

# Taxonomic studies on the Gelidiaceae (Rhodophyta) in Cheju Island

## I. Some members of *Gelidium*\*

Yong Pil Lee

(Department of Biology, Cheju National University, Cheju 690-121, Korea)

## 제주도산 우뭇가사리과(Rhodophyta)의 분류학적 연구

### I. 우뭇가사리속(*Gelidium*)의 수종

이 용 필

(제주대학교 생물학과, 제주 690-121)

### Abstract

A preliminary work was made on some members of *Gelidium* from Cheju Island. Morphotaxonomic characteristics were investigated with the taxa, *G. amansii*, *G. sesquipedale*, *G. corneum* var. *pinnatum*, *G. divaricatum*, *G. pusillum*, and *G. vagum*. The morphology of thallus, tetrasporic or cystocarpic ramuli, and cortical cells, the outlines of main axes represented by cross section, and the distribution of rhizoidal filaments were employed for classification of the taxa. The morphology of tetrasporic or cystocarpic ramuli and the outlines of main axes represented by cross section were appeared to be rather useful for delineation of the taxa. It still needs further investigation to find diagnostic characters for specific and generic circumscription of the Gelidiaceae in Korea.

### Introduction

Gelidioid algae occur in the wide range of tidal and subtidal zone all the year round in Cheju Island. The plants are composed of prostrate and erect filaments. The prostrate filaments are generally less expanded than the erect filaments, usually terete, contorted, with a role of fixing the erect filaments to substratum. In some taxa, short and wart-like attaching apparatuses are issued from erect or prostrate filaments (e.g., *G. divaricatum*, *G. pusillum*). The erect filaments of gelidioid algae are various in morphology such as simple or branching, terete to depressed linear or foliaceous. Fine rhizoidal filaments develop between medullary cells, linear with thick wall, and run generally along the growing axis. The rhizoidal filaments of *G. divaricatum* run in longitudinally

\* The present study is supported by the Science Research Program of the Ministry of Education, 1987.

interlacing mode along the growing axis.

Ultimate branchlets are generally transformed into tetrasporic or cystocarpic ramuli. The tetrasporic ramuli are rather depressed and pale in color, in which tetrasporangia are distributed. The cystocarps are also born on terminal to middle parts of the ultimate branchlets and mature in a biconvex form with one or two pores on each side.

Gelidioid algae are known to be various in morphology depending on habitats, seasons or sexualities (cf. Dixon and Irvine 1977). Weber van Bosse (1921) attached taxonomic importance to the arrangement of cortical cells in surface view of gelidioid algae. Akatsuka (1970) advocated that the morphology of cortical cells could be an effective criterion for classification of *Gelidium*. Generally, the distribution of rhizoidal filaments and thallus morphology have been employed for specific circumscription of *Gelidium* (e.g., Newton 1931, Okamura 1936, Dawson 1944, Taylor 1945, Segi 1957, Abbott and Hollenberg 1967, Dixon and Irvine 1977, Sohn and Kang 1978, etc.). Stewart and Norris (1981) confirmed the variation of the rhizoidal filament distribution by observation of serial sections of an erect filament. Rhizoidal filaments of depressed erect filaments appeared in end-view to be more congested at the marginal part than at the central part. The shape and arrangement of fructiferous ramuli was also regarded as a useful criterion for classification (e.g., Segi 1957, Gardner 1927, etc.). However, no diagnostic character has been known for delineation of *Gelidium* taxa to date. Therefore, it is difficult to discern cystocarpic, tetrasporic, male gametangial, and sterile plants in a single taxon. Sohn and Kang (1978) indicated that it would be better to employ all the characters mentioned above for classification of *Gelidium*.

This is the preliminary work on the taxonomy of the Gelidiaceae in Korea. Therefore, only some of the members of *Gelidium* occurring in Cheju Island are treated in this paper. I am grateful to Professor Dr. In Kyu Lee, Department of Botany, Seoul National University, for his kind advice. Thanks are due to Dr. Hae Bok Lee, Department of Biology, Chongju University, for critical reading this manuscript.

## Materials and Methods

The plants were collected in the intertidal and subtidal zone by skin SCUBA diving during the period from March 1987 to January 1988. The collected material was fixed with formalin-seawater (10%) and transported to the Laboratory. Some representative plants of a taxon were selected for dried specimens. The erect filaments and fructiferous branchlets were taken for microscopic observation. The cross section of the upper, middle, and lower parts of main axes were obtained with the freezing microtome (MFS 222+250) in order to get hold the outlines of main axes and to observe the rhizoidal filament distribution and cortical or medullary cell morphology. Occasionally, the longitudinal section of the middle part of main axes was obtained for side-view of the internal structure. Karo (30% + few drops of formalin) solution was used for mounting the slide preparation.

## Description of Taxa

*Gelidium amansii* Lamouroux (1813, p. 41)

Text Figs. 1-12.

Korean name : 우뚝가사리

Plants are tufted with many branches, 8-10cm high (Figs. 1, 2). Prostrate filaments are terete, contorted and issuing branches. Erect filaments are linear, slightly depressed at middle part with a composite of short and long branches subdistichously. The outlines of erect filaments represented by cross section are: ellipsoid along the whole length of erect filaments, 450-600  $\mu$ m thick and 900-1100  $\mu$ m wide (Figs. 6, 7, 8). Occasionally, the middle part of erect filaments in cross section is rather depressed and showing linear in shape, 200-220  $\mu$ m thick and 1200-1400  $\mu$ m wide (Figs. 9, 10). Cortical cells are globose to subglobose. The inner cortical cells, are ellipsoid and elongating parallelly to surface in end-view (Fig. 11). Medullary cells are fusiform with slender cell-contents (Fig. 12). Rhizoidal filaments are 5-8  $\mu$ m thick, congested in the outer medullary layers and somewhat loosely scattered in the center of medulla (Fig. 11).

Tetrasporic ramuli are born on the short branchlets of the lower part of erect filaments and become lanceolate with a short stalk. Cystocarps are formed on the terminal or middle part of the ultimate ramuli developed from the short branchlets of the lower part of erect filaments.

Collections examined: LYP 491, Hengwon, Cheju, 1987-III-18 (leg. K.J. Lee). LYP 530, Bomokri, Cheju, 1987-II-14 (leg. K.J. Lee). LYP 539, Bukchon, Cheju, 1987-VII-21.

*G. amansii* has been known as a polymorphic taxon (cf. Okamura 1934). Thus, Okamura (1934) divided this taxon into four forms; *G. amansii* f. *typica*, f. *elegans*, f. *elatum* and f. *teretiunculum*, mainly based on the morphology of erect filaments. The plants from Cheju Island agree quite well with the illustrations and descriptions of *G. amansii* f. *typica* given by Okamura (1934) in the thallus morphology and the shape and arrangement of tetrasporic ramuli. No authentic illustration of *G.*

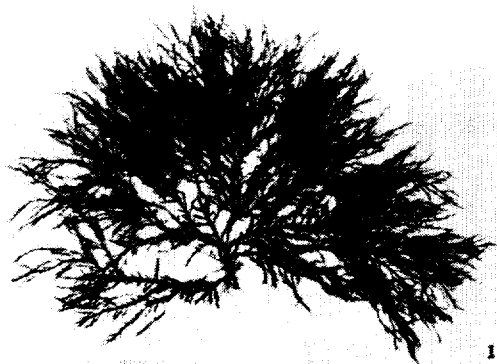


Fig. 1. *Gelidium amansii*. A tetrasporic plant. scale unit: mm.



Fig. 2. *Gelidium amansii*. A cystocarpic plant. scale unit: mm.

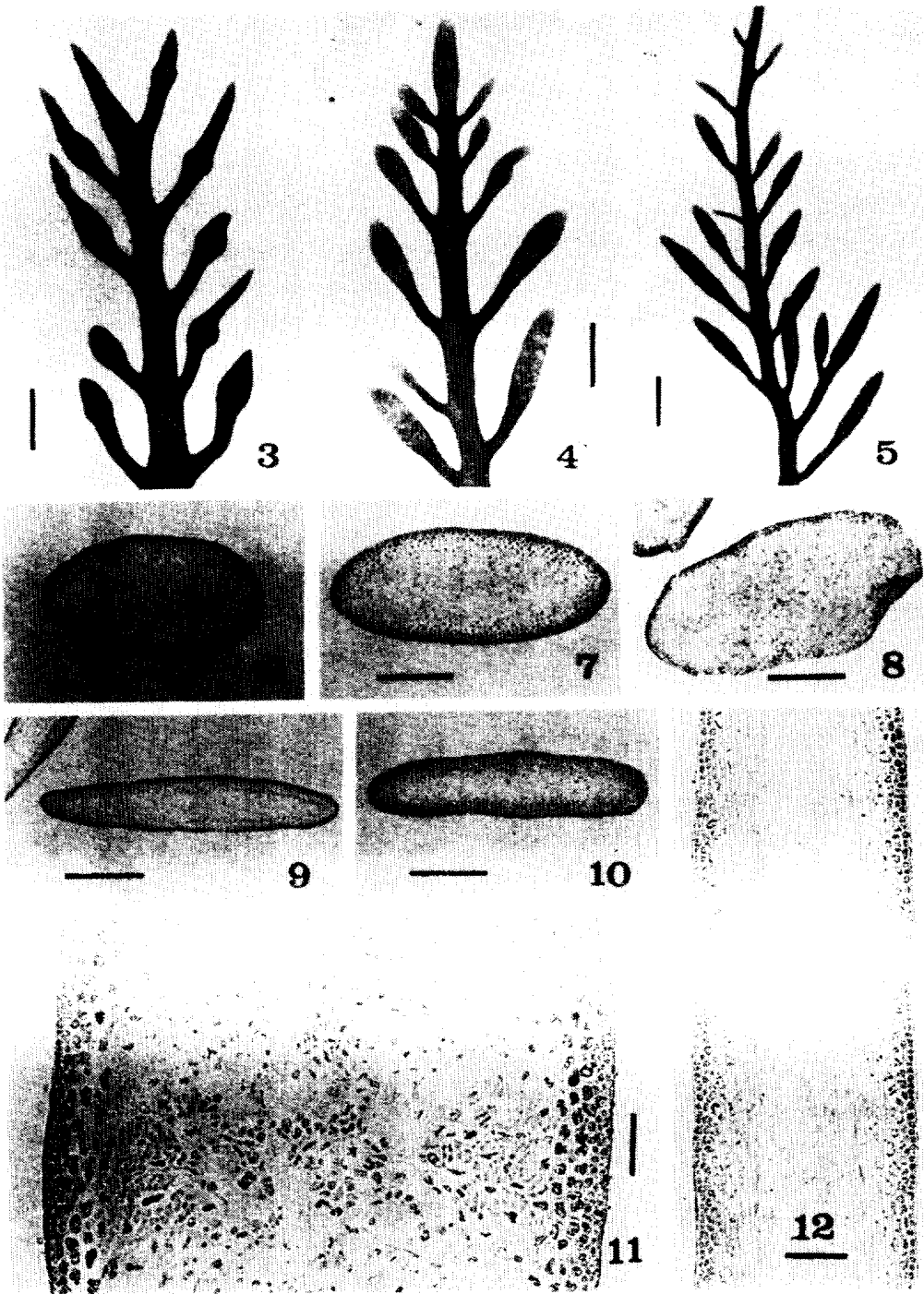


Fig. 3-12. *Gelidium amansii*. Fig. 3. A branchlet bearing cystocarpic ramuli. scale bar: 1mm. Figs. 4, 5. Branchlets bearing tetrasporic ramuli. scale bars: 1mm. Figs. 6, 7, 8, 9, 10. Outlines of erect filaments represented by cross section of upper, middle, lower, middle and middle parts respectively. scale bars: 300µm. Figs. 11, 12. Internal structures of erect filaments represented by cross and longitudinal section respectively. scale bars: 50 µm.

*amansii* given by Lamouroux could be consulted during this study. It will be interesting to observe the polymorphism according to environmental factors or sexualities.

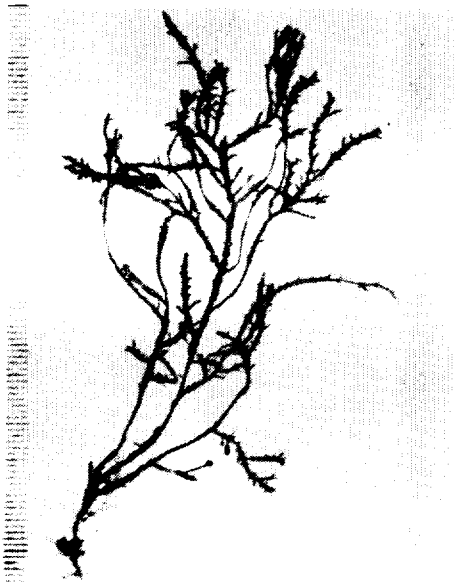
*G. amansii* was first described as *Fucus amansii* by Lamouroux in his dissertation(1804). Later, he has established a genus *Gelidium* including this taxon. Therefore, some authors treated this taxon under the name, *G. amansii* (Lamouroux) Lamouroux (e.g., Lee and Kang 1986).

*Gelidium sesquipedale* (Turner) Thuret (in Bornet and Thuret 1876, p. 61) Text Figs. 13-29.  
Basionyms:*Fucus corneus* var. *sesquipedalis* Clemente 1807; p. 31.

*Fucus sesquipedalis* Turner 1808-1819; tab. 257, fig. f.

Korean name: 가시우뚝가사리 (신창)

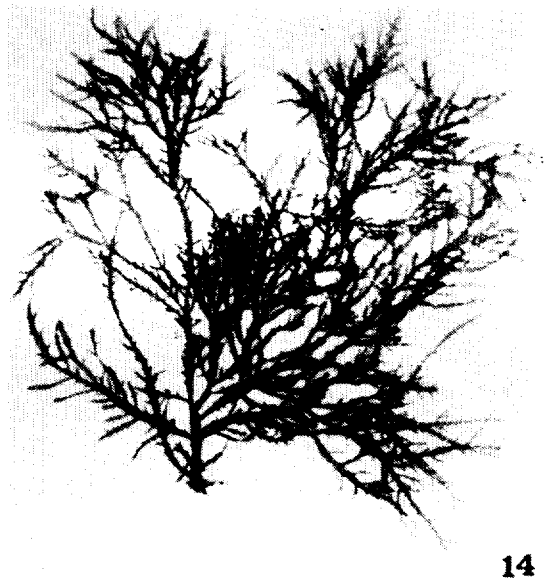
Plants occur solitarily and are somewhat rigid, 7-10cm high (Figs. 13, 14). Erect filaments are broadly depressed and doubleedged (anticipito-compressed) at the lower part (Figs. 18, 24). The long branches are few and issued at various intervals. The ultimate branchlets are distichous in arrangement and dentate in shape. Outlines of erect filaments represented by cross section are: longish ellipsoid, 240-320  $\mu$ m thick and 1100-1300  $\mu$ m wide at the upper part (Figs. 15, 23), linear, 190-380  $\mu$ m thick and 1800-2200  $\mu$ m wide at the middle part (Figs. 17, 25), fusiform, doubleedged, 540-560  $\mu$ m thick and 1300-2400  $\mu$ m wide at the lower part of erect filaments (Figs. 18, 24). Cortical cells of erect filaments in cross section are ellipsoid and anticlinally elongating to surface at the upper part (Figs. 16, 28), small and globose at the middle part (Figs. 19, 26), ellipsoid and parallelly elongating to surface at the lower part of erect filaments (Figs. 20, 29). The cortical cells in



13

Fig. 13. *Gelidium subcostatum*. A sterile plant. scale unit: mm.

*sesquipedale*



14

Fig. 14. *Gelidium subcostatum*. A cystocarpic plant. scale unit: mm.

*sesquipedale*

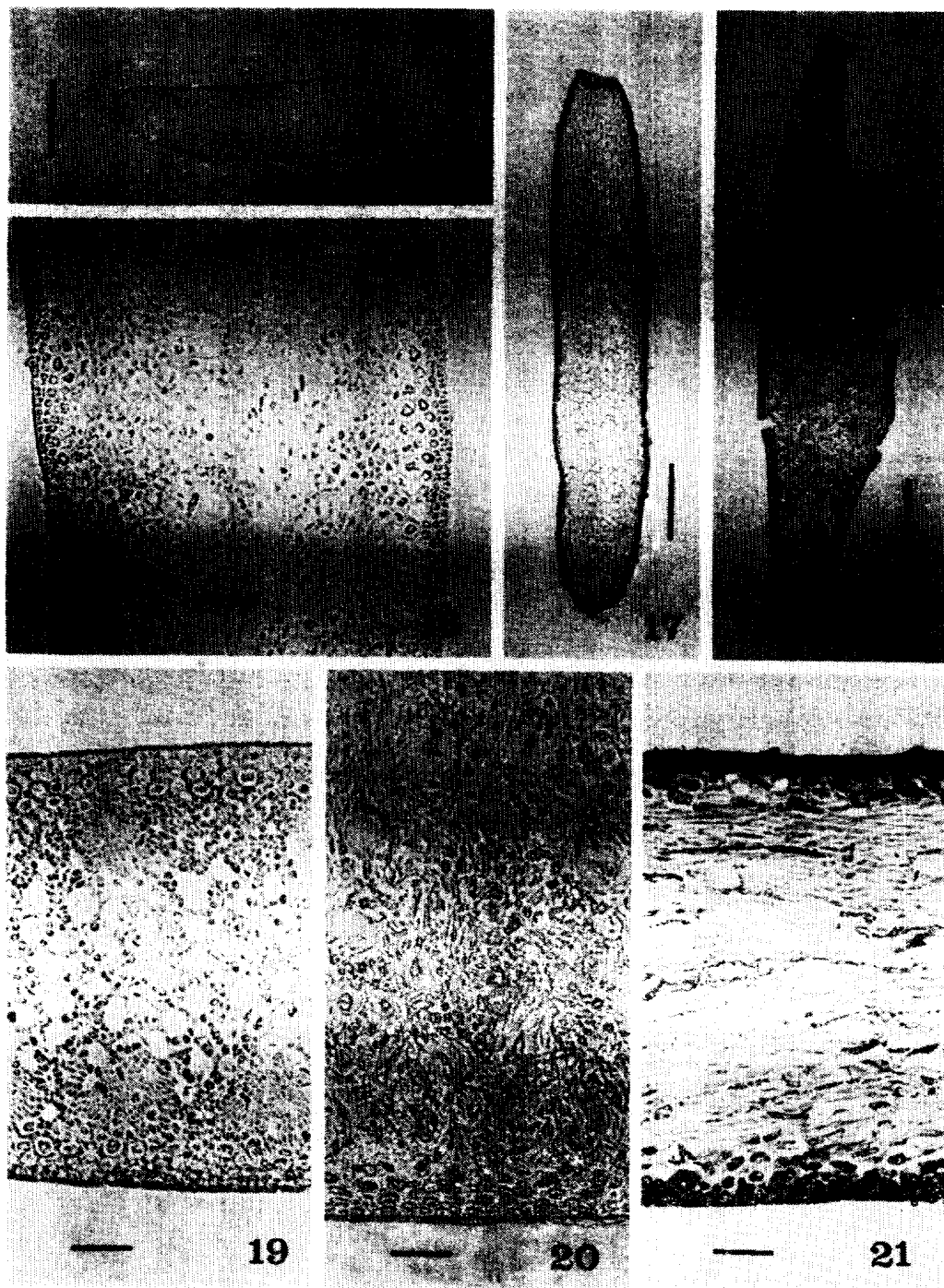


Fig. 15-21. *Gelidium sesquipedale*. Sterile plants. Fig. 15, 17, 18. Outlines of erect filaments represented by cross section of upper, middle and lower parts respectively. scale bars: 300  $\mu$ m. Fig. 16, 19, 20. Internal structures of erect filaments represented by cross section of upper, middle and lower parts respectively. scale bars: 50  $\mu$ m. Fig. 21. A longitudinal section of the middle part of erect filaments. scale bar: 5  $\mu$ m.

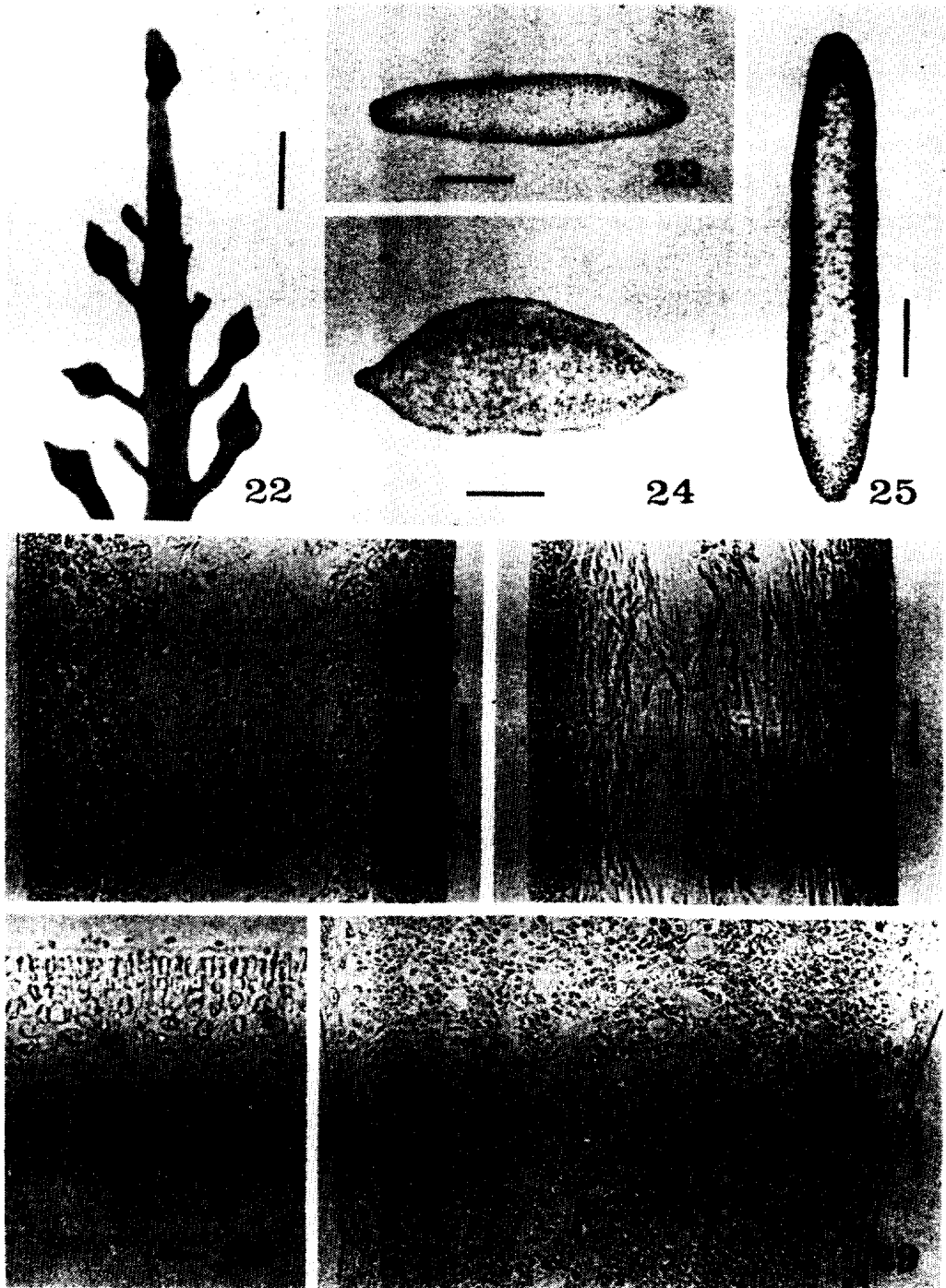


Fig. 22-29. *Gelidium sesquipedale*. Cystocarpic plants. Fig. 22. A branchlet bearing cystocarpic ramuli. scale bar: 1mm. Figs. 23,24,25. Outlines of erect filaments represented by cross section of upper, lower and middle parts respectively. scale bars: 300 $\mu$ m. Figs. 26,28,29. Internal structures of erect filaments represented by cross section of middle, upper and lower parts respectively. scale bars of 26 and 29: 50 $\mu$ m, scale bar of 28: 20 $\mu$ m. Fig. 27. A longitudinal section of erect filaments. scale bar: 50  $\mu$ m.

longitudinal section are also globose to ellipsoid (Figs. 21, 27). Rhizoidal filaments are congested in the outer medullary layers of the upper part, but in the whole medulla of the middle to lower part of erect filaments (Figs. 16, 19, 20, 26, 28, 29).

Cystocarpic plants are smaller and more branched than sterile ones (Figs. 13, 14). Cystocarps are born subterminally on ultimate branchlets of the upper part of erect filaments.

Collections examined: LYP 531, Bomokri, Cheju, 1987-II-14 (leg. K.J. Lee). LYP 497, Hengwon, Cheju, 1987-V-12 (leg. K.J. Lee).

The plants of Cheju Island agree well with the illustration and description given by Gayral (1966) except the thallus height. The plants of Cheju Island are also related to *Gelidium subcostatum* Okamura in having a midrib on erect filaments. However, the latter taxon has big cells in the outer medullary layers. Kylin (1956) established a new genus, *Berkereila*, in the Gelidiaceae on the basis of the distinct midrib on the lower part of erect filaments and merged *G. subcostatum* in this genus. Santelices and Stewart (1985) characterized the genus, *Berkereila*, as having big cells in the outer medulla. It needs more accumulation of information on the relationship between *Gelidium* and *Berkereila*.

*Gelidium corneum* (Hudson) Lamouroux var. *pinnatum* Kuetzing (1849, p. 764)

Text Figs. 30-38.

Korean name: 깃우꽃가사리(신항)

Plants are more or less tufted, 5-7 cm high (Fig. 30). Erect filaments are terete and slender at the

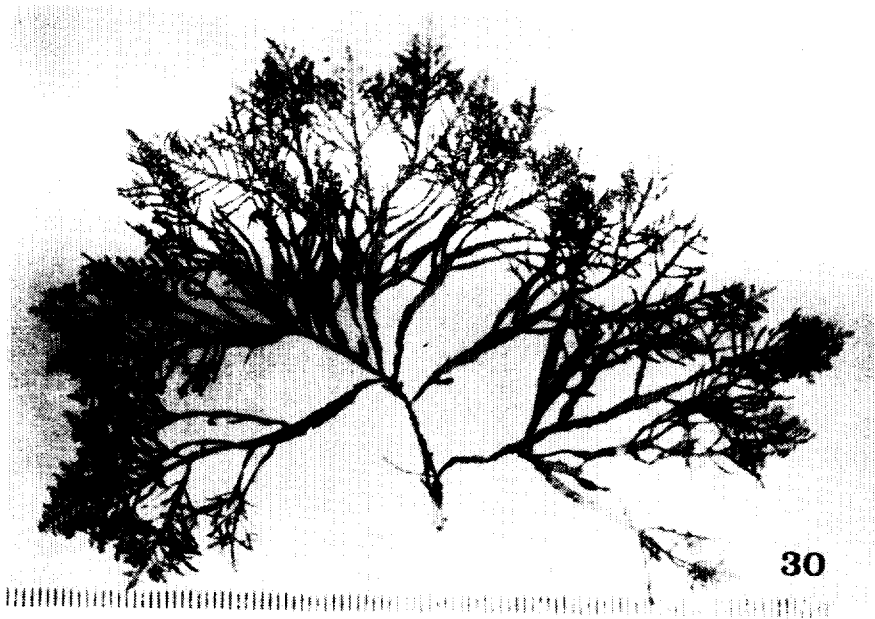


Fig. 30. *Gelidium corneum* var. *pinnatum*. A tetrasporic plant. scale unit: mm.



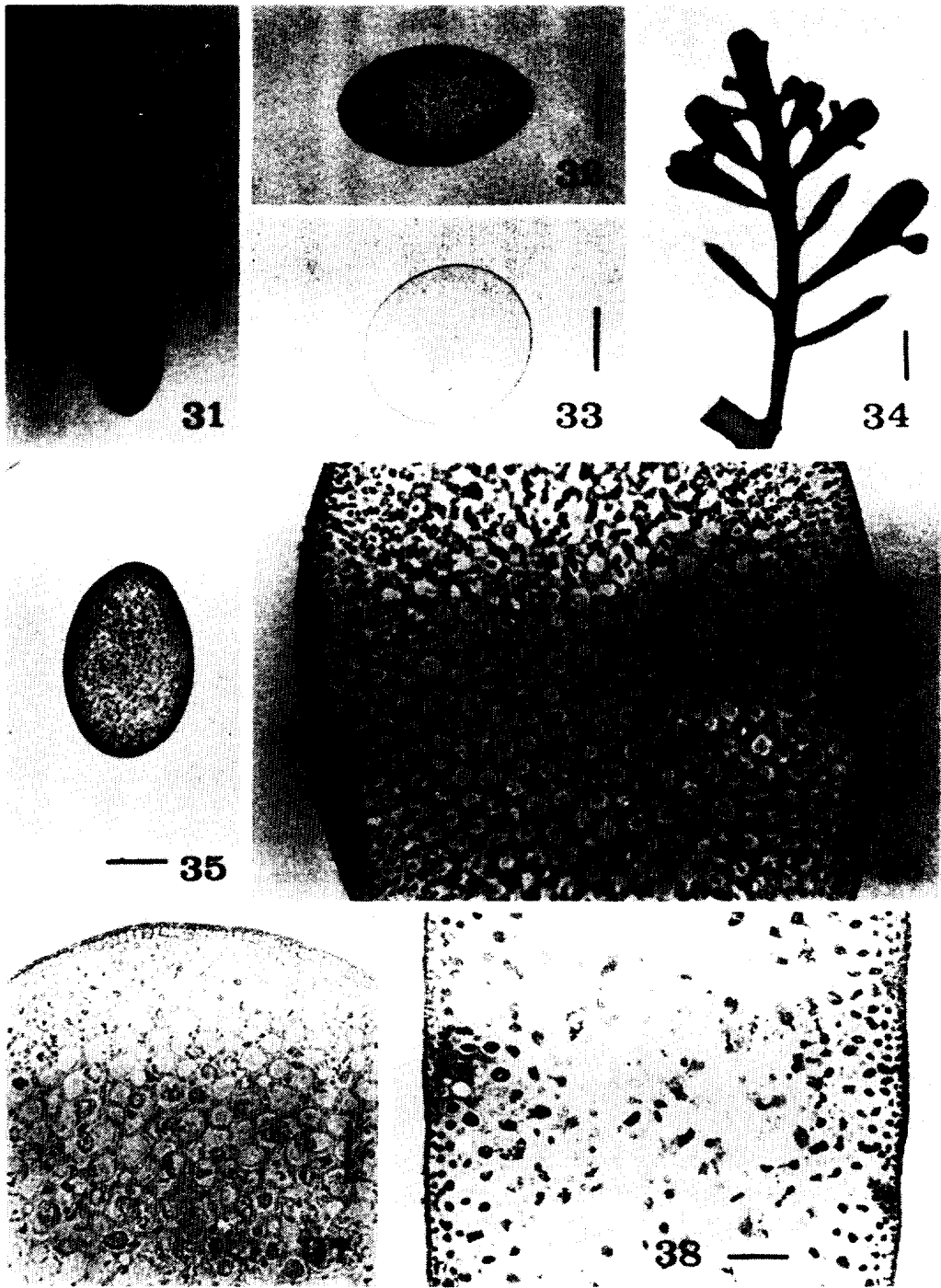


Fig. 31-38. *Gelidium corneum* var. *pinnatum*. Figs. 31,32,33,35. Outlines of erect filaments represented by cross section of middle, upper, lower and lower parts respectively. scale bars, 250μm. Fig. 34. A branchlet bearing tetrasporic ramuli. scale bar, 1mm. Figs. 36,37,38. Internal structures of erect filaments represented by cross section of upper, lower and middle parts respectively. scale bars, 50 μm.

lower part, broadly depressed at the middle part, and gradually attenuating toward the apex. Branches are issued secundly, distichously or irregularly from the edges of erect filaments. Particularly, the ultimate branchlets are arranged pinnately on the same plane. The apices of erect filaments and branchlets are depressedly inflated and retuse (Fig. 34). Outlines of erect filaments represented by cross section are ; circular to ellipsoid, ca.  $500\ \mu\text{m}$  thick and ca.  $800\ \mu\text{m}$  wide at the upper part (Fig. 32), longish ellipsoid, ca.  $400\ \mu\text{m}$  thick and ca.  $1500\ \mu\text{m}$  wide at the middle part (Fig. 31), circular to orbicular,  $600\text{--}650\ \mu\text{m}$  in diameter at the lower part of erect filaments (Figs. 33, 35). Cortical cells of erect filaments in cross section are ellipsoid and anticlinally elongating to surface at the middle to lower part of erect filaments (Figs. 37, 38). Medullary cells have a thin wall. Rhizoidal filaments are  $6\text{--}7\ \mu\text{m}$  thick and congested in outer medullary layers and scant in the center of medulla.

Tetrasporangial sori occur in the terminal to middle part of ultimate branchlets. The tetrasporic ramuli are clavate in shape (Fig. 34). Cystocarpic plants are not observed in Cheju Island.

Collections examined : LYP 511, Hengwon, Cheju, 1987- $\text{XI}$ -6 (leg. K.J. Lee).

The plants of Cheju Island agree quite well with the descriptions and illustrations given by Kuetzing (1849, 1868) in branching mode and thallus morphology. The plants of *G. corneum* var. *pinnatum* from Cheju Island are characterized by patently pinnate branchlets on the terminal region of erect filaments, retuse branchlets, and medullary cells with a thin wall. The thallus morphology is rather related to the plants of *Pterocladia robusta* Taylor (1945) in clavate and retuse branchlets. However, the rhizoidal filaments of the plants at hand are congested in the outer medullary layers and poorly scattered in the center of medulla. Bornet and Thuret (1876) regarded *G. corneum* var. *pinnatum* (*sensu* Kuetzing) as *Pterocladia capilacea* (Gmelin) Bornet on the basis of the single cystocarpic loculus. However, the thallus of the latter taxon had rhizoidal filaments in the central part of medulla. I prefer to regard the plants from Cheju Island in *Gelidium* on the basis of rhizoidal filament distribution pending that cystocarpic plants are found.

*Gelidium divaricatum* Martens (1866, p. 30, t. 8)

Text Figs. 39-44.

Korean name : 애기우뭇가사리

Plants are caespitose, forming a thin mat on rocks, less than 10 mm high. Erect filaments are terete or slightly depressed, contorted or decumbent, branching subdistichously and patently, and issuing wart-like attaching apparatuses here and there (Figs. 39, 40, 42). The erect filaments and branches attach to each other or substratum with the attaching apparatuses. Outlines of erect filaments represented by cross section is somewhat ellipsoid,  $600\text{--}700\ \mu\text{m}$  thick and  $1100\text{--}1200\ \mu\text{m}$  wide (Fig. 41). Outermost cortical cells are ellipsoid and anticlinally elongated to surface. Inner ones are globose in a cross section, but ellipsoid and anticlinally elongate to surface in a longitudinal

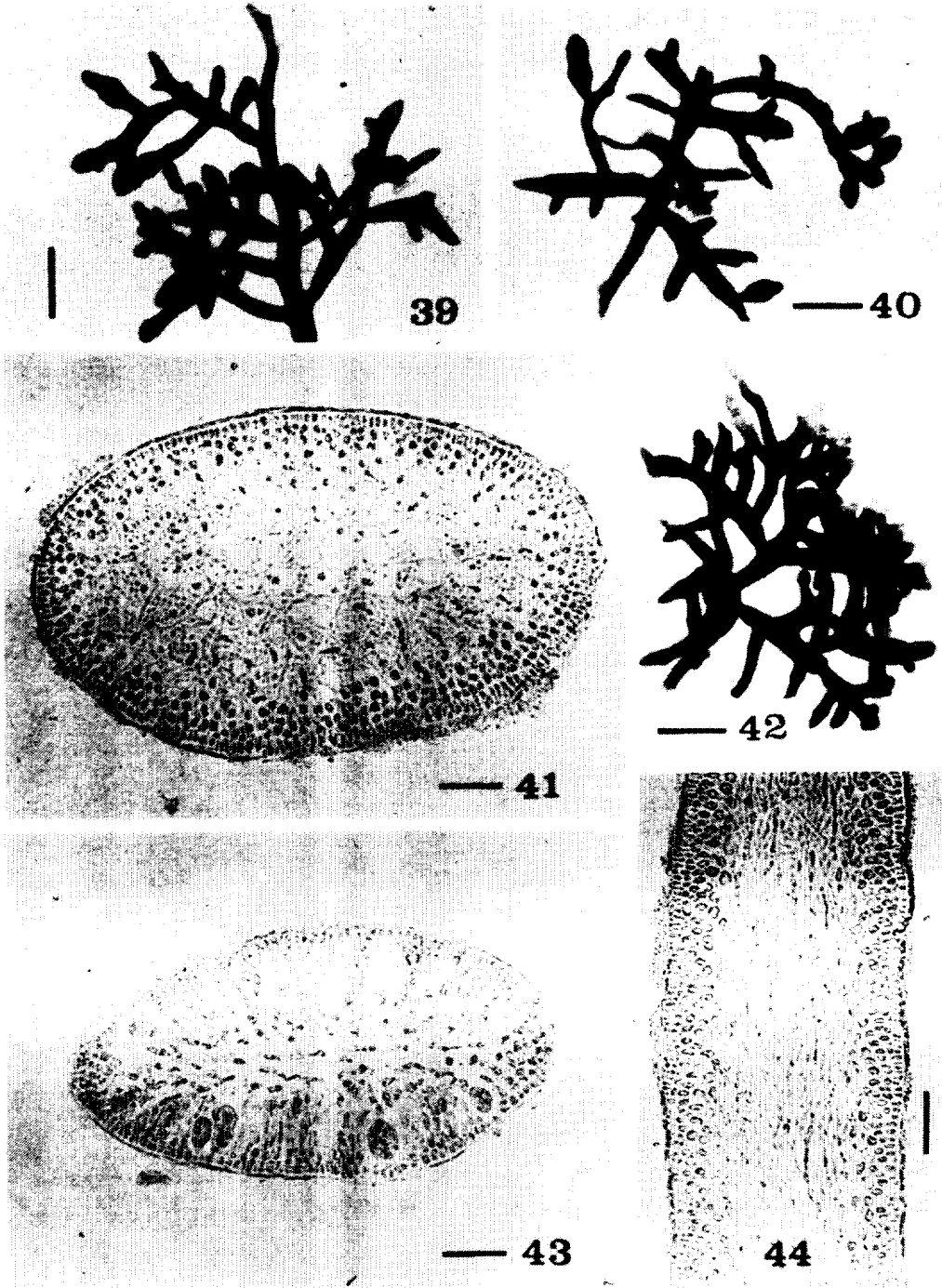


Fig. 39-44. *Gelidium divaricatum*. Figs. 39,40,42 Tetrasporic plants, scale bars: 1mm. Fig. 41. A cross section of erect filaments, scale bar: 50µm. Fig. 43. A cross section of tetrasporic ramuli, scale bar: 50µm. Fig. 44. A longitudinal section of erect filaments, scale bar: 50µm.

section (Figs. 41, 44). Medullary cells are terete and larger at the center than the outer part of medulla. Rhizoidal filaments are 4–5  $\mu$ m thick and interlace between medullary cells (Figs. 41, 44).

Tetrasporic ramuli are formed by transformation of ultimate branchlets, more or less flattened, and brighter in color than the other part of a thallus.

Collections examined : LYP 473, Daepori, Cheju, 1986–VI–8. LYP 486, Onpyong, Cheju, 1987–XII–6.

The plants of *G. divaricatum* are growing on rocks forming a broad mat in the upper tidal zone in Cheju Island. Occasionally, *Caulacanthus okamurae* Yamada associates with this species.

*Gelidium divaricatum* is distinct from other gelidioid algae in Cheju Island in the development of rhizoidal filaments, which are interlaced between medullary cells. The interlacing rhizoidal filaments also appeared in the plants of *G. microphysa* Setchell et Gardner (Sohn and Kang 1978). The dwarf habit of *G. divaricatum* is related to *G. pusillum*. However, the latter taxon has foliaceous erect filaments and rhizoidal filaments running parallelly to growing axes.

*Gelidium pusillum* (Stackhouse) Le Jolis (1863 ; p. 139)

Text Figs. 45–52.

Synonym : *Fucus pusillus* Stackhouse 1795, p. 16, Tab. VI.

Korean name : 실우뚝가사리

Plants are small, caespitose, composed of prostrate and erect filaments, 6–12 mm high. The prostrate filaments are as much expanded as erect filaments, contorted, terete and issuing erect or prostrate filaments on one side and attaching apparatuses on the other side. Occasionally, a part of the prostrate filaments is also depressed and broadened (Fig. 45). The erect filaments are abruptly broadened (to 1 mm wide) at the base showing a longish ellipsoid foliaceous form, also simple or issuing foliaceous to spine-like laterals (Fig. 48). Outlines of erect filaments represented by cross section are linear, slightly arcuate, ca. 80  $\mu$ m thick and to 1 mm wide (Fig. 47). In cross section the cortical part of erect filaments are composed of 3–4 cell layers. The outermost cortical cells are ellipsoid, anticlinally elongating to surface and inner ones are globose to subglobose in both end- and side-view (Figs. 49, 50, 51). The medulla of the foliaceous erect filaments are composed of 1–2 cell layers. Rhizoidal filaments are scanty distributed between medullary cells.

Tetrasporangial sori occur in the upper to middle part of foliaceous erect filaments (Fig. 46). Tetrasporangia are immersed beneath the cortical layers (Fig. 52).

Collections examination : LYP 474, Daepori, Cheju, 1986–VI–8.

LYP 485, Onpyong, Cheju, 1987–XII–6. LYP 518, Onpyong, Cheju, 1987–XII–6.

The plants of *G. pusillum* occur associated with *Caulacanthus okamurae* Yamada or *Gigartina*

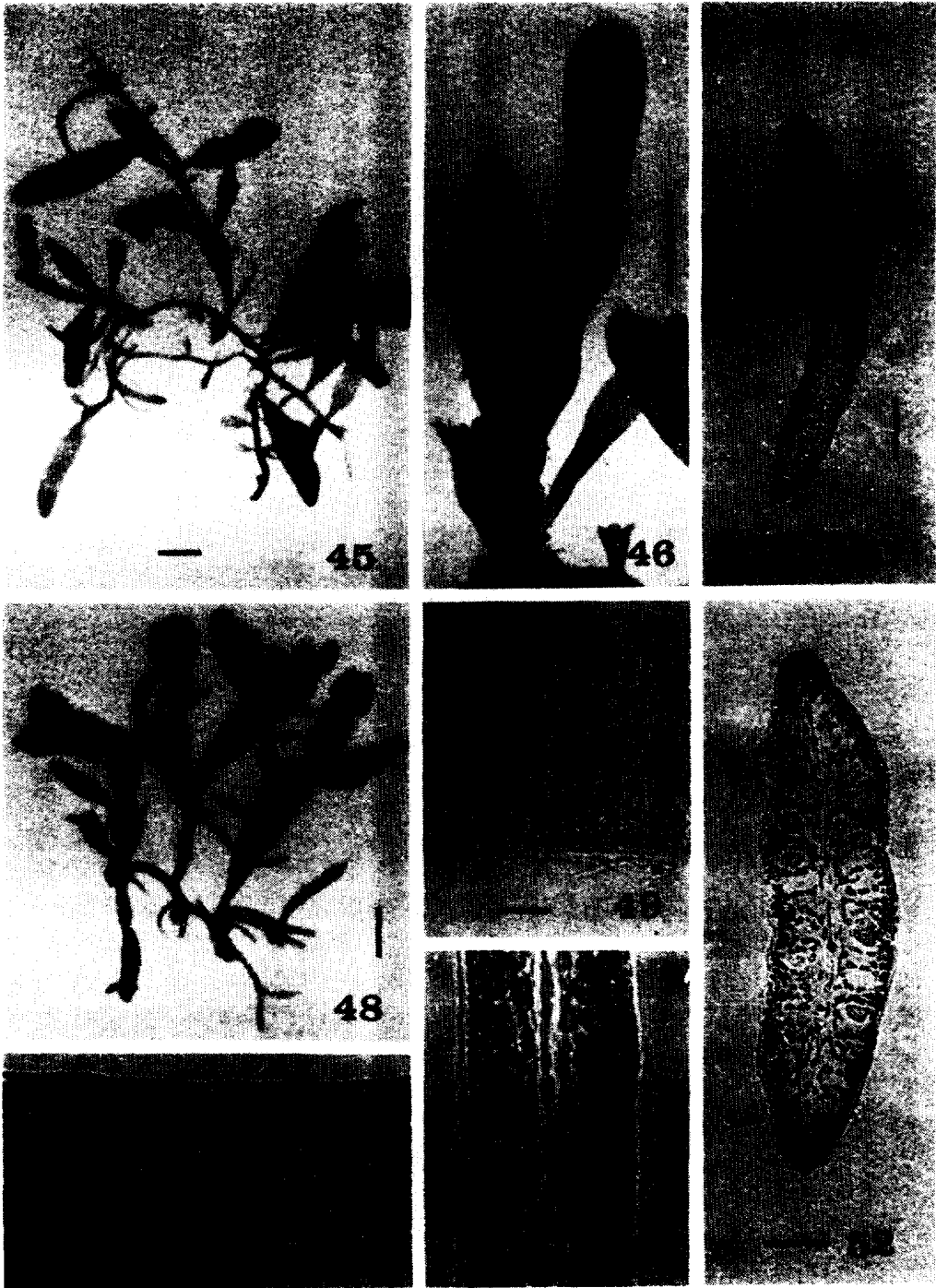


Fig. 45-52. *Gelidium pusillum*. Figs. 45,48. Tetrasporic and sterile plants respectively. scale bars: 1mm. Fig. 46. Foliaceous erect filaments bearing tetrasporangial sori. scale bar: 1mm. Fig. 47. An outline of foliaceous erect filaments represented by cross section. scale bar: 100um. Figs. 49,50. Cross sections of erect filaments. scale bars: 20um. Fig. 51. A longitudinal section of erect filaments. scale bar: 20um. Fig. 52. A cross section of a part bearing tetrasporangial sori. scale bar: 50um.

*intermedia* Suringar on sheltered rocks or crevices in the intertidal zone in Cheju Island. The plants at hand show an affinity with forma of the species, *G. pusillum* f. *foliaceum* Okamura (1934) in thallus morphology. However, Dixon and Irvine (1977) indicated that the plants of *G. pusillum* became leafy when growth slow down or stops from March to November and cylindrical during active growth from December to February in British Isles. Thus, they merged several related taxa into *G. pusillum* (e.g., *G. crinale* and *G. pulchellum*). It will be very interesting to investigate the seasonal variation of thallus form.

*Gelidium vagum* Okamura (1934; p. 58)

Text Figs. 53-63.

Korean name : 막우뚝가사리

Plants are growing solitarily associated with other gelidioid algae, 70-80 mm high (Figs. 53, 54). Erect filaments are broadly depressed and strongly tapering toward apices showing terete linear filaments at terminal parts. Branches occur distichoalternately from the margin of main axes at intervals. Ultimate branchlets are short and spine-like in shape and occasionally transforming into tetrasporic ramuli. The outlines of erect filaments represented by cross section are ; terete, 500-800  $\mu\text{m}$  in diameter at upper part (Fig. 58), longish ellipsoid to fusiform, 350-400  $\mu\text{m}$  thick and 2000-2600  $\mu\text{m}$  wide at middle part (Fig. 59), terete, 500-600  $\mu\text{m}$  in diameter at lower part of erect filaments (Fig. 60). The cortex of erect filaments is composed of 3-4 cell-layers. The outermost cortical cells in cross section are globose to oblong. Inner ones are ; globose at upper part (Fig. 57), ellipsoid and parallelly elongating to surface at middle part (Fig. 62), irregular in shape at lower part of erect filaments (Fig. 61). Rhizoidal filaments are densely congested in the outer medulla at the

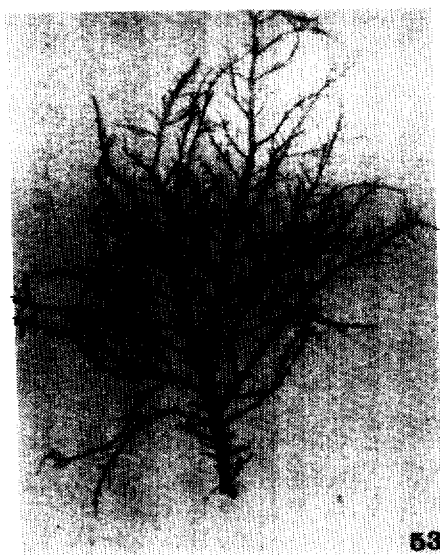


Fig. 53. *Gelidium vagum*. A tetrasporic plant. scale unit: mm.

Fig. 54. *Gelidium vagum*. A tetrasporic plant. scale unit: mm.

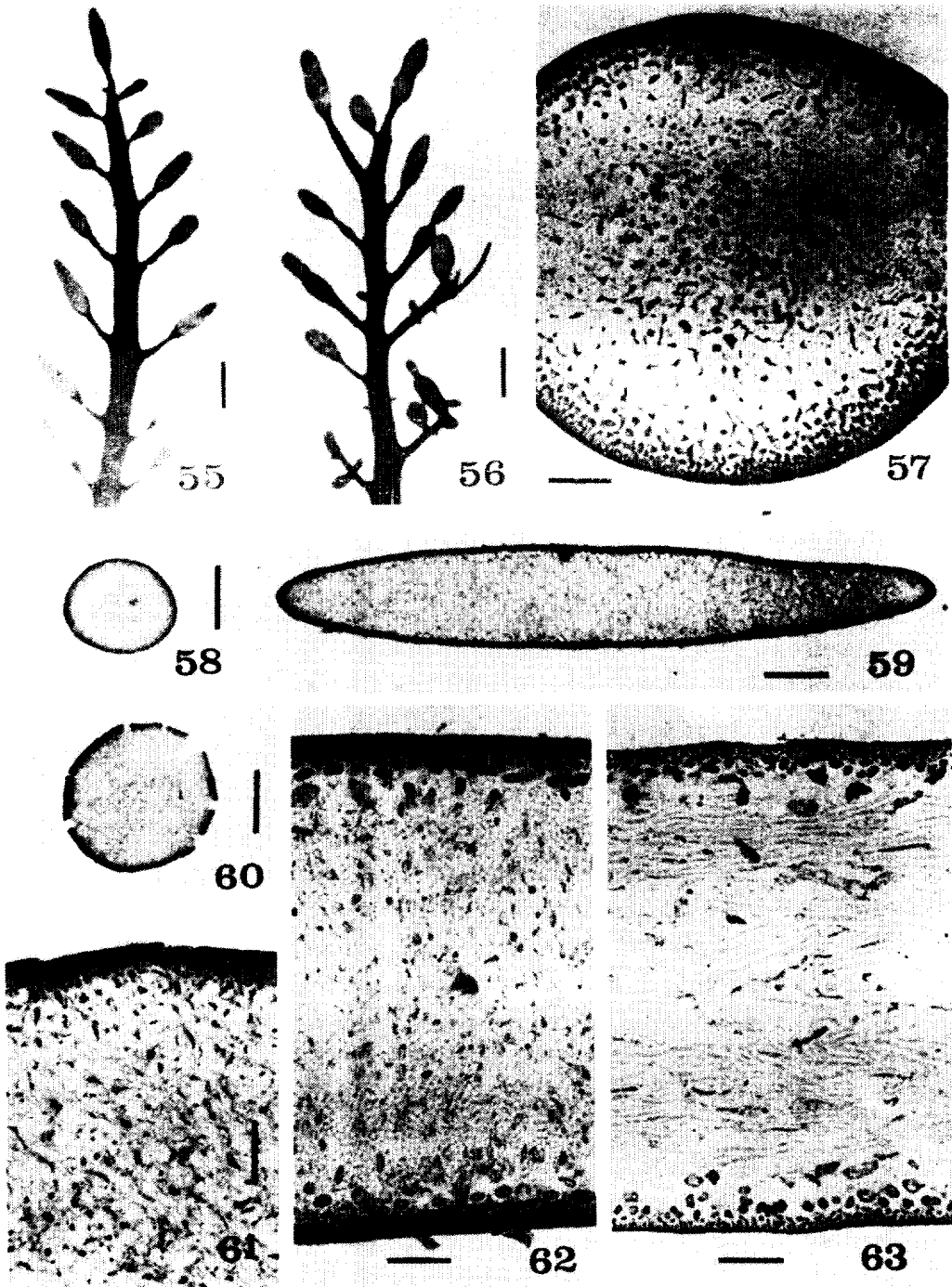


Fig. 55-63. *Gelidium vagum*. Figs. 55,56. branchlets bearing tetrasporic ramuli. scale bars. 1mm. Figs. 57,61,62. Internal structures of erect filaments represented by cross section of upper, lower and middle parts respectively. scale bars. 50 $\mu$ m. Figs. 58,59,60. outlines of erect filaments represented by cross section of upper, middle and lower parts respectively. scale bars. 250 $\mu$ m. Fig. 63. A longitudinal section of erect filaments. scale bar. 50 $\mu$ m.

upper part and in the whole medulla at the middle to lower part of erect filaments. The medullary cell contents are rather flattened or linear in the thick cell wall at the upper and the lower part of erect filaments. The cell contents at the middle of erect filaments are finely linear.

Tetrasporic ramuli are born on terminal part of distichouse branches and main axes, ellipsoid to obclabate with a short stalk (Figs. 55, 56). Occasionally, the tetrasporic ramuli show the slight constriction at their middle parts.

Collections examined: LYP 509, Hengwon, Cheju, 1987—IX-5 (leg. K.J. Lee). LYP 548, Hengwon, Cheju, 1987—IX-16 (leg. K.J. Lee).

The plants at hand agree well with the description and illustration given by Okamura (1934). Okamura (1934) described some plants having soft and twisted erect filaments. However, the plants of Cheju Island are rather rigid and spread their branches on the same plane. In this point of view, the plants of Cheju Island may be a distinct taxon from *G. vagum*.

Okamura (1934) indicated that the distribution of rhizoidal filaments of *G. vagum* was similar to *Pterocladia* plants, but the former differed from the latter in having more congestion of rhizoidal filaments at the outer part than at the central part of medulla. On the other hand, Sohn and Kang (1978) mentioned that the outermost cortical cells of *G. vagum* showed a similar form to those of *Pterocladia* species.

## Discussion

Dixon (1961) concluded that a "polysiphonia type" of life history might occur in a British species of *Gelidium*, although some irregularities were detected. Santelices (1974) said that the distribution of rhizoidal filaments, the cystocarpic structure and the external morphology of thallus constituted the most important and most discussed generic characters. Akatsuka (1979) suggested that the shape of cortical cells in surface-, end-, or side-view would be useful to delineate *Gelidium* and *Pterocladia* species. However, this suggestion needs more examination with variety of taxa to confirm whether the character would be species specific or not. Sohn and Kang (1978) found the cortical cells of *G. vagum* similar in morphology to *Pterocladia* species.

*G. corneum* var. *pinnatum* has been known as the same taxon as *Pterocladia capillacea*. The plants of *G. corneum* var. *pinnatum* collected in Cheju Island agreed well with Kuetzing's illustration of the taxon and also showed an external morphology similar to *Pterocladia robusta* (Taylor 1945). On the other hand, the rhizoidal filaments of the plants from Cheju Island are congested at the outer medullary layers, which is known to be characteristic in *Gelidium* species.

Both tetrasporangial and cystocarpic phases of *G. amansii* and Both sterile and cystocarpic phases of *G. sesquipedale* were regarded to occur in Cheju Island. Such thought of the occurrence of the two phases of a single species, *G. amansii*, or *G. sesquipedale*, was drawn by the similarity of the external



morphology and internal structure of a thallus. Dixon and Irvine (1977) said that one could do little more than compare external form and internal structure when faced with a bewildering assemblage of sterile or tetrasporangial specimens. Although Sohn and Kang (1978) regarded that the arrangement and form of cystocarpic ramuli might be same as that of tetrasporic ramuli, there was no valuable clue to confirm the two phases in a single species. Thus, it is hard to discern with conviction the tetrasporangial and cystocarpic phases of a single species because no critically useful character was detected to date.

The branching mode, the shape of ultimate branchlets, the position of cystocarps or tetrasporangial sori, the outlines of erect filaments represented by cross section, the shape of cortical cells in end- or side-view and the distribution of rhizoidal filaments were employed to discern the taxa of *Gelidium* in Cheju Island. The shape of ultimate branchlets and the outlines of erect filaments were more useful to delineate species than others.

## 적 요

제주도산 우뭇가사리과의 분류학적 연구의 일환으로 우뭇가사리속 수종 즉, 우뭇가사리, 가시우뭇가사리, 깃우뭇가사리, 애기우뭇가사리, 실우뭇가사리, 그리고 막우뭇가사리에 대한 형태분류학적인 특징을 조사하였다. 엽상체의 형태, 사분포자낭이나 낭과가 있는 가지의 형태, 피층세포의 형태, 단면으로 본 직립사의 겉모양, 그리고 근양사의 분포등의 특징이 제주도산 우뭇가사리류를 분류하는데 주로 적용되었다. 이들 특징 중에서 사분포자낭이나 낭과가 있는 가지의 형태와 단면으로 본 직립사의 겉모양이 종 식별에 보다 효과적이었지만 한국산 우뭇가사리과의 속 및 종분류에 뚜렷한 진단형질을 찾아내기 위하여 더많은 연구가 이루어져야 한다.

### Key to the species of Cheju Island

- 1. Plants minute, less than 20mm ..... 2
- 1. Plants large, more than 50mm ..... 3
  - 2. Erect filaments cylindrical ..... *G. divaricatum*
  - 2. Erect filaments foliaceous ..... *G. pusillum*
- 3. Lower parts of erect filaments double-edged ..... *G. sesquipedale*
- 3. Lower parts of erect filaments cylindrical ..... 4
  - 4. Round in end-view of the upper part and linear of the middle part ..... *G. vagum*
  - 4. Ellipsoid in end-view of the upper to middle part of erect filaments ..... 5
- 5. Apices of erect filaments acute ..... *G. amansii*
- 5. Apices of erect filaments obtuse ..... *G. comeum* var. *pinnatum*

## References

- Abbott, I. A. and G. J. Hollenberg. 1976. Marine Algae of California. Stanford Univ. Press.
- Akatsuka, I. 1970. Morphology of the cortical layer of some species of Gelidiales. Bull. Jap. Soc. Phycol. 18: 72-76.
- Bornet, E. and G. Thuret. 1876. Notes Algologiques, recueil d'observations sur les algues. Paris.
- Clemente, S. 1807. "Ensayo sobre las variedades de la vida comun que vegetan en Andalucia. Madrid."
- Dawson, E. Y. 1944. The marine algae of the Gulf of California. Allan Hancock Pacific Expeditions vo. 3: 189-358.
- Dixon, P. S. 1961. On the classification of the Florideae with particular refernece to the position of the Gelidiaceae. Botanica Marina 3: 1-16.
- \_\_\_\_\_. and L. M. Irvine. 1977. Seaweeds of the British Isles. Vol.1. Rhodophyta, Part 1. Introduction, Nemaliales, Gigartinales. British Museum.
- Gardner, N. L. 1927. New species of *Gelidium* on the Pacific Coast of North America. Univ. Calif. Publs., Bot. 13: 273-318.
- Gayral, P. 1966. Les Algues des Cotes Francaises. Paris.
- Kuetzing, F. T. 1849. Species Algarum. Lipsiae.
- \_\_\_\_\_. 1868. Tabulae Phycologicae. Vol. 18. Nordhausen.
- Kylin, H. 1956. Die Gatungen der Rhodophyceen. Lund.
- Lamouroux, J. V. F. 1804. "Dissertations sur plusiurs especes de *Fucus* connues ou nouvelles; Avec leur Description en Latin et en Francais. Agen."
- \_\_\_\_\_. 1813. Essai sur les genres de la familie des thalassiphytes non articulees. Annals Mus. Hist. nat. Paris.
- Lee, I. K. and J. W. Kang. 1986. A check list of marine algae in Korea. Korean J. Phycol. 1: 311-325.
- Le Jolis, A. 1863. Liste des algues marines de Cherberg. Mem. Soc. natn. Sci. nat. math. Cherberg. 10: 6-168.
- Martens, C. V. 1866. "Die Tange. -Die Preussische Expedition nach Ost-Asien. nach A. tlichen Quellen. Berlin."
- Newton, L. 1931. A Handbook of the British Seaweeds. London.
- Okamura, K. 1934. On *Gelidium* and *Pterocladia* of Japan. J. Imp. Fish. Inst., Tokyo 29: 47-67.
- \_\_\_\_\_. 1936. Japanese Algae. Tokyo.
- Santelices, B. 1974. Gelidioid algae, a brief resume of the pertinent literature. Marine Agronomy U.S. Sea Grant Program, Hawaii. 111 pp.
- \_\_\_\_\_. and J. G. Stewart. 1984. Pacific species of *Gelidium* Lamouroux and Gelidiales (Rhodophyta), with keys and descriptions to the common or economically important species. In Taxonomy of Economic Seaweeds with reference to some Pacific and Caribbean species, ed.

- by Abbott, I. A. and J. N. Norris. pp. 17-32. California Sea Grant College Program.
- Segi, T. 1957. The species of the genus *Gelidium* from Japan and its vicinity(II). Fac. Fish., Prefec. Univ. Mie 2: 456-462.
- Sohn, C. H. and J. W. Kang. 1978. The classification of family Gelidiaceae (Rhodophyta) in Korea. Publ. Inst. Mar. Sci., Nat. Fish. Univ. Busan 11: 29-40.
- Stackhouse, J. 1795. "Nereis Britanica. Fasc. Bath."
- Stewart, J. G. and J. N. Norris. 1981. Gelidiaceae (Rhodophyta) from the northern Gulf of California, Mexico. Phycologia 20: 273-284.
- Taylor, W. R. 1945. Pacific Marine Algae of the Allan Hancock Expeditions to the Galapagos Islands. Allan Hancock Pacific Expeditions.
- Turner, D. 1808-1819. "Fuci, sive plantarum Fucorum generi a botanicis. Londini."
- Weber van Bosse, A. 1921. Liste des algues du Siboga. II Rhodophyceae. Part 1. Protofloridae, Nemalionales, Cryptonemiales. Siboga-Exped. 59B: 187-310.