

Additions to the marine algal flora of Taiwan

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The occurrences of one species of Chlorophyceae and eight species of Rhodophyceae are newly reported in Taiwan: *Ventricaria ventricosa*, *Kallymenia perforata*, *Sebdenia agardhii*, *Botryocladia skottsbergii*, *Cryptarachne okamurai*, *Crouania minutissima*, *Griffithsia subcylindrica*, *Wrangelia tayloriana* and *Tolypiocladia glomerulata*. Annotations on their morphology, other features of taxonomic interest, habitat and world distribution are provided.

Key Index Words: Chlorophyceae—distribution—marine algae—new records—Rhodophyceae—Taiwan.

The algal flora of the main island of Taiwan has been well investigated (Yamada 1925a, b, 1938, Shen and Fan 1950, Chiang 1960, 1962, 1972, 1973a, b, Chou and Chiang 1981, Chiang and Chen 1982, Yang and Chiang 1982, Chiang and Wang 1987, Lewis and Norris 1987), but those of offshore islands are still insufficiently known. This paper deals with a collection of marine algae from Hsiao-Liuchiu island (120°21'55"E, 22°19'48"N), a small island located southwest of Taiwan (Fig. 1). Hsiao-Liuchiu island in an uplifted coral reef which is covered with recent soil, forming a plateau not higher than 70 m (Yang *et al.* 1975). Immersed in the clear warm water from the branching Kuroshio Current, Hsiao-Liuchiu has an annual average water temperature above 26°C, with yearly fluctuation within 60°C (Chu 1971, Yang *et al.* 1975). The salinity ranges between 32‰ to 34.5‰.

The algal flora of Hsiao-Liuchiu has been studied by Yamada (1950). He listed 49 species of marine algae (24 green and 25 brown algae). Since then no one has attempted to make a general study of the marine algae in this district. From March 1988 to September 1989, under the financial support of the National Science Council and the Taiwan Museum, the author made an extensive collection from the littoral zone to a depth of about

16 m around the island. It was found that a number of algal specimens were distinctly different from the previously recognized species in Taiwan. Data on the composition, distribution and seasonal succession of seaweeds of Hsiao-Liuchiu will be published in the future. In this paper, nine species of marine algae are studied, including one species of Chlorophyceae and eight species of Rhodophyceae. These species have not been previously reported for Taiwan. *Ventricaria*,

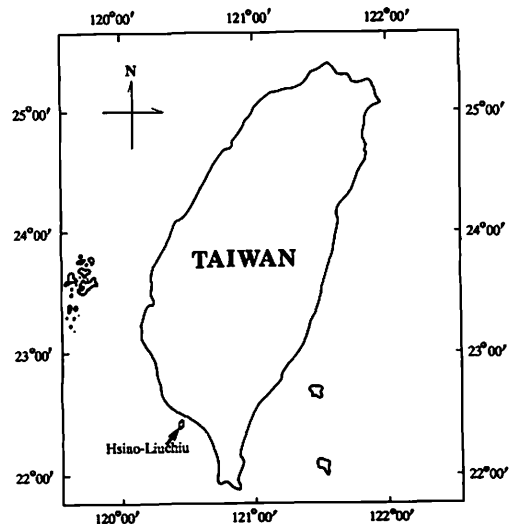


Fig. 1. Map of Taiwan, showing the location of Hsiao-Liuchiu island.

Kallymenia, *Sebdenia*, *Botryocladia*, *Crouania*, *Wrangelia* and *Tolyptocladia* are also new genera for Taiwan. All the specimens mentioned here are deposited in the herbarium of the Taiwan Museum.

List of species

Chlorophyta

Valoniaceae

Ventricaria ventricosa (J. Ag.) Olsen et West, *Phycologia* 27: 104, 1988.

-*Valonia ventricosa* J. Ag., *Algern. Syst. part 8*: 96, 1887.

Collection: H-943 (May 21, 1988), H-1343 (March 10, 1989). The plants are found growing on coral fragments or the reef flat at the sublittoral zone.

Geographical distribution: This is a widely distributed species in tropical seas.

Rhodophyta

Kallymeniaceae

Kallymenia perforata J. Ag., *Species Genera et Ordines Algarum* 3: 219, 1876.

Collection: H-1024 (Jan. 19, 1989). The specimens were all tetrasporophyte. They were found growing on rocks only in deep water (about 10–15 m).

Geographical distribution: Japan, Ceylon, West Indies, New Hollon (Irian Jaya), Tasmania.

Sebdeniaceae

Sebdenia agardhii (De Toni) Codomier in Tseng et al., p. 66, 1980.

-*Halymenia agardhii* De Toni, *Syll. alg. part 4*: 1542, 1905.

These tetrasporic specimens show the taller thallus (up to 45 cm) and roundness of the axilus as in *Sebdenia polydactyla* (Boergesen) Balakrishnan (Balakrishnan 1961) on one hand, and the blunt-ending ultimate branches as in *Sebdenia agardhii* (De Toni) Codomier on the other. Both species have several features common to each other and seem to be scarcely distinguishable (Tseng et

al. 1980). The relationship between these two species needs further anatomical study.

Collection: H-684 (March 19, 1988), H-1514 (July 9, 1989). It was occasionally found growing on the rocks of sublittoral zone at the depths of 4–16 m. Tetrasporic plants have been gathered in March.

Geographical distribution: Japan, Hong Kong, Bermuda, North Carolina, Florida, West Indies (Guadeloupe, Tobago).

Rhodymeniaceae

Botryocladia skottsbergii (Boerg.) Levring, *Meeresalgen der Juan Fernandez-Inseln*, p. 645, 1941.

-*Chrysymenia skottsbergii* Boerg., *Mar. Alg. Easter Isl.* p. 307, 1924.

-*Chrysymenia kuckuckii* W.v.B., *Monogr. Siboga Exped.* p. 446, 1928.

-*Botryocladia kuckuckii* (W.v.B.) Yamada et Tanaka, *Sci. Pap. Inst. Algal. Res. Hokkaido Univ.* 2: 77, 1938.

Collection: H-998 (Jan. 17, 1989). This plant appears to be rare and of erratic occurrence on the coast of Hsiano-Liuchiu, having only been found on two occasions, but then in abundance, growing on shaded sides of rocks or under surfaces of coral clumps in the calm area of the sublittoral zone 3–5 m deep. Plants with cystocarps were found in January.

Geographical distribution: Indonesia, Solomon Islands, Japan (Ryukyu Islands), China (Xisha Islands), Marshall Islands, Easter Island and Mauritius.

Cryptarachne okamurai (Yamada & Segawa) Zhang & Xia, *Stud. Mar. Sinica* 20: 133, 1983.

-*Chrysymenia okamurai* Yamada & Segawa, *Rec. Oceanogr. Works Japan* 1: 110, 1953.

-*Chrysymenia kaernbachii* Okamura (non Grunow), *Nippon Kaiso-si*, p. 669, 1936.

Collection: H-1345 (March 10, 1989). It was found growing as a creeping mat on rocks or coral fragments at depths of 3–6 m.

Geographical distribution: Japan (Ryukyu Islands), China (Xisha Islands).

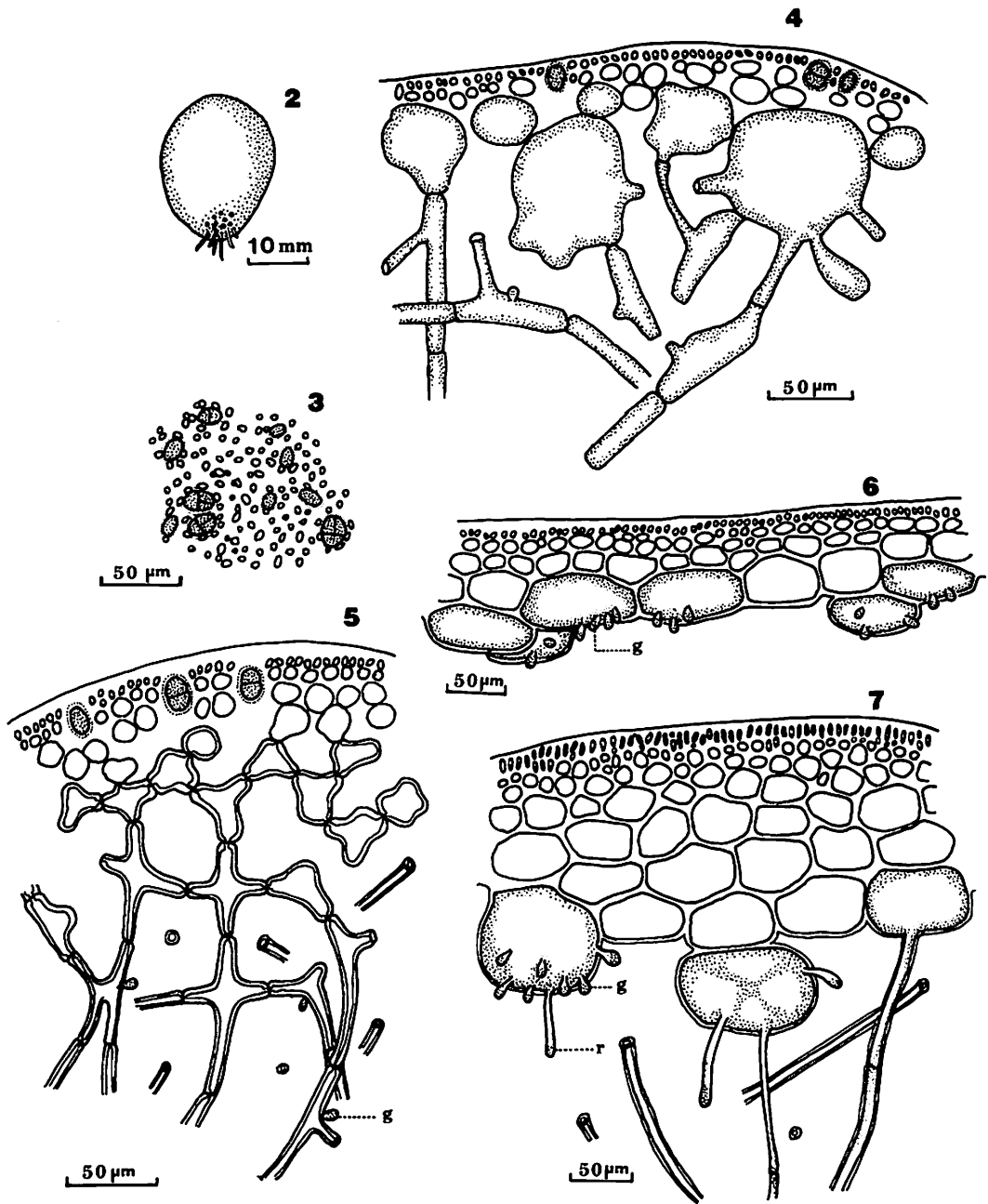


Fig. 2. Outline of *Ventricaria ventricosa*. Fig. 3. Surface view of *Kallymenia perforata*, showing tetrasporangia in the epidermal layer of thallus. Fig. 4. Transverse section of the thallus of *Kallymenia perforata*. Fig. 5. Transverse section of ultimate branch of *Sebdenia agardhii*, showing ramified filaments with glands (g). Fig. 6. Transverse section of the vesicle of *Botryocladia skottsbergii*, showing gland cells (g) grouping on the innermost layer of vesicle. Fig. 7. Transverse section of a sterile frond of *Cryptarachne okamurai*, showing gland cells (g) and rhizoid-like filament (r) from the innermost large cells.

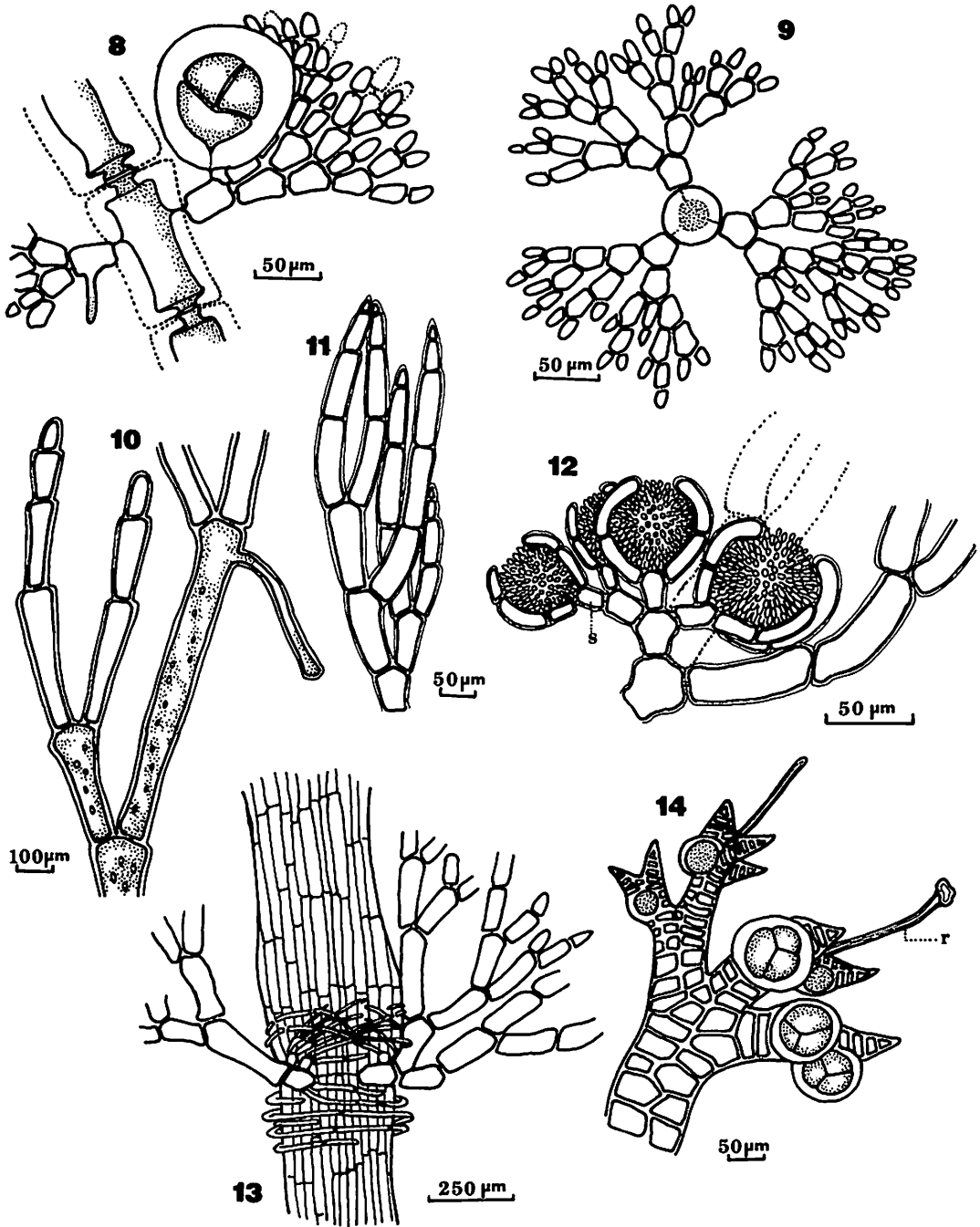
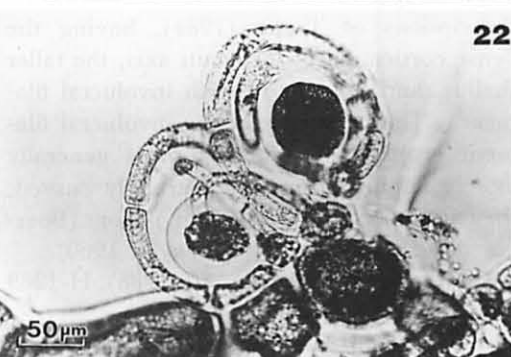
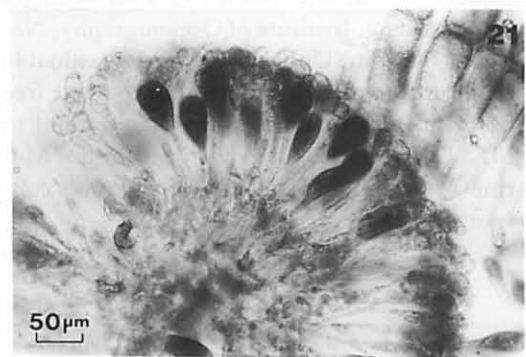
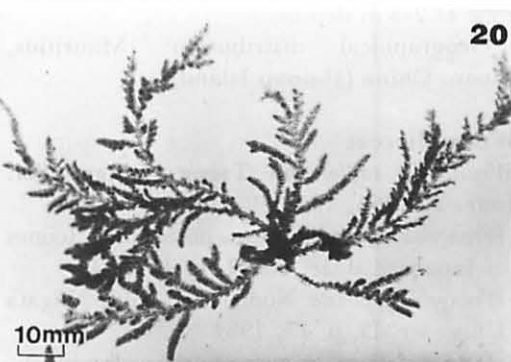
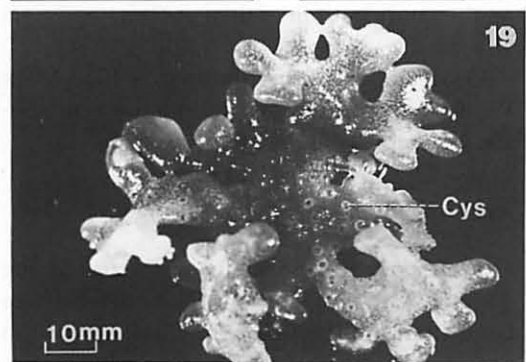
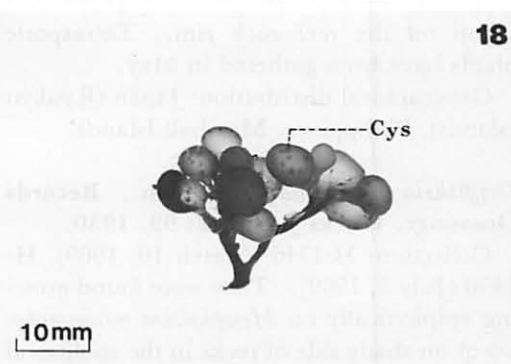
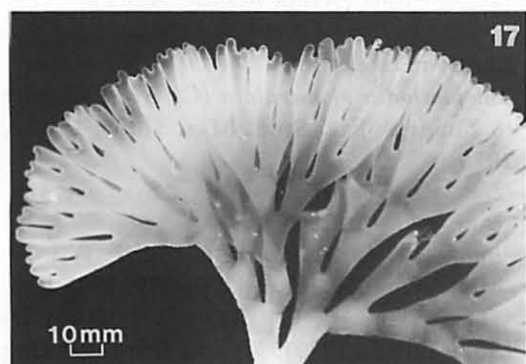
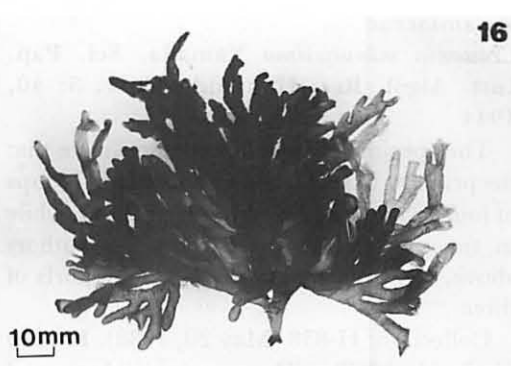
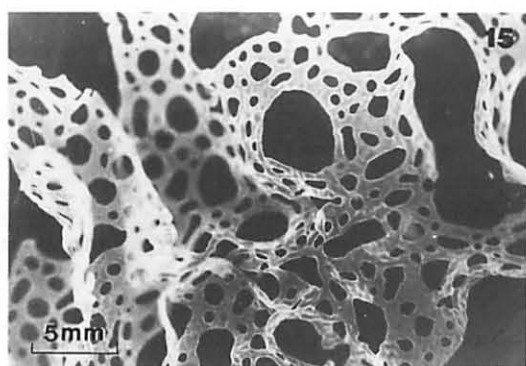


Fig. 8. Part of axis of *Crouania minutissima*, showing tetrasporangium on the basal segment of a determinate branch. Fig. 9. Cross section of *Crouania minutissima*, showing three determinate branch systems in whorl on axial cell. Fig. 10. Part of branches of *Griffithsia subcylindrica*. Fig. 11. Part of whorl-determinate branch of *Wrangelia tayloriana*. Fig. 12. *Wrangelia tayloriana*; a compact cluster of spermatangial head with involucral filaments and stalk cells (s). Fig. 13. Basal part of *Wrangelia tayloriana*. Fig. 14. A small upper part of *Tolyptocladia glomerulata*; note the rhizoid initials (r).



Ceramiaceae

Crouania minutissima Yamada, *Sci. Pap. Inst. Algol. Res. Hokkaido Univ.* 3: 40, 1944.

The specimens appear to demonstrate that the primary branchlets do not occur in groups of four as described by Yamada (1944), while in the material reported by other authors above, the branch systems were in whorls of three.

Collection: H-858 (May 20, 1988), H-1609 (Sept. 11, 1989). These were epiphytic and found on the reef rock rim. Tetrasporic plants have been gathered in May.

Geographical distribution: Japan (Ryukyu Islands), Philippines, Marshall Islands.

Griffithsia subcylindrica Okam., *Records Oceanogr. Works Japan*, 2: 99, 1930.

Collection: H-1346 (March 10, 1989), H-1498 (July 3, 1989). They were found growing epiphytically on *Mesophyllum mesomorphyum* or on shady side of rocks in the sublittoral zone at 2-3 m depths.

Geographical distribution: Mauritius, Japan, China (Hainan Island).

Wrangeliaceae

Wrangelia tayloriana Tseng, *Lingn. Sci. Jour.* 20: 264, 1942.

-*Wrangelia argus* Okamura (non Mont), *Icones of Japanese algae*, vol. 7, p. 46, 1935.

-*Wrangelia japonica* Noda, *Sci. Rep. Niigata Univ.* ser. D, p. 17, 1964.

These specimens agree fairly well with the descriptions of Tseng (1984), having the dense cortication of the main axis, the taller thallus, and 2-3 cells in each involucrel filament. The curvature of the involucrel filament around the sporangium is generally loosely applied, sometimes strongly curved; they approach *W. argus* (Mont.) Mont (Boergesen 1916, Dawson 1954, Taylor 1960).

Collection: H-254 (Jan. 20, 1988), H-1289

(March 9, 1989), H-1400 (May 19, 1989). They were found growing on rocks covered with sand, in exposed places in the lower littoral zone. Plants occur commonly through the year in Hsiao-Liuchiu. Plants bearing spermatangia were found in March, whilst cystocarps were found in May. Tetrasporic plants were commonly found from January to July.

Geographical distribution: Malay Archipelago, Stevens Island, Philippines, Japan, China (Xisha Islands, Among).

Rhodomelaceae

Tolypocladia glomerulata (C. Ag.) Schmitz in Zhang & Xia, *Stud. Mar. Sinica* 15: 38, 1979.

-*Hutchinsia glomerulata* C. Ag., *Systema Agarum*, p. 158, 1824.

-*Roschera glomerulata* (C. Ag.) W.v.B., *Monogr. Siboga Exped.* 59: 359, 1923.

Collection: H-549 (March 17, 1988), H-1507 (July 5, 1989). It was found growing on the sandy bottom of tidal pools in the littoral zone.

Geographical distribution: Indo-West Pacific region, such as Philippines, Indonesia, Solomon Islands, etc.

Acknowledgements

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Fig. 15. Habit of *Kallymenia perforata*. Fig. 16. *Sebdenia agardhii*; a slightly reduced plant. Fig. 17. Flabellate-like branching of *Sebdenia agardhii*. Fig. 18. Habit of *Botryocladia skottsbergii*; note the vesicles with cystocarp (Cys). Fig. 19. Habit of carposporic plant of *Cryptarachne okamurai*. Fig. 20. Habit of *Wrangelia tayloriana*. Fig. 21. Vertical view of a cystocarp of *Wrangelia tayloriana*. Fig. 22. Tetrasporangia with involucrel filaments on stalk cells.

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S.-F. Huang : 台湾の海藻フロラへの追加

台湾本島の南西部沖に位置する Hsiao Liuchiu 島で採集した海藻の中から新たに次の9種(緑藻1種, 紅藻8種)を台湾の海藻フロラに加えた, すなわち, オオバロニア *Ventricaria ventricosa*, ツカサアミ *Kallymenia perforata*, ヌラクサ *Sebdenia agardhii*, アツカワハナノエダ *Botryocladia skottsbergii*, *Cryptarachne okamurai*, ヒメヨツノサデ *Crouania minutissima*, キヌイトカザングサ *Griffithsia subcylindrica*, ランゲリア *Wrangelia tayloriana*, イトクズグサ *Tolyptocladia glomerulata* である。これらの海藻について, その形態, 分類の特徴, 生育場所, 世界における分布などについて説明を加えた。(Department of Botany, Taiwan Museum, No. 2, Siangyang Road, Taipei, Taiwan 10014, Republic of China)