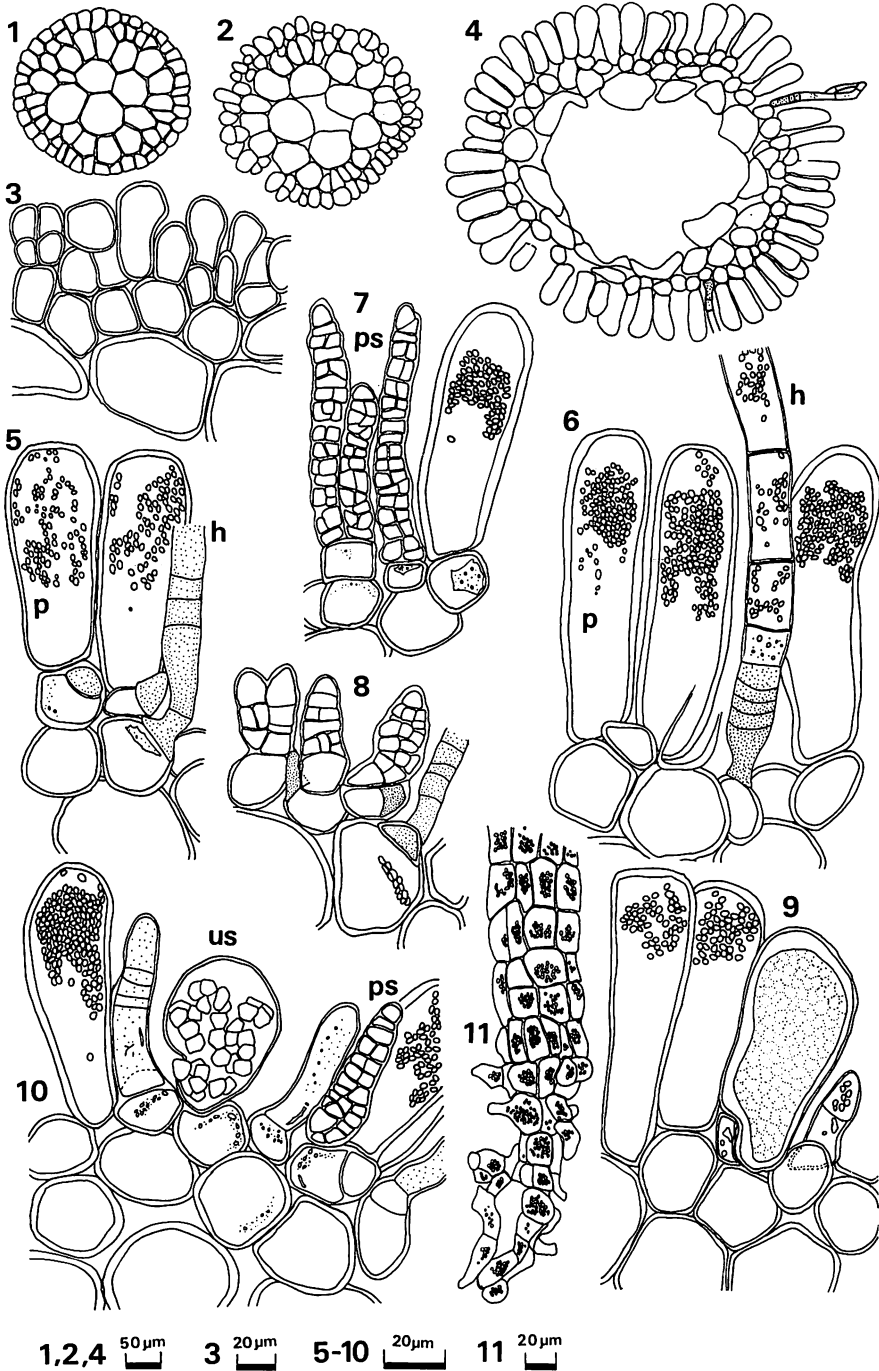
The specimens observed were collected on June 24, 1979 at Futatsuiwa, Abashiri, Hokkaido (44°02'N, 144°17'E) growing on rocks in the subtidal zone about 1 m deep in company with *Chordaria flagelliformis* (MÜLLER) C. AGARDH and *Scytosiphon lomentaria* (LYNGBYE) LINK. Preserved materials in 10% formaldehyde-seawater were used for microscopic examination.

Observations

The plants are solitary or caespitose, attached on rocks with a cushion like holdfast, filiform and simple, attenuate towards the base, roundish at the tip, olive or yellowish brown in color, and up to 8.5 cm in length and 1.3 mm in diameter (Fig. 12).

The thallus is solid when young, becoming hollow with age except in the lower part (Figs. 1-4, 13). Peripheral cells of

1) Dedicated to the memory of the late Professor Tomoo MIWA.

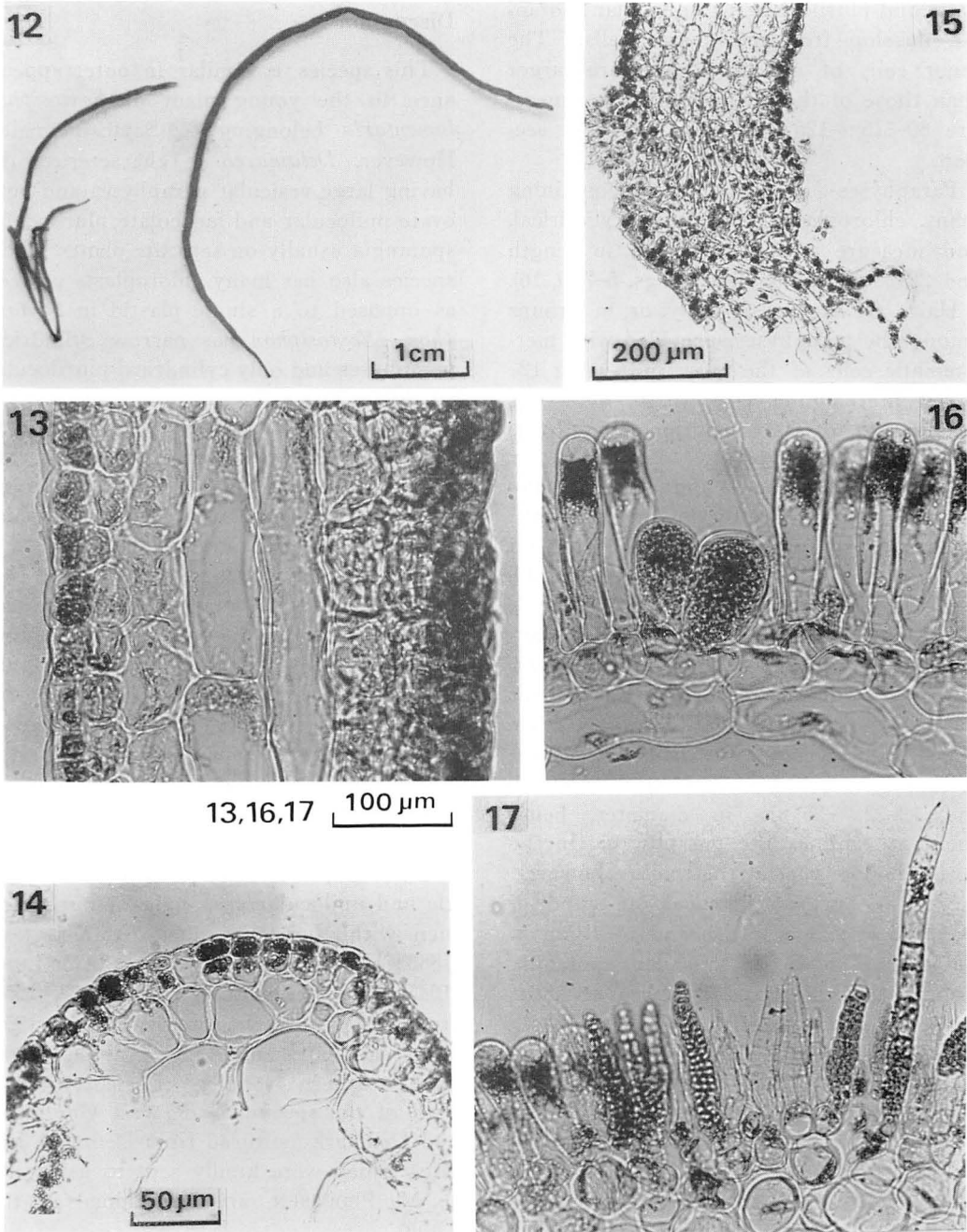


Figs. 1-11. *Delamarea attenuata* (KJELLMAN) ROSENVINGE.

1. Transverse section of young solid thallus. 2-4. Development of paraphyses from peripheral cells. 5, 6. Paraphyses and hairs. 5. Showing initials of sporangia or hairs. 7. Plurilocular sporangia and paraphyses. 8. Conical plurilocular sporangia borne in lowest part of hollow thallus. 9. Unilocular sporangium and paraphyses. 10. Unilocular sporangium borne on a plant with plurilocular sporangia. 11. Lowermost part of young thallus, rhizoidal filaments descending from the surface cells. p: paraphysis, h: hair, ps: plurilocular sporangium, us: unilocular sporangium.

young solid thallus are small and cubical, 14-33×15-30 μm in cross section, containing many discoid chloroplasts measuring

3-3.5 μm in diameter. The inner cells are large, roundish and thick walled, 55-78×47-63 μm in cross section, and nearly color-



Figs. 12-17. *Delamarea attenuata* (KJELLMAN) ROSENVINGE.

12. habit. 13. Longitudinal section of young solid thallus. 14. Transverse section of immature young thallus. 15. Longitudinal section of lower part of thallus. 16. Unilocular sporangia and paraphyses. 17. Plurilocular sporangia, paraphyses and hair.

less. In longitudinal section, the inner cells are cylindrical (Fig. 13).

When mature, the thallus becomes hollow, and clavate vesicular cells (paraphyses), hairs and plurilocular or unilocular sporangia develop from peripheral cells. The inner cells of mature thallus are larger than those of the young thallus and measure 80–115 (–125) × 50–70 μm in cross section.

Paraphyses are vesicular, containing many chloroplasts, clavate to cylindrical, and measure 65–122 (–137) μm in length and 22–35 μm in diameter (Figs. 5–7, 9, 16).

Hairs are scattered singly or in groups among the paraphyses, provided with meristematic cells at the base, measuring 12–18 μm in diameter (Figs. 5, 6, 17). The basal sheath of hair mentioned by LUND (1969) is not observed.

Plurilocular sporangia and unilocular sporangia are borne usually on distinct plants. Unilocular sporangia are rarely borne on the same plant as plurilocular ones (Fig. 10) as already mentioned by CARAM & JÓNSSON (1972). Plurilocular and unilocular sporangia are distributed evenly among paraphyses over the entire thallus except near the holdfast. Plurilocular sporangia (Figs. 7, 17) are lanceolate or linear, with two to four seriate loculi, 65–110 μm in length and 12–22 (–25) μm in diameter, being about as long as the paraphyses. In the lowest hollow part of the thallus, however, they are short and conical or roundish, being 32–50 μm in length and 14–21 μm in diameter (Fig. 8). Unilocular sporangia (Figs. 9, 16) are ovate, pyriform or short clavate, usually sessile, measuring 55–85 (–92) μm in length and 31–52 μm in diameter, being usually about 7/10 times shorter than paraphyses.

Cushion like holdfasts are composed of densely intertwined branched rhizoidal filaments 15–20 μm in diameter. Rhizoidal filaments extend horizontally in the lower part of holdfast and enclose the basal part of erect thallus in the upper part (Fig. 15). They also descend from the superficial cells of the basal part of the erect thallus (Fig.

11). The rhizoidal filaments are composed of sinuate cells, uniseriately arranged with rare cell divisions by longitudinal walls.

Discussion

This species is similar in outer appearance to the young plant of *Scytosiphon lomentaria* belonging to Scytosiphonales. However, *Delamarea* is characterized by having large vesicular paraphyses and both ovate unilocular and lanceolate plurilocular sporangia usually on separate plants. This species also has many chloroplasts per cell as opposed to a single plastid in *Scytosiphon*. *Scytosiphon* has narrow cylindrical paraphyses and only cylindrical plurilocular sporangia.

This taxon was first described by KJELLMAN (1883) as *Scytosiphon attenuatus* KJELLMAN based on the plant from Spitsbergen in the Arctic Sea. He described the plant as having only plurilocular sporangia. On the other hand, HARIOT (1889) reported also a plant similar to *Scytosiphon lomentaria* and bearing only unilocular sporangia from Miquelon Island lying south of Newfoundland, and he named it *Delamarea paradoxa* HARIOT. ROSENVINGE (1893) considered that the two species were conspecific and combined them as *Delamarea attenuata* (KJELLMAN) ROSENVINGE.

Table 1 shows a comparison of the shape and size of paraphyses, plurilocular sporangia and unilocular sporangia of our specimen with those described by KJELLMAN (1883), HARIOT (1889), ROSENVINGE & LUND (1947) from Denmark, TAYLOR (1937, 1957) from eastern North America, LUND (1959) from east Greenland and JAASUND (1965) from northern Norway. The sizes measured of the specimens of west Greenland and Denmark (cultured from Denmark isolate), which were kindly sent to us by Dr. P. M. PEDERSEN, are also added in the Table.

At first, compared with the original description by KJELLMAN (1883), our plurilocular sporangia are usually longer than those described by him, and nearly the

Table 1. Comparisons of the sizes of paraphyses, plurilocular sporangia and unilocular sporangia among the descriptions by different authors from different places

	Paraphyses (μm)	Plurilocular Sporangia (μm)	Unilocular Sporangia (μm)
Our specimen	65-122 (-137.5)×23-35	65-110×12.5-22 (-25) *(33-50×14-22)	55-85 (-92.5)×31.5-52.5
KJELLMAN (1883) (Spitsbergen)	-120×-55	30-40×15-20	—
HARIOT (1889) (Miquelon Isl.)	60-90×30-40	—	40-54×33-40
ROSENVINGE & LUND (1947) (Denmark)	133-156×35	91-123×19-21	61-86×43-55 (-63)
TAYLOR (1937, 1957) (East N. America)	60-120×30-55	—	30-60×18-40
LUND (1959) (East Greenland)	—	28-70×11-21 (-28)	—
JAASUD (1965) (Norway)	100-110×50-65	55-70×35-50	—
West Greenland, collected by PEDERSEN	63-98×12-28	63-98×12-28	—
Denmark, cultured by PEDERSEN	—	—	63-83×43-70

* showing the size in the lowest hollow part of thallus.

same as those described by ROSENVINGE & LUND (1947) and those from west Greenland. According to KJELLMAN the plurilocular sporangia are roundish or conical. Our plurilocular sporangia are usually lanceolate or cylindrical, but as mentioned before the sporangia borne in the lowest hollow part of thallus are conical to roundish and of nearly the same size as those of KJELLMAN. ROSENVINGE & LUND also reported the plants bearing such short and roundish or conical plurilocular sporangia collected at Skagen and they expected that the plants are more juvenile than those with long sporangia. Paraphyses of KJELLMAN's plant are also somewhat broader than ours and those of ROSENVINGE & LUND.

On the other hand, there are also some differences in the shape and the size of paraphyses, plurilocular sporangia and unilocular sporangia between our plant and other plants described by HARIOT, TAYLOR, LUND and JAASUND as seen in Table 1.

Unilocular sporangia described by HARIOT, and TAYLOR are shorter, plurilocular sporangia by LUND are shorter, plurilocular sporangia by JAASUND are shorter and broader and paraphyses by JAASUND are also broader than those of ours. Our plant agrees well with the plant described by ROSENVINGE & LUND in these respects. Such differences seem to be the expected variations within the same species, however the biosystematic problem at the infra-specific level remains.

HARIOT (1889) and LUND (1959) described young shoots issuing from the basal rhizoidal system, and PEDERSEN (1974) clarified by culture methods the development of erect thallus from basal rhizoidal system. We could not find such shoots in our material.

As to the systematic position of this species A. D. Z INOVA (1953, 1954) established the family Delamareaceae including *Delamarea*, *Coelocladia*, *Cladotohele* and *Stschapovia*.

LUND (1959) proposed the order Delamareales for this family presuming that *Delamarea attenuata* has polystichous thallus and isomorphic alternation of generations. But PEDERSEN (1974) demonstrated the presence of a filamentous microthallus in the life history in his culture experiments of the Denmark isolate. He proposed placing the order Delamareales in synonymy with the order Dictyosiphonales with the family Delamareaceae occupying a systematic position between the Striariaceae and Punctariaceae in the latter order. From our understanding of the structure of some of these taxa, we agree with those taxonomic conclusions, and further with PEDERSEN that *Coelocladia*, *Cladothele* and *Stschapovia* are in need of further study.

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川井浩史・黒木宗尚：日本新産，褐藻 *Delamarea attenuata* (KJELLMAN)
ROSENVINGE (ニセカヤモ：新称) の形態学的観察

オホーツク海沿岸，北海道網走において *Delamarea attenuata* (KJELLMAN) ROSENVINGE (ニセカヤモ：新称) と同定される褐藻を採集し，形態学的観察を行なった。本藻は Dictyosiphonales に属し，北半球の高緯度域に広く分布するが，太平洋の西岸からの報告はこれが最初である。本藻の外形は分枝せぬ円柱状で，カヤモノリに似るが大きな囊状の側糸と卵形の単子嚢及び披針形の複子嚢を有する点で区別される。この二つの生殖器官はふつう別々の個体に形成されるが，まれに同一の個体に形成されることもある。(060 札幌市北区北十条西八丁目 北海道大学理学部植物学教室)