

Contribution to the Marine Chlorophyta of Hawaii, I¹

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WITH ONE EXCEPTION the annotated list which follows is comprised of new or previously unreported green algae from the Hawaiian Islands. The new records result from a partially completed survey of algae from several sources, chief of which are collections by Dr. Maxwell S. Doty³ made during the past ten years, the Herbarium of the Bernice P. Bishop Museum in Honolulu, and my own collections made during March–June, 1959.

Type specimens are deposited at the University of Michigan Herbarium, Ann Arbor, Michigan.

1. *Bryopsis hypnoides* Lamouroux (prox.), 1809, p. 135, pl. 5, fig. 2.

COLLECTION: Gilbert 10060, in wash between Kawela and Kamaloo on S. shore of Molokai, June 5, 1959.

The material was present in abundance and shows many of the characteristics of *Bryopsis hypnoides*, including the production of pinnules on all sides of the axis and the gradual tapering of successive series of branches. The ultimate pinnules were 43–51 μ in diameter, the upper ones simple but with some of the lower and longer ones once or twice branched. In none of the Hawaiian material was I able to find a main axis over 180 μ in diameter. Because of the small diameter of the main axis and the relatively small diameter of the ultimate pinnules it is with hesitation that the material is assigned to *B. hypnoides*.

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2. *Caulerpa ambigua* Okamura, 1897, p. 4, pl. 1, figs. 3–12.

Fig. 1, A

COLLECTION: Doty 10224, along edge of reef, Anahola, Kauai, Feb. 7, 1952.

Despite opinions to the contrary by Eubank (1946) and Børgesen (1949), I am inclined to agree with Dawson (1956) that *Caulerpa ambigua* Okamura and *C. vickersiae* Børgesen are distinct entities. I had examined many plants of what I now believe to be *C. vickersiae* (Fig. 1, B) in both my own collections and in those of others from Hawaii before I ran across the collection by Doty, cited above, which I have assigned to *C. ambigua*. While the plants are relatively the same size as those of *C. vickersiae*, they are so clearly distinct from that species on the basis of the "basally contracted, multifarious branchlets" (Dawson, 1956: 36) that I have no hesitation in making the separation. I have compared the Hawaiian plants with the material from Kwajalein Atoll of the southern Marshalls reported by Dawson and find them to be remarkably similar, with the exception that the Marshall material does not have as many of the ramuli twice-dichotomously branched as does the Hawaiian material.

On the basis of my observations it appears that *Caulerpa vickersiae* Børg. is by far the more common of the two species in Hawaii. I believe that most if not all of the material reported by Eubank from Hawaii as *C. ambigua* is in reality *C. vickersiae*. Among my own collections it would be in order to list the following as *C. vickersiae*: Gilbert 9122, Kahana, Maui, March 22, 1959; 9413, Waikiki Beach, Oahu, April 9, 1959; 9581, Kapaa, Kauai, April 26, 1959; 10115, near Mapalehu, Molokai, June 7, 1959.

3. *Caulerpa verticillata* J. Agardh, 1847, p. 6.

COLLECTIONS: *Gilbert* 9797, Mokuoloe (Coconut Island), Kaneohe Bay, Oahu, May 14, 1959; *Doty* 8117, forming a green "meadow" around and under the prow of the Seth Parker, beached on Mokuoloe Island, Kaneohe Bay, Oahu, Oct. 3, 1950; 10100, ponds on wharf side of Mokuoloe, Kaneohe Bay, Oahu, May 9, 1953.

I have examined five different collections of this alga, all taken from a limited area at the Marine Biological Station on Mokuoloe Island in Kaneohe Bay, Oahu. It has not appeared in any of the other collections I have studied.

4. *Cladophoropsis adhaerens* sp. nov.

Fig. 2, A-C

Plantae 1-2 cm. alt., caespitem implexum patentemque, substrato umbroso saxi coralliive firme adhaerentem, efficientes; parce ad profuse ramosae; ramus plerumque sine septo ad basim effectus, infra septum filamenti, autem, ramiferi oriens; septa rara nisi ad ramos et prope basim rhizoideorum aliquorum et raro prope cacumina ramorum terminalium longorum; rhizoidea multa, ad plerosque ramos effecta; filamenta 160-290 μ diam.; membranae cellularum valde striatae, 10-54 μ crass.; cellulae in partibus parcius ramosis ad 120-140 plo longiores quam latae.

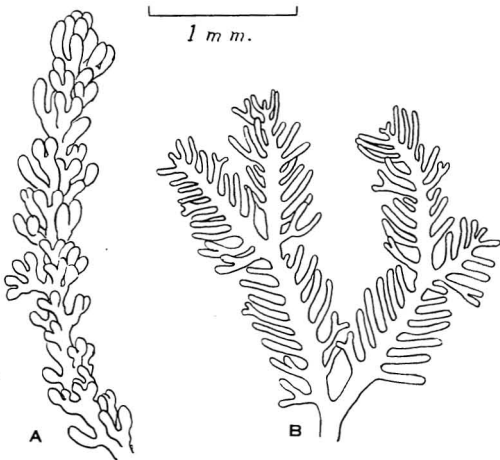


FIG. 1. *Caulerpa* spp. A, *Caulerpa ambigua* Okamura, a branch of a plant of *Doty* 10224. B, *C. vickersiae* Børgesen, part of a plant.

Planta typica, *Gilbert* num. 9410 nomine, a saxo et "concrete" ad partem molis prope litus collecta inter locos Natatorium et Societatem Alcium, Waikiki, Hawaii dictos, m. Apr. 9 an. 1959.

Plants turf-forming, spreading, matted, 1-2 cm. high, tightly adherent to rock or coral substratum, in shaded areas; sparingly to profusely branched; branch usually without a cross-wall at its base but arising beneath a cross-wall of the filament which bears it; cross-walls seldom forming except at branches, near the base of some rhizoids, and rarely near the tip of long terminal branches; rhizoids numerous, forming at most of the branches; filaments 160-290 μ diameter; cell walls strongly striated, varying from 10-54 μ in thickness; cells in the more sparsely branched portions to 120-140 diameters long.

TYPE: *Gilbert* 9410, from rock and concrete at shore end of pier between Natatorium and Elks Club, Waikiki, Honolulu, Oahu, April 9, 1959.

This species is characterized by its markedly striated thick cell walls which give the plant a tough, wiry feel which can be readily recognized on collecting. At times the cell walls appear to be so thick as to almost occlude the filaments, but careful observation frequently reveals this condition to be an artifact resulting from the strongly striated walls. However, the walls are unusually thick and I have demonstrated them to my satisfaction up to 54 μ thick. The formation of rhizoids at nearly all the branches is also characteristic of this species and results in the thallus becoming strongly adherent to the substratum and hence difficult to remove. Unlike most species of *Cladophoropsis* this one apparently prefers shaded areas and does not usually grow fully exposed to sunlight.

OTHER COLLECTIONS: *Gilbert* 9712, on basalt rocks at Kilauea Bay, near Kepuhi Point, Kauai, May 1, 1959; 10037, Del Monte Park, ca. 3 miles east of Kaunakakai, Molokai, June 5, 1959.

5. *Cladophoropsis luxurians* sp. nov.

Fig. 3, A, B

Plantae pulvinatae patentes aliquot cm. lat., 1-2 cm. alt., in substrato saxi coralliique aprico umbrosove frequentes; thallus e filamentis cylin-

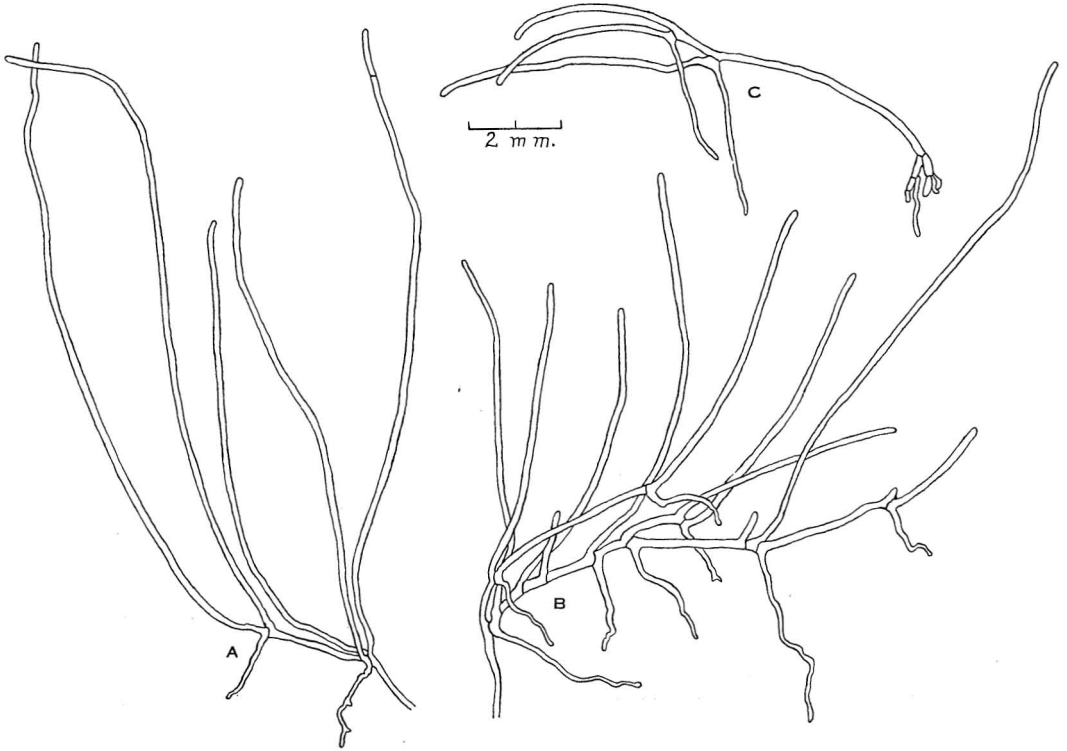


FIG. 2. *Cladophoropsis adhaerens* sp. nov. A, B, habit drawings from Gilbert 9410. C, A young plant.

dricis parce ad profuse ramosis constans, ramus sine septo ad basim effectus, infra septum filamenti, autem, ramiferi oriens; ramificatio plerumque secunda, versus substratum saepe curvata, thallo sic repente; septa inter ramos formata, in partibus plantae inferioribus frequentiora quam in superioribus nisi in ramis terminalibus qui haptera formant; haptera secundaria in partibus thalli decumbentibus, interdum ad cacumina ramorum facta; filamenta diametro variantia, usque ad 510 (770) μ , prope cacumina ramorum ad 240–350 μ , autem, gradatim attenuata; cacumina ramorum quae haptera formant plerumque paulo angustiora quam alia, membranae cellularum striatae, usque ad 9 μ crass., haptera septata aut non septata.

Planta typica, Gilbert num. 10077 nomine, in saxis et in lacubus minvente aestu relictis crescens, ad litus loci Molokai oppositi Mokuhooniki Is., Hawaii dicti, m. June 6 an. 1959.

Plants cushion-like, spreading, several centimeters wide, 1–2 cm. high, common on rock

and coral substratum in full sunlight or shade; thallus of cylindrical, sparingly to profusely branched filaments, the branch formed without cross-wall at its base but arising beneath a cross-wall of the filament which bears it; branching usually secund and often curving toward the substratum giving the thallus a repent habit; cross-walls formed between branches, more frequent in lower portions of plant than in upper parts except in those terminal branches which form holdfasts; secondary holdfasts produced on decumbent parts of thallus and occasionally at the tips of branches; filaments variable in diameter, up to 510 (770) μ in diameter, but gradually tapering to 240–350 μ near tips of branches; branch tips forming holdfasts usually somewhat narrower than others; cell walls striated, to 9 μ thick; holdfasts may or may not be septate.

TYPE: Gilbert 10077, rocks and tide pools, shore of Molokai opposite Mokuhooniki Island, Hawaii, June 6, 1959.

This species of *Cladophoropsis* has been referred to heretofore in Hawaii as *C. membranacea* (C. Ag.) Børg., and is included by that name in Egerod's (1952: 356) excellent report on the siphonous Chlorophyta. However, the resemblance of this new species to *C. membranacea* is largely superficial. The Hawaiian plant is much coarser and darker green. I have not seen on the Hawaiian material any lateral tenaculæ referred to by Børgesen as characteristic of *C. membranacea*, and the rather common formation of holdfasts from the tips of the decumbant filaments sets the Hawaiian plant apart from *C. membranacea*. *Cladophoropsis robusta* Setchell and Gardner (1924) has filaments as wide as *C. luxurians*, but the branching differs in that it is bilateral and frequent near the upper portion of the plant in *C. robusta*, rather than second and less frequent, and in that terminal holdfasts on the branches do not occur. I have seen nothing of the annular constrictions at the base of the lower filaments, to which Egerod re-

ferred, in either my material or in the collections of Papenfuss which she cited.

OTHER COLLECTIONS: *Gilbert* 9209, Hokipa Park, Maui, March 24, 1959; 9335, near Laie Point, Oahu, April 2, 1959; 9544, Wailua, Kauai, April 25, 1959; 9841, Onekehekeha Beach, Hilo, Hawaii, May 22, 1959.

6. *Derbesia fastigiata* Taylor (prox.), 1928, p. 94, pl. 11, figs. 1-3.

Fig. 4, A-C

COLLECTIONS: *Gilbert* 9012b, from cement pilings of dock at Kuhio Beach, Waikiki, Oahu, March 11, 1959; 9020, from cement pilings of dock at Kuhio Beach, Waikiki, Honolulu, Oahu, March 14, 1959.

This plant was at first thought to be undescribed but on comparison with material of *Derbesia fastigiata* Taylor¹ it seemed so similar that it is being listed as near that species. The thallus is 1-2 cm. across and consists of a plexus of interwoven basal and erect filaments. The interwoven basal filaments, the distant branching of the erect filaments, and the fasciculate character of the dichotomous branching when it does occur in the upper part of the erect filaments all suggest *D. fastigiata*. Filaments of the Hawaiian material are 47-79 μ in diameter below the branching portion and the ultimate segments are 14.5-20 μ in diameter a short distance below their rounded tips. In the latter measurement they differ somewhat from Taylor's description, which indicates the ultimate divisions to be 7.5-11 μ in diameter.

In selected specimens the unbranched portions of the erect filaments are up to 4.2 mm. long and the tuft may be up to 4.0 mm. long, but the usual height of the erect portions of the plant is considerably less. The Hawaiian material shows the slight thickening at right angles to the dichotomies referred to by Taylor. Successive dichotomies appear to be at right angles to one another. No complete cross-walls were seen in the erect filaments, although rarely a partially formed callus-like plug was observed in one of the branches immediately above a dichotomy. In the interwoven basal filaments an

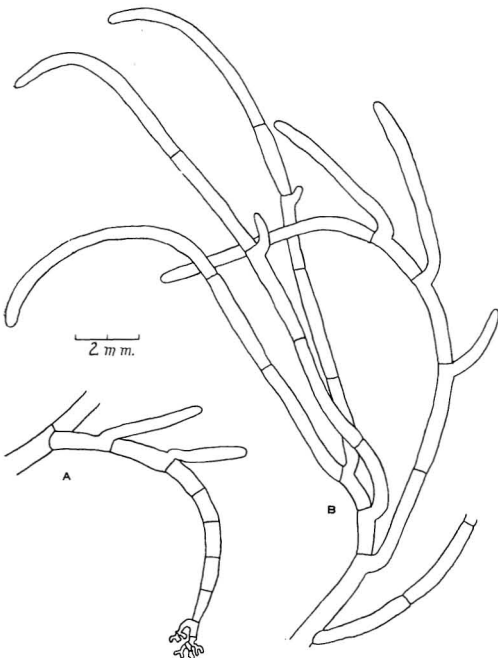


FIG. 3. *Cladophoropsis luxurians* sp. nov. A, A terminal branch with holdfast at its tip. B, Habit drawing to show second branching and curving characteristic of the terminal branches.

¹In his new book Taylor (1960; 129) includes *Derbesia? fastigiata* from Florida as a species of uncertain record.

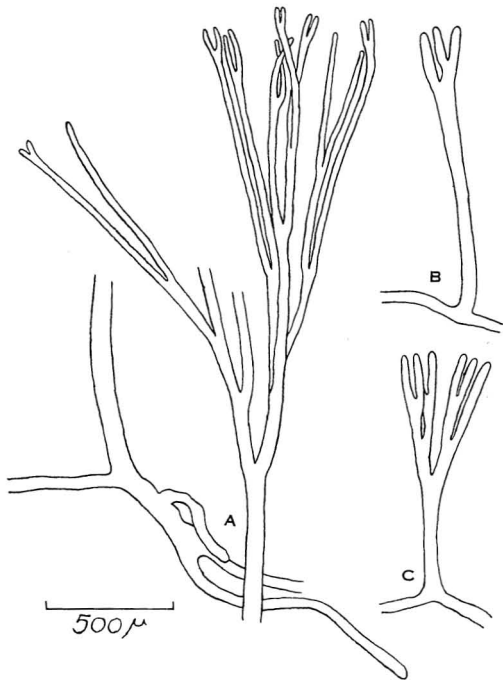


FIG. 4. *Derbesia fastigiata* Taylor (prox.). A, An older portion of the filamentous thallus showing an erect filament and a bit of the basal filament. B, C, Developing erect branches.

occasional wall is formed, usually in connection with a laterally formed rhizoid-like branch.

Similar to the Florida material, the Hawaiian plants are sterile so it is with some uncertainty that the plant is assigned to *Derbesia*.

7. *Derbesia minima* Weber-van Bosse, 1913, p. 95, fig. 23.

COLLECTIONS: *Gilbert* 9109, Lahaina Junction, Maui, March 22, 1959; 9206, Hokipa Park, Maui, March 24, 1959; 9323, from cement pilings, Kuhio Beach, Waikiki, Honolulu, Oahu, March 30, 1959; 9412, from cement pilings, Kuhio Beach, Waikiki, Honolulu, Oahu, April 9, 1959.

The plants are up to 2.0–2.3 cm. long, with filament branches infrequent, often unilateral; filaments up to 38 μ in largest diameter, decreasing to 20–25 μ diameter near their rounded tips; all collections are sterile.

8. *Halimeda gracilis* Harvey ex J. Ag., 1887, p. 82.

COLLECTIONS: *Gilbert* 9776, washed in at Kailua Beach Park, Oahu, May 13, 1959; *Strasburg* (no number) washed in at Kailua, Oahu, May 19, 1950; *Doty* 19133 Y, coral and sand at 25 fathoms, Makapuu Pt., off Bird Island, Oahu, July 25, 1959.

Although Svedelius (1924: 33) included the Hawaiian Islands in the range of *Halimeda gracilis*, only *H. discoidea* Decaisne and *H. opuntia* (L.) Lamx. were recognized by Egerod (1952) from Hawaii. Hillis (1960: 356), in her recently published monograph on *Halimeda* affirmed the presence in the Islands of *H. gracilis* and cited as a single collection *Setchell and Setchell* 10345, July 12, 1924 (U. C. 622514). I have examined this collection, which was also made at Kailua, Oahu, and agree that it is *H. gracilis*. The three additional records above amply confirm the presence of *H. gracilis* in Hawaiian waters. Since all four collections are of material which was either dredged or found unattached in the wash it seems safe to assume that in Hawaii, as elsewhere, this species is found only in deep water.

9. *Microdictyon japonicum* var. *laxum* var. nov.

Figs. 5, C, D; 6

Cellulae frondium basales ut in var. typico; cellulae mediae distalesque quasi eadem diametro ac var. typicum, 2–6 plo, autem, longiores quam latae; ramificatio eodem in plano, cellulis filiabus in ordinationem alternam aut oppositam aut flagellatam abscissis; segmenta anastomosantia frequentia ad rara; planta, anastomosisibus raris, fruticosa ob partes retis et/aut ramorum superpositas, planta anastomosisibus frequentibus laxe retiformis, maculis (150) 200–713 μ lat.

Planta typica *Gilbert* num. 9252 nomine, in rimis proiecturae basalticae in aqua non profunda, fluctu, autem, magno, crescens, in loco McGregor's Pt., Is. Maui dicto, m. Mar. 21, an. 1959.

Basal cells of fronds as in var. *typicum*; intermediate and distal cells approximately same diameter as in var. *typicum* but from 2–6 diam-

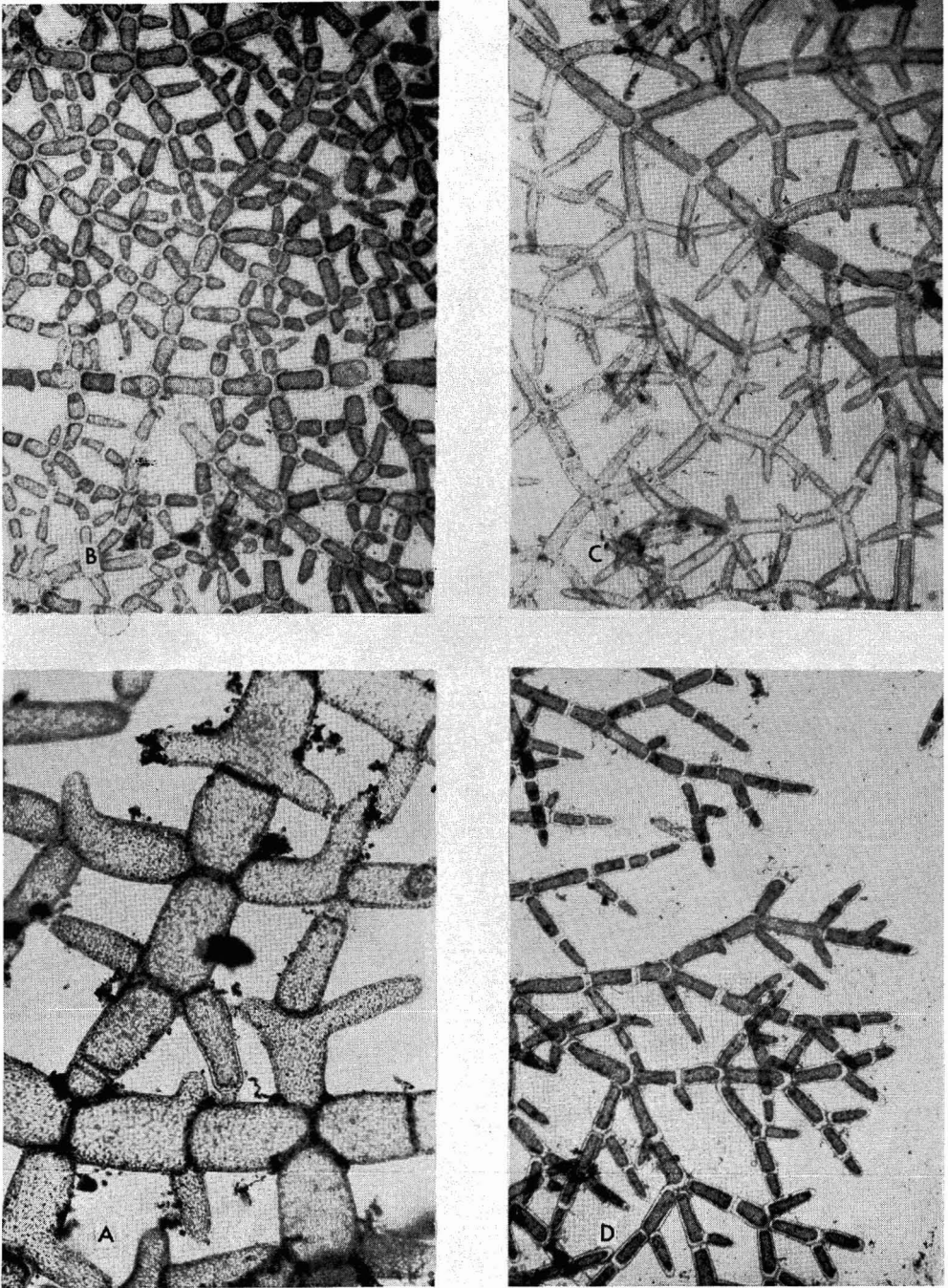


FIG. 5. *Microdictyon* spp. A, *M. montagnei* Harvey ex J. E. Gray. B, *M. japonicum* Setchell. C, D, *M. japonicum* var. *laxum* var. nov., typical appearance of plant in quiet tide pools.

eters long; branching in one plane, the daughter cells cut off in alternate, opposite, or flabellate arrangement; anastomosing segments frequent to rare; portions of net and/or branches overlapping when anastomoses are rare, resulting in a bushy habit; a loose network formed when anastomoses are frequent, with meshes from (150) 200–713 μ wide.

TYPE: *Gilbert 9252*, growing in cracks of basalt ledge in shallow water but where surf was high, McGregor's Pt., Maui, March 24, 1959.

In his monumental work on *Microdictyon*, Setchell (1929: 533) observed that in the Siboga Expedition specimens of *Microdictyon japonicum* from the Borneo Bank there was a tendency toward more delicate plants, with more slender filaments and longer ultimate segments. He also called attention to intermediates from Sailus Besar, Juan Fernandez, and Tongatabu. Setchell felt that the variations were not sufficiently different from the type specimen, however, to be segregated from it.

On the other hand I found a strong tendency among the Hawaiian plants to be divided into two groups, that which represents the type description (Fig. 5, B) and that which is here described as *M. japonicum* var. *laxum*. My material represents collections from a wide range of conditions, including quiet tide pools to cracks and surge channels exposed to the full force of waves. In the tide pools a loose network develops (Fig. 5, C, D) but the longer cells of the variety remain distinct, thus resulting in much wider meshes and frequent crossing over of segments of the net and of branch tips. Material taken where the water is rough does not develop an extensive network but is characterized, rather, by a bushy habit as the result of much overlapping of branches and the development of relatively few anastomoses (Fig. 6).

Inasmuch as the pattern of relatively longer cells, wider meshes, and overlapping of branches of segments of net (where formed), persists in the Hawaiian material and is found together with the typical form of development, it seems desirable to recognize as new *Microdictyon japonicum* var. *laxum*.

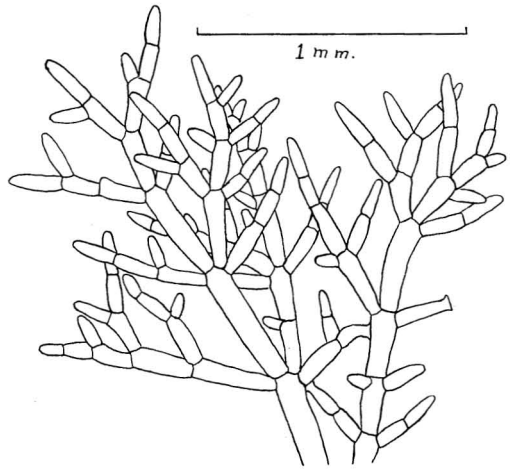


FIG. 6. *Microdictyon japonicum* var. *laxum* var. nov. Portion of a frond showing the bushy character developed when the plant is exposed to rough water.

OTHER COLLECTIONS: *Gilbert 9510*, Kaena Pt., Oahu, April 18, 1959; *9561*, Moloaa Bay, Kauai, April 25, 1959.

10. *Microdictyon montagnei* Harvey ex J. E. Gray, 1866, p. 69.

Fig. 5, A

COLLECTIONS: *Gilbert 9019*, from cement pilings, Diamond Head side of War Memorial Natatorium, Waikiki, Honolulu, Oahu, March 14, 1959; *9290*, 1/2 mile E. of McGregor's Point, Maui, March 25, 1959; *9388*, Ala Moana Park, Honolulu, Oahu, April 8, 1959.

The material agrees well with published descriptions. Some of the blades are up to 5.0 cm. in width and show only slight tendency at their margins for filaments making up the blade to branch in several planes; otherwise the plants are plane-bladed as in other species of *Microdictyon*.

I am retaining this species in the genus *Microdictyon* although some (as Egerod, 1952: 332) would transfer it to *Boodlea*.

11. *Pseudochlorodesmis parva* sp. nov.

Fig. 7

Planta filamentosa, ubiquae siphonacea, e parte basali prostrata in corallio inclusa, ramos erectos discretos efficiente constans, pars basalis abunde

et irregulariter ramosa, diametro magnopere varians, 15–35 μ , alternis angusta et lata, sic piluliformis aspectu, rami erecti ad 5 mm. long, plerumque breviores, diametro aequi, plerumque simplices, interdum, autem, semel (rarissime bis) ramosi, 29–35 (40) μ diam.; rami filamentorum erectorum laterales, saepe, autem, subdichotomosi apparentes. Reproductio ignota.

Planta typica, Gilbert num. 9767 nomine, in saxis corallinis $\frac{2}{3}$ –2 metra profundis crescens, in rupibus corallinis submarinis oppositis loco Marine Biological Laboratory, Waikiki, Honolulu, Is. Oahu, m. May 9, an. 1959.

Plant filamentous and siphonous throughout, consisting of a prostrate basal portion embedded in coral, which gives rise to erect free branches; the basal portion abundantly and irregularly branched, extremely variable in diameter ranging from 15–35 μ , alternately narrow and wide, thus producing a bead-like appearance; erect branches to 5 mm. in length, usually less, uniform in diameter, mostly simple but occasionally once-branched (very rarely twice), measuring

29–35 (40) μ diameter; branches of erect filaments lateral but often appearing subdichotomous. Reproduction unknown.

TYPE: *Gilbert 9767*, growing on coral rocks, 2–6 feet deep, reef opposite Marine Biological Laboratory, Waikiki, Honolulu, Oahu, May 9, 1959.

This plant appears as a soft felt-like growth on the surface of corals. In order to study the basal portion of the plant it is necessary to cut out pieces of the coral in which the plant is growing and to decalcify the specimen.

Except for its diminutive size and the infrequency of branching in the erect filaments, this species is suggestive of *Pseudochlorodesmis furcellata* (Zanard.) Børgesen (1925: 78). While similar to *P. tenuis* Ercegovic (1957: 33–35) in diameter of the erect filaments, *P. parva* differs from that species in the scarceness of branches in its erect filaments, the bead-like character of its basal filaments, the lack of repeat branches, and in the absence of the cluster of short lateral branches sometimes occurring at the tips of the longer filaments.

OTHER COLLECTIONS: *Gilbert 9661*, Anahola Beach, Kauai, April 29, 1959; *10141*, Waikiki, Honolulu, Oahu, June 10, 1959.

12. *Tetraselmis tetrathele* (West) Butcher, 1959, p. 64.

COLLECTION: *Gilbert 9765*, Koko Head Parking Lot, Oahu, May 7, 1959.

This interesting alga was found in abundance in a high-lying spray pool that was obviously fouled with bird excreta. I am assigning it to this species but with considerable uncertainty. The cells were slightly broader (up to 10–11 μ) than some published descriptions (as *Platymonas subcordiformis* (Wille) Hazen, 1921: 251).

13. *Udotea? abbreviata* sp. nov.

Fig. 8, A–C

Plantae ubique siphonaceae partem basalem irregulariter ramosam frondes erectas laxe ordinatas efficientem habentes; frondes e stipite monosiphonaceo, supra ter ad quinquies dichotome ramoso, constantes, dichotomiis successivis magna ex parte eodem in plano, confertis aut distantibus; filamenta frondium non calcifacta,

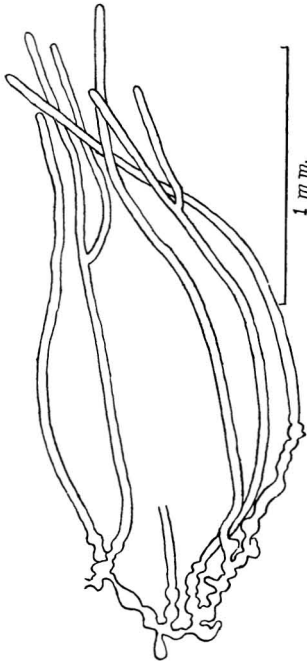


FIG. 7. *Pseudochlorodesmis parva* sp. nov. Habit drawing to show prostrate and erect branches.

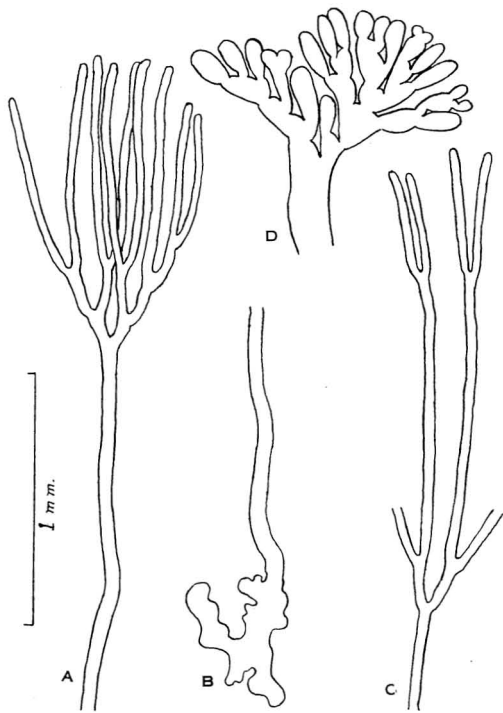


FIG. 8. *Udotea? abbreviata* sp. nov. A, B, Upper and lower portions of the same plant. C, Upper portion of a plant to illustrate that dichotomies may be close or distant. D, *Udotea javensis*, a young plant.

non cohaerentia, sine constrictionibus super dichotomias; plantae ad 5 mm. alt., stipite ad 72 μ diam., ordines successivos ramulorum minorum habentes, ramulis terminalibus 25–38 μ lat.

Planta typica, Gilbert num. 9511 nomine, in saxi calcaris 1 ad 1½ m. infra superficiem crescens, in rupibus submarinis corallinis oppositis loco Marine Biological Laboratory, Waikiki, Honolulu, Is. Oahu dicto, m. Apr. 21, an. 1959.

Plants completely siphonous with an irregularly branching basal portion giving rise to erect loosely organized fronds; fronds consisting of a monosiphonous stalk branching above dichotomously three to five times, the successive dichotomies largely in one plane and close or distant; filaments of frond uncalcified, not cohering, and without constrictions above the dichotomies; plants to 5 mm. in height, diameter

stalk to 72 μ , with successive orders of branches smaller in size with the terminal branchlets from 25–38 μ in width.

TYPE: *Gilbert 9511*, on calcareous rocks, 3–4 feet below surface on reef opposite Marine Biological Laboratory, Waikiki, Honolulu, Oahu, April 21, 1959.

These small plants, which are very easily overlooked in the field, were thought for some time to be either young or depauperate plants of *Udotea javensis* (Montagne) A. & E. S. Gepp (1911). After study of many plants of *U. javensis*, both young (Fig. 8, D) and old, I came to the conclusion that the plants described above did not represent that species.

They differ from *U. javensis* in that the entire stature of the plant is smaller, including the diameter of the monosiphonous stalk, in the lack of calcification, in the absence of constrictions above the dichotomies, and in the fewer dichotomies of the filaments making up the blade. In their dimorphic habit and free noncalcareous filaments the plants are suggestive of *Flabellaria minima* (Ernst) A. & E. S. Gepp (1911), which is generally assigned to *Udotea*, but the Hawaiian plants differ from this species in their smaller stature, their much more slender filaments, and in the fact that the stalk is never multisiphonous. Due to the uncalcified character of the filaments making up the blade there is real uncertainty as to the correct genus to which this species should be assigned.

14. *Ulva reticulata* Forsskål, 1775, p. 187.

COLLECTIONS: *Gilbert 9013*, entangled on other algae near War Memorial Natatorium, Waikiki Beach, Honolulu, Oahu, March 11, 1959; *9125*, Kahana, West Maui, March 22, 1959; *9547*, on reef flat just N. of Wailua River mouth, Wailua, Kauai, April 25, 1959; *9947*, Kahaluu Park, S. of Kailua, Hawaii, May 26, 1959; *10108*, Napelehu, Molokai, June 7, 1959.

It is difficult to understand why this well-known *Ulva* has not been reported previously from Hawaii. I found it one of the commonest elements in the green algal flora of the five islands which I visited.

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