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Observations on *Antithamnion miharae* TOKIDA and *A. corallina* KJELLMAN (Rhodophyta, Ceramiales) from the east coast of Hokkaido, Japan

Tadao YOSHIDA

Observations on *Antithamnion miharae* TOKIDA collected from Akkeshi (eastern Hokkaido) showed the general characteristics of *Antithamnionella* LYLE, such as 1) axial cells bearing 2-3 (rarely 4) whorl branchlets, 2) apical part of an indeterminate axis curving sinusoidally, 3) gland cells being cut off laterally from cells of whorl branchlets, 4) tetrasporangia dividing tetrahedrally, and 5) deflecting branch apex after fertilization. The earlier transfer of this species to *Antithamnionella* was, therefore, justified. *Antithamnion corallina* KJELLMAN (=*Callithamnion corallina* RUPRECHT, nom. illeg.) was ascertained to have features such as 1) 3-4 whorl branchlets borne on an axial cell usually showing unequal length and branching, and 2) apical part of fertile branch continues to grow after fertilization of carpogonium. These characteristics show that this species should be removed to the genus *Scagelia* WOLLASTON: *Scagelia corallina* (KJELLMAN) YOSHIDA comb. nov.

In the course of my studies of the marine algae from the eastern part of Hokkaido, Japan, where the cold Oyashio current predominates, I have collected 4 species of antithamnioid algae. These are *Antithamnion corticatum* TOKIDA, *A. sparsum* TOKIDA, *A. miharae* TOKIDA and *A. corallina* KJELLMAN. Among these, *A. corticatum* has been shown to represent a new genus *Tokidaea* (YOSHIDA, 1973), and *A. sparsum* was concluded to be conspecific with *A. defectum* KYLIN (YOSHIDA, 1981). Observations on the remaining two species are given here and some taxonomic problems are discussed. As for the terminology concerning determinate laterals of antithamnioid algae, there are several terms such as pinna, branchlet, ramulus, pleuridium, or phyllidium. I use here the term whorl branchlet.

Observations

1. *Antithamnion miharae*[1] TOKIDA (Figs. 1-8)

This species was described by TOKIDA (1942) based on materials collected

1) Original spelling '*miharai*' is corrected here in accordance with the provisions of Art. 32.4, Art. 73.10 and Rec. 73C.1 of the International Code of Botanical Nomenclature (1978).

from Tomari Bay, Kunashiri Island, southern Kuriles. The plant grew on an ascidian dredged at a depth of 11–14 m.

The plants that are identified with this species were collected growing epiphytically or on pebbles or molluscan shells dredged at about 5 m deep at Akkeshi. Mature plants were rather commonly collected in August and September. This species was very rare in other seasons.

Vegetative structure: The plants from Akkeshi are 1.5–2 cm high, and are composed of prostrate and erect parts. The prostrate part attaches to the substratum by multicellular rhizoids issuing from basal cells of the whorl branchlets. The main axis of the erect part branches irregularly giving an elongate feather-like appearance. Each cell of the axis bears usually a pair of whorl branchlets, but occasionally 3 (or 4) whorl branchlets are formed on an axial cell. Several segments of the secondary axis near the branching have only one determinate lateral on the abaxial side to the primary axis. Apical part of an indeterminate axis curves sinusoidally as a group of first-formed laterals is cut off in an alternating secund pattern, always bending away from the side that is producing the last group of initials (Fig. 1). The whorl branchlets are shorter in length near the basal part, and well developed in the erect distal parts. They are usually simple with blunt apices, but sometimes they become pectinate with a few adaxial branchlets. Basal cell of the whorl branchlet has nearly same dimension as other cells of the lateral.

Gland cells (Fig. 7) are produced laterally on the cells of lower part of the whorl branchlets. They are nearly the same length, or slightly shorter than the cells which cut them off.

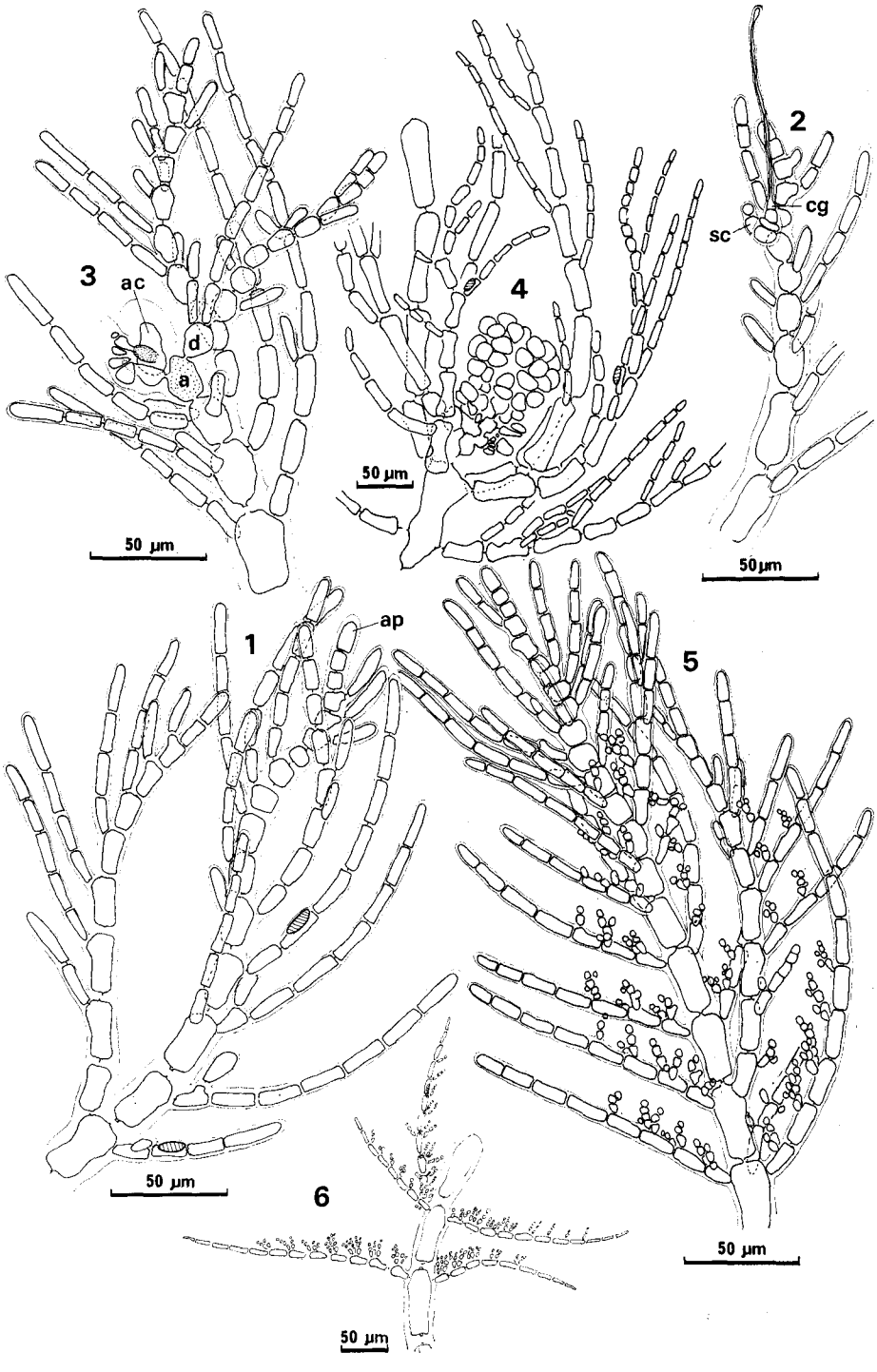
Reproductive structures: Tetrasporangia are formed adaxially on the whorl branchlets. They are first cut off from the basal cell of the lateral, then formed successively on several neighboring cells. They are sessile, oval or elliptical in shape, measure 35–40 × 50–55 μm in size, and divide tetrahedrally (Figs. 7, 8).

Spermatangial clusters, rather simple in organization, about 30 μm long, are formed on the adaxial side of whorl branchlet, one to several on one cell (Figs. 5, 6).

Carpogonial branch is formed singly on a supporting cell, which is the

Figs. 1–6. *Antithamnionella miharae* (TOKIDA) ITONO.

1. Apical part of the thallus with sinusoidally curved axis. ap: apical cell. 2. Apical part of female thallus. cg: carpogonium, sc: supporting cell. 3–4. Development of carposporophyte. ac: auxiliary cell, a: axial cell basal to fertile lateral, d: deflected cell of arrested vegetative axis. 5–6. Male plants with spermatangial clusters.


3
ac
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basal cell of the whorl branchlet reduced to 2 cells (Fig. 2). When the carpogonial branch is mature, the axial cell row bends at the cell producing the fertile lateral. Then the growth of the axis distal to the fertile lateral is arrested and gives the appearance of carrying a terminal gonimoblast. As the gonimoblast develops, whorl branchlets formed on axial cells just beneath the fertile one elongate and some of them are transformed into axis of indeterminate growth (Figs. 3, 4). Although several gonimolobes are formed, the first formed one is the largest and nearly all cells of the gonimoblast become carposporangia.

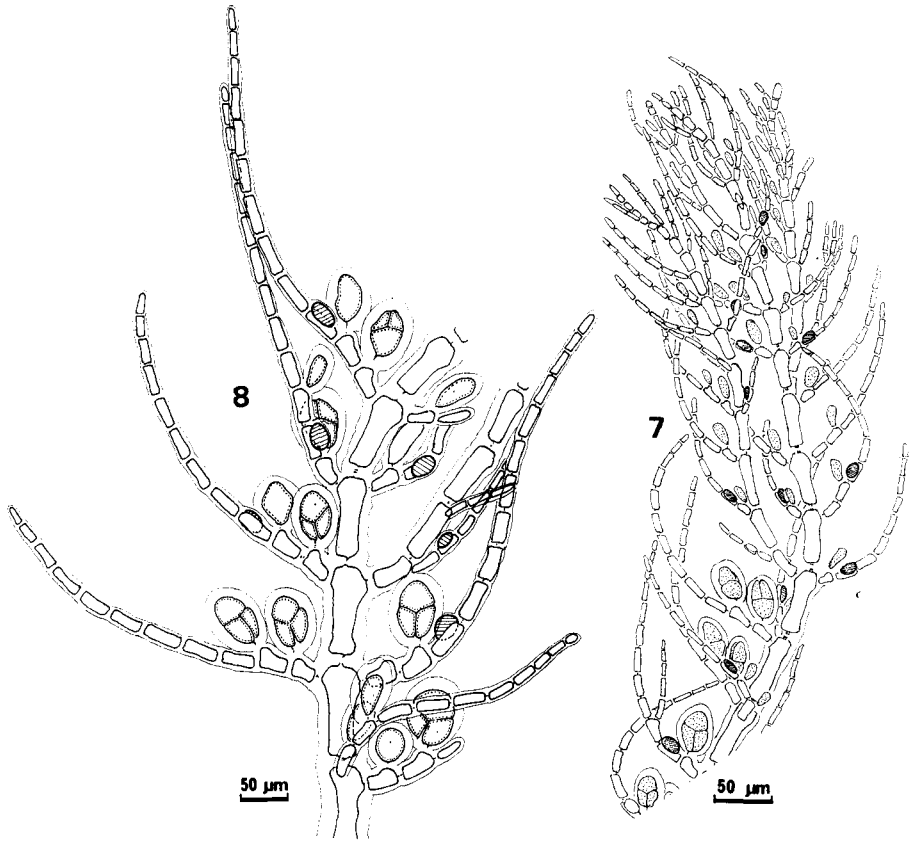
2. *Antithamnion corallina* KJELLMAN[1] (Figs. 9–14)

TOKIDA (1932) identified a plant collected from Robben Island, north Hokkaido, with *Antithamnion corallina* KJELLMAN 1877. This species was first collected by RUPRECHT (1850) at Dshukdshandra, Okhotsk Sea and referred to the genus *Callithamnion*. Later, this taxon was treated variously by different authors as *Antithamnion boreale* f. *corallina* (KJELLMAN) KJELLMAN 1883, *A. boreale* var. *corallina* (KJELLMAN) SUNDENE 1962 or *A. plumula* var. *boreale* f. *corallina* (KJELLMAN) BOERGESEN 1902. On the coast of Hokkaido, YAMADA and TANAKA (1944) reported this species from Akkeshi, where it grows on larger algae, stones or molluscan shells at a depth of about 5 m. Fertile individuals were abundantly collected in May to July, by dredging or as drift on the shore. The plant disappears in August. Specimens were also collected from Nemuro, eastern Hokkaido.

Vegetative structure: The frond is up to 10 cm high, without a prostrate portion at the base, adhering to the substratum by rhizoids issued from axial cells in the lowest part. Tip of the rhizoid expands to form a small disc. The axis branches alternately. Tetrasporic plants are light rosy red in color and the cystocarpic ones are darker in color.

The axis is uniseriate without cortication of any kind. Cells of the axis measure up to 300 μm in diam., each being 2–5 times as long as broad. The apical cell of the axis divides with a transverse wall. Usually an antepenultimate cell of the axial cell row begins to give rise to a lateral initial of determinate growth (Fig. 12). Three to four whorl branchlets of determinate growth are formed on a cell of the axis. They are unequal in length and degree of branching (Fig. 9). Basal cell of the lateral is nearly same

1) The binominal *Antithamnion corallina* is based on *Callithamnion corallina* RUPRECHT, 1850: 341, *pl. 18, f. n-q*. But *C. corallina* RUPRECHT is illegitimate because of the presence of LYNGBYE's name. Therefore, the epithet *corallina* must be treated as new in the genus *Antithamnion* in accordance with the Art. 72, Note 1 of the International Code of Botanical Nomenclature (1978) as *A. corallina* KJELLMAN, 1877: 24.



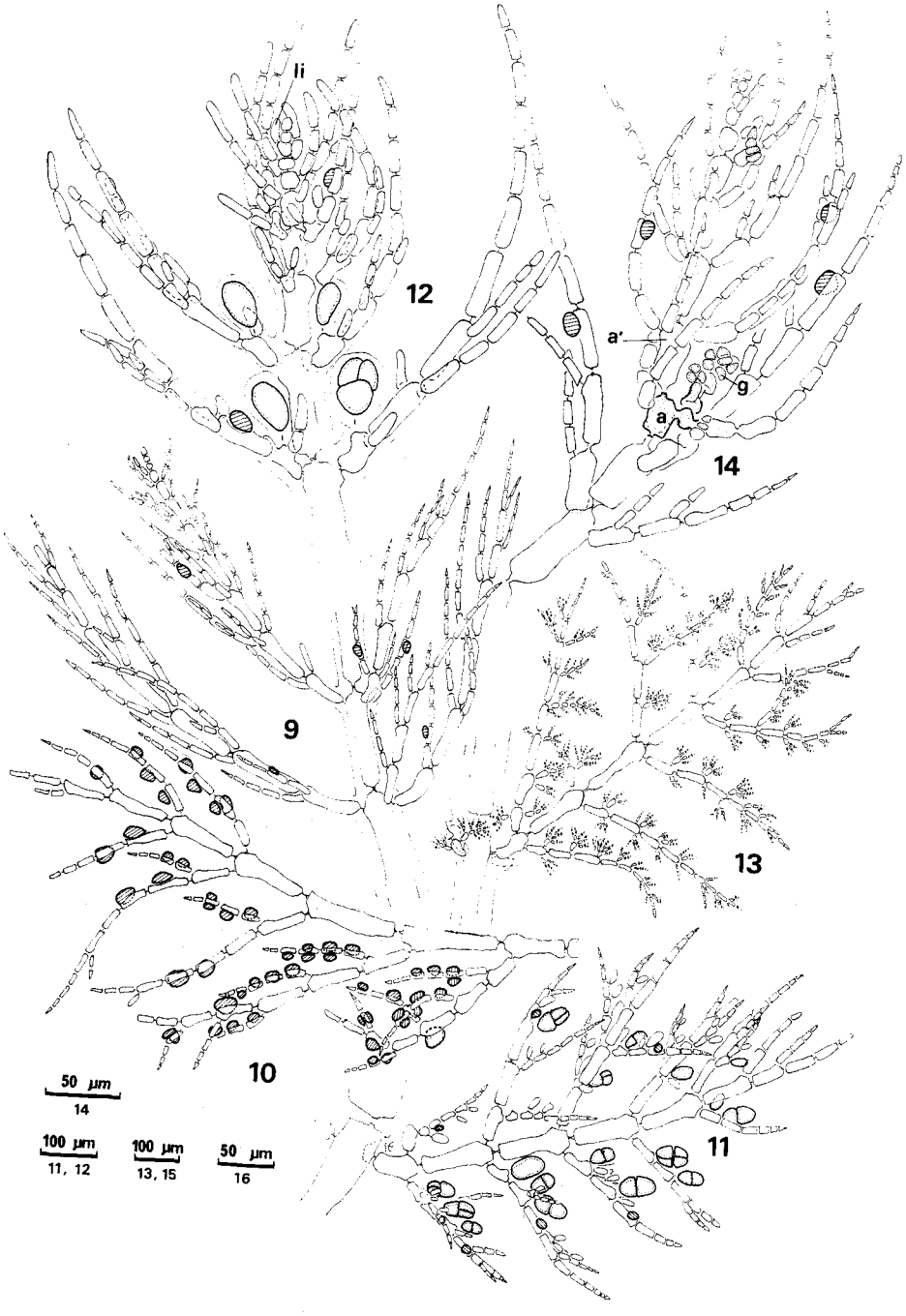
Figs. 7-8. *Antithamnionella miharae* (TOKIDA) ITONO.
Thalli with tetrasporangia.

in size as the cell distal to it, and bears branchlets of the next order. The whorl branchlet gives rise to branchlets of next orders adaxially and abaxially in one plane.

Gland cells are formed laterally on the cells of whorl branchlet singly or rarely in pairs, and are shorter or nearly same in length as the cells bearing them (Fig. 10).

Reproductive structures: Tetrasporangia are first cut off adaxially from the basal cells of whorl branchlets (Fig. 12), then they are formed from other cells of the branch, without a stalk (Fig. 11). They are elliptical in shape, measuring 50-60 μm in diam., 70-100 μm in length, and divide cruciately.

Spermatangial clusters, rather simple in construction, are formed on the cells of whorl branchlet as ultimate branchlets (Fig. 13).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12
a'
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a
14
9
g
13
10
11
50 µm
14
100 µm
11, 12
100 µm
13, 15
50 µm
16

Carpogonial branches are produced singly on the basal cells of the laterals, which are similar in its development to sterile ones. As represented in Fig. 14, apical part of the axis distal to the fertile lateral continues to grow to give rise to another fertile lateral.

Discussion

The circumscription of the genus *Antithamnion* NÄGELI 1847 as typified by *A. cruciatum* (C. AGARDH) NÄGELI has been altered several times in the past. G. FELDMANN (1940) widened the definition to include the genera *Pterothaminon* NÄGELI (with the type species *P. plumula* (ELLIS) NÄGELI), *Antithamnionella* LYLE (lectotype, *A. sarniense* LYLE) and *Platythamnion* J. AGARDH, (type, *P. heteromorphum* J. AGARDH). Since G. FELDMANN (1940), however, a retrieval of these genera and their critical evaluation has been effected primarily by WOLLASTON (1968, 1971, 1979) and MOE and SILVA (1980). WOLLASTON (1968, 1971, 1972) restricted the genus *Antithamnion* to those species which have a combination of following characters: 1) all axes prostrate and indeterminate, occasionally free and erect only at tips of branches, 2) axes completely lacking rhizoidal cortication, 3) pinnae (whorl branchlets) all similar and arranged in opposite pairs, either distichous or decussate; each pinna has a small basal cell which does not bear pinnules; pinnules are distichous on the rachis of the pinnae and may be either opposite, alternate or secund, 4) gland cells borne on special, short 2-4 celled branches, 5) tetrasporangia cruciately divided, usually ovoid when mature, and 6) carpogonial branches borne singly on the basal cells of pinnae at branch apices; a series of (2-)8-20 procarps are developed successively at each fertile branch apex, but only 1 carposporophyte matures on each branch.

If this circumscription is adopted, the two species treated here must be excluded from the genus *Antithamnion* as defined by WOLLASTON. To accomodate these two species, several antithamnioid genera must be taken into account.

Antithamnionella LYLE is defined by WOLLASTON (1976) by the following characters: 1) Thalli erect or of erect branches arising from prostrate bases; axes monosiphonous, uncorticated, bearing whorls of 1-4 branchlets

Figs. 9-14. *Scagelia corallina* (KJELLMAN) YOSHIDA.

9. Whorl branchlets of unequal length. 10. Gland cells. 11-12. Part of the thallus with tetrasporangia. li: lateral initial. 13. Part of male plant with spermatangial clusters. 14. Apical part of female plant with carpogonium and developing carposporophyte. a: axial cell basal to fertile lateral, a′: axial cell bearing elongated vegetative axis, g: developing gonimoblast.

(whorl branchlets) on each axial cell, these initiated in irregular or unilateral sequence from curved branch apices. 2) Branchlets rebranched or unbranched, with basal cells similar in size to adjacent cells. 3) Gland cells cut off laterally, usually from central or inner cells of branchlets. 4) Tetrasporangia ovoid or subspherical, cruciately or tetrahedrally divided, sessile or pedicelled on inner cells of branchlets. 5) Carpogonial branches borne singly at branch apices on basal cells of immature branchlets, those not elongating more than 1 or 2 cells beyond supporting cell; after fertilization, branch apex ceasing to elongate and deflecting to one side as gonimoblast matures.

As shown above, *A. miharae* has a set of characters that clearly correspond to the genus *Antithamnionella* as defined by WOLLASTON (1976). ITONO (1977) transferred the species from *Antithamnion* to *Antithamnionella*, following the limits as drawn by WOLLASTON. My examination of this taxon from northern Japan is the first since TOKIDA (1942) and shows the position of the carpogonial branch (Fig. 2) on the reduced lateral. Though *Antithamnionella glandulifera* (KYLIN) WOLLASTON (1971) appears similar to *A. miharae*, it is a highly variable species and its variations not understood. Further comparisons will be necessary.

Antithamnion corallina has such characteristics as 1) whorl branchlets borne on an axial cell usually unequal in length and branching, and 2) apical part of fertile branch continues to grow after the fertilization of carpogonium. These are essential diagnostic characters of the genus *Scagelia* as proposed by WOLLASTON (1971), and with which *A. corallina* agrees.

Scagelia corallina (KJELLMAN) YOSHIDA comb. nov.

Basionym: *Antithamnion corallina* KJELLMAN, 1877: 24.

Synonyms: *Callithamnion corallina* RUPRECHT, 1850: 341. *pl. 18, f. n-q.* (nom. illeg.), non *Callithamnion corallinum* LYNGBYE 1819: 126.

Antithamnion plumula var. *boreale* f. *corallina* (KJELLMAN) BOERGESEN, 1902: 386.

A. boreale f. *corallina* (KJELLMAN) KJELLMAN, 1883: 180.

A. boreale var. *corallina* (KJELLMAN) SUNDENE, 1962: 15.

Comparison with the type and only species of the genus, *S. occidentale* (KYLIN) WOLLASTON, indicates that *S. corallina* is more robust in that the size of axial cell is larger and tetrasporangia are also bigger.

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