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Type.—Cast ashore, Strandfontein, False Bay, Cape Province, South Africa, 13.xi.1935, *G. F. Papenfuss* 24 (UC 920260).

Known Range.—Champion Bay, W.A., to Western Port, Vic.; Currie River, Tas. Swakopmund, South West Africa, around the Cape of Good Hope to the mouth of the Limpopo River, Mozambique.

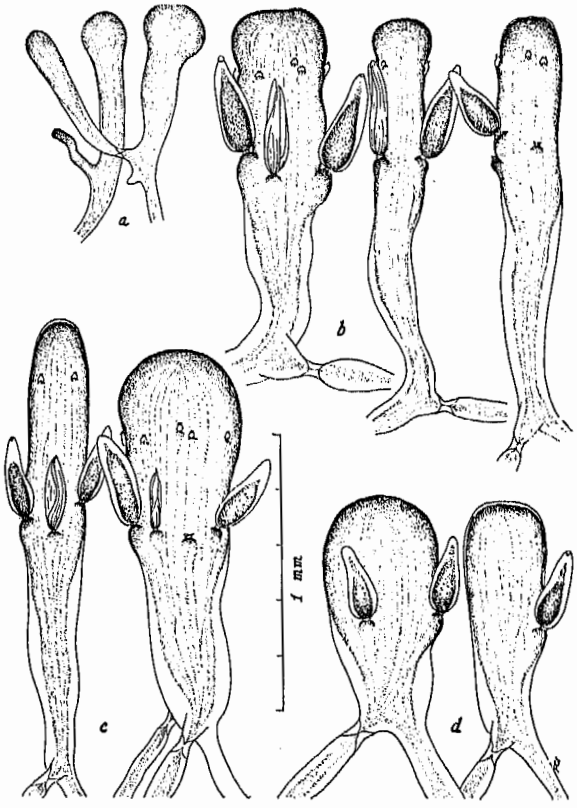

Fig. 10.—*C. dulhieae.* *a*, *b*, Strandfontein, False Bay, Cape Province, South Africa, *Papenfuss* 24=type. *a*, utricles from tip; *b*, utricles from middle of frond; *c*, (Elliston, S.A., *Womersley* (AD, A16,624)) utricles from middle of frond; *d*, (Melkbosch, Cape Province, South Africa, *Papenfuss* 358) utricles from middle of frond.

Representative Australian Specimens Examined.—WESTERN AUSTRALIA: Champion Bay (MEL). Fremantle, *W. H. Harvey*, Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (BM, K, PC); ibid. Rottnest I. (TCD). Point Peron, 28.i.1950, *Royce* 513 (PERTH); 15.viii.1950, *Cribb* 69·27 (UC). Hamelin Bay, 21.x.1949, *Royce* 437 (PERTH). SOUTH AUSTRALIA: Marino, drift, 21.v.1953, *Womersley* (AD, A18,659) (UC). Elliston, upper sublittoral, 15.i.1951, *Womersley* (AD, A13,624) (UC). Coffin Bay, upper sublittoral, 10.i.1951, *Womersley* (AD, A13,775). Pig I., Pelican Lagoon, Kangaroo I., upper sublittoral, 2.xi.1947, *Womersley* (AD, A6157) (L, MICH, UC). Nora Creina, upper sublittoral pool, 14.xi.1955, *Womersley* (AD, A20,018). VICTORIA: Port Phillip, *Rawlinson* (TCD). Port Phillip Heads, 13.i.1891, *J. B. Wilson* (K); 1859, *F. von Mueller* (BM). Western Port, *F. von Mueller* (S). TASMANIA: Currie River, *Perrin & Lucas*, Mar. 1935 (CANB).

C. duthieae in Australia occurs mainly in relatively calm bays and inlets, from just below low tide level downwards.

This species has sometimes been referred in Australia to *C. elongatum* C. Agardh, a nomenclatural synonym of *C. decorticatum* (Woodw.) Howe, which is a closely related species from warm Atlantic waters (Harvey 1863, p. lvii; Sonder 1880, p. 38; Wilson 1892, p. 187; Lucas 1912, p. 171, pro parte). Specimens from Fremantle, with terete rather than complanate branches, were distributed (along with representatives of several other species) by Harvey as Algae Australicae Exsiccatae 573 (BM, K, PC, TCD) under the name *C. tomentosum* Stackhouse, an unrelated species restricted to the eastern North Atlantic.

11. **Codium harveyi** Silva, sp. nov.

Fig. 11; Plate 2, Fig. 1

Thallus erectus, ad 30 cm alt., (ad 10 ordines) dichotome ramosus; rami teretes, 5 mm dia. ad basim, ad 1 mm dia. prope apices attenuati. Utriculi pyriformes, 170–590 μ dia., 340–850 μ long., 1·3–2·5 plo longiores quam lati, apicibus

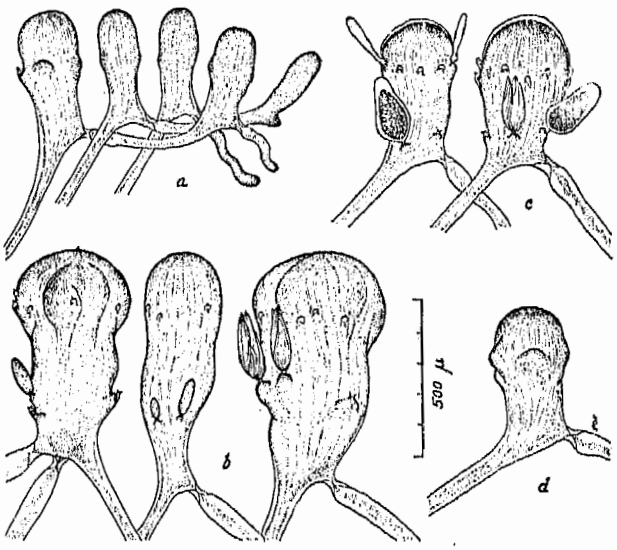

Fig. 11.—*C. harveyi*. *a*, *b*, Low Head, Tas., *Perrin*. *a*, utricles from tip; *b*, utricles from middle of frond; *c*, (Mouth of Tamar River, Tas., *Herb. Mackay*, K) utricles from middle of frond; *d*, (Long Bay, PortArthur, Tas., *Cribb* 65·3) utricle from middle of frond.

late rotundatis; membrana utricularis 1·5 μ crass., prope apicem paululum ad modice (ad 24 μ) incrassata. Pili (aut pilorum cicatrices) multi in zona 135–240 μ infra apicem. Filamenta medullaria plerumque 34–62 μ dia., obturaculo sito juxta locum originis ex utriculo. Gametangia ovata ad lanceo-ovata, 68–136 μ dia., 150–240 μ long., 1–4 per utriculum, omnia in pediculis brevibus (*c.* 7 μ long.) in protuberantia in parte infima utriculi (310–480 μ infra apicem) portata.

Thallus erect, to 30 cm high, dichotomously branched (to 10 orders); branches terete, 5 mm dia. at base, tapering to 1 mm dia. at apices. Utricles pyriform, 170–590 μ dia., 340–850 μ long, 1·3–2·5 × long as broad, with broadly rounded apices; utricular wall 1·5 μ thick, at apex slightly to moderately thickened (to 24 μ). Hairs (or hair scars) frequent, in zone 135–240 μ below apex. Medullary filaments mostly 34–62 μ dia., with plug close to point of departure from utricle. Gametangia ovoid to lance-ovoid, 68–136 μ dia., 150–240 μ long, 1–4 per utricle, each borne on short pedicel (about 7 μ long) on protuberance on lowermost part of utricle (310–480 μ below apex).

Type.—Vivonne Bay, Kangaroo I., S.A., 2.i.1949, drift, *Womersley* (AD, A10, 557). Isotypes in BM, UC.

Known Range.—Champion Bay, W.A., around southern Australia to Lake Macquarie, N.S.W.; Tasmania. New Zealand.

Representative Specimens Examined.—WESTERN AUSTRALIA: Champion Bay (MEL). SOUTH AUSTRALIA: Vivonne Bay, Kangaroo I., drift, 17.i.1950, *Womersley* (AD, A20,382). Lacepede Bay, 1895, *Englehardt* (BM, M). Nora Creina, 15 miles S. of Robe, 14.iii.1955, drift, *Womersley* (AD, A19,873). VICTORIA: Portland, drift, 7.i.1951, *C. Beauglehole* (AD, A15,650). Port Phillip Heads, 19.i.1886, *J. B. Wilson* (K). Phillip I., *F. von Mueller* (MEL). Portsea, Jan. 1919, *A. H. S. Lucas* (UC). TASMANIA: Low Head, Sept. 1950, *Mrs. F. Perrin* (UC). Long Bay, Port Arthur, 22.vi.1950, dredged, *Cribb* 65·3 (AD, F. MEL, UC). NEW SOUTH WALES: Eden, Jan. 1910, *A. H. S. Lucas* (UC). Jervis Bay, July 1899, cast up, *A. H. S. Lucas* (NSW). Lake Macquarie, *F. von Mueller* (M).

C. harveyi appears to be a sublittoral species of moderate to rough coasts.

C. harveyi and *C. australicum* Silva, sp. nov., heretofore have been confused with *C. muelleri*, which has thus gained an undeserved reputation for troublesome variability.

Although typical *C. harveyi* has been found on the east coast of Australia only as far north as Lake Macquarie, N.S.W., the influence of genes in this species may be seen in a population of intergrades extending to Rockingham Bay, Qld. (to be discussed under *C. australicum*).

A typical specimen collected in New Zealand by Dr. Lyall has been examined (BM).

12. **Codium muelleri** Kuetzing, Tab. Phyc. **6**: 34, pl. 95, II (1856). Sonder, Fragm. Phytogr. Aust. **11** (suppl.) p. 38 (Lefebre Peninsula specimen only) (1880). J. Agardh, Acta Univ. Lund. **23**: 42 (1887) (Fremantle specimen only). De Toni, Syll. Alg. **1**: 493 (1889) (Fremantle specimen only). Lucas, Proc. Linn. Soc. N.S.W. **37**: 171 (1912) (pro parte). Schmidt, Bibl. Bot., Stuttgart **23** (Heft 91): 51 (1923) (pro parte, et excl. fig. 35). Lucas, Seaweeds S. Aust. **1**: 54 (1936) (pro parte). Setchell, Proc. Nat. Acad. Sci., Wash. **26**: 444 (1940). Womersley, Trans. Roy. Soc. S. Aust. **73**: 145 (1950). Silva, Univ. Calif. Publ. Bot. **25**: 91, 92, 94, fig. 10 (1951). Womersley, Rep. Aust. Geogr. Soc. No. **1** (3B): 36 (1953).

Fig. 12

Codium schmidtii Vouk, Acta Bot., Zagreb **10**: 9, pl. 1, text-figs. 1–4 (1935).

Thallus erect, to 25 cm high, dichotomously branched (to 10 orders), branches terete, 5 mm dia. at base, 2·5–3 mm dia. above base, attenuating to 1·5 mm dia. at apices. Utricles irregularly cylindrical to pyriform, broadest about one-third below apex, 130–520 μ dia., 290–860 μ long, 1·5–3·5 × long as broad; apices truncate or broadly rounded; utricular wall 1·5 μ thick, at apex thin or occasionally thickened (to 54 μ), with an introrse umbo to 42 μ long. Hairs (or hair scars) common, one to several per utricle in zone 100–185 μ below apex. Medullary filaments mostly 28–62 μ dia., plug on outgoing side 80–350 μ from base of utricle. Gametangia ovoid, lance-ovoid, or ampulliform, 77–145 μ dia., 170–290 μ long, 1–4 per utricle, each borne on pedicel about 18 μ long on protuberance well below middle of utricle.

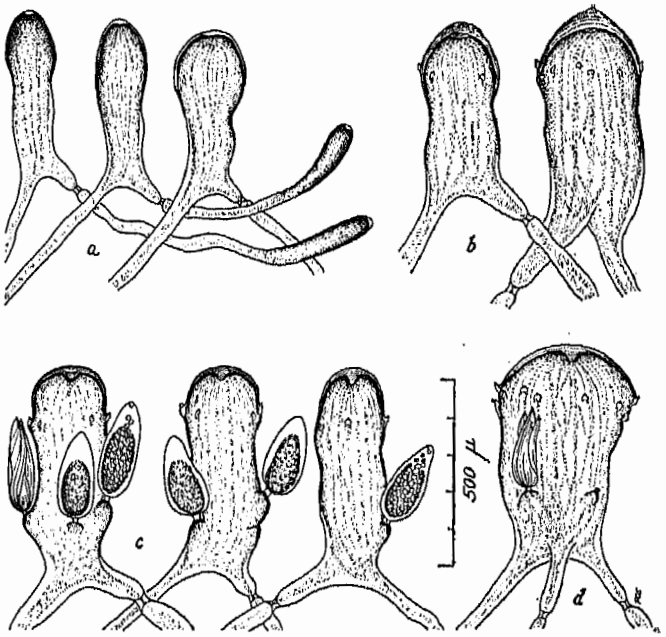

Fig. 12.—*C. muelleri*. *a*, *c*, *d*, Marino, Holdfast Bay, S.A., *Womersley* (AD, A18,661). *a*, utricles from tip; *b*, (Fremantle, W.A., *Royce* 1159) utricles from base; *c*, utricles from middle of frond; *d*, utricle from base.

Type.—Lefebre Peninsula, S.A., July 1852, *F. von Mueller* (L 937. 337–772).

Known Range.—Fremantle, W.A., around southern Australia to Rivoli Bay, S.A.

Representative Specimens Examined.—WESTERN AUSTRALIA: Rottnest I., 9.iv.1927, *W. A. Setchell* (UC). Fremantle, *W. H. Harvey*, Algae Australicae Exsiccatae 573 (LD, BM, K, NSW, US); drift, 10.iv.1952, *Royce* 1159, 1161 (PERTH, UC). Geographe Bay, 1870, *F. von Mueller* (MEL). King George's Sound, *W. H. Harvey*, Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (BM). Israelite Bay, *Miss Brooks* (LD). SOUTH AUSTRALIA: Elliston, drift, 13.i.1951, *Womersley* (AD, A13,588). Marino, Holdfast Bay, drift, 21.v.1953, *Womersley* (AD, A18,661) (UC). Rocky Point Beach, Kangaroo I., drift, 4.vi.1947, *Womersley* (AD, A5715) (F). Kingscote, Kangaroo I., drift, 12.i.1948, *Womersley* (AD, A6957) (L). Lefebre Peninsula, July 1852, *F. von Mueller* (FI, L, MEL, PC). Cape Jaffa, drift, 31.viii.1949, Womersley (AD, A10,884) (MICH, UC). Rivoli Bay, *F. von Mueller* (MEL).

C. muelleri is a sublittoral species, found mainly in moderate to calm bays. Setchell (1940) first showed that *C. schmidtii* is synonymous with *C. muelleri*.

Owing to the confusion of *C. harveyi* and *C. australicum* with *C. muelleri*, records of the latter species are especially unreliable and must be evaluated by examining the specimens upon which they are based. The following erroneous records of *C. muelleri* are based entirely on *C. harveyi* and *C. australicum*: Wilson 1892, p. 188; Lucas 1929*a*, p. 10; May 1938, p. 212; Guiler 1952, p. 75. The following records remain unverified: Levring 1946, p. 216; Lucas 1929*b*, p. 46; Reinbold 1899, p. 41. Along with other dichotomously branched species, *C. muelleri* has been erroneously referred to *C. tomentosum* (Sonder 1853, p. 660, pro parte; Harvey 1863, p. lvii, pro parte).

Although the easternmost record of unmistakable *C. muelleri* is Rivoli Bay, S.A., a specimen from Victoria (M) has been examined in which the utricles are similar to those of this species except that they are not regularly introrsely umbonate and the medullary filaments are plugged near their origin. The suggestion is that this specimen is a hybrid between *C. muelleri* and *C. harveyi*.

13. **Codium australicum** Silva, sp. nov.

Fig. 13; Plate 2, Fig. 2

Thallus erectus, ad 50 cm alt. (ad 20 ordines) dichotome ramosus; rami teretes, ad basim 5 (–10) mm dia., proxime super basim 3–6 mm dia., ad 2 mm dia. ad apices sensim attenuati. Utriculi cylindrici ad clavatos (100–) 130–210 (–300) μ dia., 460–800 μ long. (2–) 3–5 (–6) plo longiores quam lati, apicibus truncatis aut subrotundatis; membrana utricularis 1·5 μ crass., ad apicem plerumque paululum incrassata (–15 μ), interdum modice incrassata (–35 μ), apicibus incrassatis lamellatis, saepe interne alveolatis, interdum externe verruculosis, raro aliquantulum introrse umbonatis. Pili (aut pilorum cicatrices) frequentes, unus ad paucos per utriculum, in zona 65–130 μ infra apicem portati. Filamenta medullaria magna ex parte 20–35 μ dia., obturaculo plerumque 65–200 μ a basi utriculi sito. Gametangia anguste ellipsoideo-ovata aut cylindrica, 80–160 μ dia., 235–390 μ long., 1–3 per utriculum, omnia in pediculis c. 21 μ long., in protuberantia prope aut saepius infra partem mediam utriculi portata.

Thallus erect to 50 cm high, dichotomously branched (to 20 dichotomies), branches terete, 5 (–10) mm dia. at base, 3–6 mm dia. immediately above base, tapering gradually to 2 mm dia. at apices. Utricles cylindrical to clavate (100–) 130–210 (–300) μ dia., 460–800 μ long, (2–) 3–5 (–6) × long as broad, with truncate or slightly rounded apices; utricular wall 1·5 μ thick, at apex usually slightly thickened (–15 μ); at times moderately thickened (–35 μ), incrassate apices lamellate, often internally alveolate, sometimes externally verruculose, seldom slightly introrsely umbonate. Hairs (or hair scars) common, one to few per utricle, borne in zone 65–130 μ below apex. Medullary filaments mostly 20–35 μ dia., plug on outgoing side usually 65–200 μ from base of utricle. Gametangia narrowly ellipsoid-ovoid or cylindrical, 80–160 μ dia., 235–390 μ long, 1–3 per utricle, each borne on pedicel about 21 μ long on protuberance at or more often below middle of utricle.

Type.—Robe, S.A., 17.iii.1956, drift, *Elise Wollaston* (AD, A20, 409). Isotypes in BM, L, LD, MEL, NY, PC, UC.

Known Range.—Geographe Bay, W.A., around southern Australia to Tuggerah Lakes, N.S.W.; Tasmania. New Zealand.

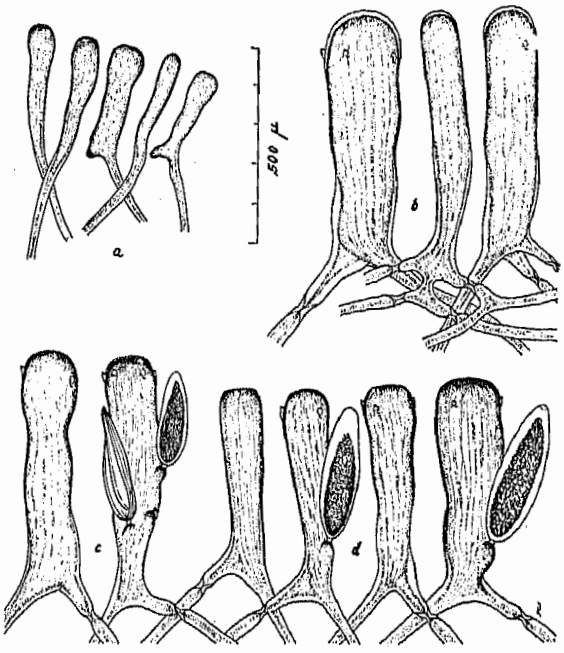

Fig. 13.—*C. australicum*. *a*, *b*, *d*, Port Arthur, Tas., *Cribb* 150·1. *a*, utricles from tip; *b*, utricles from base; *c*, (Marino, Holdfast Bay, S.A., *Womersley* (AD, A18,662)), utricles from middle of frond; *d*, utricles from middle of frond.

Representative Specimens Examined.—WESTERN AUSTRALIA: Geographe Bay, 1885, *Miss Priest* (MEL). King George's Sound, *W. H. Harvey* (TCD). SOUTH AUSTRALIA: Pondalowie Bay, drift, 24.iv.1955, *Womersley* (AD, A19,883). Marino, Holdfast Bay, drift, 21.v.1953, *Womersley* (AD, A18,662) (UC). Pennington Bay, Kangaroo I., drift, 27.i.1940, *Womersley* (AD, A2943). Robe, 17.iii.1956, drift, *Wollaston* (AD, A20,409). Nora Creina, 15 miles S. of Robe, 14.iii.1955, drift, *Womersley* (AD, A19,875). VICTORIA: Port Phillip Heads, 3.i.1890, *J. B. Wilson* (LD, BM). Woodbourne, Feb. 1949, *Iona Maclennan* (UC). Mouth of Hopkins River, *F. von Mueller* (MEL). NEW SOUTH WALES: Maroubra Bay, July 1910, *A. H. S. Lucas* (NSW). Entrance, Tuggerah Lakes, *Turner & Lucas* Dec. 1915 (CANB). TASMANIA: Marrawah, *Mrs. F. Perrin* (UC). Orford Beach, 20,vi.1950, drift, *Cribb* 64·1 (AD, MEL, UC). Port Arthur, 20.vi.1951, drift, *Cribb* 150·1 (UC 949, 773).

C. australicum is apparently (like *C. muelleri* and *C. harveyi*) a sublittoral species which rarely, if ever, reaches low tide mark. It occurs on moderate to rough coasts.

Two typical specimens purportedly from New Zealand have been examined: "New Zealand" (K); and "New Zealand, Antarctic Expedition 1839–1843, J. D. H[ooker]" (BM).

Although *C. australicum* and *C. harveyi* represent broad plateaus of morphological uniformity, the occurrence of a fairly large number of intergrades suggests hybridization between these two species. The following is a short series of intergrades running from *C. australicum* to *C. harveyi*: Oyster Bay, Tas. (NSW), typical *C. australicum* but with medullary filaments plugged near origin; Port Jackson, N.S.W., Feb. 1926, *A. H. S. Lucas* (UC), in which the presence of *C. harveyi* genes is manifested in the tendency toward pyriform utricles and medullary filaments with plugs fairly close to their origin; Port Phillip Heads, *F. von Mueller* (BM), similar to *C. harveyi* but with a tendency toward truncate apices.

C. australicum, *C. muelleri*, and *C. harveyi* comprise a closely related group of species. The first two share a character unique in the genus—the development of plugs in medullary filaments at a conspicuous distance from the base of the originating utricle. Evidence from putative hybridization points to a very close relationship between *C. australicum* and *C. harveyi*, but it should be remembered that degree of hybridization is not necessarily proportional to genotypic differences inasmuch as in the evolution of sympatric species divergence occurs only after the appearance of crossability barriers, which therefore are in effect selected.

14. **Codium fragile** (Sur.) Hariot, Mission scientifique du Cap Horn **5**: 32 (1889). Schmidt, Bibl. Bot., Stuttgart **23** (Heft. 91): 47 (1923). Lucas, Seaweeds, S. Aust., **1**: 54, fig. 37 (1936). May, Proc. Linn. Soc. N.S.W. **63**: 212 (1938). Levring, Acta Hort. Gothoburg. **16**: 216 (1946). Guiler, Pap. Roy. Soc. Tasm. **86**: 75 (1952).

Acanthocodium fragile Suringar, Ann. Mus. Bot. Lugduno-Batavi **3**: 258 (1867).

Codium mucronatum J. Agardh, Acta Univ. Lund. **23** (Afd. 3, Nr 2): 43, pl. I, figs. 2, 3 (1887). De Toni, Syll. Alg. **1**: 494 (1889). Wilson, Proc. Roy. Soc. Viet. **4**: 187 (1892). Lucas, Proc. Linn. Soc. N.S.W. **37**: 171 (1912). Cotton, Proc. R. Irish Acad. **31**:(15): 116 pl. 8, fig. 7 (1912). Lucas, Pap. Roy. Soc. Tasm. 1928: 10 (1929*a*).

Type.—Japan, *Textor* (L 910.187–1712).

Known Range.—Australia, New Zealand, Japan, Korea, China, Siberia; Alaska to Baja California, Mexico; southern Chile, Argentina, Falkland Islands; British Isles, Scandinavia, Netherlands, Atlantic and Mediterranean France, Meditteranean Spain; South West Africa around Cape of Good Hope to Robberg, Cape Province, South Africa.

C. fragile in southern Australia extends from the sublittoral zone into the lower littoral, on coasts of moderate to rough wave action. Often it is plentiful at low tide level.

The Australian representatives of this complex taxon were given taxonomic recognition by J. Agardh (as *C. mucronatum* var. *tasmanicum*). Although the morphological variation encountered among the Australian plants is so great that one might readily be led to question the usefulness or validity of recognizing infraspecific taxa, a careful study of a long series of collections (more than 200) has suggested that this species would best be treated as being represented by two subspecies in Australia with numerous intergrades.

14a. **Codium fragile** subsp. **tasmanicum** (J. Agardh) Silva, comb. nov.

Fig. 14*a*, *b*

Codium mucronatum J. Agardh var. *tasmanicum* J. Agardh, Acta Univ. Lund. **23** (Afd. 3, Nr. 2): 44, pl. 1, fig. 2 (1887). De Toni, Syll. Alg. **1**: 495 (1889); Lucas, Proc. Linn. Soc. N.S.W. **37**: 171 (1912).

Thallus comprising one to several erect, abundantly dichotomo-fastigiately branched fronds 10–30 cm high, attached to substratum by broad, spongy, basal disk; branches terete, 7–8 mm dia. at base, tapering to 3 mm at apices, dark green to blackish green, at times densely tomentose with long hyaline hairs. Young

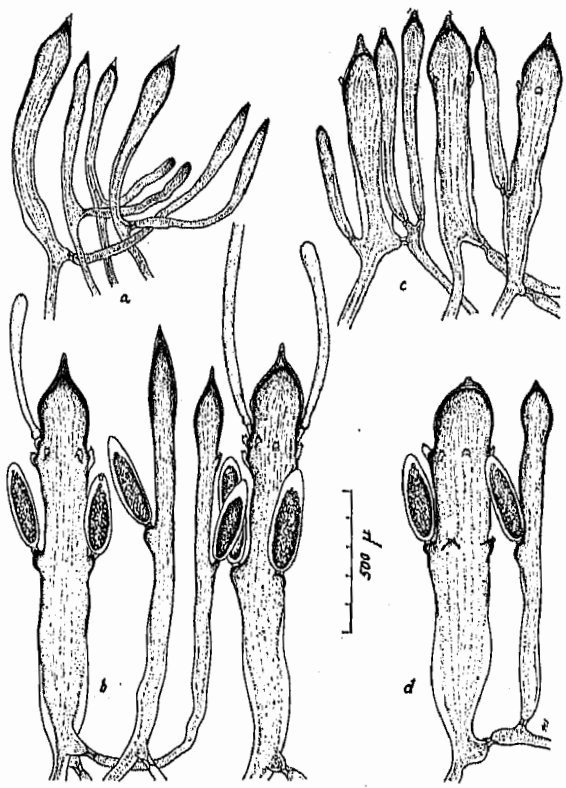

Fig. 14.—*a*, *b*, *C. fragile* subsp. *tasmanicum*. *a*, (Low Head, Tas., *Perrin*) utricles from tip; *b*, (Port Arthur, Tas., *Cribb* 126·9) utricles from middle of frond. *c*, *d*, *C. fragile* subsp. *novae-zelandiae*. *c*, (Narrabeen Head, N.S.W., *May* 2103) utricles from base; *d*, (Point Lonsdale, Vic., *Maclennan*) utricles from middle of frond.

utricles slender, cylindrical; older utricles slightly clavate (70–) 130–330 (–390) μ dia. (710–) 1000–1450 (–1750) μ long (3–) 5–10 × long as broad; apices pointed; utricular wall 2 μ thick, thickened at apex and prolonging point into sharp mucro to 77 μ long. Hairs stout, gradually expanding upward, 52–104 μ dia. at apex; hair scars abundant in zone 185–450 μ below apex of utricle. Medullary filaments

mostly 26–46 μ dia. Gametangia lance-ovoid, narrowly ellipsoid, or cylindrical, 90–130 μ dia., 260–450 μ long, 1–4 per utricle, each borne on pedicel 10–14 μ long on protuberance 460–850 μ below apex.

Lectotype.—Tasmania, *R. Gunn* (LD, Herb. Agardh 15606).

Known Range.—Victor Harbour, S.A., to Walkerville, Vic.; Tasmania.

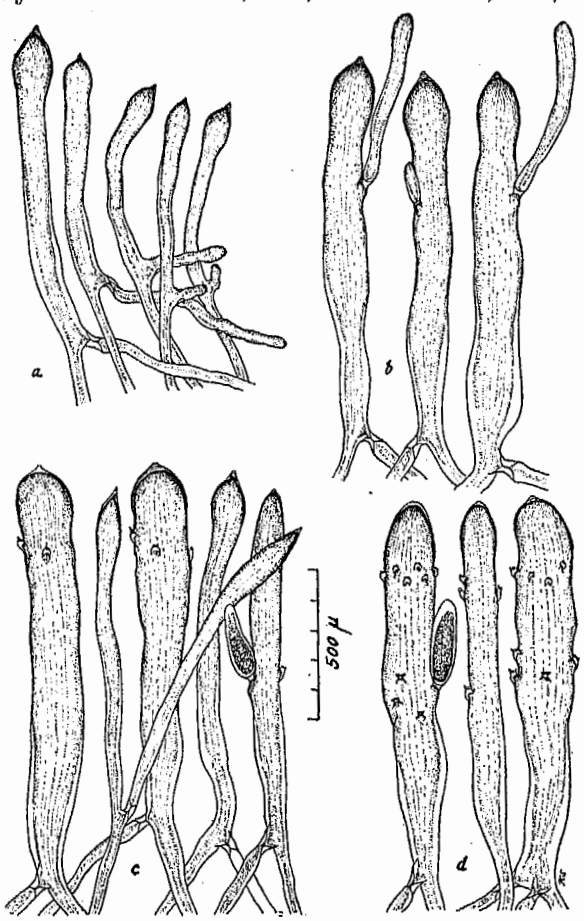

Fig. 15.—*C. fragile* subsp. *novae-zelandiae*. *a*, *b*, Robe, S.A., *Womersley* (AD, A10,998). *a*, utricles from tip; *b*, utricles from middle of frond; *c*, (New Zealand, *Berggren*=lectotype) utricles from middle of frond; *d*, (Port Phillip, Vic., L) utricles from middle of frond.

Representative Specimens Examined.—SOUTH AUSTRALIA: Victor Harbour, drift, 17.x.1948, *Womersley* (AD, A9291). VICTORIA: Port Fairy, *W. H. Harvey*, Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (MEL). Port Phillip Heads, *J. B. Wilson*, 22.xi.1890 (K); 3.xii.1890 (MEL). Walkerville, lower littoral, Nov. 1949, *I. Bennett* (AD, A15,238). TASMANIA: *R. Gunn* (LD, K, MEL, S). Mouth of Tamar River, Jan. 1928, *A. H. S. Lucas* (UC). Georgetown, R. *Gunn*, Harvey's Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (TCD). Low Head, Sept. 1950, *Mrs. F. Perrin* (UC). Port Arthur, 29.iii.1950, *Cribb* 48·8 (F, UC); 6.ii.1951, *Cribb* 126·9 (UC). Mouth of Currie River, 17.ix.1950, *Cribb* 75·1 (UC); 5.xii.1934, *L. M. Jones*, Tilden's South Pacific Plants, ser. 2, no. 209 (F).

14b. **Codium fragile** subsp. **novae-zelandiae** (J. Agardh) Silva, comb. nov.

Fig. 14c, *d*; 15

Codium mucronatum J. Agardh var. *novae-zelandiae* J. Agardh, Acta Univ. Lund. **23** (Afd. 3, Nr. 2): 44 (1887). De Toni Syll. Alg. **1**: 495 (1889).

Codium fragile (Sur.) Har. var. *novae-zelandiae* (J. Ag.) Collins, Tufts Coll. Stud. **3**: 99 (1912).

Differs from subsp. *tasmanicum* in that the apices of utricles tend to be rounded and bluntly mucronate.

Lectotype.—New Zealand, *S. Berggren* (LD, Herb. Agardh 15613).

Known Range.—Robe, S.A. to Ballina, N.S.W.: Tasmania. New Zealand. Argentina.

Representative Specimens Examined.—SOUTH AUSTRALIA: Robe, 29.viii.1949, *Womersley* (AD, A10,998) (L, MICH, S, UC). VICTORIA: Portland Bay, *F. von Mueller* (BM). Port Fairy, *W. H. Harvey*, Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (BM). Port Phillip Heads, 22.xi.1800, *J. B. Wilson* (K). Brighton Beach, Port Phillip, 20.v.1948, *Womersley* (AD, A8329) (F). Point Lonsdale, Sept. 1948, *Iona Maclennan* (UC). NEW SOUTH WALES: Manly, near Sydney, 4.vi.1906, *Cheel* 20 (K). Narrabeen Head, near Sydney, 1.vii.1940, *May* 2103 (AHFH, UC). Ballina, *Henderson* (MEL). TASMANIA: Hunter Island, N.W. Tas., upper sublittoral, 14.i.1954, *I. Bennett* (AD, A19,668). Triabunna, 18.iii.1950, *Cribb* 41·9 (UC). Port Arthur, 22.i.1951, *Cribb* 115·13 (UC); River Derwent (K).

Although the Australian representatives of *C. fragile* may be arranged in a long series showing morphological intergradation, the distinctness of the extremes together with considerable geographic correlation makes the recognition of two subspecies feasible. The acuminate, sharply mucronate utricles typical of subsp. *tasmanicum* are to be found in most Tasmanian plants and in a few from Victoria and South Australia. The rounded and bluntly mucronate apices of utricles typical of subsp. *novae-zelandiae* are to be found in most plants from the Australian mainland. Intergrades (specimens which can be assigned to one or another subspecies only arbitrarily) are fairly common, though not abundant enough to make the recognition of subspecies impracticable.

Intergrades Examined.—WESTERN AUSTRALIA: Mabel Cove, west end of Rottnest I., 18.x.1934, *L. M. Jones*, Tilden's South Pacific Plants, ser. 2, no. 77 (F). VICTORIA: Port Fairy, *W. H. Harvey*, Algae Australicae Exsiccatae 573, sub. *C. tomentosum* (E). NEW SOUTH WALES: Eden, Jan. 1910, *A. H. S. Lucas* (UC). Long Bay, June 1898, *A. H. S. Lucas* (NSW).

A specimen of typical subsp. *tasmanicum* labelled Cape York (Queensland) has been found in the British Museum, but the locality is certainly questionable.

Plants of *C. fragile* were often reported as *C. tomentosum* Stackhouse in older literature (Hooker and Harvey 1847, p. 416; Harvey, 1860, p. 339; Harvey 1863, p. lvii, pro parte; Sonder 1880, p. 38, pro parte).

15. **Codium spinescens** sp. nov.

Fig. 16; Plate 3

Thallus dichotomus regulariter, ad 20 cm (aut plus) alt., rami teretes, tenues, 3 mm dia. ad basem, ad 1–2 mm dia. prope apices attenuati, virides aut fusco-virides. Utriculi juvenales tenues, utriculi ceteri crassi, irregulariter cylindrici ad clavatos, 80–270 μ dia., 475–680 μ long., 3–6 plo longiores quam lati; apices

acuminati asymmetricaliter; membrana utricularis 2 μ crass., ad apicem incrassata cum longo prominenti mucrone; mucro cum tenuibus lamellis, saepe scalariformis (cum cubiculis) ad 80 μ long. Pili (aut pilorum cicatrices) frequentes, 4–8 per utriculum, positi in attenuata utriculi regione (170–240 μ infra apicem). Filamenta medullaria plerumque 20–30 μ dia. Gametangia ovata, ellipsoidea aut cylindrica, 70–160 μ dia., 175–240 μ long., 1–3 per utriculum, omnia in pediculis brevissimis in protuberantia infra partem mediam utriculi portata.

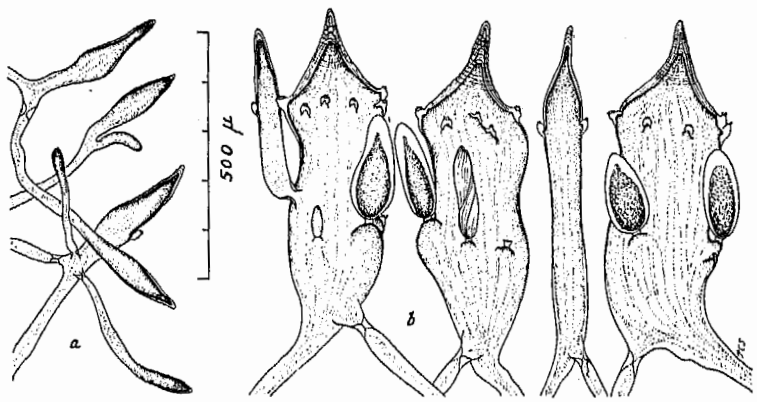

Fig. 16.—*C. spinescens*. Torpedo Rocks, Yallingup, W.A., *Royce* 616. *a*, utricles from tip; *b*, utricles from middle of frond.

Thallus regularly dichotomous, to 20 cm (or more) high; branches terete, slender, 3 mm dia. at base, tapering to 1–2 mm dia. at apices, medium to dark green. Young utricles slender, other utricles stout, irregularly cylindrical to clavate, 80–270 μ dia., 475–680 μ long, 3–6 $\times$ long as broad; apices asymmetrically acuminate; utricular wall 2 μ thick, at apex thickened and prolonging point into pronounced mucro; mucro finely lamellate, often scalariform (chambered), to 80 μ long. Hairs (or hair scars) common, 4–8 per utricle, borne in region where utricle begins to taper (170–240 μ below apex). Medullary filaments mostly 20–30 μ dia. Gametangia ovoid, ellipsoid, or cylindrical, 70–160 μ dia., 175–240 μ long, 1–3 per utricle, each borne on very short pedicel on protuberance below middle of utricle.

Type.—Ten miles east of Eucla (on S.A.–W.A. border), 3.ii.1954, drift, *Womersley* (AD, A19,240). Isotype in UC.

Other Specimens Examined.—WESTERN AUSTRALIA: Houtman Abrolhas (BM). Israelite Bay, Algae Muellerianae (MEL). Torpedo Rocks, Yallingup, W.A., 1.vi.1950, drift, *Royce* 616 (PERTH).

C. spinescens is closely related to *C. fragile*, from which it is readily distinguishable, however, by its very slender branches and short, stout, spinous utricles. Although morphologically it is, perhaps, no more different from certain segments of the *C. fragile* complex than forms that have been recognized by Silva as subspecies of *C. fragile* (for example, subsp. *scandinavicum* Silva 1957), its treatment as a species is probably justified in consideration of its geographical and morphological homogeneity and lack of intergradation.

Excluded Species.—The phycological literature pertinent to Australia contains many references to the first-described species of *Codium*, namely, *C. adhaerens* C. Ag., *C. bursa* (L.) C. Ag., *C. decorticatum* (Woodw.) Howe (or its nomenclatural synonym *C. elongatum* C. Ag.), and *C. tomentosum* Stackh. Careful study of these species shows that they are restricted to the Atlantic Ocean. In general, the applanate species have passed as *C. adhaerens*, the subglobose species as *C. bursa*, and the dichotomously branched species as *C. tomentosum*. *C. duthieae*, as previously indicated, was sometimes referred to *C. elongatum*. References to *C. decorticatum* from New South Wales and Queensland are to an undescribed species. It is regrettable that even in current literature (such as Guiler 1952) one may find references to European species that specialists long since have excluded from the Australian flora.

Phytogeographic Relationships.—Of the 15 species of *Codium* found in southern Australian waters, eight, constituting the largest geographical group, are endemic. With reference to their distribution, they may be listed as follows, from west to east: *C. laminarioides*, *C. spinescens*, *C. muelleri*, *C. harveyi*, *C. australicum*, *C. pomoides*, *C. capitulatum*, *C. perrinae*. The next largest group comprises those species which also occur in South Africa: *C. duthieae*, very likely *C. lucasii*, and possibly *C. galeatum*. Two species, *C. mamillosum* and *C. spongiosum*, are Indo-Pacific in affinity; of these, *C. spongiosum* also occurs in South Africa. Finally, *C. fragile* and *C. dimorphum* are antarctic circumpolar in distribution, the former being pantemperate and bipolar in addition.

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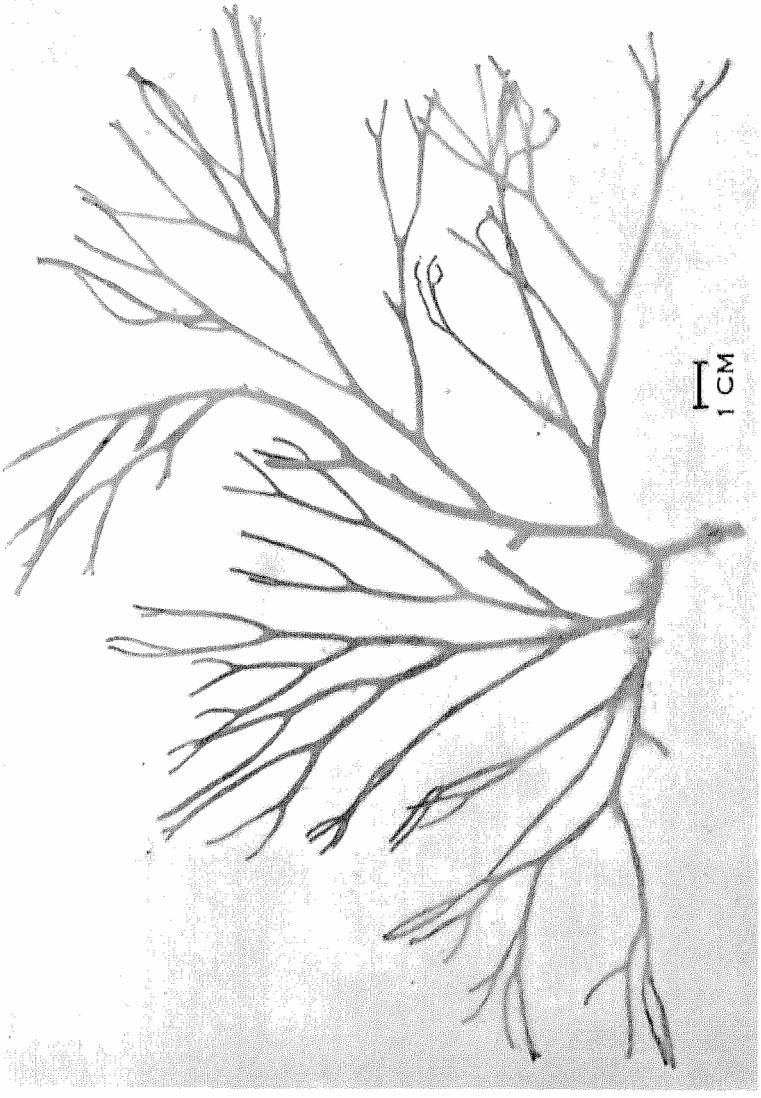
THE GENUS CODIUM IN SOUTHERN AUSTRALIA



C. spinescens. 10 miles E. of Eucla (W.A.-S.A. border), Womersley (AD. A19.240, type).

THE GENUS CODIUM IN SOUTHERN AUSTRALIA

Fig. 2.—*C. duthieae*. Elliston, S.A., Womersley (AD, A19,385).

Fig. 1.—*C. capitulatum*. Elliston, S.A., Womersley (AD, A19,384, type).

THE GENUS CODIUM IN SOUTHERN AUSTRALIA

Fig. 2.—*C. australicum*. Robe, S.A., Wollaston. (AD, A20,469, type).

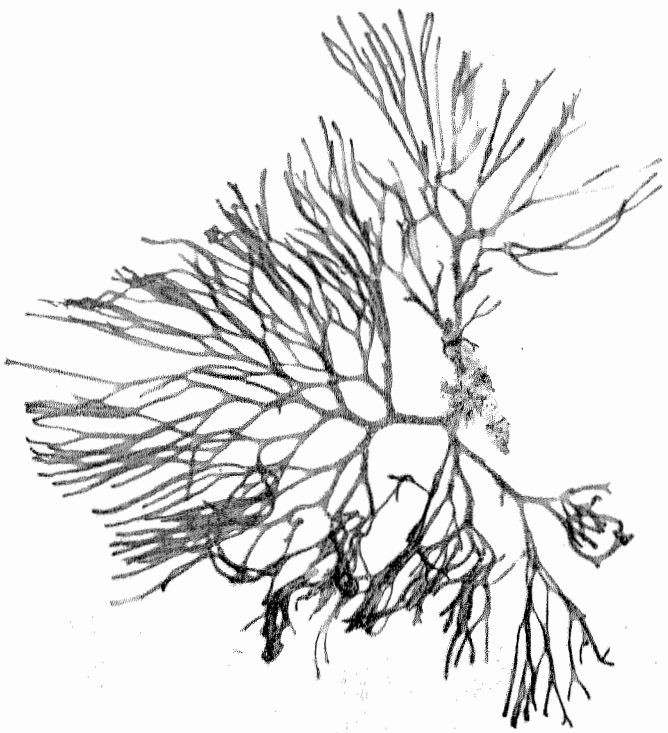


Fig. 1.—*C. harveyi*. Vivonne Bay, Kangaroo I., S.A., *Womersley* (AD, A10,557, type).