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## Four New Species of *Galaxaura* from Japan

By

TAKESI TANAKA

With Plates XVII-XVIII.

Since 1933 I have been studying systematically the Japanese species of *Galaxaura* under the direction of Prof. Y. YAMADA, in the Botanical Institute, Faculty of Science, Hokkaido Imperial University. It has now been elucidated that about 23 species grow in the Japanese waters, of which the following four prove to be new species.

The material used for this study consists of specimens collected by Prof. YAMADA, and compared by him with the types of KJELLMAN etc. in European herbaria, the herbarium of Dr. K. OKAMURA and Mr. S. SEGAWA, and my own collection.

Here I wish to express my hearty thanks to Prof. Y. YAMADA for his kind guidance during the course of this study. Thanks are also due to Dr. K. OKAMURA and Mr. S. SEGAWA, who allowed me to use their specimens.

### *Galaxaura articulata* sp. nov.

Pl. XVII, 1 and Text-fig. 1-2.

Frons ca. 5 cm alta, teres, saepe articulata, 0.72-1 mm crassa, dichotoma, brevissime stipitata; stipite subtereti, pilis brevibus instructo; internodiis 4-12 mm longis, interdum tumidis; tela assimilatoria e cellularum stratis tribus contexta, ca. 65 $\mu$  crassa; cellulis strati superficialis papillas singulas sustinentibus. Papillae in fronde juniore numerosissimae, clavatae, apice acutae vel raro rotundatae, ca. 35 $\mu$  longae, 9-18 $\mu$  latae.

Japanese name. *Kuda-garagara*.

Hab. Haha-jima, Bonin Islands (S. SEGAWA).

Fronde about 5 cm high, nearly terete, 0.72-1 mm in diameter, often articulate, regularly dichotomous, shortly stipitate, attached to the substratum by means of a rather small disc; stipe almost terete, pilose, consisting of numerous rhizoidal filaments; medullary filaments 7-15 $\mu$  thick, running very loosely; peripheral tissue consisting of three layers of cells,

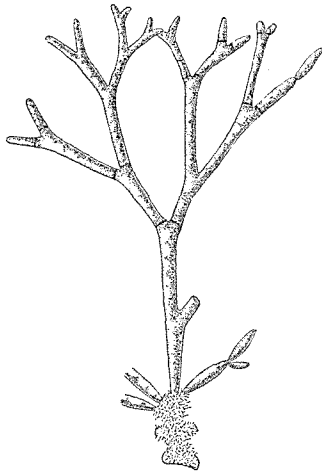


Fig. 1. *Galaxaura articulata*  
sp. nov.  $\times$  ca. 1.

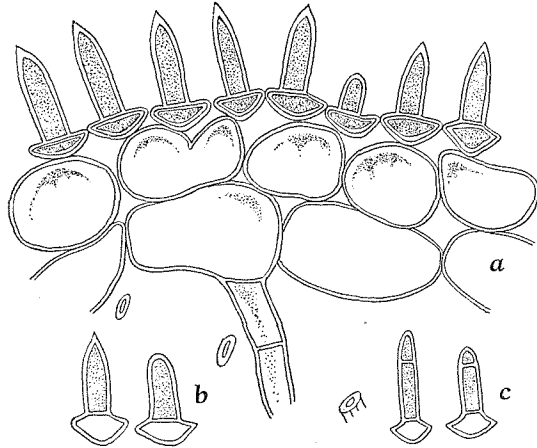


Fig. 2. *Galaxaura articulata* sp. nov.  
a. Cross-section of the frond.  $\times$  380.  
b, c. Papillate processes.  $\times$  380.

parenchymatic, about  $65\mu$  thick except papillose process; cells of the innermost layer largest, about  $60\mu$  broad, about  $27\mu$  high; those of the next layer roundish or often lobed,  $30\text{--}60\mu$  broad and about  $25\mu$  high; outermost cells irregularly pentagonal or hexagonal in the surface view, rounded-trigonal or lens-like in cross-section; papillose processes clavato-cylindrical;  $9\text{--}18\mu$  broad and about  $35\mu$  long, apiculate or rarely rounded at the apex. Colour a pretty rose or light red.

The present species is quite different from other species of the Section *Vepreculae*, having almost cylindrical internodes of the frond. But some specimens from the Bonin Islands show a striking resemblance in habit to the slender form of *G. obtusata* LAMX. In the anatomical structure of the frond, *G. occidentalis* BOERG. seems to come very near to the present species.

### *Galaxaura elegans* sp. nov.

Pl. XVII, 3 and Text-fig. 3.

Frons arborescens, 5–10 cm alta, dichotoma, breviter stipitata; stipes subteres; internodia complanata, saepe basi contracta, in statu sicco plus minus canaliculata, superne subglabra obsolete transverse striata, 0.8–2 cm longa, 2 mm lata, ca.  $250\mu$  crassa; tela assimilatoria e cellularum stratis tribus contexta, ca.  $70\mu$  crassa; papillae clavatae, apice rotundatae vel acutae. Spermogonia subglobosa, diametro ca.  $180\text{--}230\mu$ .

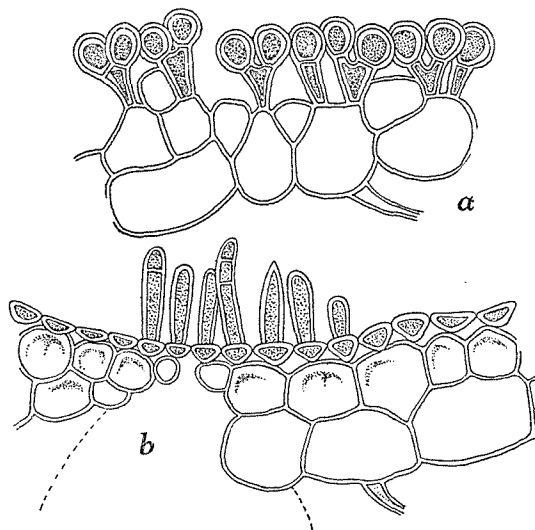


Fig. 3. *Galaxaura elegans* sp. nov.

- a. Cross-section through the frond of a tetrasporic (?) plant.  $\times 265$ .  
 b. Cross-section through the frond of a sexual plant.  $\times 265$ .

Japanese name. *Hime-garagara*.

Hab. Garanbi (Formosa). Spermogonia in spring. Growing in quiet places in the lower littoral belt.

Frond arborescent, 5–10 cm high, regularly dichotomous, shortly stipitate; internodes complanated, more or less canaliculate when dried, 0.8–2 cm long, 2 mm wide,  $250\mu$  thick, jointed at the base, with very faint transverse striations near the apex of the frond; medullary filaments about  $15\mu$  thick, ramifying very rarely, entangling in an irregular manner; cortex consisting of three layers of cells, parenchymatic, about  $70\mu$  thick; cells of the innermost layer largest, about  $45\mu$  broad, about  $34\mu$  high; those of the next layer almost spherical, often lobed, about  $36\mu$  in diameter; epidermal cells containing well developed chromatophores lens-like or obconical in shape, but 5–6-gonal when seen from above; papillate processes usually wanting, but existing only near the opening of the antheridial conceptacles, about  $36\mu$  long, about  $14\mu$  broad, usually composed of 1–3 cells, apiculate or round at the apex; antheridial conceptacles almost spherical, scattered in the upper portion of the frond, 180–230  $\mu$  in diameter. Colour light red.

Together with the specimens described above there are some which show the structure of the Section *Brachycladia*, though they cannot be

distinguished from the former by habit. These two kinds of specimens, belonging respectively to *Vepraculae* and *Brachycladia*, however, often grow together in the same places and may therefore be considered as sexual and asexual individuals of one and the same species. Very unfortunately I have not yet seen any tetrasporangium, the specimens belonging to the Section *Brachycladia* being always sterile. The present species bears a strong resemblance to *G. hystrix* KJELLM. but the frond of the new species is more encrusted with lime and the papillae are usually very scarce at the internodes.

***Galaxaura latifolia* sp. nov.**

Pl. XVIII and Text-fig. 4.

Frons 5–12 cm alta, complanata, dichotoma, membranacea, in statu siccio canaliculata, brevissime stipitata; internodia 4–8 mm longa, 3–4 mm

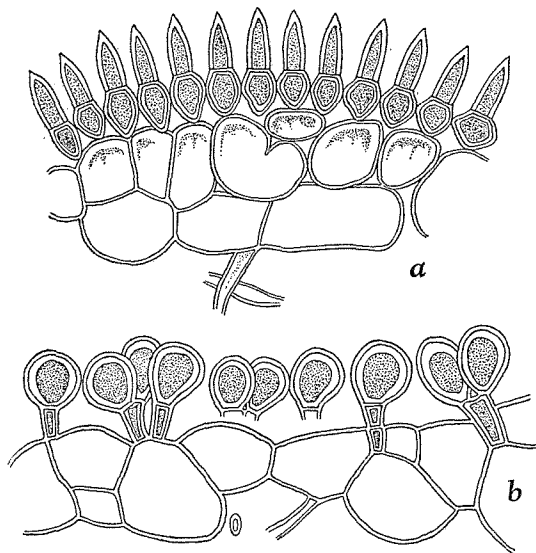


Fig. 4. *Galaxaura latifolia* sp. nov.

- a. Cross-section through the frond of the male or female plant (at the marginal portion).  $\times 265$ .  
 b. Cross-section through the frond of the tetrasporic(?) plant.  $\times 265$ .

lata, 150–200  $\mu$  crassa, ad marginem frondis 450  $\mu$  crassa; tela assimilatoria e cellularum stratis tribus contexta, ca. 84  $\mu$  crassa, cellulis strati superficialis papillas singulas sustentibus; papillae clavatae, acutae, 35–42  $\mu$  longae, 10–14  $\mu$  crassae. Cystocarpia ellipsoidea vel globosa, solum in mar-

ginibus frondis disposita,  $200\mu \times 250\mu - 450\mu \times 500\mu$ . Spermogonia subglobosa, diametro ca.  $220\mu$ .

Japanese name. *Hiroba-garagara*.

Hab. Kelung, Dairi (Formosa). Growing on rocks near the low-tide mark. Both cystocarps and antheridia in spring.

Fronde 5–12 cm high, regularly dichotomous, very shortly stipitate; internodes complanated, canaliculate in dried specimens, 4–8 mm long, 3–4 mm wide,  $150-200\mu$  thick, at the margin  $450\mu$  thick, with faint transverse striations; medullary filaments running very loosely, about  $10-15\mu$  thick; peripheral tissue consisting of three layers of cells, parenchymatic, about  $84\mu$  thick; cells of the innermost layer largest, round, polygonal, about  $60\mu$  broad, about  $32\mu$  high; epidermal cells closely united, rounded-trigonal in transverse section, 5–7-gonal when seen from above; cells of the middle layer almost spherical, often lobed, about  $32\mu$  in diameter; papillae clavate, shortly apiculate, about  $35-42\mu$  long,  $10-14\mu$  broad, often found in the upper portion of the frond; antheridial conceptacles nearly spherical, about  $220\mu$  in diameter; cystocarps nearly spherical or ellipsoid, scattered only on the margin of the internodes,  $200\mu \times 250\mu - 450\mu \times 500\mu$ . Colour rose or grayish red.

Among the specimens referred to this species are some, which are to be distinguished from those described above by the anatomical characters of the frond. They have never been found with any kind of sexual organs, and the cross-section of the frond shows every characteristic of the Section *Brachycladia*. The parenchymatic layer of those specimens consists of 2–3 layers of elliptical cells, the innermost cells being about  $35\mu$  wide and about  $50\mu$  long, and the assimilating filaments having an almost unicellular pedicel. These pedicels are  $20\mu$  long and  $15\mu$  broad. The terminal cells of the assimilating filaments are nearly ovate, with rounded apex, but those found at the margin of the frond are rarely apiculate.

Although no tetrasporangium has been found in these specimens, it seems very probable that they belong to the asexual generation of the present species.

### ***Galaxaura pacifica* sp. nov.**

Pl. XVII, 2 and Text-fig. 5–6.

Frons disco magno basilari adfixa, 3–5 cm alta, teretiusecula,  $1.7 \times 2.5$  mm crassa, dichotoma, glabra, saepe articulata, superne transverse rugosa, a filis assimilatoria destituta, longissime stipitata; stipite 1–1.5 cm longo,

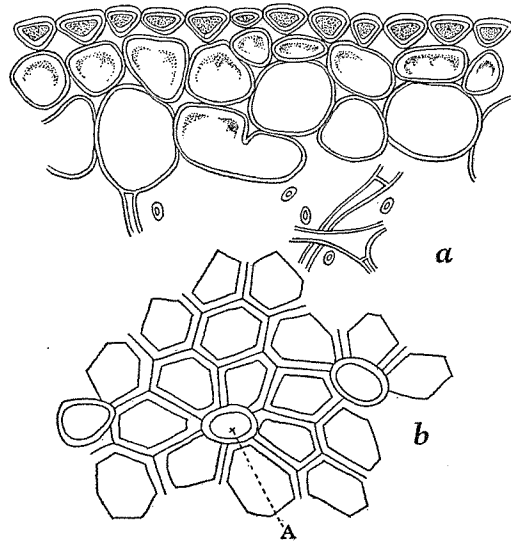


Fig. 5. *Galaxaura pacifica* sp. nov.  
 a. Cross-section of the frond.  $\times 260$ .  
 b. Epidermal cells seen from above.  
 A. Abortive cell.  $\times 425$ .

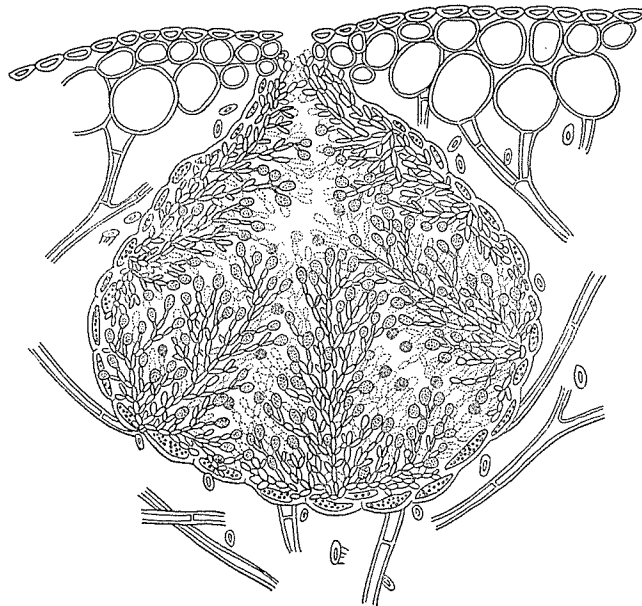


Fig. 6. *Galaxaura pacifica* sp. nov.  
 Transverse section of an antheridial conceptacle.  $\times 180$ .

fere cylindraceo, e cellulis rhizoideis numerosis composito; tela assimilatoria subparenchymatica, tristoromatica, ca.  $78\mu$  crassa. Spermogonia subglobosa, diametro  $250-350\mu$ .

Japanese name. *Tyabo-garagara*.

Hab. Haha-jima (Bonin Islands); Garanbi (Formosa). Antheridia in spring.

Fronde arising from a rather large basal disc, reaching a height of about 3-5 cm; lower stem-like portion 1-1.5 cm high, almost cylindrical, consisting of numerous rhizoidal cells; rhizoidal cells about  $12-18\mu$  thick, provided with hairs; hairs long, often more than 1 mm long, especially at the upper part of the stem-like portion; upper portion of the frond subcylindrical or somewhat compressed, about  $1.7 \times 2.5$  mm thick in cross section, glabrous, faintly annulate, dichotomously ramified, often articulate, generally with rather short internodes scarcely 1 cm long; peripheral tissue consisting of 2-3 layers of cells, subparenchymatic; cells of the innermost layer oblong-ovale,  $35-100\mu$  broad, about  $38\mu$  high, but variable in size, often lobed; those of the next layer smaller, nearly spherical,  $20-30\mu$  in diameter; epidermal cells containing well developed chromatophores,  $15-20\mu$  high,  $18-25\mu$  broad in cross section, pentagonal or hexagonal when seen from above; assimilating filaments absent; intermediate layer consisting of dichotomously ramified filaments, whose diameter varies between  $7\mu$  and  $18\mu$ , encrusted with lime; central axis consisting of loosely entangled filaments, running in the mucilagenous substance; antheridial conceptacles nearly spherical, scattered in the upper portion of the frond, opening through the wall of the frond, mostly with a diameter of about  $250-350\mu$ . Colour pale rose or grayish green.

The present species seems to belong to the Section *Microthoe*, but is quite different from the other species of this Section. The frond of the present species is divided into two parts, the comparatively longer, lower part, and the upper one, which are quite different from each other as regards both outer appearance and anatomical structure. In the present species the frond is not so much encrusted with lime as in other species of the Section *Microthoe*, especially the central axis of the frond of this species is quite free from lime. The structure of the lower stem-like portion reminds one very much of what we find in the Section *Brachycladia*. As to the anatomical characters of the upper glabrous portion of the frond, however, the present species agrees very well with the other species of this Section, with the exception of wanting assimilating filaments.

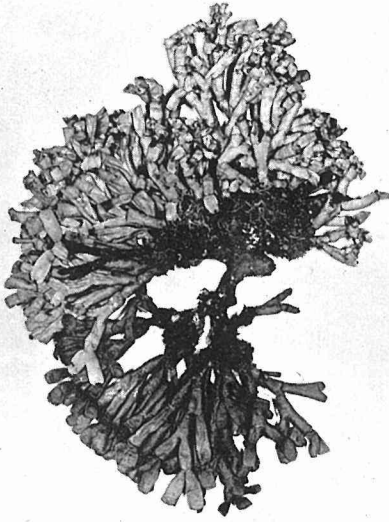
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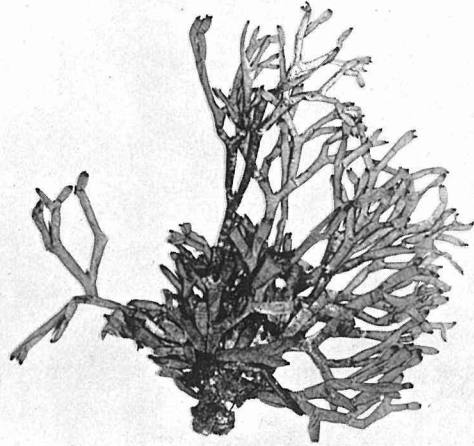
PLATE XVII

PLATE 17

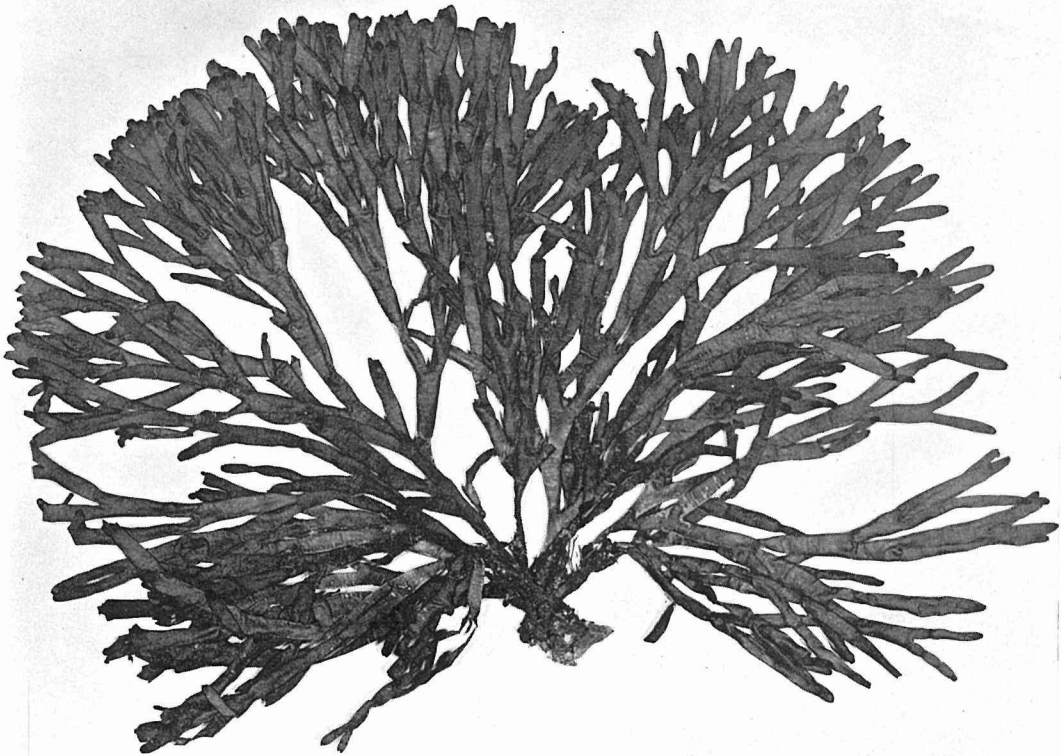
1. *Galaxaura articulata* sp. nov.  
The type specimen. ×1
2. *Galaxaura pacifica* sp. nov.  
The type specimen. ×1
3. *Galaxaura elegans* sp. nov.  
The type specimen. ×1



2



1



3

PLATE XVIII

PLATE 18

*Galaxaura latifolia* sp. nov. The type specimen.  $\times \frac{1}{2}$

