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Studies on the freshwater Rhodophyta of Micronesia I. Six new species of *Batrachospermum* ROTH[1)]

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Six species of *Batrachospermum* ROTH (Rhodophyta, Nemalionales) from Micronesia are described as new species. *B. mahlacense* resembles *B. hirosei* KUMANO et RATNASABAPATHY (1982), but differs from the latter in the shape and size of whorls and axial cells. *B. doboense* resembles *B. tortuosum* KUMANO (1978), but differs from the latter in the number of cells per carpogonium-bearing branch, and the shape of whorls and trichogynes. *B. omodoense* resembles *B. mahlacense* but differs from the latter in the shape of wholrs and trichogynes, and the number of cells per fascicle and carpogonium-bearing branch. *B. tabagatenense* resembles *B. iriomotense* KUMANO (1982), but differs from the latter in the size of whorls, carpogonia and carposporangia. *B. nechochoense* resembles *B. tabagatenense* and *B. iriomotense*, but differs from *B. tabagatenense* in the size of trichogynes and from *B. iriomotense* in the size of whorls and carposporangia, and the shape of trichogynes. *B. faroense* resembles *B. doboense*, but differs from the latter in the number of cells per fascicle and the shape of whorls and trichogynes. A tentative key to the known taxa of the section *Contorta* is shown in the present study.

Key Index Words: Batrachospermum doboense, *sp. nov.*; Batrachospermum faroense, *sp. nov.*; Batrachospermum mahlacense, *sp. nov.*; Batrachospermum nechochoense, *sp. nov.*; Batrachospermum omobodoense, *sp. nov.*; Batrachospermum tabagatenesne, *sp. nov.*; *freshwater Rhodophyta*; *Micronesia*; *taxonomy*.

Although many phycologists studied the marine algae of Pacific islands, few investigations have been undertaken for the freshwater algal floras of these islands. Guam is the only Pacific island where some freshwater Rhodophyta taxa have been reported: *Audouinella* sp. by RAULERSON (1979), *Thorea gaudichaudii* by AGARDH (1824, 1828), and by SETO (1979), and *Bostrychia tenella* by KUMANO (1979). Palau, Western Caroline Islands, has the most extensive freshwater streams system in Micronesia. However, only four taxa of freshwater algae have been reported from Palau (BRIGHT, 1979). No freshwater Rhodophyta taxa have been reported from Palau and also from Truk, Eastern Caroline Islands. The present authors initiate a series of studies on the Micronesian freshwater Rhodophyta.

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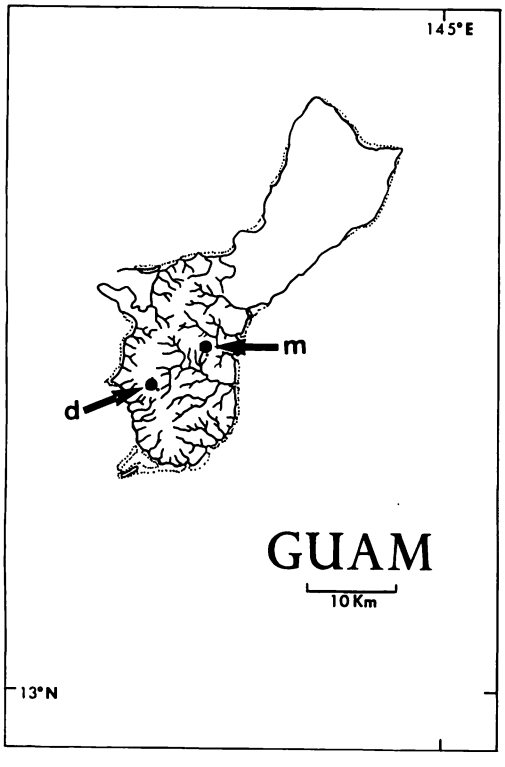
Topography and Collection Sites

All specimens examined in the present

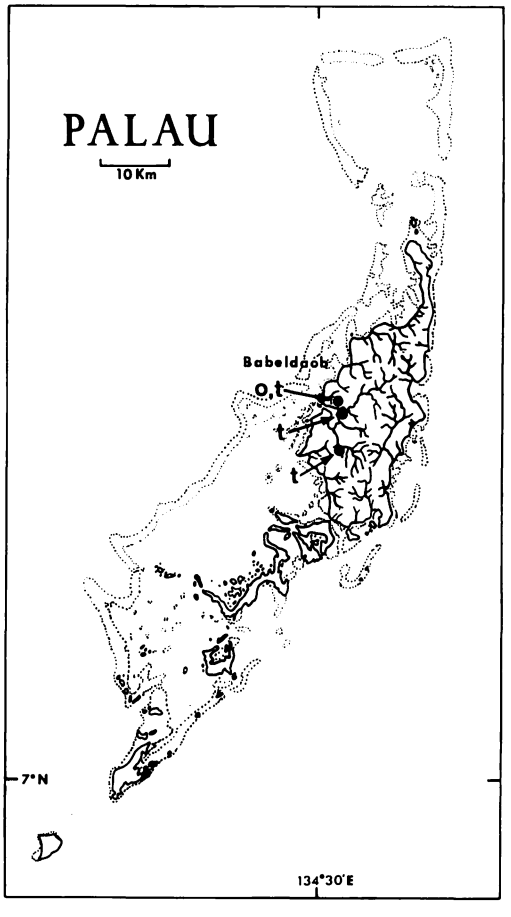
study were collected by W. Austin BOWDEN-KERBY from Guam, Mariana Islands, Palau, Western Caroline Islands, and Truk, Eastern Caroline Islands.

Guam (Map 1) is approximately 45 km long and 12 km wide. The northern half is composed of an elevated limestone plateau, while the southern half is mainly ancient volcanic origin. Guam's heavy tropical rainfall, on an average almost 2,000 mm/year, is absorbed by the limestone areas, but it runs off in the southern volcanic areas, forming several well-developed drainage systems. A smaller limestone cap overlaies at the high elevation in the southern half as well, and though it absorbs all rainfall, it releases the water as numerous perennial springs at lower elevation where the water meets impervious volcanic rock. The freshwater Rhodophyta were found at twelve locations on southern Guam, all in such springs or spring-fed headstreams; *Audouinella* sp. at nine sites, *Thorea gaudicahudii* at four sites and the two species of *Batrachospermum*, *B. mahlacense* and *B. doboense*, described here at one site each, associated with *Thorea gaudichaudii*.

Babeldaob Island of Palau (Map 2) is the largest land mass of volcanic origin in Micronesia, 43 km long and 15 km wide. Babeldaob is dominated by gently rolling hills, reaching an elevation of about 60 m in several localities. Grass- and fernlands dominate the upper ridges, while dense tropical forest covers the valleys. Palau lacks the limestone cap as in the southern Guam and therefore has fewer perennial springs. It has about 3,300 mm of rainfall per year, and streams are therefore very



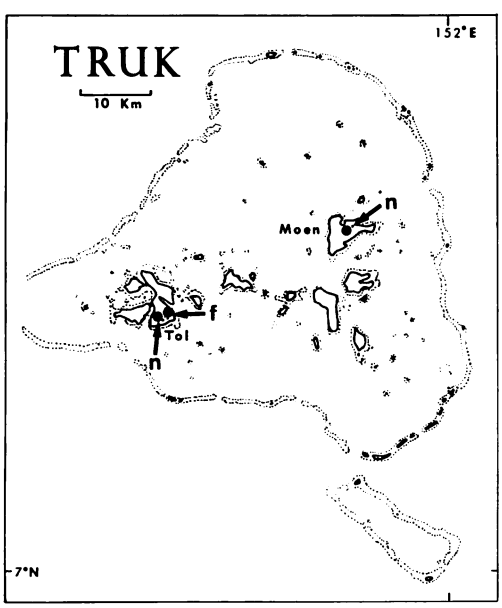
Map. 1. Site locations on Guam. (m: *B. mahlacense*, d: *B. doboense*)



Map. 2. Site locations on Palau (o: *B. omobodoense*, t: *B. tabagatenense*)

numerous. All three sites, where *Batrachospermum omobodoense* and *B. tabagatenense* were found in Palau, receive a few hours of direct sunlight each day, being lightly shaded for the remainder. This contrasts with those heavily shaded most other streams. These three sites are also lotic, having a slight current originating from seeps or springs.

Truk (Map 3) is composed of a large coral atoll of many low, sandy islands surrounding several mountainous volcanic islands located at the centre of the lagoon. Tol and Moen are the largest and highest ones among sixteen volcanic islands. Both are about 8 km in length, and up to 4 km in width. Tol is mainly occupied by the highest mountain in Truk, which is 443 m in height and forms a large plateau steeply ascending from the shore. Perennial streams are absent at the higher elevations, but the base of this volcanic mass is fringed by numerous perennial and intermittent springs and associated streams and rivulets. These streams have a hard substratum of dense volcanic rock or cobbles. Moen Island rises steeply to 373 m in height from a flat, swampy coastal plain. Like Tol, Moen is fringed by numerous springs which arise near the base of the volcanic mass. The water from these springs flows as streams or rivulets into coastal swamps or into mangrove-lined bays. The largest stream in Truk, called Wichen, is found on Moen and it flows at the rate of about 1 m^3/min. in a well-developed valley. It is rarely more than 2-3 m wide and 3-20 cm deep.



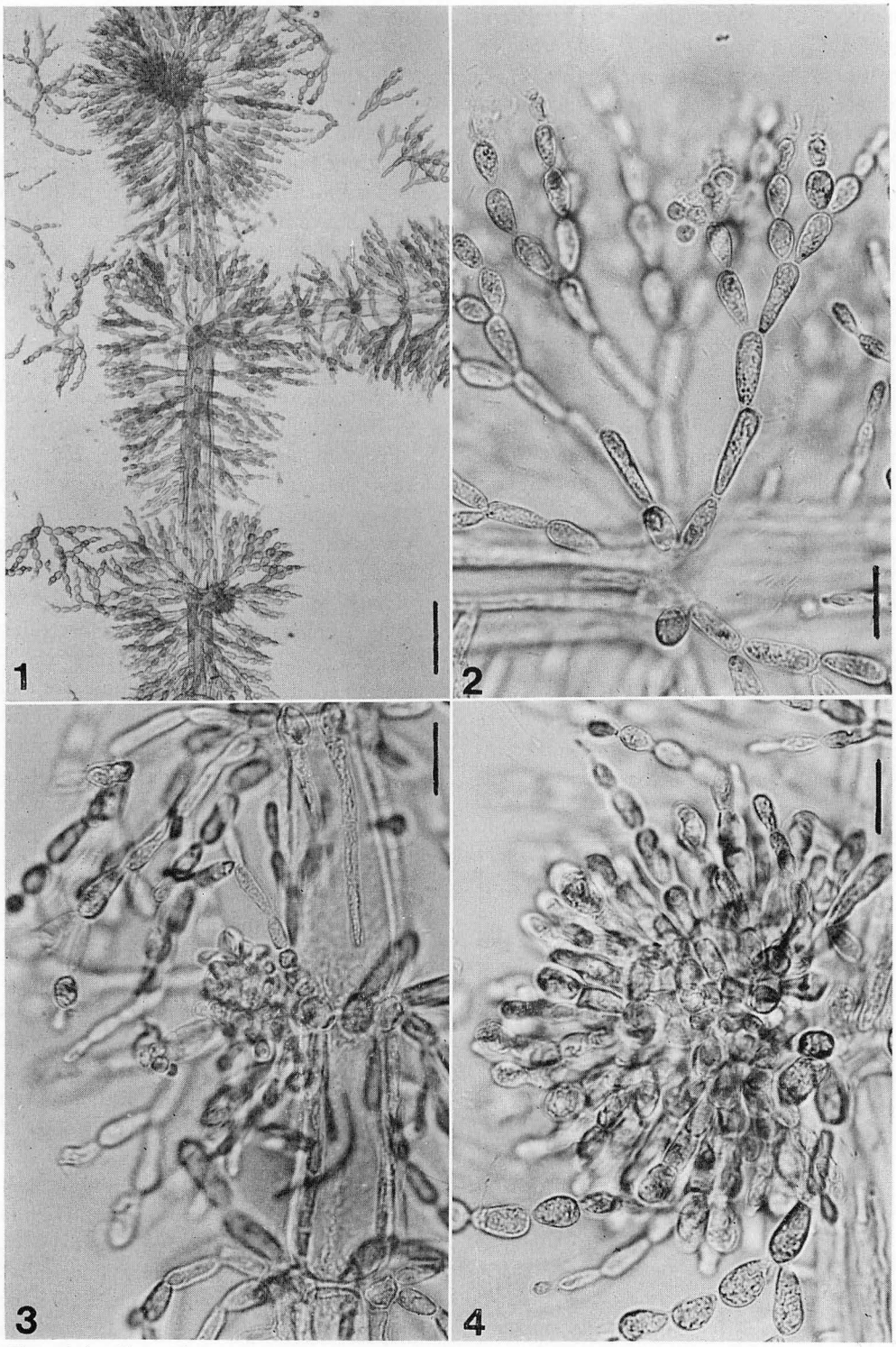
Map. 3. Site locations on Truk. (n: *B. nechochoense*, f: *B. faroense*)

Descriptions of the Species

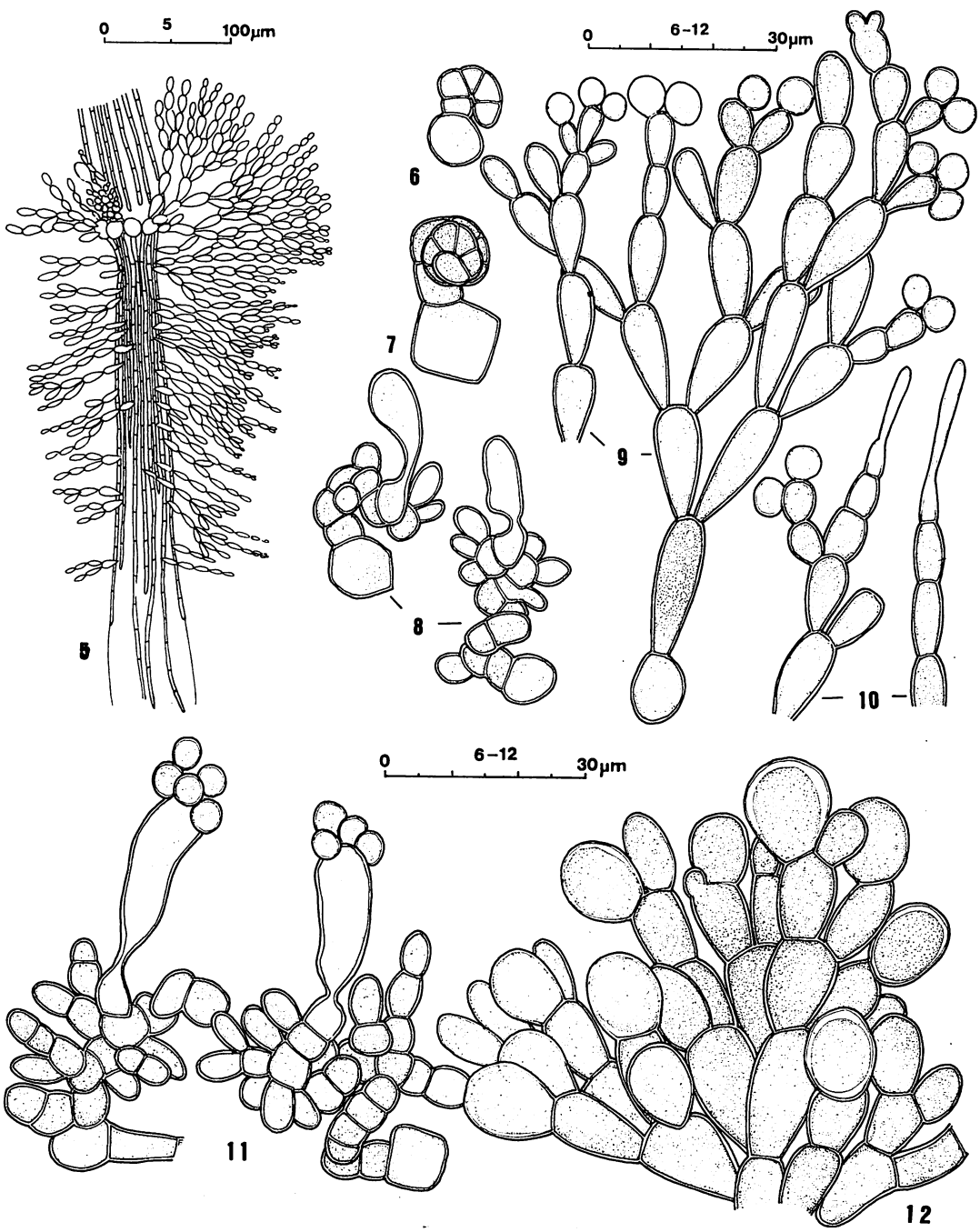
1. *Batrachospermum mahlacense* KUMANO et BOWDEN-KERBY, sp. nov. (Figs. 1-4, 5-12)

Frons monoica, ca. 6 cm alta, 250-400 μm crassa, abundanter irregulariterque ramosa, modice mucosa, glauca. Cellulae axiales cylindricae, 30-60 μm crassae, 200-400 μm ongae. Verticilli pyriformes. Ramuli primarii dichotome ramificantes, ex 7-9 cellulis constantes; cellulae fasciculorum ellipticae; pili plus minusve breves. Fila corticales bene evoluta. Ramuli secundarii numerosi, non vel dichotome ramificantes, ex 6-7 cellulis constantes, totum internodium obtegentes. Spermatangia globosa, 4-6 μm diametro, in ramulis primariis et secundariis terminalia vel lateralia. Ramuli carpogoniferi e cellulis basi ramulorum primariorum orientes, ex cellulis 5-15 doliiformibus constantes, valde tortuosi; carpogonium 25-40 μm longum, basi 4-5 μm crassum, apice 7-8 μm crassum; trichogyne ellipsoidea vel urnformes, plus minusve distincte pedicellata. Bracteae numerosi et breves. Gonimoblasti singuli vel duo, globosi vel semiglobosi, 140-170 μm crassi, 80-160 μm alti, in centro verticilli inserti. Carposporangia obovoidea, 7-12 μm crassa, 12-14 μm longa.

Fronds monoecious, ca. 6 cm high, 250-400 μm wide, abundantly and irregularly branched, moderately mucilaginous, dark greyish green. Axial cells cylindrical, 30-60 μm wide, 200-400 μm long. Whorls pear-shaped. Primary branchlets dichotomously branched, consisting of 7-9 cell-stories; cells of fascicles ellipsoidal; hairs more or less short. Cortical filaments well-developed.



Figs. 1-4. *Batrachospermum mahlacense* KUMANO et BOWDEN-KERBY, sp. nov. 1. A part of thallus showing pear-shaped whorls; 2. Spermatangia; 3. A part of whorls showing a carpogonium-bearing branch with a fertilized trichogyne; 4. A gonimoblast. (Scale bar; 100 μm for Fig. 1; 20 μm for Figs. 2-4).



Figs. 5-12. *Batrachospermum mahlacense* KUMANO et BOWDEN-KERBY, sp. nov. 5. A part of thallus showing axial cells, primary branchlets, cortical filaments, secondary branchlets and a carpogonium-bearing branch; 6-7. Coiled carpogonium-bearing branches at very early stages in development; 8. Early stages in development of coiled carpogonium-bearing branches with young carpogonia; 9. Spermatangia; 10. Hairs; 11. Fertilized carpogonia with spermatia; 12. Carposporangia terminal on gonimoblast filaments.

Secondary branchlets numerous, consisting of 6-7 cell-stories, non or dichotomously branched, covering all the internodes. Spermatangia globose, 4-6 μm in diamter, terminal or lateral on primary and secondary branchlets. Carpogonium-bearing branch arising from the basal cell of primary branchlet, consisting of 5-15 barrel-shaped cells, twisted strongly; carpogonium 25-40 μm long, 4-5 μm wide at the base, 7-8 μm wide at the apex; trichogyne ellipsoidal or urn-shaped, more or less distinctly stalked. Bracts numerous and short. Gonimoblasts single or couple, globose or semiglobose, 140-170 μm wide, 80-160 μm high, inserted centrally. Carposporangia obovoidal, 7-12 μm wide, 12-14 μm long.

Holotype: Upper reaches of the Mahlac River, Talofofo, Guam, Mariana Islands (BOWDEN-KERBY 25/VIII 1983), Herbarium of Faculty of Science, Kobe University, Japan. Isotype: (BOWDEN-KERBY 25/VIII 1983), University of Guam Herbarium, U. S. A..

Other specimens examined: Upper reaches of Mahlac River, Talofofo, Guam, Mariana Islands (BOWDEN-KERBY 15/VII 1984).

Habitat: Attached on rocks in a perennial spring, and epiphytic on *Phragmites* in another nearby spring-fed rivulet. The pH value of water was 7.2 and water temperature was 25°C during the July 1984 collection.

Distribution: Known from the type locality and Ibobang in Palau, Western Caroline Islands.

2. *Batrachospermum doboense* KUMANO et BOWDEN-KERBY, sp. nov. (Figs. 13-16, 17-25).

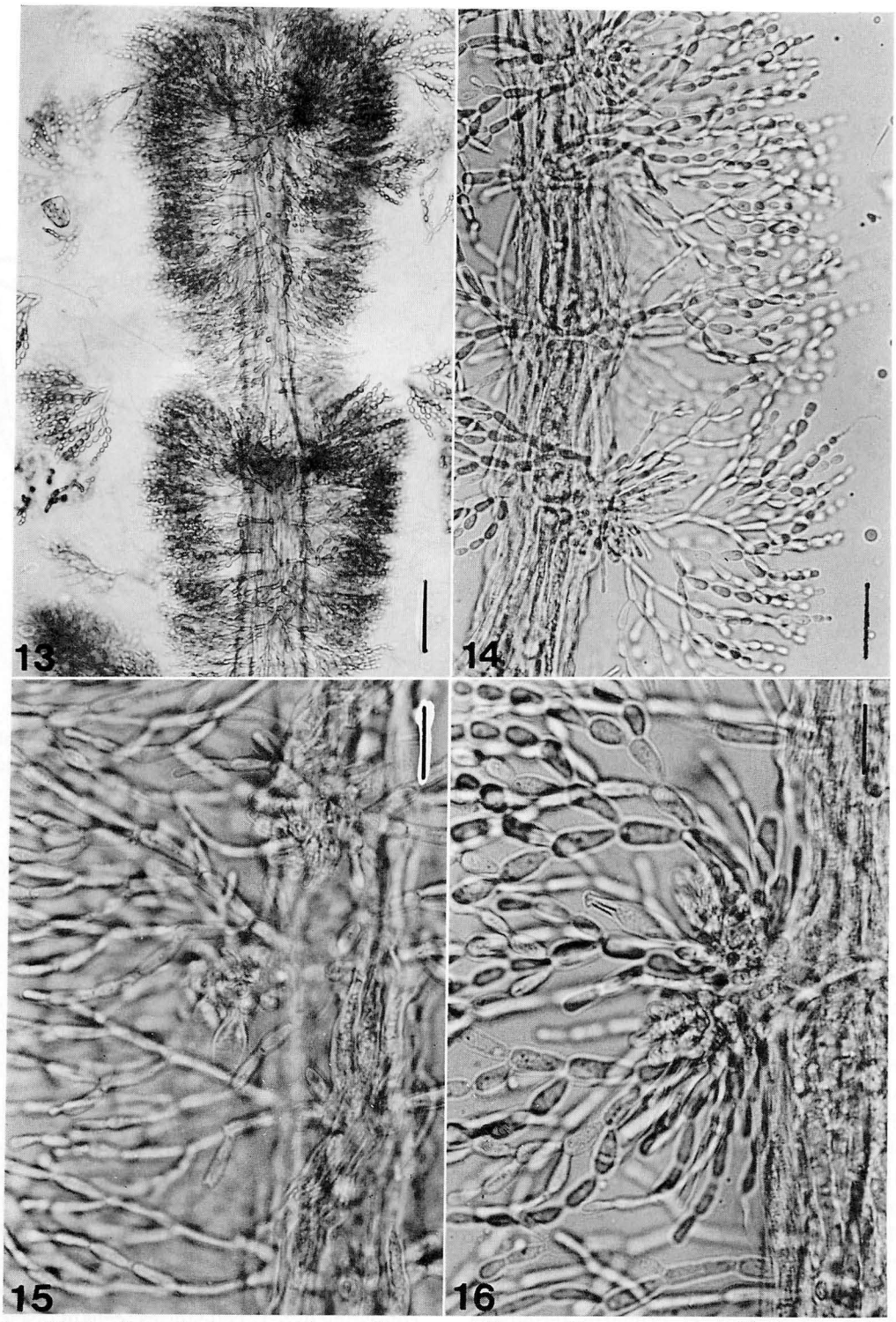
Frons dioica?, ca. 4 cm alta, 300-400 μm crassa, abundanter irregulariterque ramosa, mucosa, viridia. Cellulae axiales cylindricae, 30-90 μm crassae, 70-350 μm longae. Verticilli pyriformes, in parte vetustiore frondis contigui. Ramuli primarii dichotome ramificantes, ex 9-14 cellulis constantes; cellulae proximales fasciculorum lanceolato-claviformes, cellulae distales fusiformes vel obovoideae; pili breves. Fila corticales densissime evoluta. Ramuli secundarii numerosi, dichotome ramificantes, ex 9-12 cellulis constantes. Spermatangia ignota. Ramuli carpogoniferi e cellulis basi ramulorum primariorum orientes, ex cellulis 5-11 doliiformibus constantes, tortuosi; carpogonium 25-40 μm longum, basi 3-7 μm crassum, apice 7-9 μm crassum; trichogyne ellipsoidea vel claviformes, indistincte pedicellata, ad basim saepe flexa. Bractea breves. Gonimoblasti et carposporangia ignota.

Fronds dioecious?, ca, 4 cm high, 300-400 μm wide, abundantly and irregularly branched, mucilaginous, green. Axial cells cylindrical. 30-90 μm wide, 70-350 μm long. Whorls pear-shaped, touching each other in aged part of the fronds. Primary branchlets dichotomously branched consisting of 9-14 cell-stories; proximal cells of fascicles lanceolate club-shaped, distal cells fusiform or obovoidal; hairs short. Cortical filaments very densely developed. Secondary branchlets numerous and dichotomously branched, consisting of 9-12 cell-stories. Spermatangia unknown. Carpogonium-bearing branches arising from the basal cells of primary branchlets, consisting of 5-11 barrelshaped cells twisted; carpogonium 25-40 μm long, 3-7 μm wide at the base, 7-9 μm wide at the apex; trichogyne ellipsoidal or club-shaped, indistinctly stalked, often bent at the base. Bracts short. Gonimoblasts and carposporangia unknown.

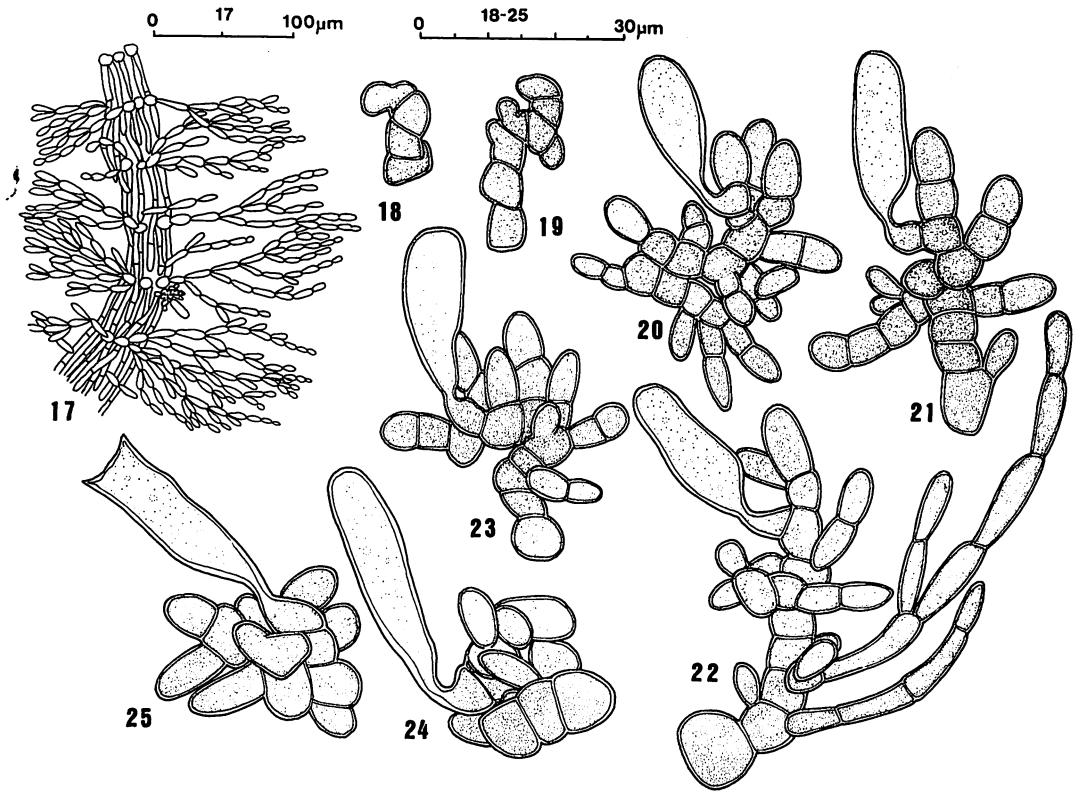
Holotype: Dobo Spring, Guam, Mariana Islands (BOWDEN-KERBY 7/VII 1984), Herbarium of Faculty of Science, Kobe University, Japan. Isotype: (BOWDEN-KERBY 7/VII 1984), University of Guam Herbarium, U. S. A..

Habitat: Growing in a perennial spring of flowing water, with *Thorea gaudichaudii*, the pH value was 7.5 on July 7, 1984.

Distribution: Known from the type locality only.



Figs. 13-16. *Batrachospermum doboense* KUMANO et BOWDEN-KERBY, sp. nov. 13. A part of thallus showing well-developed cortical filaments and pear-shaped whorls; 14. A part of young thallus showing well-developed cortical filaments, primary branchlets and two carpogonia; 15. Cortical filaments, primary branchlets and carpogonia; 16. A carpogonium-bering branch with a mature carpogonium. (Scale bar; 100 μm for Fig. 13; 40 μm for Fig. 14; 20 μm for Figs. 15-16).

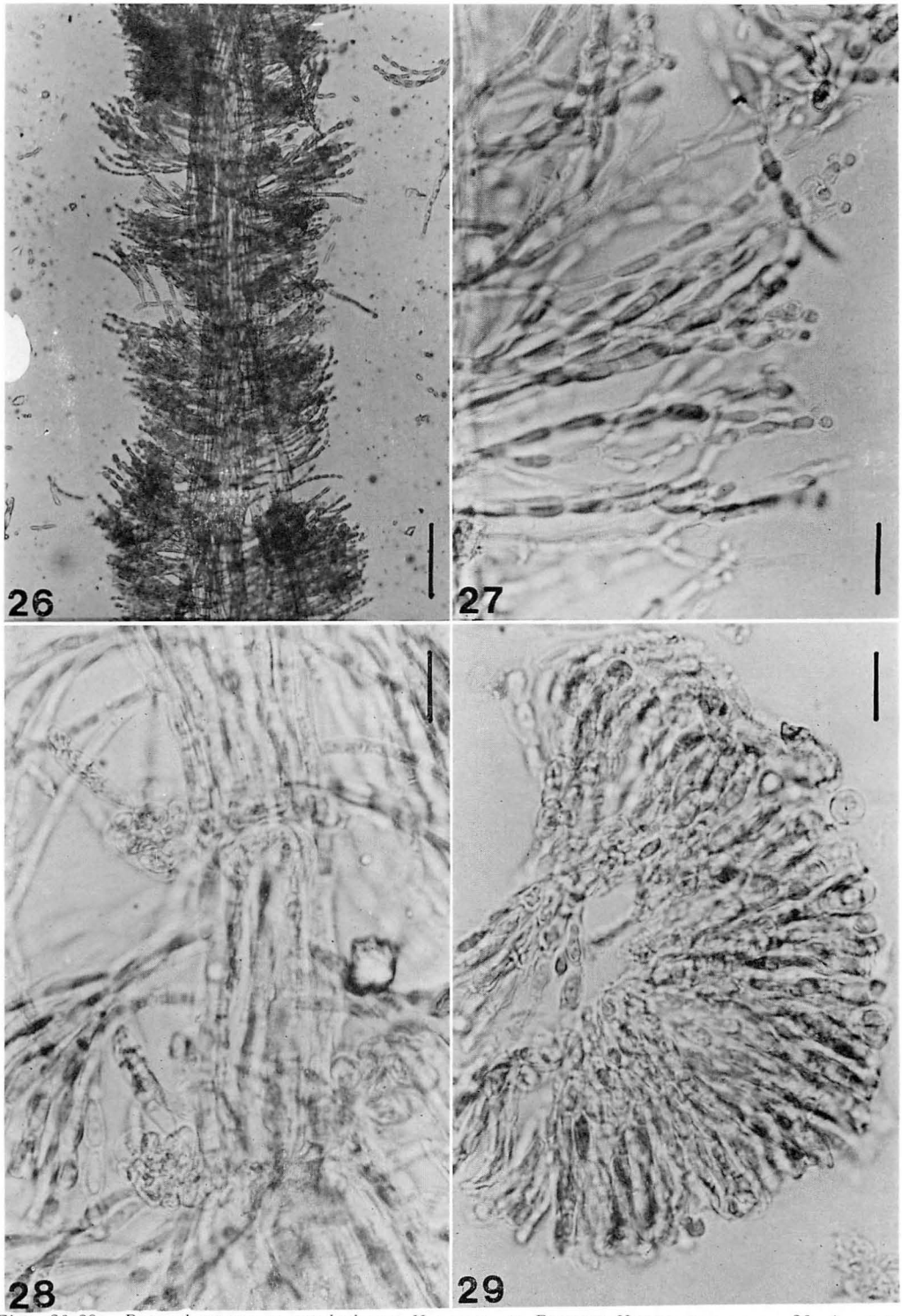


Figs. 17-25. *Batrachospermum doboense* KUMANO et BOWEDN-KERBY, sp. nov. 17. Apart of thallus showing axial cells, primary branchlets and a carpogonium-bearing branch; 18-19. Curved carpogonium-bearing branches at very young stages in development; 20-25. Carpogonium-bearing branches.

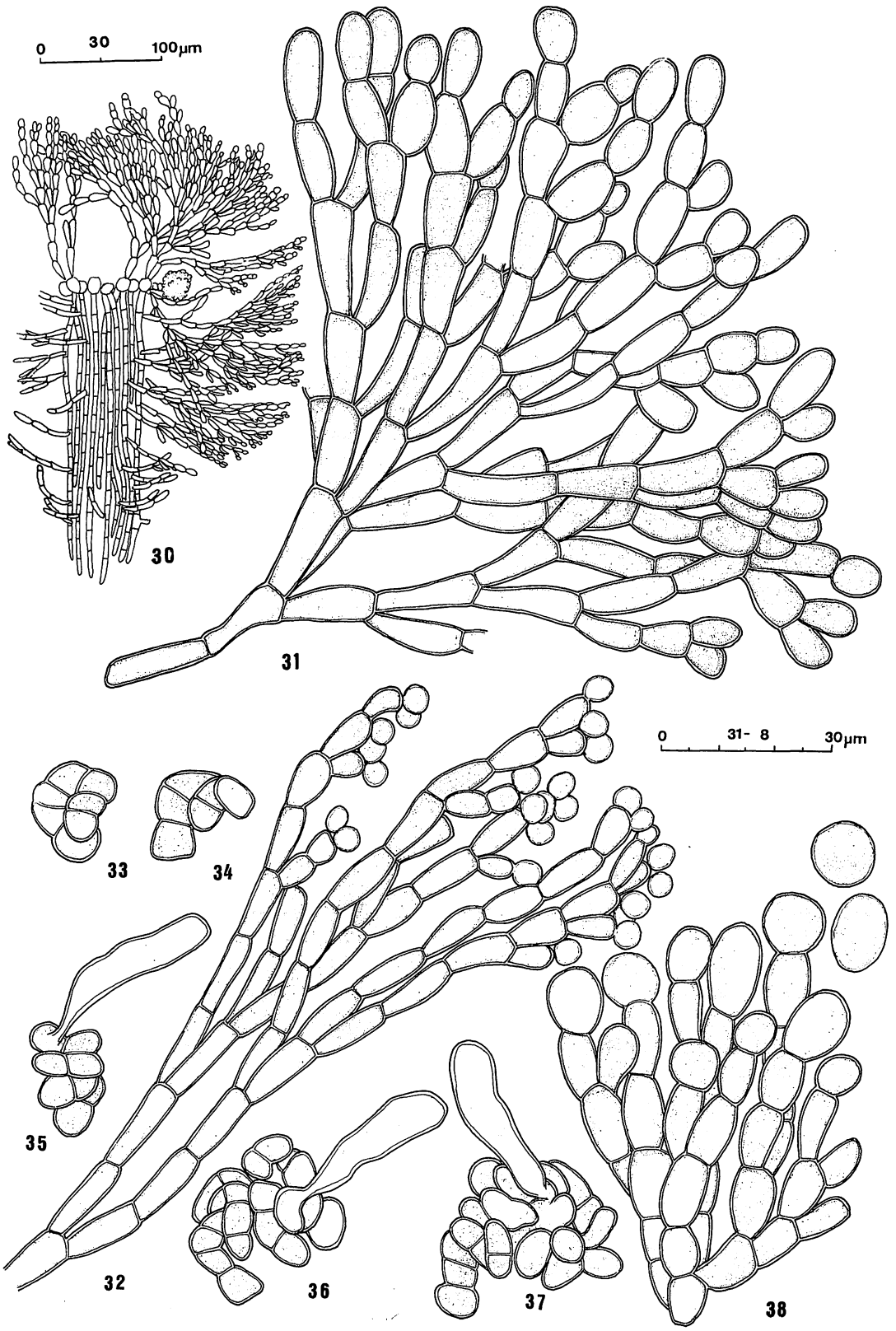
3. *Batrachospermum omobodoense* KUMANO et BOWDEN-KERBY sp. nov. (Figs. 26-29, 30-38).

Frons monoica, ca. 4 cm alta, 250-350 μm crassa, plerumque pseudo-dichotome ramosa, mucosa, atrovirens. Cellulae axiales cylindricae, 35-60 μm crassae, 90-320 μm longae. Verticilli doliiformes, in parte vetustiore frondis contigui. Ramuli primarii plus minusve unilateraliter ramificantes, ex 8-12 cellulis constantes; cellulae fasciculorum ellipticae; pili nuli. Fila corticales bene evoluta. Ramuli secundarii numerosi, ex 6-12 cellulis constantes, non vel dichotome ramificantes, totum internodium obtegentes. Spermatangia globosa, 3-5 μm diametro, in ramulis secundariis et primariis terminalia vel lateralia. Ramuli carpogoniferi e cellulis basi ramulorum primariorum orientes, ex cellulis 5-7 doliiformibus constantes, valde spiratim tortuosi; carpogonium 35-40 μm longum, basi 3-5 μm crassum, apice 7-8 μm crassum, trichogyne claviformes, indistincte pedicellata. Bracteae sparsae et breves. Gonimoblasti singuli vel duo, globosi vel semiglobosi, 170-220 μm crassi, 120-190 μm alti, in centro verticilli inserti. Carposporangia obovoidea, 8-11 μm crassa, 10-14 μm longa.

Frond monoecious, ca. 4 cm high, 250-350 μm wide, very frequently pseudo-dichotomously branched, mucilaginous, deep green. Axial cells cylindrical, 35-60 μm wide, 90-320 μm long. Whorls barrel-shaped, touching each other in aged parts of fronds. Primary branchlets more or less unilaterally branched, consisting of 8-12 cell-stories; cells of fascicles ellipsoidal; hairs lacking. Cortical filaments well-developed. Secoudary branchlets numerous, non or dichotomously branched,



Figs. 26-29. *Batrachospermum omobodoense* KUMANO et BOWDEN-KERBY, sp. nov. 26. A part of thallus showing barrel-shaped whorls; 27. Spermatangia terminal on secondary branchlets; 28. A part of thallus showing axial cells, primary branchlets and two carpogonium-bearing branches; 29. Carposporangia terminal on compactly agglomerated gonimoblasts. (Scale bar; 100 μm for Fig. 26; 20 μm for Figs. 27-29).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consisting of 6-12 cell-stories, covering all the internodes. Spermatangia globose, 3-5 μm in diameter, terminal or lateral on secondary and rarely on primary branchlets. Carpogonium-bearing branch arising from the basal cell of the primary branchlet, consisting of 5-7 barrel-shaped cells, spirally twisted; carpogonium 35-40 μm long, 3-5 μm wide at the base, 7-8 μm wide at the apex; trichogyne club-shaped. Bracts sparse and short. Gonimoblasts single or couple, globose or semiglobose, 170-220 μm wide, 120-190 μm high, inserted centrally. Carposporangia obovoidal, 8-11 μm wide, 10-14 μm long.

Holotype: Omobodo Stream, Ngeremlengui State, Palau (BOWDEN-KERBY 25/XII 1983), Herbarium of Faculty of Science, Kobe University. Isotype: (BOWDEN-KERBY 25/XII 1983), University of Guam Herbarium.

Habitat: Attached to rocks in a slightly to moderately flowing current with several hours of direct sunlight per day, and in a large pool in Omobodo Stream which arises from the Ngeremlengui taro swamp.

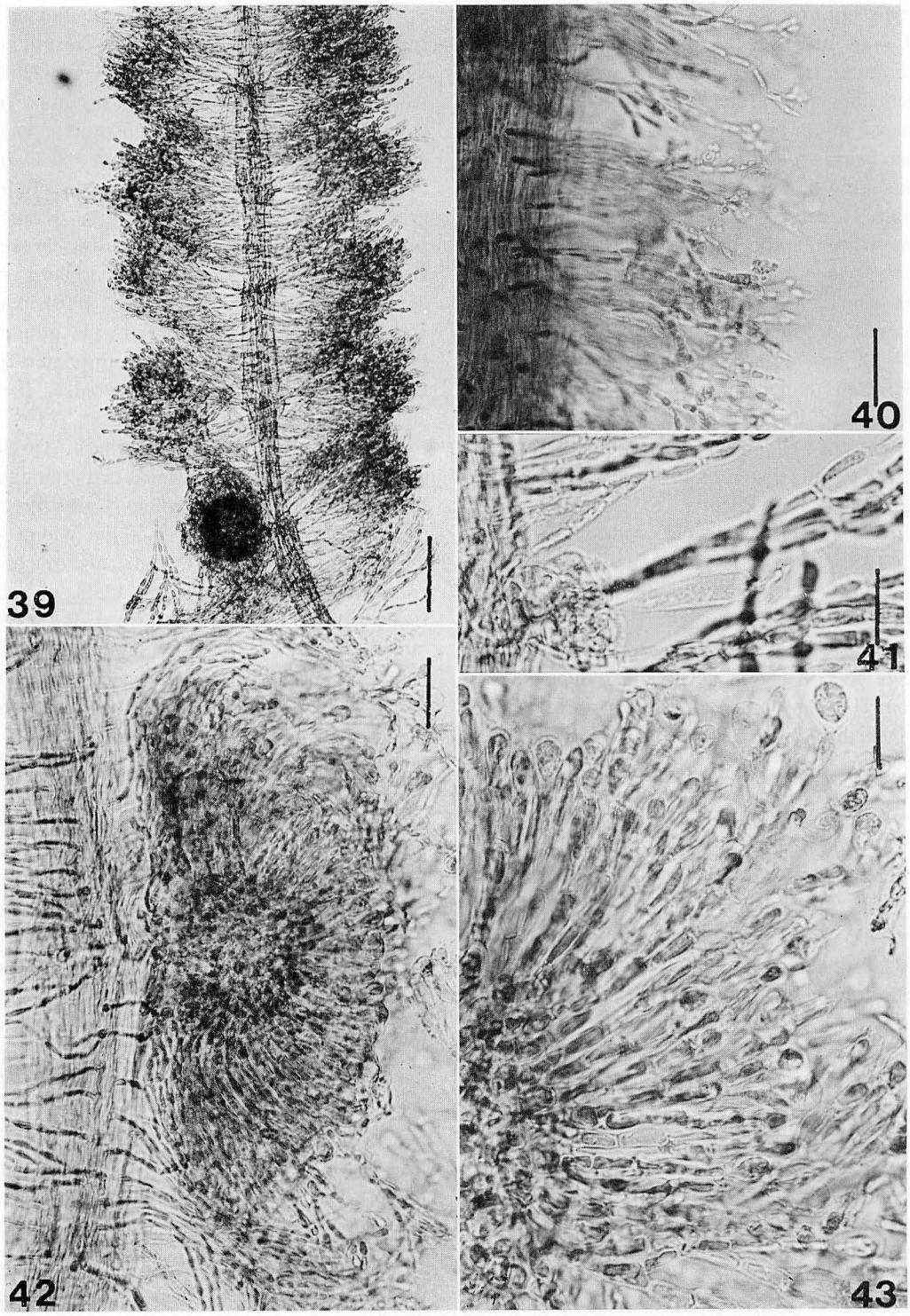
Distribution: Known from the type locality only.

4. *Batrachospermum tabagatenense* KUMANO et BOWDEN-KERBY, sp. nov. (Figs. 39-43, 44-52).

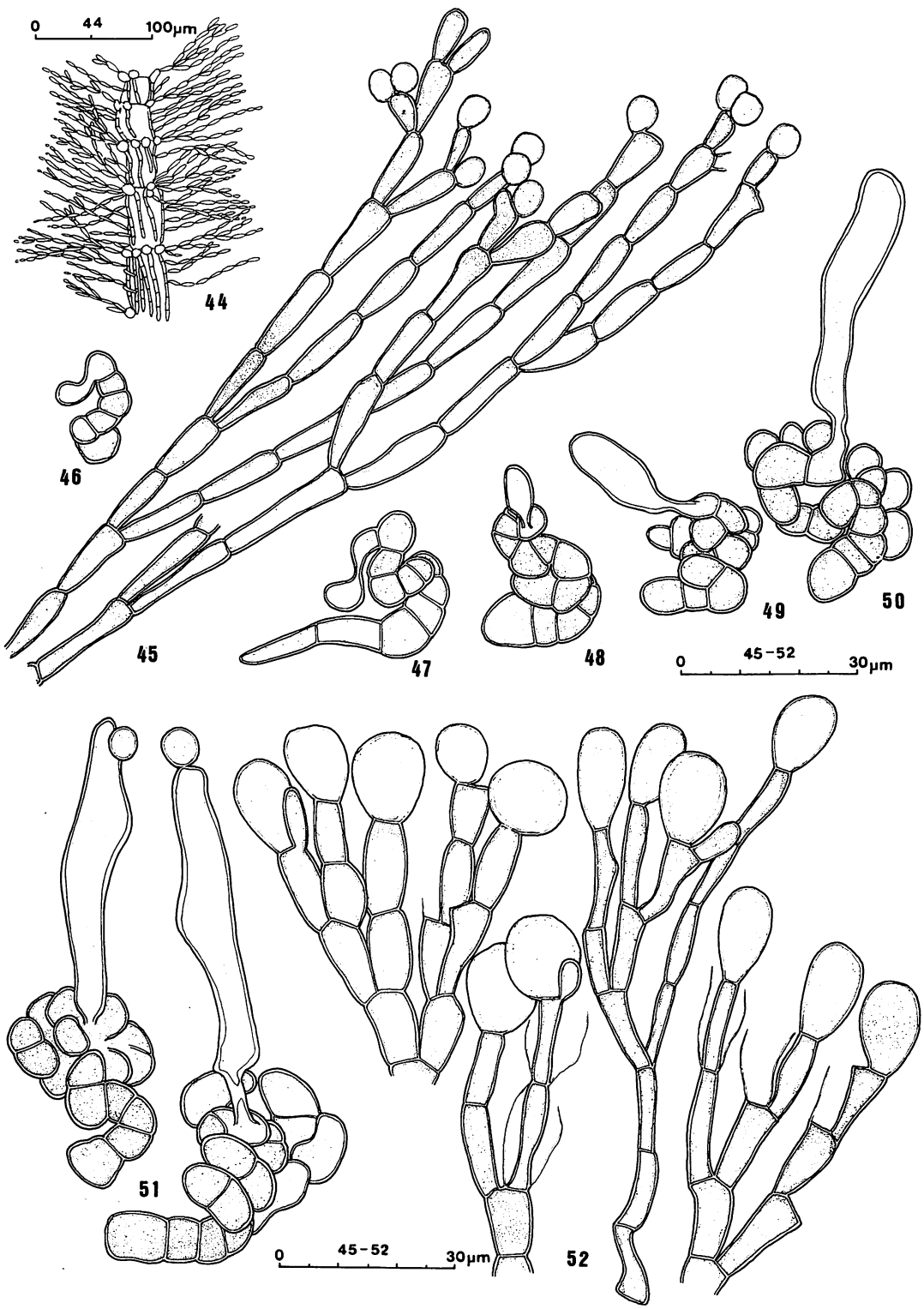
Frons mononica, ca. 3cm alta, 350-550 μm crassa, sparsim pseudo-dichotome ramosa, valde mucosa, glauca. Cellulae axiales cylindricae, 20-50 μm crassae, 80-180 μm longae. Verticilli cylindricae contigui. Ramuli primarii dichotome ramificantes, ex 9-13 cellulis constantes; cellulae fasciculorum primariorum lanceolato-claviformes; pili raro. Fila corticales bene evoluta. Ramuli secundarii numerosi, dichotome ramificantes, ex 8-11 cellulis constantes, totum internodium obtegentes, ramuli primarii aequantes. Spermatangia globosa, 4-5 μm diametro, in ramulis primariis et secundariis terminalia vel lateralia. Ramuli carpogoniferi e cellulis basi ramulorum primariorum orientes, ex cellulis 6-13 doliiformibus constantes, valde spiratim tortuosi; carpogonium 50-65 μm longum, basi 3-6 μm crassum, apice 8-10 μm crassum; trichogyne claviformes, distincte pedicellata. Bracteae sparsae et breves. Gonimoblasti singuli vel duo, globosi vel semiglobosi, 180-300 μm crassi, 130-250 μm alti, in centro verticilli inserti; fila gonimoblastorum plus minusve laxe agglomeratia. Carposporangia globosa vel obovoidea, 10-14 μm crassa, 12-16 μm longa.

Frond monoecious, ca. 3 cm high, 350-550 μm wide, sparsely and pseudo-dichotomously branched, very mucilaginous, gray-green. Axial cells cylindrical, 20-50 μm wide, 80-180 μm long. Whorls cylindrical, touching each other. Primary branchlets dichotomously branched, consisting of 9-13 cell-stories; cells of fascicles lanceolate club-shaped; hairs rare. Cortical filaments well-developed. Secondary branchlets numerous, dichotomously branched, consisting of 8-11 cell-stories, covering all the internodes and equaling primary branchlets. Spermatangia globose, 4-5 μm in diameter, terminal or lateral on primary and secondary branchlets. Carpogonium-bearing branch arising from the basal cell of primary branchlet, consisting of 6-13 barrel-shaped cells, spirally coiled; carpogonium 50-65 μm long, 3-6 μm wide at the base, 8-10 μm wide at the apex; trichogyne club-shaped, indistinctly stalked. Bracts sparse and short. Gonimoblasts single or couple, globose or semiglobose, 180-300 μm wide, 130-250 μm high, centrally inserted; gonimoblast filaments more or less loosely agglomerated. Carposporangia globose or obovidal, 10-14 μm wide, 12-16 μm long.

Figs. 30-38. *Batrachospermum omodoboense* KUMANO et BOWDEN-KERBY, sp. nov. 30. A part of thallus showing an axial cell, primary branchlets, secondary branchlets and a young gonimoblast; 31. Primary branchlets more or less unilaterally branched; 32. Spermatangia terminal or lateral on secondary branchlets; 33-34. Coiled carpogonium-bearing branches at very young stages in development; 35-37. Coiled carpogonium-bearing branches with mature trichogynes; 38. Carposporangia terminal on gonimoblast filaments.



Figs. 39-43. *Batrachospermum tabagatense* KUMANO et BOWDEN-KERBY, sp. nov. 39. A part of thallus showing cylindrical whorls and a gonimoblast; 40. Spermatangia terminal or lateral on secondary branchlets; 41. A carpogonium-bearing branch with a mature trichogyne; 42. Semiglobose gonimoblast; 43. Carposporangia terminal on more or less loosely agglomerated gonimoblast filaments. (Scale bar; 100 μm for Fig. 39; 40 μm for Figs. 40, 42; 20 μm for Figs. 41, 43).



Figs. 44-52. *Batrachospermum tabagatenense* KUMANO et BOWDEN-KERBY, sp. nov. 44. A part of thallus showing axial cells, primary branchlets, secondary branchlets and cortical filaments; 45. Spermatangia terminal or lateral on secondary branchlets; 46-49. Coiled carpogonium-bearing branches at very young stages in development; 50. A carpogonium-bearing branch with a mature trichogyne; 51. Fertilized carpogonia with spermatia; 52. Carposporangia terminal on more or less loosely agglomerated gonimoblast filaments.

Holotype: Tabagaten River, Nekking, Palau, (BOWDEN-KERBY 19/V 1984), Herbarium of Faculty of Science, Kobe University. Isotype: (BOWDEN-KERBY 19/V 1984), University of Guam Herbarium.

Other specimens examined: Seep-fed pond in Ibobang, Palau (BOWDEN-KERBY 26/V 1984).

Habitat: Attached to rocks and free roots in a small rivulet of gentle current, arising from a leaf-clogged spring, receiving about one hour of direct sunlight per day. The pH value was 6.0 in a man-made pond from a seep in Ibobang on Babeldaob Island on May 26, 1984.

Distribution: Known from the type locality and a seep-fed pond in Ibobang, Palau.

5. *Batrachospermum nechochoense* KUMANO et BOWDEN-KERBY, sp. nov. (Figs. 53-57, 58-65).

Frons monoica, ca. 2 cm alta, 350-550 μm crassa, abundanter irregulariterque ramosa, mucosa, glauca. Cellulae axiales cylindricae, 30-70 μm crassae, 100-330 μm longae. Verticilli doliiformes, in parte vetustiore frondis contigui. Ramuli primarii dichotome, raro tetrachotome ramificantes, ex 11-14 cellulis constantes; celllulae proximales fasciculorum lanceolato-claviformes, cllulae distales obovoideae vel pyriformes; pili breves. Fila corticales bene evoluta. Ramuli secundarii dichotome ramificantes, ex 8-11 cellulis constantes, bene evolutae. Spermatangia globosa vel pyriformia, 5-7 μm diametro, praecipue in ramulis primariis terminalia vel lateralia. Ramuli carpogoniferi e cellulis basi ramulorum primariorum orientes, ex cellulis 7-11 doliiformibus constantes, valde spiratim tortuosi; carpogonium 25-30 μm long, basi 5-6 μm crassum, apice 7-12 μm crassum; trichogyne clavivel urn-formes, plus minusve indistincte pedicellata. Bracteae breves. Gonimonlasti singuli, semiglobosi, 150-220 μm crassi, 140-180 μm alti, in centro verticilli inserti; fila gonimoblastorum laxe agglomeratia. Carposporangia obovoidea, 7-8 μm crassa, 10-16 μm longae.

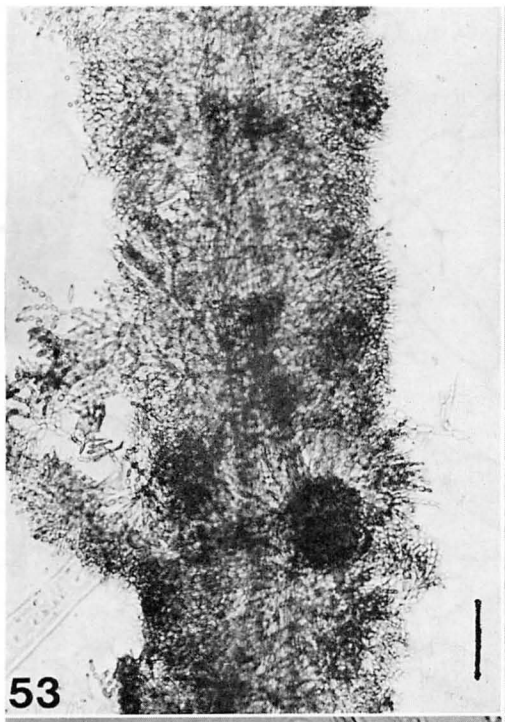
Frond monoecious, ca. 2 cm high, 350-550 μm wide, abundantly and irregularly branched, mucilaginous, gray-green. Axial cells cylindrical, 30-70 μm wide, 100-330 μm long. Whorls barrel-shaped, touching each other in aged fronds. Primary branchlets dichotomously, trichotomously, rarely tetrachotomously branched, consisting of 11-14 cell-stories; proximal cells of fascicles lanceolate club-shaped, distal cells obovoidal or pear-shaped; hairs short. Cortical cells well-developed. Secondary branchlets dichotomously branched, consisting of 8-11 cell-stories, well-developed. Spermatangia globose or pear-shaped, 5-7 μm in diameter, terminal and lateral mainly on primary branchlets. Carpogonium-bearing branch arising from the basal cell of the primary branchlet, consisting of 7-14 barrel-shaped cells; spirally twisted; carpogonium 25-30 μm long, 5-6 μm wide at the base, 7-12 μm wide at the apex; trichogyne club- or urn-shaped, more or less indistinctly stalked. Bracts short. Gonimoblasts single semiglobose, 150-220 μm wide, 140-180 μm high, centrally inserted; gonimoblast filaments loosely agglomerated. Carposporangia obovoidal, 7-8 μm wide, 10-16 μm long.

Holotype: A small spring-fed stream, Nechocho, Tol Island, Truk, (BOWDEN-KERBY 14/III 1982), Herbarium of Faculty of Science, Kobe University. Isotype: (BOWDEN-KERBY 14/III 1982), University of Guam Herbarium.

Other specimens examined: Wichen River, Moen Island, Truk (BOWDEN-KERBY 18/VI 1982).

Habitat: Attached on rocks in a spring-fed

Figs. 53-57. *Batrachospermum nechochoense* KUMANO et BOWDEN-KERBY, sp. nov. 53. A part of thallus showing barrel-shaped or cylindrical whorls; 54. Primary branchlets di- or trichotomously branched with hairs; 55. A carpogonium-bearing branch with fertilized trichogyne; 56. A part of thallus showing axial cells cortical filments, primary and secondary branchlets and a carpogonium bearing-branch; 57. Carposporangia terminal on loosely agglomerated gonimoblast filaments. (Scale bar; 100 μm for Fig. 53; 40 μm for Figs. 54, 56; 20 μm for Figs. 55, 57).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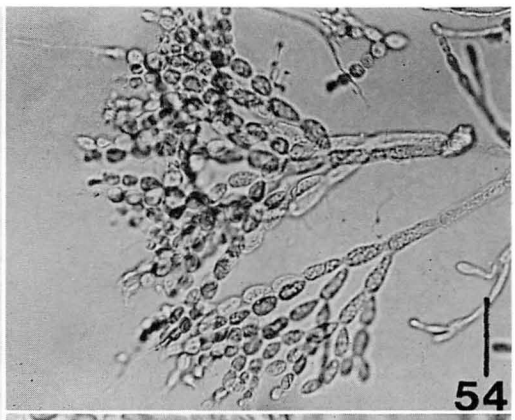
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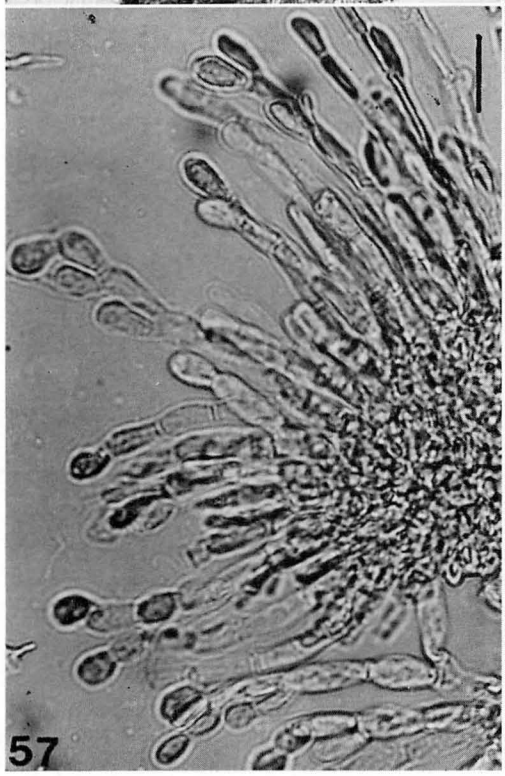
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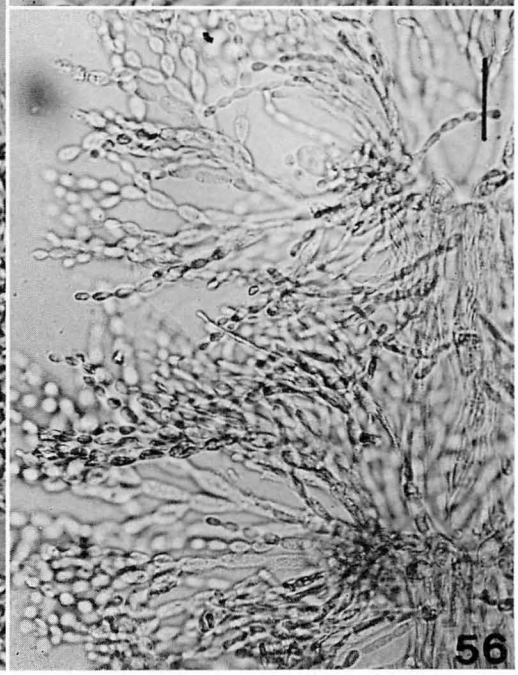
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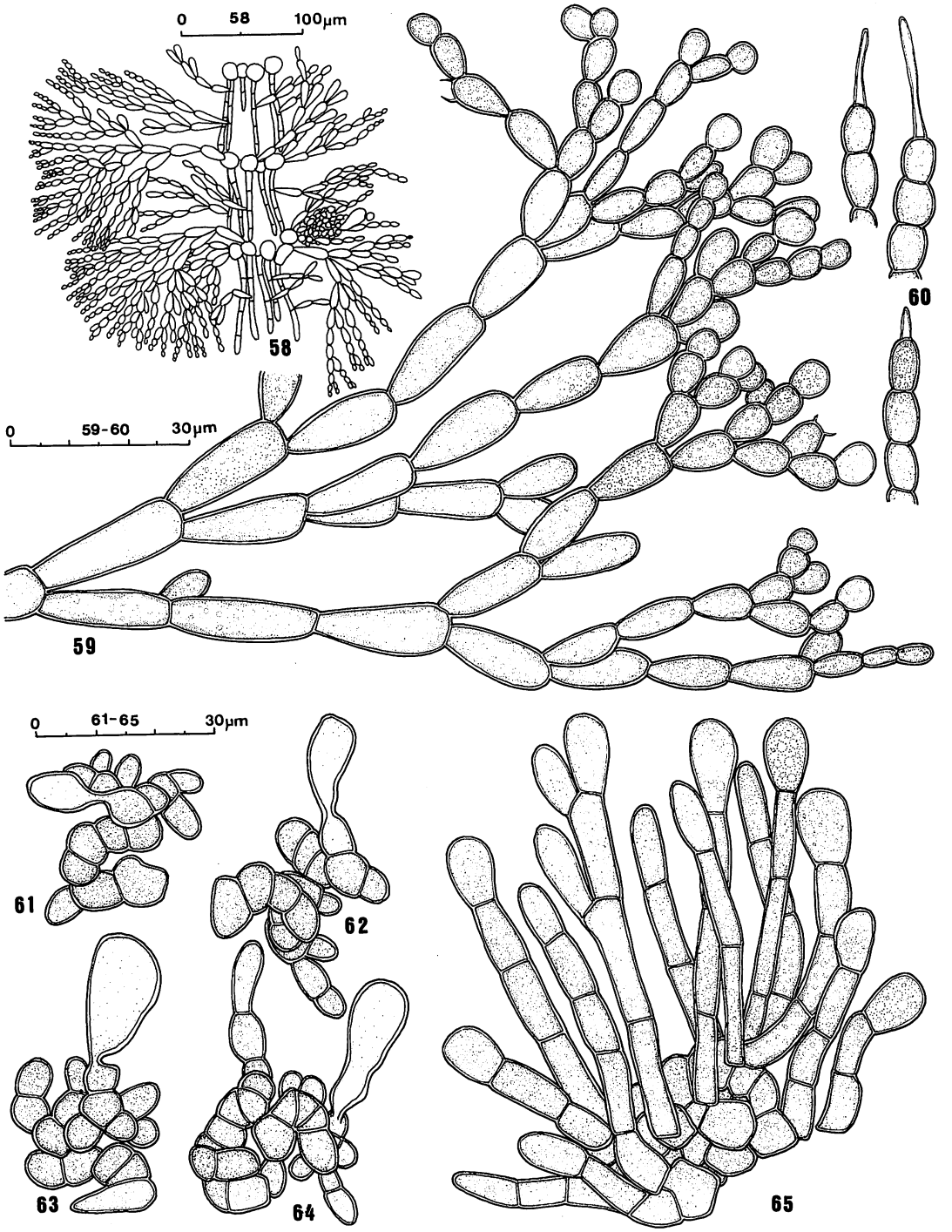


Figs. 58-65. *Batrachospermum nechochoense* KUMANO et BOWDEN-KERBY, sp. nov. 58. A part of thallus showing axial cells, cortical filaments, primary and secondary branchlets and a carpogonium-bearing branch; 59. Spermatangia terminal and lateral on primary branchlets; 60. Short hairs; 61-64. Coiled carpogonium-bearing branches with trichogynes; 65. Carposporangia terminal on loosely agglomerated gonimoblast filaments.

stream and on a pool wall in slowly-flowing water. On Moen the water temperature was 27°C and the pH value 6.5 in August, 1984.

Distribution : Known from the type locality and the Wichen Stream on Moen Island, Truk.

6. *Batrachospermum faroense* KUMANO et BOWDEN-KERBY, sp. nov. (Figs. 66-70, 71-81).

Frons monoica, ca. 3.5 cm alta, 300-500 μm crassa, abundanter irregulariterque ramosa, mucosa, aeruginosa. Cellulae axiales cylindricae, 50-100 μm crassae, 230-320 μm longae. Verticilli doliiformes, in parte vetustiore frondis contigui. Ramuli primarii dichotome raminificantes, ex 7-10 cellulis constantes; cellulae proximales fasciculorum lanceolato-claviformes, cellulae distales obovoideae vel pyriformes; pili breves. Fila corticales bene evoluta. Ramuli secundarii non vel dichotome raminificantes, 5-10 cellulis constantes, totum internodium obtegentes. Spermatangia globosa, 4-6 μm diametro, in ramulis primariis et secundariis terminalia vel lateralia. Ramuli carpogoniferi e cellulis basi primariorum orientes, ex cellulis 5-10 doliiformibus constantes, tortuosi; carpogonium 30-40 μm longum, basi 4-6 μm crassum, apice 5-9 μm crassum; trichogyne claviformes, indistincte pedicellata. Bracteae plus minusve breves. Gonimoblasti singuli, semiglobosi, 200-250 μm crassi, 150-200 μm alti, in centro verticilli inserti; fila gonimoblastorum, in parte distalibus, plus minusve laxe agglomeratia. Carposporangia obovoidea, 7-11 μm crassa, 12-15 μm longa.

Frond monoecious, ca. 3.5 cm high, 300-500 μm wide, abundantly and irregularly branched, mucilaginous, deep green. Axial cells cylindrical, 50-100 μm wide, 230-320 μm long. Whorls barrel-shaped, touching each other in aged fronds. Primary branchlets dichotomously branched, consisting of 7-10 cell-stories; proximal cells of fascicles lanceolate club-shaped, distal cells obovoidal or pear-shaped; hairs short. Cortical filaments well-developed. Secondary branchlets non or dichotomously branched, consisting of 5-10 cell-stories, covering all the internodes. Spermatangia globose, 4-6 μm in diameter, terminal or lateral on primary and secondary branchlets. Carpogonium-bearing branch arising from the basal cell of the primary branchlet, consisting of 5-10 barrel-shaped cells, twisted; carpogonium 30-40 μm long, 4-6 μm wide at the base, 5-9 μm wide at the apex; trichogyne club-shaped indistinctly stalked. Bracts more or less short. Gonimoblasts single, semiglobose, 200-250 μm wide, 150-200 μm high, centrally inserted; distal portion of gonimoblast filaments more or less loosely agglomerated. Carposporangia obovoidal, 7-11 μm wide, 12-15 μm long.

Holotype: A rivulet flowing from a taro swamp, Faro Village, Tol Island, Truk, (BOWDEN-KERBY 11/V 1982), Herbarium of Faculty of Science, Kobe University.

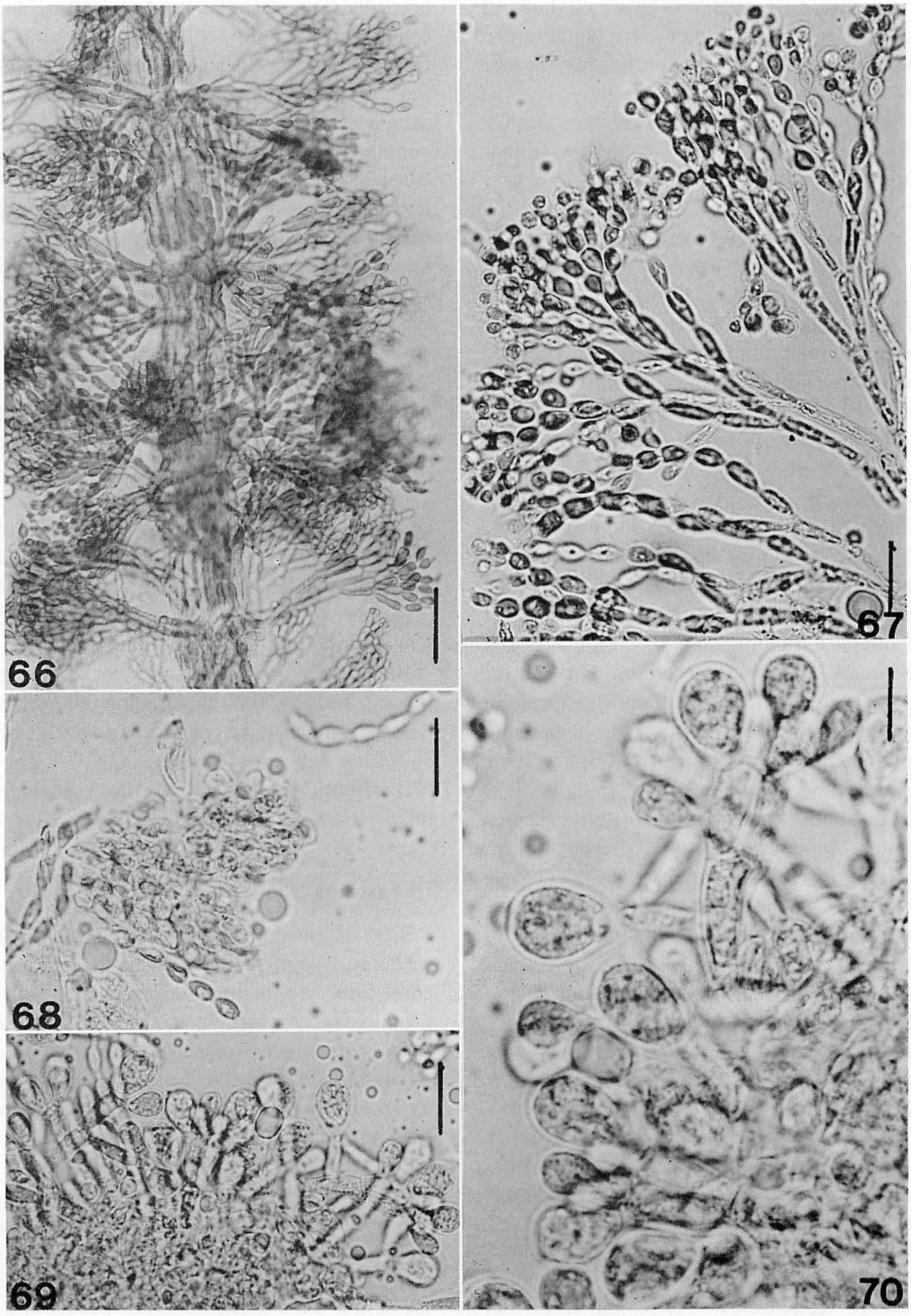
Isotype: (BOWDEN-KERDY 11/V 1982), University of Guam Herbarium.

Habitat: Growing on small rocks on the muddy bed of the slowly flowing rivulet. The pH value of the water was 6.0 at the collecting time in August, 1982.

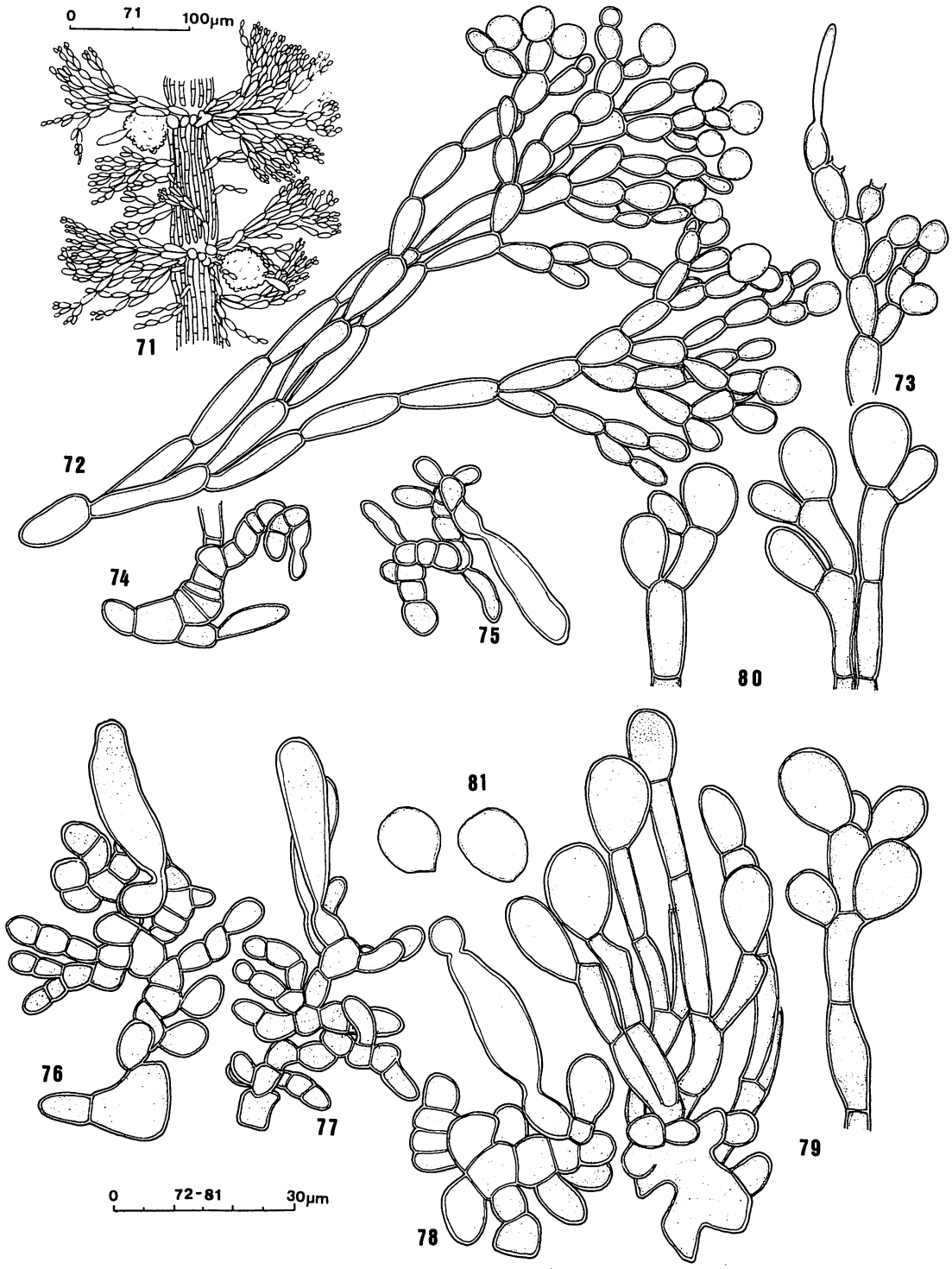
Distribution : Known from the type locality only.

Discussions

The six presently described new species seems to assign to the section *Contorta* and constitute two distinct groups. The first group is represented by *B. doboense* and *B. faroense*, which resemble *B. tortuosum* KUMANO (1978) and *B. tortuosum* var. *majus* KUMANO (1982) in having the curved carpogonium-bearing branches. However, they differ from the latter two taxa in the cell number per carpogonium-bearing branch. The carpogonium-bearing branches for *B. doboense* and *B. faroense* consist of 5-11 cells, while those for *B. tortuosum* and *B. tortuosum* var. *majus* consist of only 2-4 cells. *B. faroense* differs from *B. doboense* in the number of cells consisting a fascicle and the shape of whorls and trichogynes;



Figs. 66-70. *Batrachospermum faroense* KUMANO et BOWDEN-KERBY, sp. nov. 66. A part of thallus showing barrel-shaped worls; 67. Spermatangia terminal and lateral on primary branchlets; 68. A coiled carpogonium-bearing branch; 69-70. Carposporangia terminal on more or less loosely agglomerated gonimoblast filaments. (Scale bar; 40 μm for Fig. 66; 20 μm for Figs. 67-69; 10 μm for Fig. 70).



Figs. 71-81. *Batrachospermum faroense* KUMANO et BOWDEN-KERBY, sp. nov. 71. A part of thallus showing axial cells, cortical filaments, primary and secondary branchlets and two gonimoblasts; 72. Spermatangia terminal and lateral on primary branchlets; 73. Hairs; 74. An early stage in development of a coiled carpogonium-bearing branch; 75-77. Coiled carpogonium-bearing branches with mature trichogynes; 78. Fertilized carpogonium with a spermatium; 79-80. Carposporangia terminal on more or less loosely agglomerated gonimoblast filaments; 81. Carpospores.

for *B. doboense*, whorls are pear-shaped, the fascicle is composed of 9-14 cell-stories and the trichogyne is club-shaped and bent at the base.

The second group characterized by the spirally coiled carpogonium-bearing branches is divided into two subgroups. The first subgroup is represented by *B. tabagatenense* and *B. nechochoense*, which resemble *B. iriomotense* KUMANO (1982) in having the loosely agglomerated gonimoblasts. However, they differ from the latter species in the size of carpogonia and carposporangia. *B. nechochoense* differs from *B. tabagatenense* in the length of trichogyne; 25-30 μm v. s. 50-65 μm. *B. nechochoense* differs from *B. iriomotense* in the size of whorls and carposporangia and the shape of trichogyne; whorls are 150-240 μm wide, carposporangia are 16-19 μm long and the trichogyne are club-shaped for *B. iriomotense*. The second subgroup is represented by *B. omobodoense*, which resembles *B. hirosei* RATNASABAPATHY et KUMANO (1982) and *B. mahlacense* in having the compactly agglomerate gonimoblasts. However, *B. omobodoense* differs from the latter two species in the fascicles more or less unilaterally branched. This species differs from *B. hirosei* in the number of cells per carpogonium-bearing branch and fascicle, the size of whorls and the shape of trichogyne; for *B. hirosei*, the carpogonium-bearing branch consisting of 6-13 cells, the fascicle is composed of 6-8 cell-stories, the whorls are 100-220 μm wide and the trichogyne is ellipsoidal. *B. omobodoense* differs from *B. mahlacense* in the shape of whorls and trichogyne and the number of cells per fascicle and carpogonium-bearing branch; for *B. mahlacens*, whorls are pear-shaped, fascicle consist of 7-9 cell-stories, the carpogonium-bearing branch is composed of 5-15 cells and the trichogyne is ellipsoidal or urn-shaped.

The section *Contorta* was established by SKUJA (1931) based on *Batrachospermum procarpum* SKUJA. The main characteristics of the section *Contorta* is the curved, spirally coiled or hook-like carpogonium-bearing branch, while the carpogonium-bearing brances are straight for the other sections of the genus *Batrachospermum*. The section *Contorta* appears to contain the most numerous species among the sections of the genus *Batrachospermum*, and was pointed out by KUMANO and NECCHI (1985) to be very heterogenous. A tentative key to the known taxa of the section is shown as follow (* reported in the present paper):

Tentative Key to the Taxa of the Section *Contorta*

1. Monosporangia present.
   2. Monosporangia terminating the laterals of carpogonium-bearing branches, sometimes primary and secondary branchlets.
      3. Monosporangia 11-15 μm long. .... *B. intortum* JAO
      3. Monosporangia 13-23 μm long. ....*B. pseudocarpum* REIS
   2. Monosporangia terminating the primary and secondary branchlets.
      4. Carpogonium-bearing branch consisting of 4-7 cells. .... *B. woitapense* KUMANO
      4. Carpogonium-bearing branch consisting of 6-14 cells. ....*B. lusitanicum* REIS
1. Monosporangia absent.
   5. Carpogonium-bearing branch curved.
      6. Carpogonium-bearing branch consisting of 2-4 cells.
         7. Gonimoblast 50-60 μm in diameter. ..... *B. tortuosum* KUMANO
         7. Gonimoblast 220-300 μm in diameter. .... *B. tortuosum* KUMANO var. *majus* KUMANO
      6. Carpogonium-bearing branch consisting of 5-11 cells.
         8. Trichogyne bent at the base. .... **B. doboense* KUMANO et BOWDEN-KERBY
         8. Trichogyne does not bent at the base. ....**B. faroense* KUMANO et BOWDEN-KERBY
   5. Carpogonium-bearing branch twisted,

consisting of 3-8 cells.
9. Fascicles di- or trichotomously branched.
10. Carpogonium 17-34 μm long. .... *B. kushiroense* KUMANO et OHSAKI
10. Carpogonium 40-72 μm long.
11. Gonimoblast 400-550 μm in diameter, primary branchlets consisting of 4-5 cell-stories. .... *B. capense* STARMACH ex NECCHI et KUMANO var. *breviarticulatum* NECCHI et KUMANO
11. Gonimoblast 600-860 μm in diameter, primary branchlets consisting of 7-13 cell-stories. .... *B. capense* STARMACH ex NECCHI et KUMANO
9. Fascicles alternately branched, consisting of cylindrical cells.
12. Gonimoblast 100-300 μm in diameter..... *B. procarpum* SKUJA
12. Gonimoblast 300-900 μm in diameter.
13. Carposporangia 8-15 μm long. *B. cipoense* KUMANO et NECCHI
13. Carposporangia 19-24 μm long. .. *B. equisetoideum* KUMANO et NECCHI
5. Carpogonium-bearing branch spirally coiled, consisting of 6-15 cells.
14. Gonimoblast loosely agglomerated.
15. Carpogonium 50-65 μm long. .... *B. tabagatenense* KUMANO et BOWDEN-KERBY
15. Carpogonium 25-40 μm long.
16. Carposporangia 10-16 μm long. .. *B. nechochoense* KUMANO et BOWDEN-KERBY
16. Carposporangia 16-19 μm long. ..... *B. iriomotense* KUMANO
14. Gonimoblast compactly agglomerated.
17. Fascicles sparsely branched. .... *B. tiomanese* KUMANO et RATNASABAPATHY
17. Fascicles well-branched.
18. Fascicles unilaterally branched. .. **B. omobodoense* KUMANO et BOWDEN-KERBY
18. Fascicles dichotomously branched.
19. Whorls 100-200 μm wide. .. .. *B. hirosei* KUMANO et RATNASABAPATHY
19. Whorls 250-400 μm wide. .. .... **B. mahlacense* KUMANO et BOWDEN-KERBY

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熊野 茂*・ボーデンケルビー, W. A.：ミクロネシアの淡水産紅藻 I. カワモズク属の6新種**

カワモズク属の6新種がミクロネシアから記載された。*B. mahlacense* は *B. hirosei* RATNASABAPATHY et KUMANO 1982 に似るが輪生枝叢および中軸細胞の形と大きさとで後者と区別できる。*B. doboense* は *B. tortuosum* KUMANO 1978 に似るが造果器をつける枝の細胞数，輪生枝叢および受精毛の形とで後者と区別できる。*B. omobodoense* は *B. mahlacense* に似るが輪生枝叢と受精毛の形，輪生枝と造果器をつける枝の細胞数とで後者と区別できる。*B. tabagatenense* は *B. iriomotense* KUMANO 1982 に似るが輪生枝叢および造果器と果胞子の大きさで後者と区別できる。*B. nechochoense* は *B. tabagatenese* と *B. iriomotense* KUMANO 1982 とに似るが受精毛の大きさで *B. tabagatenense* と，輪生枝叢および果胞子の大きさ，受精毛の形で *B. iriomotense* KUMANO 1982 と区別できる。*B. faroense* は *B. doboense* に似るが輪生枝叢と受精毛の形，輪生枝の細胞数で後者と区別できる。ミクロネシアから記載された6新種を含むコントルタ節の既知種の検索表を示す。 (*657 神戸市灘区六甲台 神戸大学理学部生物学教室，**96941 ミクロネシア連邦，ポナペ，コロニア私書箱 159，ミクロネシア教員養成大学科学部)